Traffic Simulation Project

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This project deals with traffic simulation using machine learning techniques to predict congestion levels based on data that was randomly generated.

We used a Logistic Regression model in this project to predict congestion levels (Low, Medium, High) based on

the number of vehicles, speed, and time of day. The system was designed using Object-Oriented Programming (OOP) to ensure flexibility

and ease of handling different datasets.

In this project, we generated random data using the NumPy library. The data includes vehicle count,

speed, and time of day. The data was classified into different categories based on speed and vehicle count,

and then used to train a logistic regression model that predicts congestion levels.

We used **Matplotlib** to visualize the resulting data and display the distribution of congestion levels using a bar chart.

Challenges and Difficulties:

We faced some challenges while working on this project. One of the most prominent challenges was handling the random data and ensuring the model can handle a variety of inputs correctly. It was crucial to ensure factors like time of day affected congestion classification, as time is a key aspect of the problem.

Moreover, ensuring **model accuracy** was another important challenge, as it was necessary to test many cases to ensure that the model produced accurate results that aligned with real-world traffic patterns. Some random values could be illogical, which required fixes at times in how data is generated or adjusting the prediction conditions.

Additionally, it was difficult to define clear boundaries for congestion levels based on a wide variety of inputs.
It was important to take into account that **vehicle count** and **speed** alone might not determine congestion, but time of day should also play a significant role.

In conclusion, we were able to create a system capable of predicting congestion levels based on generated data that can help in various applications like traffic analysis in cities or improving public transport services.
However, there is still room to improve the model, whether in terms of **accuracy** or **handling real-world data** instead of random data.

The second page continues to elaborate on the challenges we faced in model optimization and data handling.
One of the challenges we encountered was the difficulty in finding real-world traffic data to train the model more effectively.
Using randomly generated data worked for initial testing, but it wasn't as realistic as data gathered from real traffic systems.

Furthermore, handling different traffic patterns based on time of day, such as rush hours and off-peak times, added complexity
to our model. We needed to carefully consider how various factors like time and speed interact with congestion levels.

Despite these challenges, the system we developed has the potential for improvement, especially in integrating real-time data
and enhancing its accuracy by refining the model parameters and using more complex machine learning techniques like
decision trees or **neural networks**. Moreover, increasing the sample size for training the model can also contribute to better accuracy.

In future work, we plan to implement these improvements and test the model on a larger scale to ensure that the predictions
are both accurate and reliable for real-world traffic analysis.

The third page of this report further discusses the potential applications of the traffic simulation system in real-life scenarios.

Our model could be used to optimize traffic flow in cities, improve public transportation scheduling, and help urban planners make informed decisions.

By predicting congestion levels in different parts of the city at specific times, authorities can adjust traffic signals,

divert traffic to less congested routes, or even suggest optimal travel times to commuters.

Moreover, this system can contribute to reducing pollution by easing traffic congestion, leading to smoother traffic flow and less idle time on the road.

It could also be used in developing smarter cities that can efficiently manage resources and improve the quality of life for their residents.

In conclusion, this project has shown the feasibility of using machine learning models to simulate traffic and predict congestion levels.

It has provided valuable insights into how traffic management can be optimized through predictive modeling, and there is great potential

for applying these concepts to real-world traffic systems. Future improvements will make this system even more accurate and applicable in various settings.