Final Project Progress Report

Power Load Forecasting

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Project scope update

This project investigates short-term household power load forecasting using time-series and machine learning models. The work initially considered ARIMA as a baseline, but the seasonal structure and periodic patterns in the data motivated a switch to **SARIMA**.

The final comparison focused on four models: **SARIMA**, **ETS** (Exponential Smoothing), **XGBoost**, and **LSTM**. Using consistent train/test splits and common features, the results showed that **LSTM achieved the best forecasting accuracy**, XGBoost ranked second, ETS was stable and competitive on seasonal signals, while SARIMA captured seasonality explicitly but underfit nonlinear effects.

Data sources

- **UCI Household Power Consumption (2006–2010)** — provides minute-level household power readings, aggregated to hourly intervals for modeling consistency. Automatically downloaded by the project (no manual download needed). Original dataset: `https://archive.ics.uci.edu/dataset/235/individual+household+electric+power+consumption`
- **Meteostat API** — provides hourly *temperature*, *humidity*, and *wind speed* data for **Paris**.

The datasets were merged using timestamps and resampled to hourly intervals. Missing data were handled through linear interpolation, and normalization was applied to ensure feature comparability.

Issues / difficulties

- **Model adaptability:** Classical seasonal models (SARIMA/ETS) struggled with complex nonlinear patterns; LSTM and XGBoost handled them better.
- **Different sampling rates:** Power data required conversion from minute-level to hourly; weather data was already hourly, so careful alignment and trimming were required.
- **Training cost:** The LSTM model required longer training time, GPU support, and more extensive hyperparameter tuning.
- **Data quality:** Occasional gaps in weather data slightly reduced the amount of usable training data and affected evaluation fairness.

Repository: `https://github.com/xhuang21/power-load-forecasting`