Seasons of Code 2025: RL in Self-Driving Cars
Assignment - 1

Objective

This assignment evaluates your understanding of fundamental reinforcement learning algorithms. You will implement classic tabular methods and modern actor-critic algorithms from scratch, apply them to OpenAI Gym environments, and analyze their behavior through reward plots and rollout videos.

Environments

- **FrozenLake-v1 (deterministic)** – for tabular methods (discrete state/action space).
- **Pendulum-v1** – for continuous control algorithms (PPO, DDPG, SAC).

Tasks

Task 1. Theory: Write a short explanation of the mathematical foundations of all 5 algorithms:

- Q-Learning
- Monte Carlo Control
- PPO (Proximal Policy Optimization)
- DDPG (Deep Deterministic Policy Gradient)
- SAC (Soft Actor Critic)

Task 2. FrozenLake-v1:

- Implement **Tabular Q-learning** with epsilon-greedy exploration.
- Implement **Monte Carlo Control** (First-Visit).

Task 3. Pendulum-v1:

- Choose any **2 out of 3** from the following:
  - (a) Implement PPO from scratch.
  - (b) Implement DDPG from scratch.
  - (c) Implement SAC from scratch.

Task 4. Log and plot the total reward per episode for all implementations.

Task 5. Record and save a video of each trained agent performing in its environment.

Requirements

Install the following Python packages:

```
pip install gym matplotlib numpy imageio
```

Submission

Submit a ZIP folder named `Name_RollNo.zip` containing the following:

- A PDF generated from your **Word or LaTeX document** for **Task 1** (Mathematical explanations of all algorithms).

- Python scripts for all implemented algorithms:
  - `q_learning.py`
  - `monte_carlo.py`
  - `ppo.py`, `ddpg.py`, or `sac.py` (any two)

- All reward **plots**

- All rollout **videos**