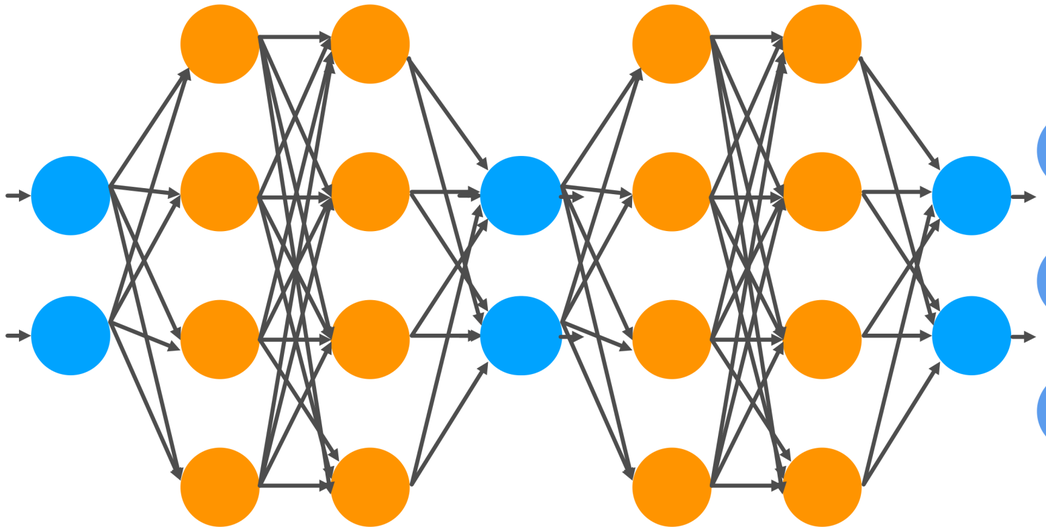
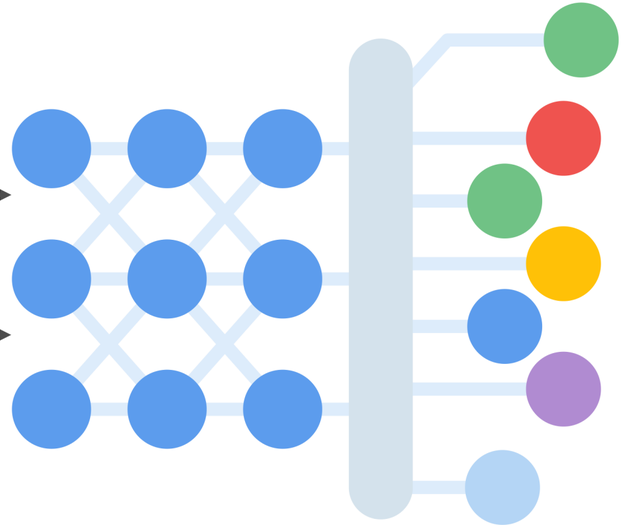
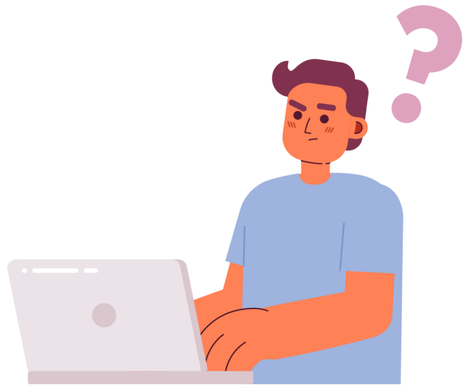
WHAT ARE NEURAL NETWORKS

(SIMPLY) EXPLAINED

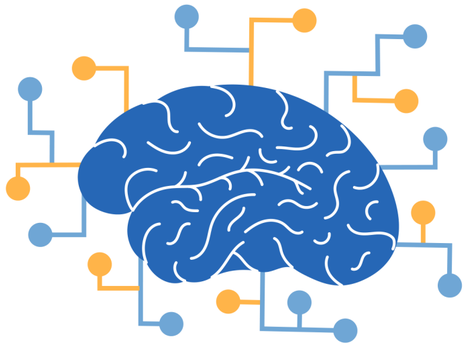






Shivang Kainthola

DEEP LEARNING

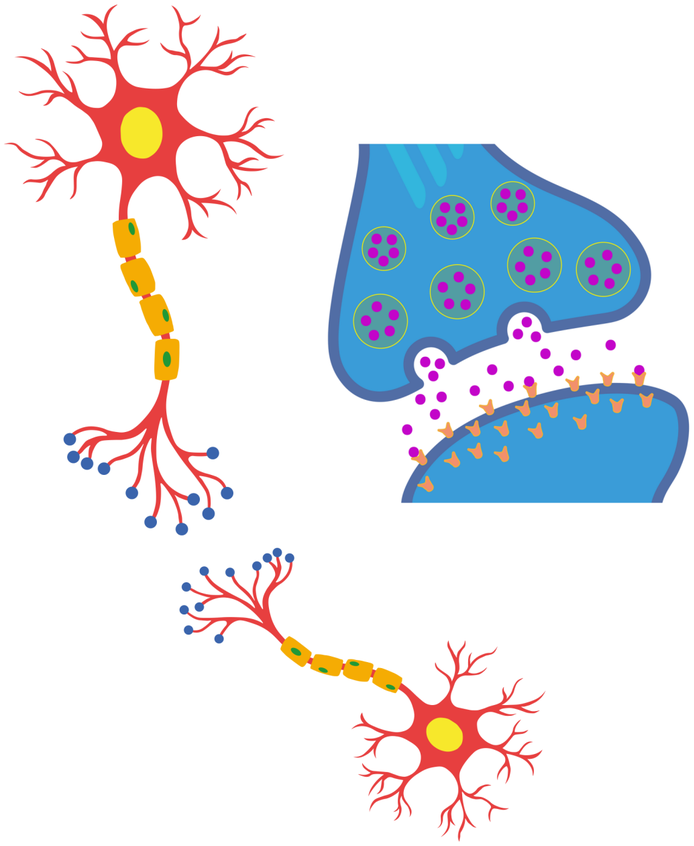


Deep learning is a subset of machine learning that involves training artificial neural networks with multiple layers (deep architectures) to learn representations of data.

Deep learning methods accomplish the tasks of traditional machine learning by using neural networks.

The basis of neural network is a **neuron**.

THE NEURON

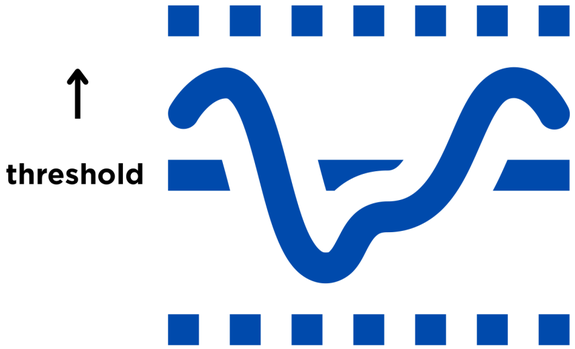


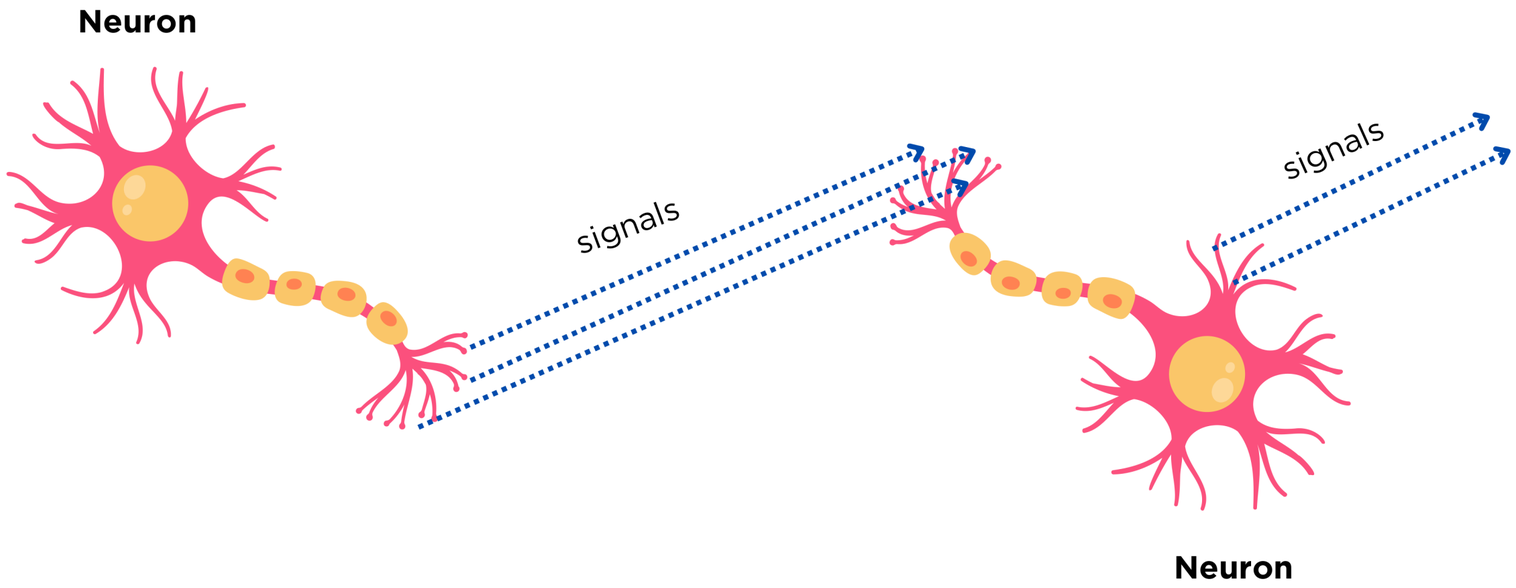
A **neuron**, also known as a nerve cell is **responsible for transmitting electrical and chemical signals in the brain.**

It **receives** signals from other neurons and sensory receptors through dendrites and **integrates them**.

These signals are the ***basis of information***

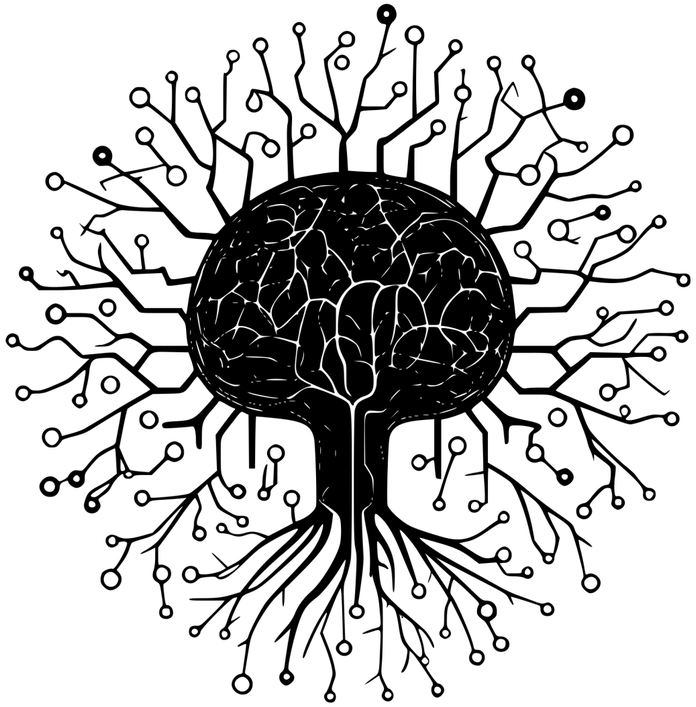
If the **integrated** signals reach a ***certain threshold***, the neuron **generates an action potential**, an electrical impulse that travels along the axon **toward other neurons** or **target cells**.





In simpler terms, it integrates processed information and passes it further **only** if a threshold is passed.

A **combination of neurons** can be made to form **complex networks and circuits**, which are capable of storing and processing information, identifying patterns, generate responses or emotions, learn from experiences etc. ; **facilitate many of our human capabilities**.



With ideas being conceived since 1943, it was recognized that the way neurons can make our brains work the way they do, could be replicated for other tasks.

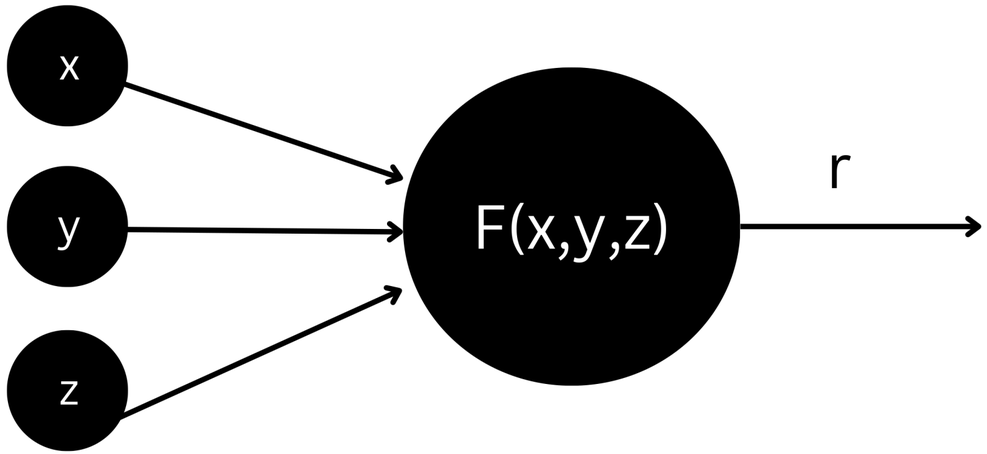
But ***how ?***

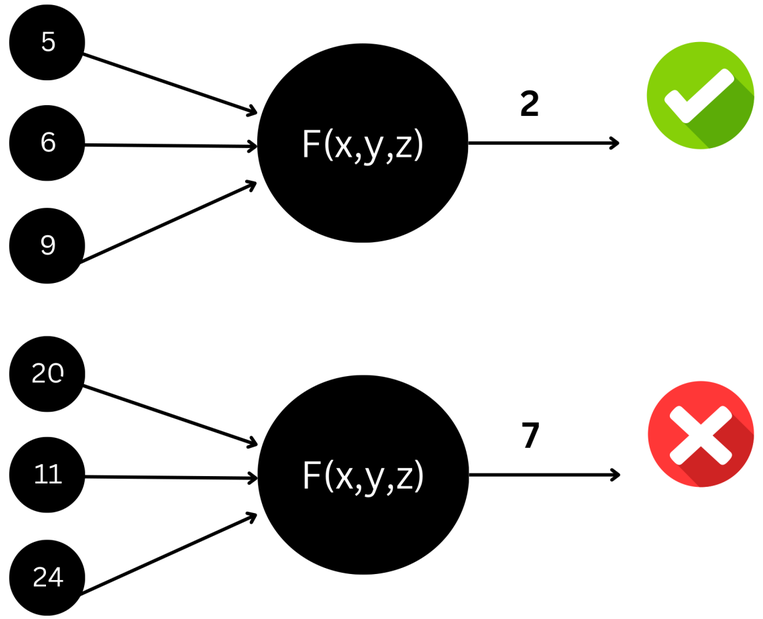
Functions?

Functions can take **multiple values as input**, and process them together, and **return an output**.

For example, a function F(x,y,x) = x+y-z which returns value as r.

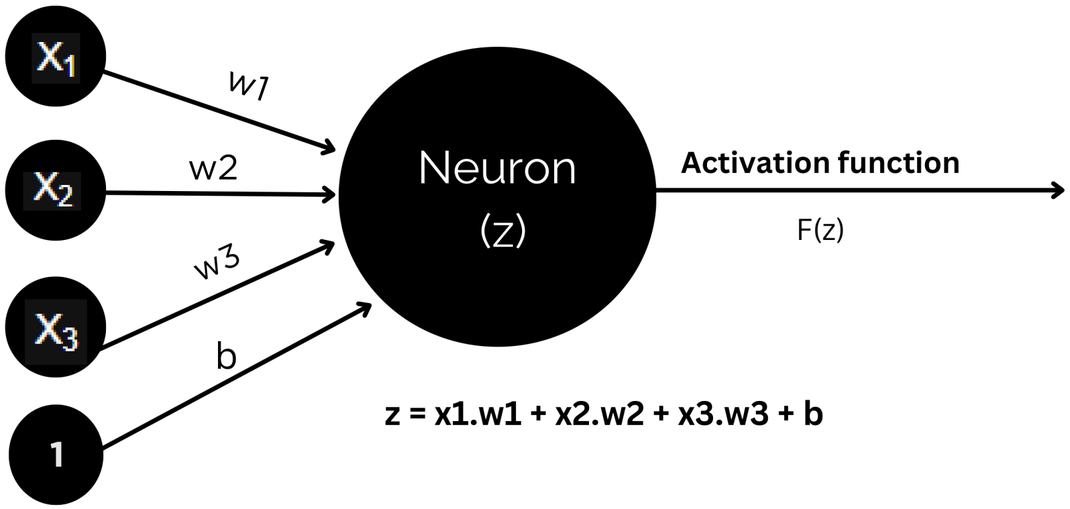
Suppose, this function works as a neuron, and takes signals as numbers and only passes signal further if the processed result is less than 5.

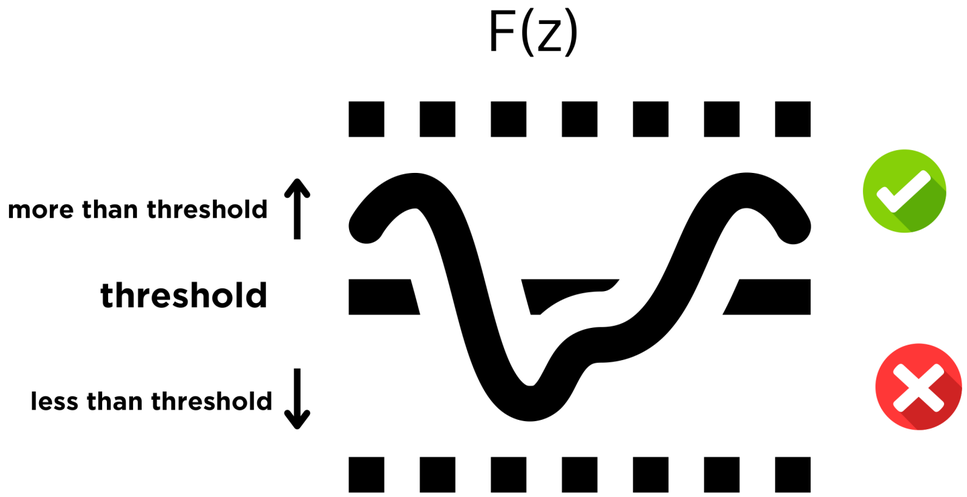




The working of neurons as functions can be augmented with using **weights** for adjusting input values and their effect on the ouput and a **bias (b)** term to adjust outputs according to our needs.

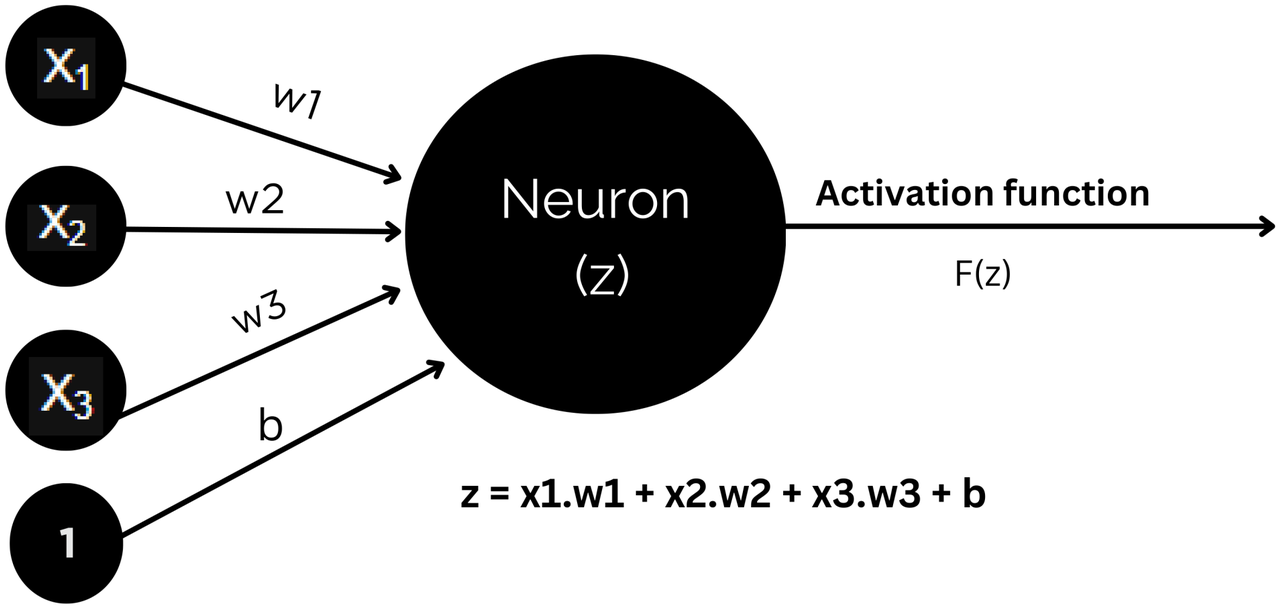
The function which works on the combined input, whose result decides whether the signal will flow, is referred to as the **'activation' function.**





So, we can simulate neurons with functions, and by adjusting the activation function, the weight and biases, we can control how the neurons work, and maybe even learn ?

THE NEURON



z = x1.w1 + x2.w2 + x3.w3 + b

Each neuron has a method of processing input values by assigning weights (w1,w2..), adding a bias term and finally an activation function.

A single layer of a sequential neural network has a set of neurons which often share the same activation function.

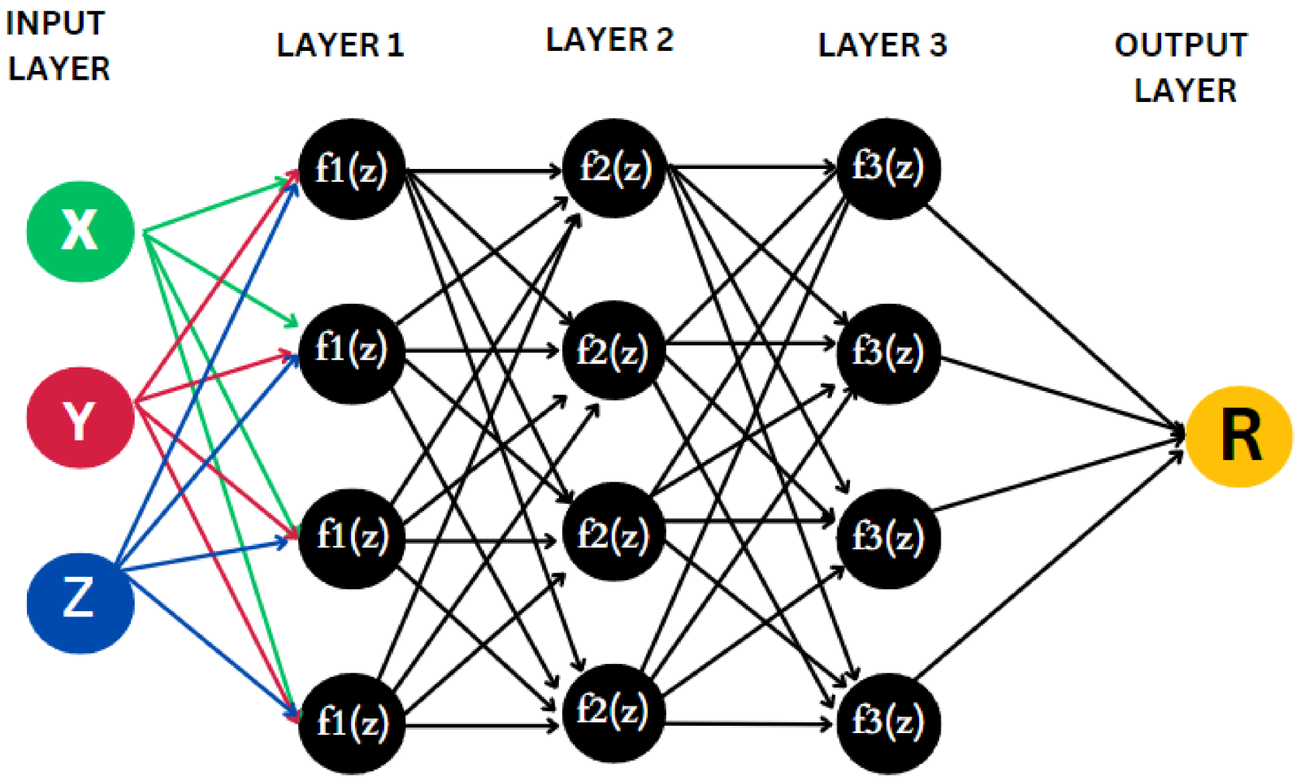
THE NEURAL NETWORK

Suppose we take some neurons, and arrange them sequentially in layers as columns.
Each layer of neurons has its own functions ,weights and/or bias values

The first layer takes the input values, the following layer accepts the results from the first layer.

This continues until the last layer, where all inputs are processed to give the result.

This is a type of neural network.



HOW NEURAL NETWORKS USUALLY WORK

1. Pass the input to the neural network

2. The input layer takes the input data and passes to hidden layers

3. The hidden layer has parameters to process the values and then passes them through an activation function to further hidden layers.

4. The final layer (output layer) generates an output value.

The output values are compared to the actual ground truth value, using a function called the loss function.
This is used to correct the neural network.

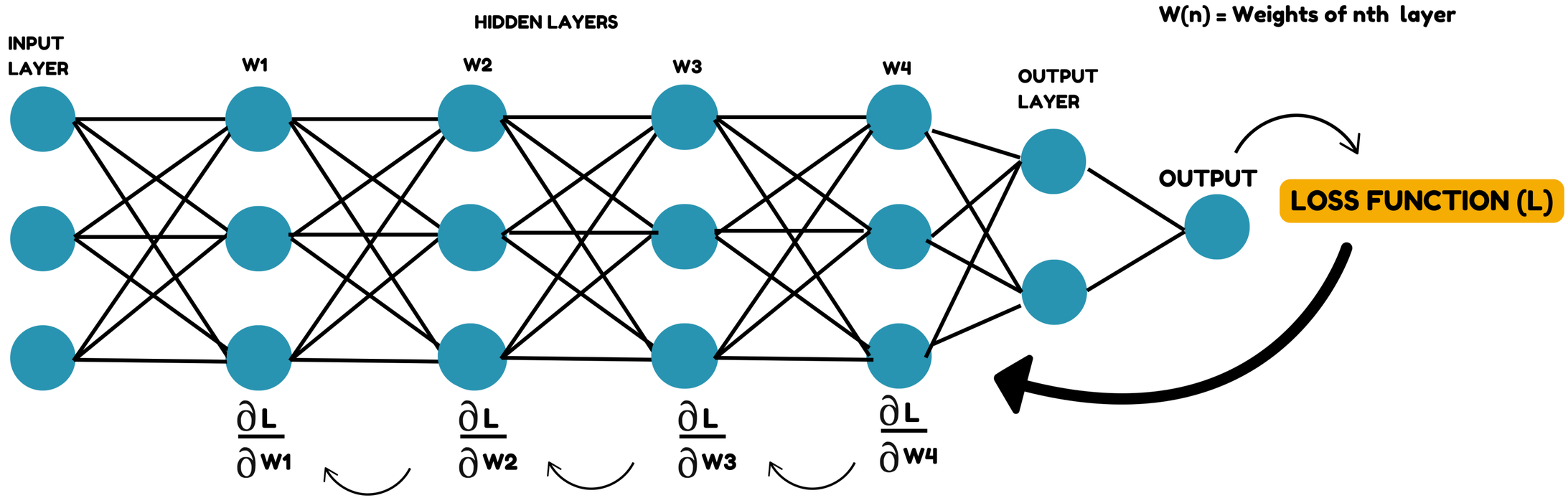
ACTUAL VALUES : [50, 101, 42, 95]

LOSS FUNCTION (L)

OUTPUT VALUES : [50, 100, 40, 90]

The loss function represents the ‘errors’ of the neural network as a whole, but the network has multiple separate layers and parameters.

To find out how we should adjust a single parameter, we take the derivative of the loss function with respect to the parameter.
This derivative is used to update the weights of that layer.



This is done for every layer, starting with the penultimate layer, and update each layer until the first layer is updated.

1. The process of passing input values to the network, where it is sequentially passed forward among hidden layers and ultimately used to generate output is called **forward propagation**.

2. Following generation of output, **Backpropagation** is carried out.

   It involves calculating the gradient of the loss function with respect to each weight by the chain rule,
   propagating the error backward from the output layer to the input layer, and then updating the weights to minimize the loss.

A single instance using the entire training data is called an **epoch**.

DEEP LEARNING

Requires preferably larger datasets

Does not require thorough feature engineering

Complex and not easily interpretable

Useful with large amounts of data and complex tasks like image processing, natual language processing, speech recognition.

TRADITIONAL ML

Works best with smaller datasets

Requires pre-processed data and key features to be selected

Easy to explain and interpret

Useful for a wide variety of tasks including regression, classification, clustering etc.

THANK YOU !

WHILE I'M WORKING ON THE NEXT ARTICLE, I'M OVER HERE ON

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