

Neural Networks

Overview

A **Neural Network** is a type of machine learning model inspired by the human brain.

It consists of layers of interconnected nodes, or *neurons*, that learn to recognise complex patterns in data.

Neural Networks form the foundation of modern **Deep Learning**, powering everything from voice recognition to image classification.

Key Concepts

- **Neuron:** The basic unit that receives input, applies a transformation, and passes the result forward.
 - **Layers:** Organised groups of neurons — including input, hidden, and output layers.
 - **Weights and Biases:** Parameters adjusted during training to minimise prediction errors.
 - **Activation Function:** Determines whether a neuron “fires” (common examples include ReLU, Sigmoid, and Tanh).
 - **Loss Function:** Measures how far off the network’s predictions are from the actual results.
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Visual Summary

Input Layer → Hidden Layer(s) → Output Layer Each layer transforms data and passes it forward.

The network “learns” by adjusting its internal connections until outputs match the desired results.

Real-World Applications

- 🧠 **Facial Recognition:** Apple’s Face ID or Meta’s photo tagging.
 - 🗣️ **Voice Assistants:** Siri, Alexa, and Google Assistant.
 - 📧 **Spam Detection:** Filtering emails in Gmail.
 - 💳 **Fraud Detection:** Identifying unusual financial transactions.
 - 📷 **Image Recognition:** Detecting objects in photos or videos.
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Example

In a simple neural network predicting loan approval:

Inputs: [Income, Age, Credit Score] → Hidden Layers: Detect relationships → Output: Approve / Deny

The model adjusts internal weights each time it predicts incorrectly until it learns the right decision pattern.

Why It Matters

Neural Networks are incredibly flexible — they can learn from almost any type of data: text, sound, or images.

They enable many of the intelligent systems that define the modern world, making them essential for any AI-driven organisation.