Project Title	**PowerPulse: Household Energy Usage Forecast**
Skills take away From This Project	**Data Preprocessing, Feature Engineering, Regression Modeling,Evaluation Metrics**
Domain	**Energy and Utilities**

Problem Statement:

In the modern world, energy management is a critical issue for both households and energy providers. Predicting energy consumption accurately enables better planning, cost reduction, and optimization of resources. The goal of this project is to develop a machine learning model that can predict household energy consumption based on historical data. Using this model, consumers can gain insights into their usage patterns, while energy providers can forecast demand more effectively.

By the end of this project, learners should provide actionable insights into energy usage trends and deliver a predictive model that can help optimize energy consumption for households or serve as a baseline for further research into energy management systems.

Business Use Cases:

1. **Energy Management for Households:** Monitor energy usage, reduce bills, and promote energy-efficient habits.
2. **Demand Forecasting for Energy Providers:** Predict demand for better load management and pricing strategies.
3. **Anomaly Detection:** Identify irregular patterns indicating faults or unauthorized usage.
4. **Smart Grid Integration:** Enable predictive analytics for real-time energy optimization.

5. **Environmental Impact:** Reduce carbon footprints and support conservation initiatives.

Approach:

1. **Data Understanding and Exploration:**
    - Load and explore the dataset to understand its structure, variables, and quality.
    - Perform exploratory data analysis (EDA) to identify patterns, correlations, and outliers.
2. **Data Preprocessing:**
    - Handle missing or inconsistent data points.
    - Parse date and time into separate features.
    - Create additional features such as daily averages, peak hours, or rolling averages.
    - Normalize or scale the data for better model performance.
3. **Feature Engineering:**
    - Identify relevant features for predicting global active power consumption.
    - Incorporate external data (e.g., weather conditions) if available.
4. **Model Selection and Training:**
    - Split the dataset into training and testing sets.
    - Train regression models such as Linear Regression, Random Forest, Gradient Boosting, and Neural Networks.
    - Perform hyperparameter tuning to optimize model performance.
5. **Model Evaluation:**
    - Evaluate models using appropriate metrics (e.g., RMSE, MAE, R-squared).
    - Compare model performance and select the best-performing model.

Results:

Learners should aim to achieve:

- An accurate prediction model for household power consumption.
- Clear insights into key factors influencing energy usage.
- Visualization of energy trends and predictive performance.

Project Evaluation metrics:

1. **Root Mean Squared Error (RMSE):** Measures prediction accuracy.

2. **Mean Absolute Error (MAE):** Evaluates average error magnitude.
3. **R-Squared (R^2):** Indicates how well the model explains the variability of the target variable.
4. **Feature Importance Analysis:** Demonstrates understanding of influential factors.
5. **Visualization Quality:** Assesses the effectiveness of graphical insights.

Technical Tags:

- **Data Preprocessing**
- **Regression Modeling**
- **Feature Engineering**
- **Hyperparameter Tuning**
- **Visualization**
- **Python**
- **Scikit-learn**
- **Pandas**
- **Matplotlib/Seaborn**

Data Set:

Dataset : Individual Household Electric Power Consumption

Project Deliverables:

1. **Source Code:** Python scripts or notebooks with clear documentation.
2. **Report:** A comprehensive report summarizing:
    - Approach
    - Data analysis
    - Model selection and evaluation
    - Insights and recommendations
3. **Visualizations:** Graphs and plots showcasing trends, model performance, and feature importance.

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Project Guidelines:

1. **Coding Standards:**
    - Use consistent naming conventions and comments for readability.
    - Follow best practices for Python programming.
2. **Version Control:**
    - Use Git for version tracking.
    - Maintain a clean and organized repository.
3. **Testing and Validation:**
    - Validate models using cross-validation techniques.
    - Ensure reproducibility by setting random seeds.

Timeline:

The project must be completed and submitted **within 7 days from the assigned date**

References:

Project Live Evaluation	**Project Live Evaluation**
EDA Guide	**Exploratory Data Analysis (EDA) G…**
Capstone Explanation Guideline	**Capstone Explanation Guideline**
GitHub Reference	**How to Use GitHub.pptx**
Project Orientation (English)	**POWER_PLUS_ENGLISH_ORIE…**
Project Orientation (Tamil)	**POWER_PLUS_TAMIL_ORIENTA…**

PROJECT DOUBT CLARIFICATION SESSION (PROJECT AND CLASS DOUBTS)

About Session: The Project Doubt Clarification Session is a helpful resource for resolving questions and concerns about projects and class topics. It provides support in understanding project requirements, addressing code issues, and clarifying class concepts. The session aims to enhance comprehension and provide guidance to overcome challenges effectively.
Note: Book the slot at least before 12:00 Pm on the same day

Timing: Monday-Saturday (4:00PM to 5:00PM)

Booking link :https://forms.gle/XC553oSbMJ2Gcfug9

LIVE EVALUATION SESSION (CAPSTONE AND FINAL PROJECT)

About Session: The Live Evaluation Session for Capstone and Final Projects allows participants to showcase their projects and receive real-time feedback for improvement. It assesses project quality and provides an opportunity for discussion and evaluation.
Note: This form will Open only on Saturday (after 2 PM) and Sunday on Every Week

Timing: Monday-Saturday (05:30PM to 07:00PM)

Booking link : https://forms.gle/1m2Gsro41fLtZurRA