LSTM Architecture

What is LSTM?

A **Long short-term memory** (LSTM) is a type of Recurrent Neural Network specially designed to prevent the neural network output for a given input from either decaying[Vanishing Gradient Problem] or exploding as it cycles through the feedback loops.

The feedback loops are what allow recurrent networks to be better at pattern recognition than other neural networks. Memory of past input is critical for solving sequence learning tasks and Long short-term memory networks provide better performance compared to other RNN architectures by alleviating what is called the vanishing gradient problem.

LSTMs due to their ability to learn long term dependencies are applicable to a number of sequence learning problems including language modelling and translation, acoustic modelling of speech, speech synthesis, speech recognition, audio and video data analysis, handwriting recognition and generation, sequence prediction, and protein secondary structure prediction.

Core Idea of LSTM

LSTM introduces:

- A **cell state** (long-term memory)
- **Gates** to control information flow

Instead of just passing hidden state like vanilla RNN:

$$h_t = tanh(W_{xt} + U_{ht-1})$$

So an LSTM maintains: Hidden state (h_t) and Cell state (C_t)

An LSTM cell contains:

1. **Forget Gate**

2. **Input Gate**

3. **Candidate Memory**

4. **Output Gate**

Each gate is a small neural network with:

- Sigmoid activation (for gates)

- Tanh activation (for memory values)

Learn in depth about the LSTM Architecture:

https://developer.nvidia.com/discover/lstm