

# Seasons of Code 2025

## Week 6 Assignment: RL in Self-Driving Cars

### Objective

In this assignment, you will use deep reinforcement learning algorithms such as PPO, DDPG, or SAC to train an autonomous driving agent in the **highway-env** simulation. You will apply your previously implemented RL algorithms knowledge to the **highway-v0** environment, make a small custom modification to the simulation settings (e.g., number of vehicles or lanes), and evaluate the effect of these changes on performance.

### Tasks

#### Task 1: Environment Setup

Install and initialize **highway-env**. Explore the **highway-v0** or **merge-v0** scenario. For instance:

```
import gymnasium as gym
import highway_env

env = gym.make("highway-v0")
obs, _ = env.reset()
```

Visualize or inspect the observations to understand state/action spaces.

#### Task 2: Algorithm Implementation

Choose one algorithm (PPO, DDPG, or SAC). You are encouraged to use **Stable-Baselines3 (SB3)** for PPO or SAC, as it offers robust, optimized implementations and faster experimentation. However, if you wish, you may also use your own implementation from previous assignments.

**Note:** The primary purpose of implementing these algorithms yourself was to gain a deeper understanding of their inner workings. Your custom implementations may not be as optimized or stable as SB3 versions, so expect to encounter errors or unstable training. That is completely okay—treat it as part of the learning experience.

If using DDPG/SAC, configure the environment for continuous actions:

```
env = gym.make("highway-v0", config={"action": {"type": "ContinuousAction"}})
```

Ensure your networks match the shape of the observations in **highway-env**.

#### Task 3: Training

Train your agent and log episode rewards, collisions, or other metrics. Plot reward curves to monitor learning. Tune hyperparameters as needed.

## Task 4: Environment Customization

Modify one setting of the environment to create a custom traffic scenario. For example:

```
env.unwrapped.config["vehicles_count"] = 30
env.unwrapped.config["lanes_count"] = 3
env.reset()
```

Retrain or evaluate the agent in this new setting. Record any changes in learning performance or agent behavior.

## Task 5: Analysis Write-up

Prepare a 1-2 page report describing:

- The algorithm used and any key implementation details
- Plots of reward vs. episodes and other metrics
- Insights and challenges encountered

## Deliverables (Submit a ZIP file similar to previous assignments)

- Python script or notebook for your training and evaluation code
- Report in PDF format summarizing your approach and findings
- Optional: video, GIF, or screenshots of the simulation

## Resources

- GitHub Repository: <https://github.com/Farama-Foundation/HighwayEnv>
- Getting Started: <https://highway-env.farama.org/>
- Environment Reference: <https://highway-env.farama.org/envs/>
- Configuration Guide: <https://highway-env.farama.org/config/>
- Actions: <https://highway-env.farama.org/actions/>