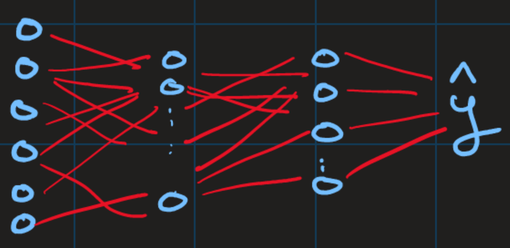
DL INTRO

22 January 2026 01:54



BUT WHY DEEP LEARNING???

Well you see… Its because DL is EASY!.(And crazy good)

Traditional or standard machine learning works well **only when humans tell the computer what to look for**. Before a model can learn, people must first convert raw data into useful features. This creates several serious problems.

Heavy Dependence on Human-Made Features
In standard machine learning, the process looks like this:
Raw data → Hand-crafted features → ML model → Output
For example:

- Images → edges, corners designed by humans → classifier
- Speech → manually chosen sound features → model
- Text → word counts → classifier

The model does **not** learn from raw data directly. Instead, it learns only from the features humans give it.

Feature Engineering Does Not Scale
As data became larger (millions of images, hours of speech, huge text corpora):

- Models had more data
- But features stayed the same

So even with more data, performance stopped improving.
The **features became the bottleneck**, not the data or the model.

What Deep Learning Changed
Deep learning removes the need for manual feature design.
Instead of:
Humans → features → model
Deep learning does:
Raw data → model learns features automatically → output
Deep neural networks learn:

- Simple patterns first
- Then combine them into complex ideas

For example in images:

- Pixels → edges → shapes → objects

All of this happens **automatically**, using data.

DEEP LEARNING INTRODUCED

Representation Learning

The biggest idea introduced by deep learning is **representation learning**.
Instead of humans deciding *what* features are important, deep learning allows the model to **learn its own features** from raw data.
Example:

- Standard ML: “Edges are important” (human decision)
- Deep Learning: “I will figure out what matters by looking at data”

Hierarchical Feature Learning (Depth)

Deep learning introduced **depth**—multiple layers that build understanding step by step.
Each layer learns something more complex than the previous one:

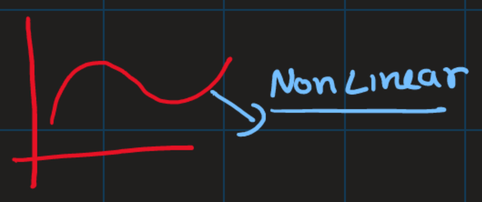
- Layer 1: simple patterns
- Layer 2: combinations of patterns
- Layer 3: higher-level concepts

Learning from Raw, High-Dimensional Data

Deep learning models can directly handle:

- Raw images
- Raw audio waveforms
- Raw text sequences

They naturally learn spatial and temporal structure without flattening or heavy preprocessing.



How Deep Learning Networks Learn and Achieve Non-Linearity

Deep learning networks learn by **gradually adjusting their internal parameters** so that the overall computation they perform becomes a good approximation of the true relationship in the data. This learning process depends on two essential mechanisms:

1. **Non-linear transformations**
2. **Error-driven optimization**

1. The Basic Computation in a Deep Network

Each layer of a deep neural network performs two operations:

1. **Linear transformation**

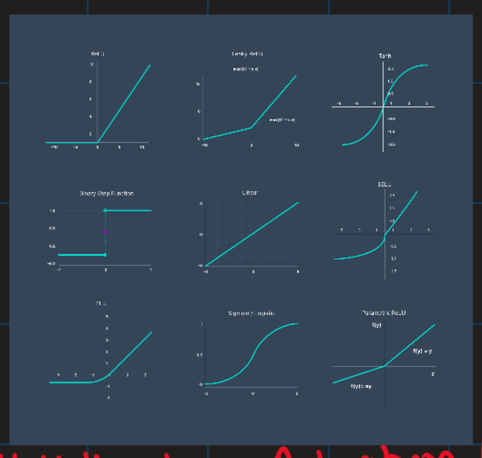
$$z = Wx + b$$

2. **Non-linear transformation (activation)**

$$h = \sigma(z)$$

This pattern is repeated many times.

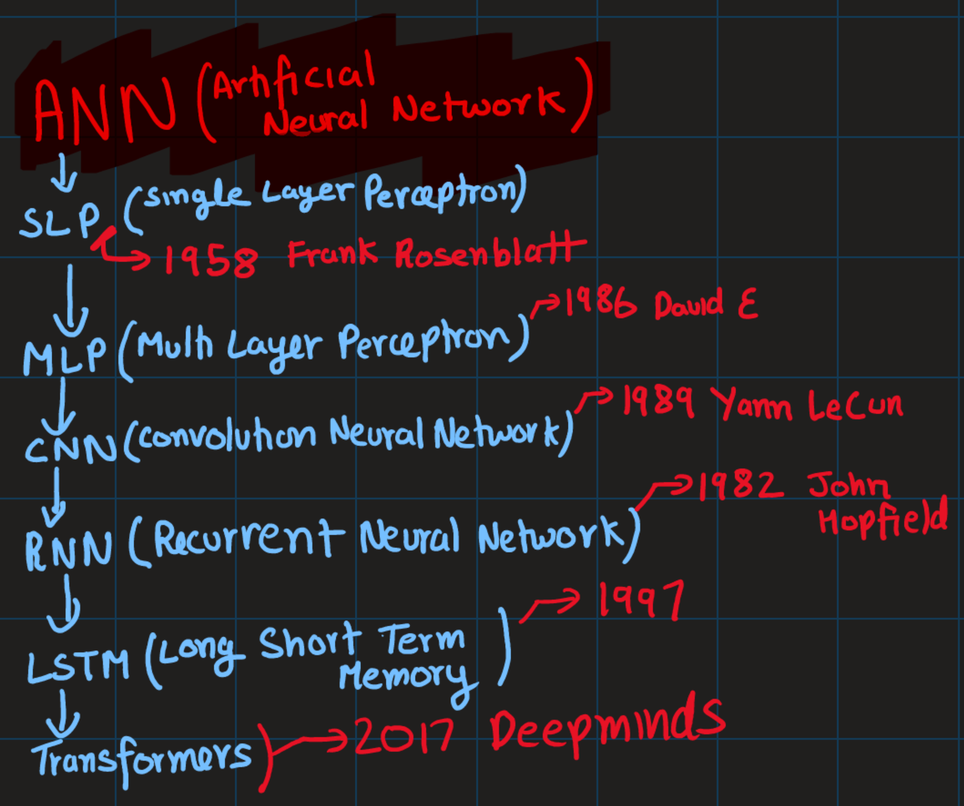
where σ is any function
Added just to introduce chaos in the network
Eg :- ReLU, SeLU etc



#Without an Activation function Each Layer is a Linear combination

$$y = Wx + b$$
$$y = W_3(W_2(W_1 x_1)) \approx W(x)$$

GITHUB :
https://github.com/idklol22/ANN-MLP-from-Scratch-in-Numpy/docs



What is an Artificial Neural Network (ANN)?
An ANN is a machine learning model inspired by the human brain.
It is made of small units called **neurons**.
Each neuron takes input, multiplies it by weights, adds bias, and applies a **non-linear activation function**.
Neurons are arranged in layers: input layer, hidden layers, and output layer.
The network learns by adjusting its weights to reduce prediction error.