# LSTM model for predicting daily flow entering Dau Tieng reservoir

**Question 1:** **Why is normalization important in the machine learning?**

**Answer:** Normalization is crucial for handling data with widely varying scales and units, offering several benefits:

+ **Accelerates Training Convergence:** Normalization helps algorithms converge faster and more reliably by ensuring features are on a similar scale. This stabilizes gradient updates during optimization, leading to more efficient training.

+ **Prevents Feature Dominance:** Without normalization, features with larger scales can overpower those with smaller scales, skewing model performance, especially in neural networks where input scale significantly affects activation functions.

+ **Improves Numeric Stability:** Normalizing input values prevents numerical instabilities such as overflow or underflow, which are common in operations like dot products and nonlinear transformations in neural networks.

+ **Enhances Learning in Deep Networks:** It maintains consistent activation and gradient levels across the network, preventing gradient vanishing or exploding, crucial for the stability of deep and recurrent networks.

**Question 2:** **How many normalization methods are there ? and what are criteria for selecting the appropriate method?**

**Answer:** Several methods exist, such as Min-max scaling, Standardization, and Robust Scaling. Selecting the method depends on the data’s characteristics and the model’s requirements. Generally, standardization method typically used for data that follows a normal distribution. In contrast, Min-Max Scaling is better suited for data without a normal distribution. Additionally, Robust scaling, which is similar to Min-Max scaling, offers the added benefit of being less sensitive to outliers.

**Question 3:** **What are roles of the sequence step in the Long Short – Term Memory (LSTM) model buiding?**

**Answer:** Creating sequences from the data is a critical step, which fundamentally changes how the model views the data, and significantly affect the performance and accuracy of the predictions. Reasons why the creating sequences plays an important role, include:

+ Capturing temporal depencies: With the appropriate sequence length, LSTMs can understand not just individual data points, but also the context surrounding them over time. Furthermore, it can contribute in regulating the flow of information. Particularly, retaining key information from earlier in the sequence, called long-term dependencies and forgetting non-essential details, called short-term dependences.

+ Structuring input data for LSTMs: Firstly, the sequence is created to be served as an input example to the LSTM. For instance, if we set each sequence will contain 30 days of timeseries flow data, the model will use these 30 days to predict the flow for the 31st day. Secondly, the LSTMs can process these sequences in batches efficiently. This processing capability helps in faster convergence and better generalization when training the model.

+ Improving prediction accuracy: The model ability is significantly impacted by the sequence lengths. Particularly, too short a sequence might not provide enough historical context, while too long a sequence might introduce noise or irrelevant information. Plus, the sequence length help the LSTM in automatically extracting and learning important features from the temporal data, which are critical in predicting future values accurately.