🚗 Reinforcement Learning Autonomous Driving in CARLA - Roadmap

🔹 Phase 1: Understanding & Setup (1-2 Weeks)

✅ Step 1: Install & Run CARLA

- You've already done this! 🎯

✅ Step 2: Learn CARLA's Python API

- Write a simple script to:
    - Spawn a car.
    - Control the car manually (throttle, brake, steering).
    - Read sensor data (camera, LIDAR, IMU).
    - Reset the environment.

✅ Step 3: Set Up a Custom CARLA Gym Environment

- Convert CARLA into an OpenAI Gym environment.
- Define:
    - **Observations**: Camera/LIDAR data, speed, position.
    - **Actions**: Steering, throttle, brake.
    - **Reward Function**: Staying on the road, avoiding collisions.

🔹 Phase 2: Training the RL Model (3-5 Weeks)

✅ Step 4: Choose an RL Algorithm

- Use **Deep Q-Network (DQN)** for a basic version.
- Later, upgrade to **Proximal Policy Optimization (PPO) or Soft Actor-Critic (SAC)** for continuous control.

✅ Step 5: Train the RL Agent

- Run training episodes in CARLA.
- Tune rewards, hyperparameters.
- Save and test the trained model.

✅ **Step 6: Evaluate and Improve**

- Test on different roads/weather conditions.
- Improve the model with better rewards and hyperparameters.

🔹 **Phase 3: Advanced Features & Optimization (2-4 Weeks)**

✅ **Step 7: Implement Camera-Based Driving**

- Train the agent using images instead of just sensor data.

✅ **Step 8: Optimize Performance**

- Improve training speed.
- Use **Transfer Learning** to reuse trained models.

✅ **Step 9: Simulate in Complex Environments**

- Try night, rain, and traffic scenarios.
- Compare RL vs. traditional driving algorithms.

💡 **Bonus (Optional)**

- Use **LIDAR** for obstacle detection.
- Integrate **Deep Learning** (CNNs for vision-based driving).
- Simulate **multi-agent environments** (handling traffic).