**Autonomous Highway Driving Using Reinforcement Learning**

**Introduction**

* This project aims to develop an RL-based agent to drive on highways using the **highway-env** simulation. [click](https://github.com/Reinforcement-Learning-Code/highway-env)

It will train the agent to make driving decisions like lane changes, speed adjustments, and collision avoidance in a simulated highway environment.

**Objectives**

* The goal is to build an RL agent that:
  + Learns to drive safely and efficiently in **highway-env**.
  + Uses two RL algorithms: Deep Q-Network (DQN) and Proximal Policy Optimization (PPO).
  + Is evaluated based on safety (e.g., avoiding collisions), efficiency (e.g., maintaining speed), and adaptability (e.g., handling dense traffic).

**Actions in Highway-Env**

* The agent can perform these specific actions:
  + **Keep Lane:** Maintain the current lane and speed.
  + **Change to Left Lane:** Move to the left lane, if possible, to overtake slower vehicles.
  + **Change to Right Lane:** Move to the right lane, if possible, for safer driving.
  + **Accelerate:** Increase speed to match traffic flow or overtake.
  + **Decelerate:** Reduce speed to maintain safe distances.

**Methodology**

* **Week 1:** Set up **highway-env** and understand the action space.
* **Week 2-3:** Implement DQN and PPO algorithms to train the agent to make decisions based on rewards.
* **Week 4:** Train the agent across different scenarios, tuning it for better performance.
* **Week 5:** Evaluate the agent’s performance in terms of safety, efficiency, and adaptability.
* **Week 6:** Summarize results, write a final report, and prepare a presentation.

**5. Expected Outcomes**

* The project will result in an RL agent that can drive safely and efficiently in a highway environment. We will compare the performance of DQN and PPO to see which algorithm works better.

**6. Resources**

* **Highway-env** for simulation, Python for RL implementation, and a computer with sufficient processing power for training.

There are also more challenging environments (3D) that we can explore if we have extra time.