Introduction to Reinforcement Learning

Reinforcement learning is a powerful tool for training agents to make optimal decisions in complex environments. It enables machines to learn from experience, just like humans. This presentation will delve into the fascinating world of reinforcement learning, covering its fundamentals, algorithms, and applications.

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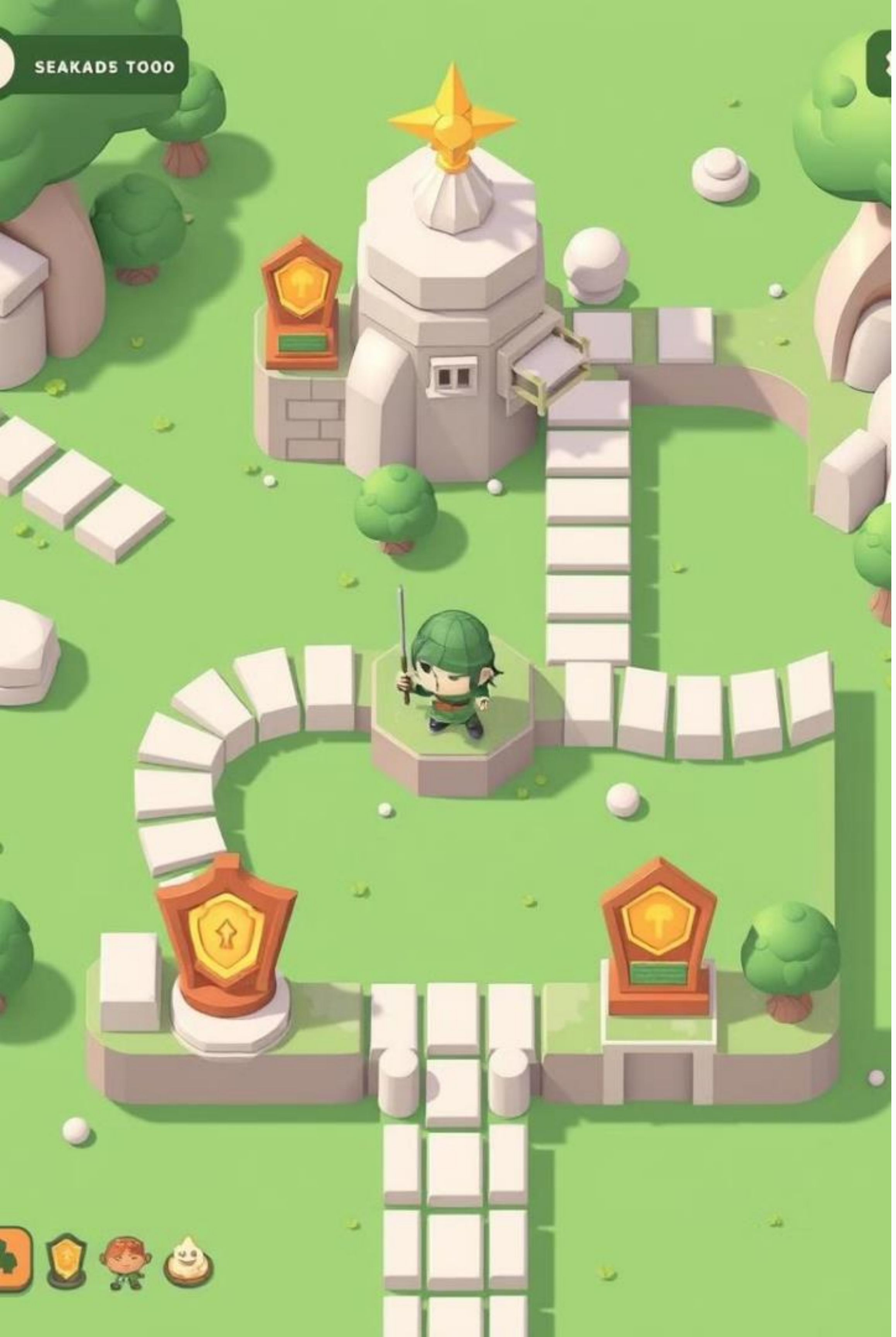
What is Reinforcement Learning?

Learning from Experience

Reinforcement learning involves an agent learning to interact with an environment by trial and error.

Rewards and Penalties

The agent receives rewards for performing desired actions and penalties for undesirable actions.



Fundamentals of Reinforcement Learning

Agent

The learner that interacts with the environment.

Environment

The external world with which the agent interacts.

Actions

The agent's choices that influence the environment.

Rewards

Feedback from the environment based on actions.

Markov Decision Processes

States

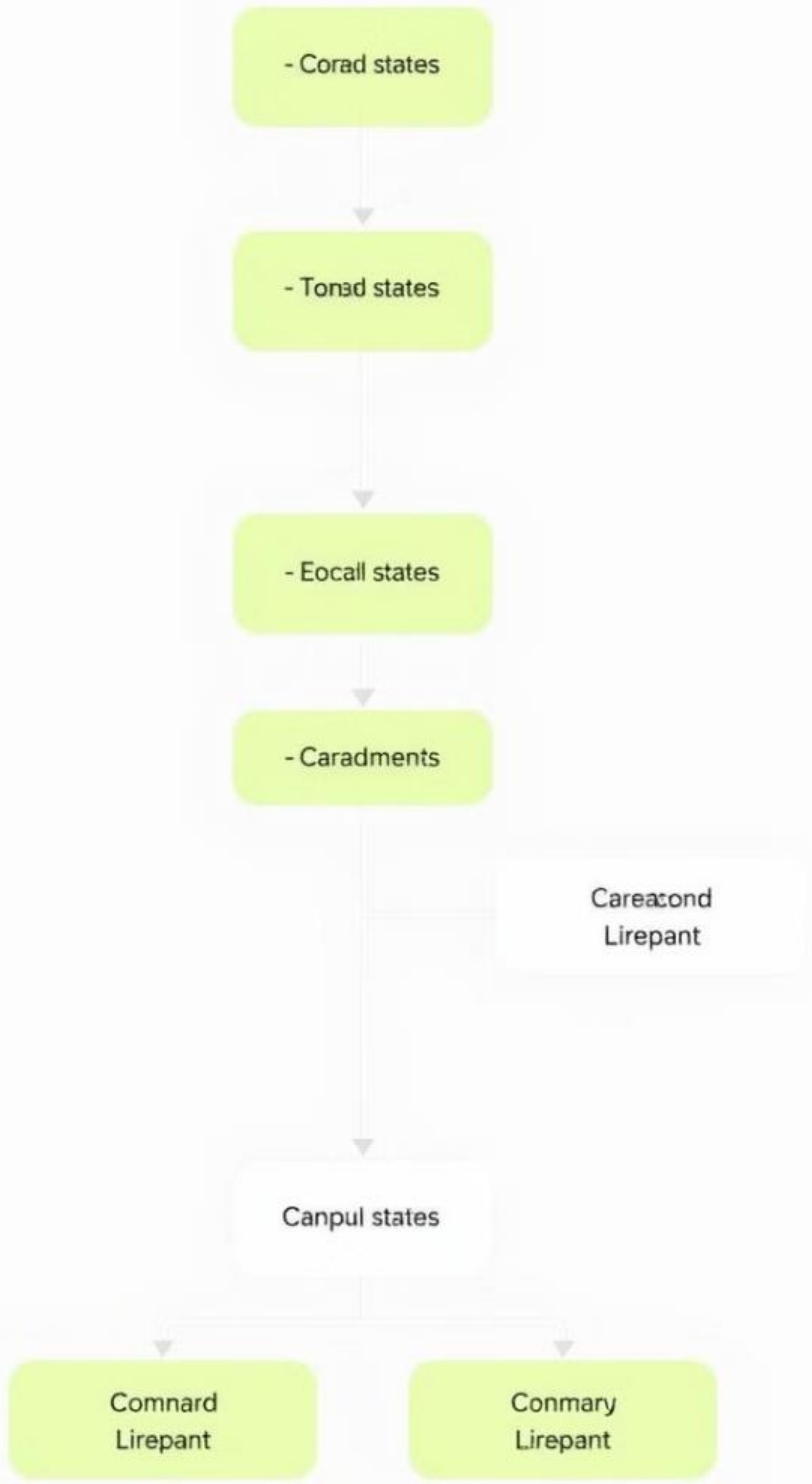
Representations of the environment at different times.

Transitions

Changes in states based on actions taken.

Rewards

Values assigned to transitions based on their desirability.



Reinforcement Learning Algorithms

1. Dynamic Programming: Solves optimal control problems using recursion and backward induction.

2. Monte Carlo Methods: Estimate values by averaging returns from multiple simulations.

3. Temporal Difference Learning: Updates estimates based on the difference between predicted and actual rewards.

Exploration vs. Exploitation

1

Exploration

Trying new actions to learn about the environment.

2

Exploitation

Using the current knowledge to maximize rewards.

3

Balance

Finding the right balance between exploration and exploitation is key to achieving optimal performance.

Value-based Methods

1

Value Function

Measures the expected long-term reward for a given state.

2

Q-learning

Learns the optimal action to take in each state by maximizing the Q-value.

3

SARSA

Updates the Q-value based on the action taken, not the optimal one.

Policy-based Methods

1

Policy

A function that maps states to actions.

2

Policy Gradient

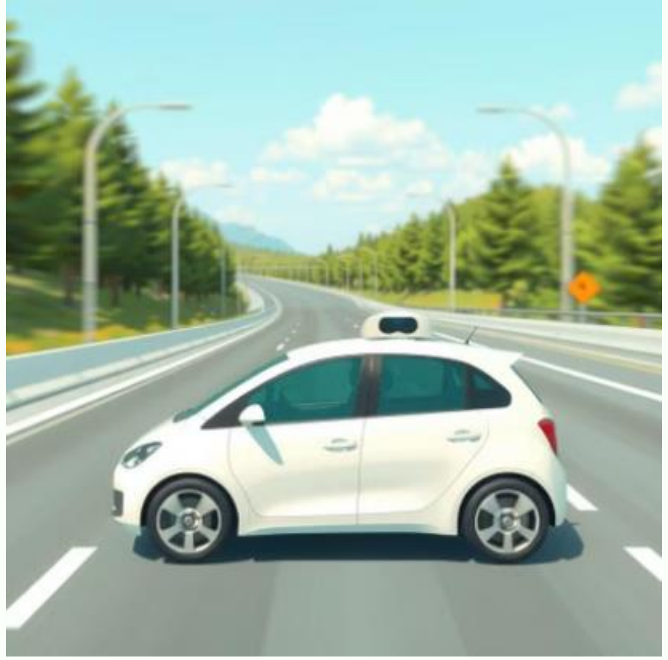
Optimizes the policy by adjusting its parameters to maximize rewards.

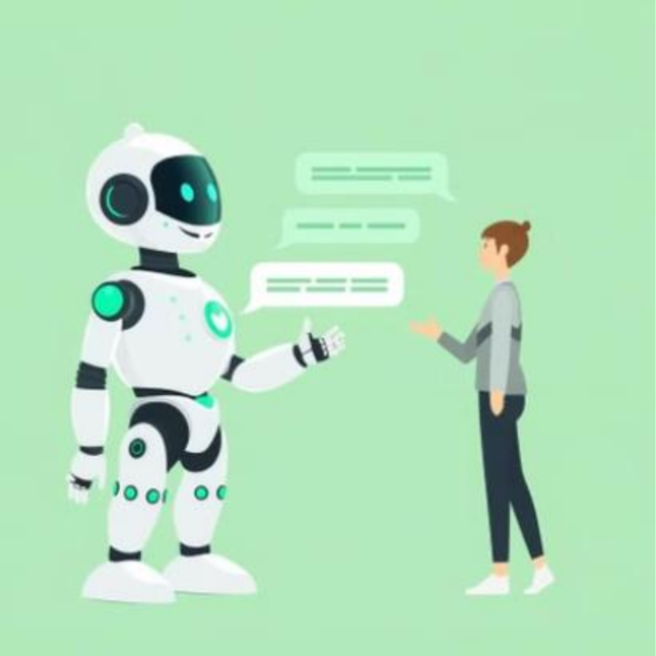
3

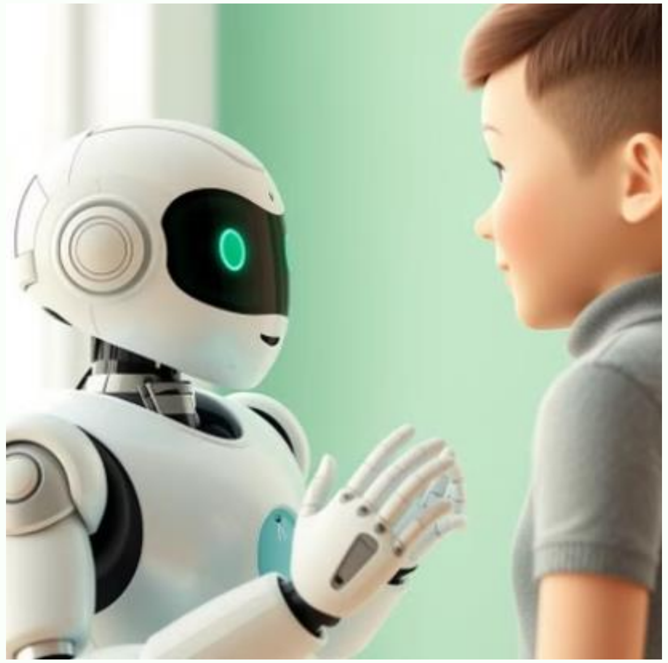
Actor-Critic

Combines value and policy methods, using both a value function and a policy.

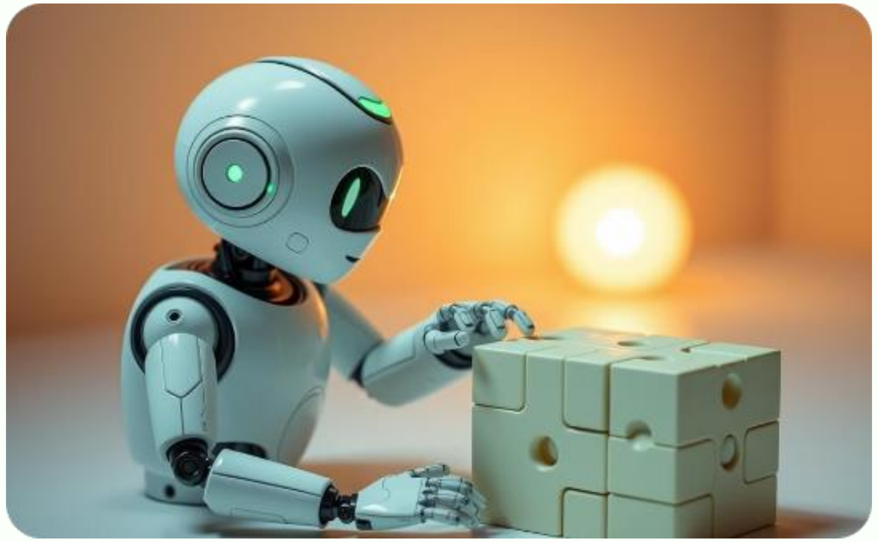
Applications of Reinforcement Learning







Challenges and Future Directions



Scalability

Scaling RL to complex real-world problems is a major challenge.

Safety

Ensuring the safety of RL agents in real-world applications is crucial.

Explainability

Understanding the decisions made by RL agents is essential for trust and reliability.