Final Project Report
Project Title: Forecasting of Smart City Traffic Patterns
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I. Introduction

Traffic congestion is a significant challenge in urban areas, affecting transportation efficiency and city infrastructure planning. This project aimed to forecast traffic patterns across four major junctions in a city using advanced data-driven approaches. The insights derived from this project will help in improving traffic management and future infrastructure planning.

II. Objectives

1. Analyze historical traffic data to identify patterns and trends.
2. Develop predictive models to forecast traffic volume at different junctions.
3. Compare traditional statistical models with machine learning and deep learning approaches.
4. Optimize forecasting models for real-time deployment.
5. Provide data-driven recommendations for better traffic management.

III. Methodology

1. Data Collection and Preprocessing

- The dataset was obtained from the provided source, containing traffic volume records across four junctions.
- Preprocessing steps included handling missing values, normalizing data, and feature engineering.

2. Exploratory Data Analysis (EDA)

- Visualized traffic trends across different time periods (daily, weekly, monthly).
- Identified peak traffic hours, anomalies, and seasonal variations.

3. Model Implementation

- **Traditional Models:** ARIMA, SARIMA, Prophet.
- **Machine Learning Models:** Random Forest, XGBoost.
- **Deep Learning Models:** LSTM, GRU.

4. Model Evaluation and Optimization

- Performance metrics: RMSE, MAE, MAPE.
- Fine-tuning hyperparameters using Bayesian Optimization and GridSearchCV.
- Applied ensemble techniques to combine model strengths.

5. Visualization and Interpretation

- Developed interactive dashboards using Matplotlib, Seaborn, and Plotly.
- Used SHAP and LIME to interpret deep learning model predictions.

IV. Key Findings and Insights

1. **Traffic peaks observed during morning and evening rush hours.**
2. **Weekends and holidays exhibit different traffic patterns compared to weekdays.**
3. **LSTM and GRU outperformed traditional models in long-term forecasting.**
4. **Feature importance analysis revealed significant contributing factors to congestion.**
5. **Real-time forecasting feasibility depends on computational resources and optimization strategies.**

V. Challenges and Solutions

1. **Data Imbalance:** Addressed using SMOTE and data augmentation techniques.
2. **High Computational Cost:** Optimized deep learning models and used cloud-based solutions.
3. **Interpretability Issues:** Implemented SHAP and LIME for explainability.
4. **Model Performance Trade-offs:** Balanced accuracy and efficiency through ensemble methods.

VI. Recommendations and Future Scope

1. **Deploy real-time forecasting models integrated with city traffic systems.**
2. **Incorporate additional data sources such as weather conditions and road incidents.**
3. **Enhance model accuracy through advanced deep learning architectures (e.g., Transformer models).**

4. **Collaborate with urban planners to implement AI-driven traffic control measures.**

VII. Conclusion

This project successfully developed a predictive framework for forecasting city traffic patterns. The insights generated can assist the government in making informed decisions to enhance traffic management and urban infrastructure. Future enhancements can focus on integrating real-time data streams for improved accuracy and efficiency.

This report encapsulates the entire project lifecycle, from data collection to model evaluation and recommendations. Let me know if you need any modifications or additional details!