Neural Network & Deep Learning

HI 743

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What is Deep Learning?

Definition

Deep learning is a class of machine learning techniques that use **multi-layered neural networks** to learn data representations and predictive models.

- Capable of modeling **highly complex, non-linear** relationships in data.
- Processes raw inputs through multiple layers to learn useful features *automatically*.
- Particularly effective for tasks involving **images**, **speech**, **text**, and **healthcare records**.
- Enables end-to-end learning: from raw input to final prediction.

Neural Networks

What is a Neural Network?

A **neural network** is a layered mathematical model designed to approximate complex functions by combining many simple units (neurons).

- Composed of **layers**:
  - **Input layer**: Receives raw features (e.g., patient age, lab values).
  - **Hidden layers**: Transform inputs using weighted combinations and activation functions.
  - **Output layer**: Produces the final prediction (e.g., diagnosis probability).
- Each unit (**neuron**) computes a weighted sum of its inputs, applies a non-linear function, and passes it forward.
- The network **learns** by adjusting weights to minimize prediction error, often using *gradient descent*.
- With enough hidden layers, a neural network can approximate almost any function (**Universal Approximation Theorem**).

Neural Networks Explained

But what is a neural network? — by 3Blue1Brown