Weekly Project: Traffic-Related Time Series Forecasting Project

Objective:

Students will select a specific traffic-related issue (e.g., congestion, accidents, public transportation ridership) and develop time series forecasting models using LSTM, RNN, or GRU neural networks to address it. By analyzing traffic patterns, trends, and external factors, they will create accurate models to inform traffic management strategies, optimize transportation systems, and enhance overall urban mobility.

Project Overview:

Students will use LSTM, RNN, or GRU neural networks to solve a traffic-related problem by analyzing trends and patterns. They will collect, preprocess, and analyze data, followed by developing and training models. After evaluating the model's performance, they will use the results to drive data-informed decisions aimed at improving traffic efficiency and supporting better transportation planning and urban development.

Project Tasks:

Task 1: Problem Identification and Data Gathering

- Define the specific traffic-related problem to address.
- Identify and collect relevant traffic datasets (e.g., traffic volume, speed, public transportation data).
- Collect the data either by gathering the data by yourself or obtaining data from the internet.
- Ensure data quality and completeness.

Task 2: Exploratory Data Analysis (EDA)

- Clean and preprocess the collected data.
- Explore data distributions, correlations, and patterns (e.g. Seasonal Trend, Occasional Trend, Cyclic Trend).
- Identify potential features for model development.
- Visualize data to understand traffic trends and seasonality.

Task 3: Model Development and Training

- Select the appropriate architectures LSTM, RNN, or GRU (or even more complex models if you want).
- Preprocess data for model input (e.g., normalization, scaling).

- Train the model.

Task 4: Model Evaluation and Selection

- Evaluate the performance of developed models.
- Compare models based on accuracy, computational efficiency, and interpretability (if you used and experimented with more than one).

Deliverable: A notebook with the entire workflow (data collection, preprocessing, model selection, implementation, training, evaluation), and a presentation slides.

Team Collaboration and Task Assignment:

Each student should contribute to the project, and it is important to document who did each task. Ensure that all tasks, from data gathering and preprocessing to model design and evaluation, are clearly assigned and recorded in the presentation.

Presentation Questions:

To assist with the presentation, consider the following questions:

1. What challenges did you face during data collection and how did you overcome them?
2. Why did you choose your specific model architecture?
3. How does the performance of your chosen model compare to alternative approaches, and what factors contributed to the differences?
4. What did you learn from storing the data in a database, and how did it impact your workflow?
5. If you were to extend this project, what additional features or improvements would you consider?

Main Grading System:

The following table outlines the grading criteria for the main project. Each component is assigned a maximum number of points, with the total possible score being 100 points. The grade then will be transformed into 20 grades on this week's evaluation.

Component	Description	Points
Project Idea Selection	Clarity, feasibility, and relevance of the chosen traffic-related problem.	10
Data Relevance	How relevant is the data to traffic management?	20
Data Collection & Preprocessing	Quality of data collection, handling missing data, normalization, and augmentation.	10
Model Selection & Implementation	Appropriateness of model choice, design, and implementation, including code quality and efficiency.	10
Model Training & Evaluation	Effectiveness of model training, hyperparameter tuning, and evaluation on test data.	10
Database Integration	Proper storage and retrieval of data from a database, including documentation of the process.	25
Presentation	Quality of the presentation, including clear explanation of the problem, methodology, and results.	10
Team Collaboration & Contribution	Equal participation, clear task assignment, and documentation of who did each task.	10

Bonus Tasks for Extra Credit:

Students could complete the following bonus tasks to earn extra points if they missed grades in the main project. These tasks encourage additional effort, creativity, and the use of advanced techniques.

Bonus Task	Description	Bonus Points
Data Scraping or Manual Data Collection	If students scraped data from the web or collected data manually instead of using an existing dataset.	+5
Use of Advanced Frameworks (e.g., PyTorch)	If students used advanced frameworks like PyTorch instead of simpler tools.	+5
Implementation of Custom Data Augmentation	If students implemented custom data augmentation techniques beyond standard transformations.	+5
Advanced Model Architectures	If students implemented advanced model architectures instead of simpler models.	+5
Deployment of the Model	If students deployed their model on a cloud service or as a web application/API.	+10