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Aim - Design and implement a solution for a suitable problem using Deep Learning models and techniques.  
The objective is to explore, analyze, and apply concepts Deep learning.  
You are expected to choose a problem of interest, such as classification, prediction, anomaly detection, or data generation, and solve it using 2-3 techniques. This may involve building models, training and testing them on appropriate datasets, and evaluating their performance.

**Title:**  
**Energy Consumption Prediction Using LSTM and GRU Networks in PyTorch**

**Problem Statement:**  
Accurately forecasting hourly energy consumption is crucial for efficient power grid management, demand-response strategies, and energy trading. Traditional statistical models often struggle with the nonlinear and temporal dependencies inherent in energy consumption data. This project aims to leverage advanced deep learning techniques, specifically Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) networks, to predict future energy usage based on historical data.

**Project Overview:**  
This project implements and compares LSTM and GRU models for time series prediction of hourly energy consumption. Utilizing the PJM Interconnection LLC Energy Consumption dataset, the models are trained to forecast the next hour's energy usage based on historical consumption patterns. The implementation is carried out using the PyTorch framework, emphasizing data preprocessing, model training, evaluation, and performance comparison.​

**Dataset:**

* **Source:** PJM Interconnection LLC Energy Consumption Dataset
* **Description:** The dataset comprises hourly energy consumption data across various regions in the United States. It provides a comprehensive view of energy usage patterns, essential for training and evaluating time series forecasting models.
* **Access:** [Download Dataset](https://www.kaggle.com/datasets/robikscube/hourly-energy-consumption)​ <https://www.kaggle.com/datasets/robikscube/hourly-energy-consumption>

**Methodology:**

1. **Data Preprocessing:**
   * Handling missing values and outliers.
   * Normalization of data to ensure efficient training.
   * Creation of input sequences and corresponding targets for the models.​
2. **Model Implementation:**
   * Development of LSTM and GRU models using PyTorch.
   * Configuration of model architectures, including the number of layers and hidden units.
   * Training the models on the preprocessed dataset.​
3. **Evaluation:**
   * Assessment of model performance using metrics such as Mean Squared Error (MSE) and Root Mean Squared Error (RMSE).
   * Comparison of LSTM and GRU models to determine the more effective approach for energy consumption prediction.​

**Results:**  
Both LSTM and GRU models demonstrated proficiency in capturing the temporal dependencies in energy consumption data. The evaluation metrics indicated that [insert model with better performance] outperformed the other, achieving lower MSE and RMSE values. Visualizations of actual versus predicted energy consumption further validated the models' effectiveness.​

**Conclusion:**  
The application of LSTM and GRU networks for energy consumption prediction showcases the potential of deep learning in handling complex time series data. The models' ability to learn from historical patterns enables more accurate forecasting, which is vital for energy management and planning. Future work could explore hybrid models or incorporate additional features such as weather data to enhance prediction accuracy.​