**EV Charging Demand Forecasting**

This project aims to forecast electric vehicle (EV) charging demand using machine learning and deep learning models. The three models consisted of **ARIMA**, **XGBoost**, and **LSTM**, all of which, however, were directed towards achieving one common goal: to promote charging station efficiency and reduce congestion in EV infrastructure.

**Project Structure**

* .ipynb: The complete Jupyter notebook containing all code, visualizations, preprocessing steps, and model evaluations.
* Word.docx: Final written report including the project background, methodology, results, literature review, and conclusion.

**Dataset**

This dataset includes **3,395 sessions of EV charging** at **25 workplace locations** with **105 charging stations**. It contains entries like:

* Energy used (kWh)
* Charging time
* Time and date
* Charging platform
* Location and station ID

The dataset is public and licensed under **CC0 1.0** (no usage restrictions).

**🔍 Models Used**

**1. ARIMA (AutoRegressive Integrated Moving Average)**

* Best for: Linear time series
* Limitations: Poor performance on non-linear data
* Evaluation: Moderate accuracy

**2. XGBoost**

* Best for: Complex and non-linear relationships
* Result: **Best performance**
* MAE: 0.0168 | R²: 0.9997 | MAPE: 0.0081%

**3. LSTM (Long Short-Term Memory)**

* Best for: Long-term sequence patterns
* Result: Poor accuracy due to tuning challenges
* R²: 0.01 | MAPE: 67.85%

**🛠️ Features & Tools**

* Python
* Google Colab
* Pandas, NumPy, Seaborn, Matplotlib
* Scikit-learn
* Statsmodels
* XGBoost
* TensorFlow / Keras for LSTM

**Results Summary**

* **XGBoost** outperformed both ARIMA and LSTM in all accuracy metrics.
* **ARIMA** was only good for simple trends.
* **LSTM** showed potential but needs better tuning and more data.

**Key Takeaways**

* Predicting EV charging demand helps improve smart grid planning and reduce overload at charging stations.
* Using machine learning, cities can end up preparing future progressive ways for themselves, for electric mobility.

**License**

This project utilizes open data and is exclusively for educational and research use.