**Title: Report on CADRE: A Cascade Deep Reinforcement Learning Framework for Vision-based Autonomous Urban Driving**

Executive Summary:

This report provides a detailed analysis of the implementation and evaluation of CADRE, a Cascade Deep Reinforcement Learning Framework for Vision-based Autonomous Urban Driving. The primary objective was to develop a robust framework capable of training autonomous vehicles to navigate urban environments efficiently using vision-based inputs. CADRE employs a cascade architecture, hierarchically decomposing the driving task to facilitate effective learning and decision-making in complex scenarios.

Approach:

Our approach to implementing CADRE involved several key steps:

* Literature Review: Conducted an extensive review of existing research on deep reinforcement learning (DRL) frameworks for autonomous driving to inform our implementation strategy.
* Framework Implementation: Implemented CADRE based on the architecture described in the research paper, adapting it to suit our specific requirements and experimental setup.
* Integration with Urban Driving Simulator: Integrated CADRE with an urban driving simulator to assess its performance in a realistic environment, allowing for comprehensive evaluation under various driving scenarios.
* Training and Evaluation: Trained the CADRE framework using simulated driving scenarios and rigorously evaluated its performance metrics to assess effectiveness and identify areas for improvement.

Basis for CADRE Framework:

The selection of CADRE was based on its innovative cascade architecture, which offers advantages in handling complex urban driving tasks. The framework's hierarchical approach enables efficient learning and decision-making, making it well-suited for our objectives.

Performance Evaluation:

Performance Analysis:

Upon running inference, it was observed that the ego vehicle exhibited slow movement, resulting in prolonged route completion times.

Out of the 14 designated routes, the vehicle successfully completed only 12 routes, indicating a performance gap between expected and observed outcomes.

Solution:

To address the issue of slow vehicle movement and incomplete route completion, the following solutions were implemented:

* Performance Analysis: Conducted a comprehensive analysis of the ego vehicle's behaviour to identify underlying causes of slow movement and incomplete route completion.
* System Optimization: Implemented optimizations to enhance the overall efficiency and responsiveness of the system, focusing on perception, decision-making, and control algorithms.
* Parameter Tuning: Adjusted parameters related to vehicle dynamics, acceleration, and braking to optimize the ego vehicle's movement behaviour and improve speed profile during route completion.
* Scenario Simulation: Utilized scenario simulation techniques to replicate real-world driving conditions and assess the vehicle's performance under various scenarios, including high-traffic situations and complex urban environments.
* Continuous Monitoring and Feedback: Implemented mechanisms for continuous monitoring of the vehicle's performance during route completion, enabling real-time feedback and adjustment of system parameters to address emerging issues and improve overall performance.
* Iterative Development: Adopted an iterative development approach, incorporating feedback from testing and evaluation phases to iteratively refine the system and enhance its capabilities over time.

Conclusion:

This report highlights the implementation and evaluation of CADRE for vision-based autonomous urban driving. Despite encountering challenges such as slow vehicle movement and incomplete route completion, the framework shows promise in enabling effective navigation in complex urban environments. By addressing identified issues and implementing appropriate solutions, we aim to further improve the performance and reliability of CADRE for broader deployment in real-world applications. Future work will focus on continued refinement and optimization of the framework to achieve optimal performance and scalability.