Topic Proposal

📝 Topic Name:

GridGenius – AI-Powered Energy Optimization

(Energy Demand Forecasting Using Machine Learning)
A data-driven approach to predict and optimize urban energy consumption.

1. Description

What is the topic about? What specific problem are you trying to address?

- **Overview**:
  This project aims to develop a machine learning model to accurately forecast energy demand in urban areas using historical power consumption data. The goal is to help energy providers optimize supply, reduce wastage, and lower operational costs.
- **Key Challenges**:
  - Handling high-dimensional time-series data with seasonal trends.
  - Ensuring model scalability for large datasets.
  - Balancing model complexity and interpretability.
- **Potential Impact**:
  - Improve energy efficiency and reduce carbon footprint.
  - Assist city planners in developing data-driven policies.
  - Help utility companies optimize infrastructure planning.

2. Keywords

energy forecasting, machine learning, time-series analysis, smart grids, demand prediction, energy optimization.

3. References and Links

Document useful resources related to the topic.

Research Papers

Title	Author(s)	Link
Energy Demand Forecasting Using Machine Learning Perspective Bangladesh	Avijit Paul Piyal, Khan Fahad Rahman, Siam Ahmed, Khan Fahad Rahman, Abu S. M. Mohsin	View Paper
Building Energy Use Prediction Using Time Series Analysis	ZHOU Ruijin, PAN Yiqun, HUANG Zhizhong, WANG Qiujian	View Paper

Datasets

Name	Source (e.g., Kaggle, UCI, etc.)	Link	Description / Notes
Power Consumption of Tetouan City	UCI	Dataset Link	Hourly power usage data for different city zones

Other Resources

Resource Type	Description	Link
Blog / Tutorial	Introduction to Time-Series Forecasting	Resource Link
Tool / Framework	scikit-learn for ML modeling	Resource Link

4. Research Notes

Summarize insights or takeaways from your research.

- **Important Concepts**:
  - *Seasonality*: Understanding recurring patterns in energy consumption.
  - *Feature Engineering*: Utilizing weather, holidays, and time-based features to improve model accuracy.
- **Relevant Methods / Techniques**:
  - ARIMA: Classical statistical model for time-series forecasting.
  - LSTM/GRU: Deep learning models for sequential energy prediction.

5. Dataset Analysis

If you've shortlisted a dataset for the topic, provide details here.

- **Dataset Name**: Power Consumption of Tetouan City
- **Source**: UCI Machine Learning Repository
- **Key Features**:
  - Energy consumption in different city zones.
  - Environmental parameters like temperature and humidity.
  - Time-based attributes (day, hour, season).
- **Challenges**:
  - Dealing with missing data and outliers.
  - Identifying long-term trends in power consumption.

6. Ideas and Improvements

- **How can this topic be expanded or improved?**
  - Idea 1: Combine the dataset with external factors like economic activity.
  - Idea 2: Build an interactive dashboard for real-time monitoring.
- **Unique Angle**:
  - Using ensemble methods (e.g., combining ARIMA and deep learning models) to improve forecasting accuracy.

7. Final Topic Evaluation

Summarize your assessment of the topic.

- **Feasibility**: 4/5
- **Novelty**: 3/5
- **Potential Impact**: 5/5
- **Overall Score**: 4/5

8. To-Do

Checklist for further research or actions needed.

- [ ] Search for additional datasets.
- [ ] Identify more research papers.
- [ ] Experiment with baseline forecasting models.
- [ ] Develop a proof-of-concept implementation.

9. Additional Notes

Any other thoughts, questions, or ideas?

- Consider adding real-time data pipelines for continuous prediction.
- Evaluate the trade-off between accuracy and interpretability for stakeholders.