**Please provide a summary of your progress to date.**

目前为止，我已经写出的DQN算法，是一个有两层神经网络的机器学习算法。并且在一个椭圆形赛道中，可以通过事先添加路径的形式让车完成赛道。我做此的目的是通过DQN算法研究讨论replay buffer对于训练效率的影响，比如replay buffer的大小，抽样训练的方法，这些都可能是影响训练的主要因素。现在我正在通过不事先添加路径的方式让车通过自己的不断试错自己独立完成训练，但是目前来看这个进度不是很理想。虽然我当前的算法车的确可以有一定的学习效果，但是效率过慢，甚至有无法训练完成的可能是我目前要解决的问题。

So far, I have developed a deep reinforcement learning framework based on the Deep Q-Network (DQN) algorithm, which has been successfully applied to an autonomous driving simulation on an oval track. The model utilizes a two-layer fully connected neural network that learns to complete the track by controlling the vehicle's movement through interaction with the environment.

In the initial phase, to verify the algorithm's basic learning capability and ensure stable convergence, I employed a pre-defined path guidance approach, allowing the vehicle to follow a known route during early training. This setup helped confirm the feasibility of applying DQN to the track navigation task.

Currently, I am transitioning to a more challenging setting in which the vehicle must learn to complete the track entirely through trial and error, without any prior trajectory or external guidance. Progress in this phase has been relatively slow: while the model exhibits some early signs of learning, its training efficiency remains low, stability is inconsistent, and in some cases, it fails to converge altogether. Solving these issues is now my primary focus and a critical step toward achieving a fully autonomous learning agent.

**Please also include a list of tasks that you still require to complete before submission.**

有关我的research，我还有很多要努力的地方。可能是由于当前赛道有些复杂，我需要先通过一个简单的赛道进行训练，比如绘制一个直线赛道。然后后续通过不断增加转弯，增加赛道难度，不管更新我的算法。当我的算法可以成功训练完成赛道任务之后，我需要继续讨论replay buffer对于训练效率的影响。需要修改各种hyperparameter，buffer大小，取样方式等分别讨论怎样可以提高训练效率。

1. **Simplify the Environment Design**
   * Construct a basic linear track to lower the initial learning complexity;
   * Gradually introduce curves and more complex track structures once the model performs well on the simpler track, to enhance its generalisation capabilities.
2. **Conduct In-Depth Experiments on the Replay Buffer**
   * Vary the size of the Replay Buffer and assess its impact on training convergence speed and stability;
   * Implement **Prioritised Experience Replay (PER)** to evaluate its effect on sample efficiency;
   * Compare different sampling strategies and analyse their influence on training performance.
3. **Hyperparameter Tuning**
   * Systematically explore combinations of learning rate, discount factor (γ), batch size, and other relevant parameters;
   * Optimise the balance between training efficiency and overall model performance.
4. **Performance Visualisation and Evaluation**
   * Integrate visual tools such as reward progression curves and vehicle trajectory plots during training;
   * Conduct comparative testing across different track configurations to assess robustness and adaptability.
5. **Report Writing and Analysis**
   * Summarise experimental results under various Replay Buffer configurations;
   * Compile a comprehensive final report detailing the experimental design, results analysis, and recommendations for future improvements.
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