**Monthly Milk Production Forecasting**

**Using RNN, LSTM, and GRU Deep Learning Models**

**Step 1: Identify the Business Problem**

From the file name monthly\_milk\_production.csv, it is clear that this dataset showing the monthly milk production of a dairy farm or industry.

**Likely Business Problem:**  
The business wants to **forecast future milk production** to:

* Ensure proper supply chain and distribution planning.
* Manage inventory and storage efficiently.
* Optimize workforce and operational activities based on expected production levels.
* Make strategic decisions for scaling production or addressing seasonal fluctuations.

**Step 2: Define the Objective**

**Objective Statement:**

*The objective is to develop a time series forecasting model that accurately predicts the monthly milk production for the upcoming months. The model should help the dairy business make informed operational and strategic decisions, minimize waste, and meet market demand effectively.*

Steps to include;

**✅ Assignment Tasks**

1. **Exploratory Data Analysis (EDA)**
   * Visualize trends, seasonality, and anomalies in the milk production data.
   * Check for any missing values or outliers.
   * Normalize or scale the data for neural network models.
2. **Data Preparation for Deep Learning**
   * Create input-output sequences (time windows) suitable for training RNNs/LSTMs/GRUs.
   * Split data into training, validation, and test sets.
   * Reshape data for model input dimensions.
3. **Model Building**
   * Build three separate models:
     + **Basic RNN**
     + **LSTM**
     + **GRU**
   * Tune hyperparameters (e.g., window size, number of units, batch size, epochs).
   * Use appropriate loss functions and optimizers.
4. **Model Evaluation**
   * Plot predictions vs. actual values.
   * Calculate forecasting metrics: **RMSE, MAE, MAPE**.
   * Compare the performance of RNN, LSTM, and GRU.
5. **Prediction and Visualization**
   * Forecast milk production for the next 12 months.
   * Visualize the predicted trend with uncertainty or confidence intervals if possible.
6. **Business Insights**
   * Interpret results and recommend how the dairy business can use these forecasts for better planning and resource allocation.