"EAGLES SOAR BECAUSE THEY ALWAYS FOCUS ON THEIR GOALS"

Deep Learning

What is Deep Learning?

What are Artificial Neural Networks?

Architecture of ANN

ANN Models

Perceptron

What is Deep Learning?

What is Deep Learning?
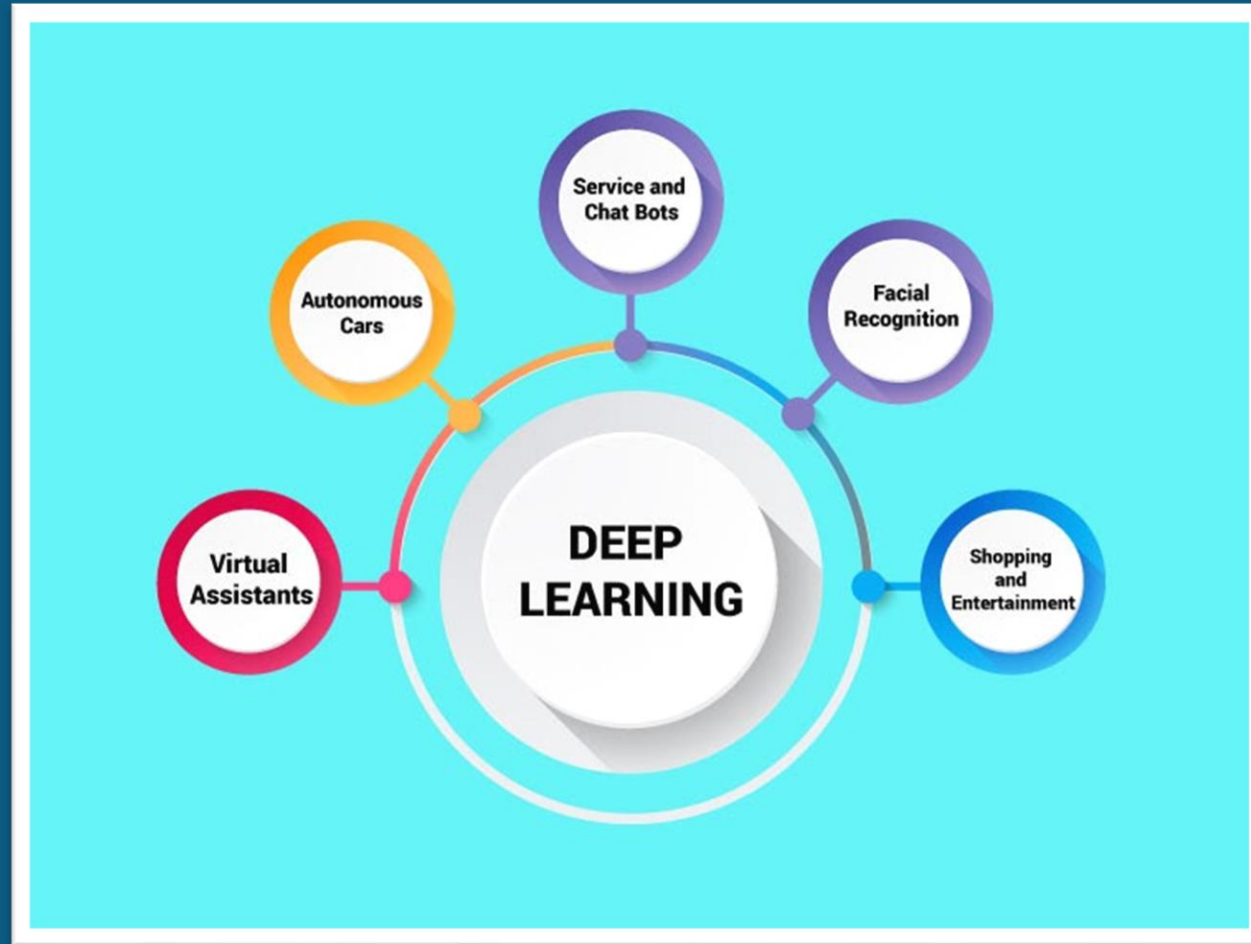
- Deep learning, also known as deep neural networks or neural learning, is a form of artificial intelligence (AI) that seeks to replicate the workings of a human brain.

- It is a collection of statistical techniques of machine learning for learning feature hierarchies that are actually based on artificial neural networks.
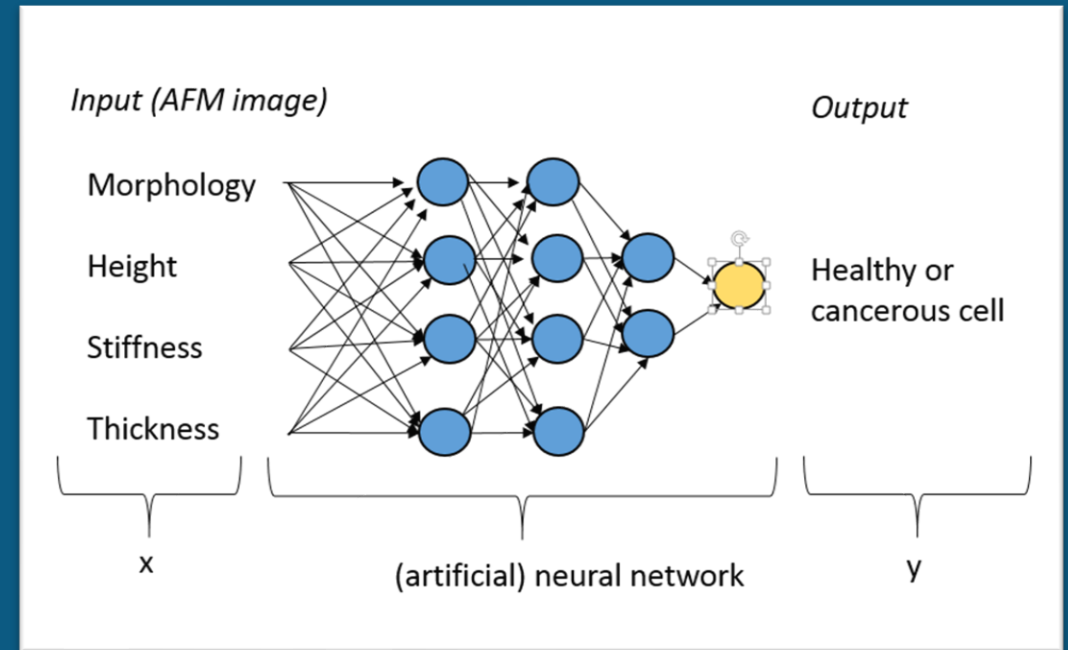
Practical Applications

What are Artificial Neural Networks ?
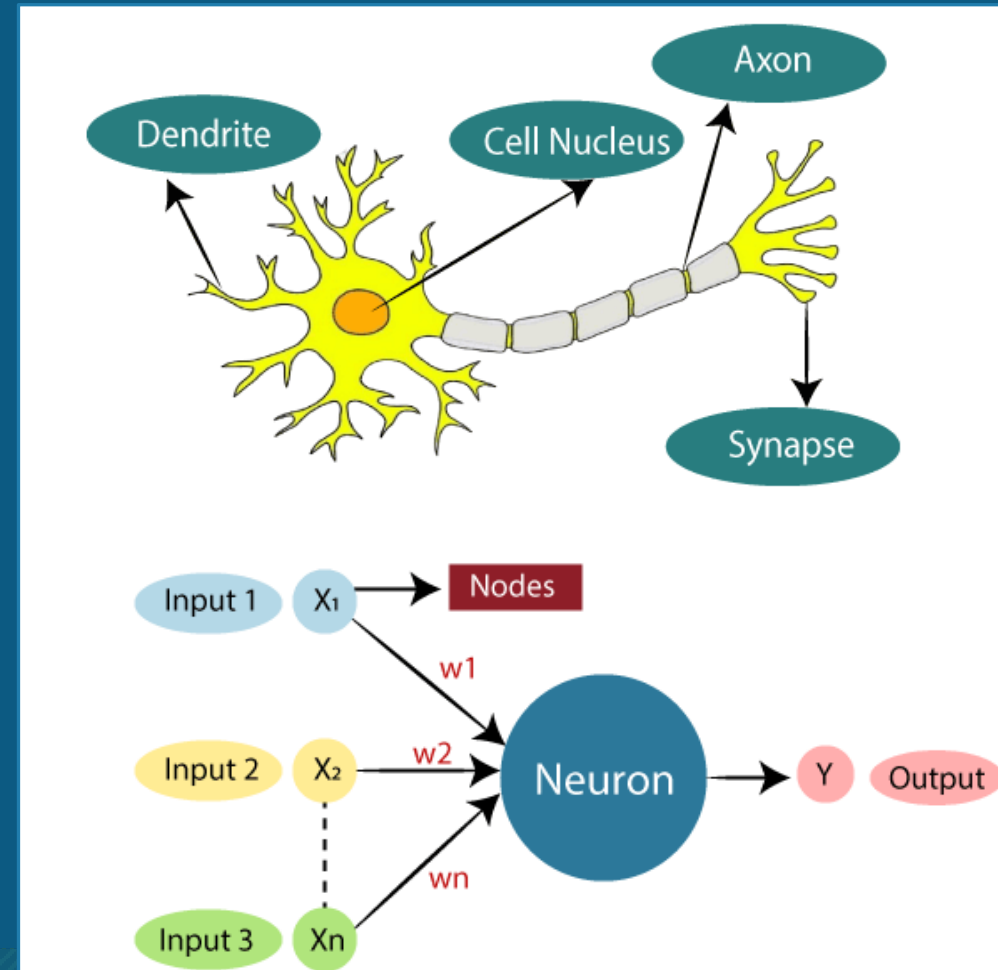
What are Artificial Neural Networks ?

- The term Artificial Neural Network is derived from biological neural networks and is usually a computational network based on biological neural networks that mimics the structure of human brain.

Biological NN	Artificial NN
Dendrites	Inputs
Cell Nucleus	Nodes
Synapse	Weights
Axon	Output

Architecture of ANN

- ANN comprises of three layers :-

    - Input Layer: This layer accepts input in several different formats provided by the programmer.

    - Hidden Layer: The layers between the input and output layers are called Hidden Layers. It performs all the calculations to find hidden features and patterns.

    - Output Layer: This layer is conveys the final output. The final output is calculated by applying activation function on the weighted sum of inputs and includes a bias.

$$\sum_{i=1}^{n} Wi * Xi + b$$
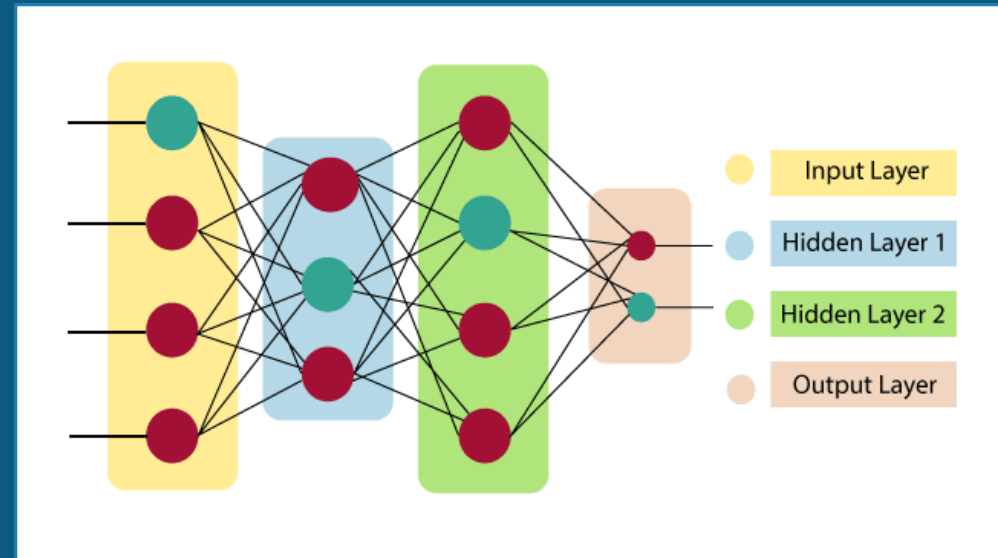
ANN Models

Single-layer feed forward network

Multilayer feed forward network
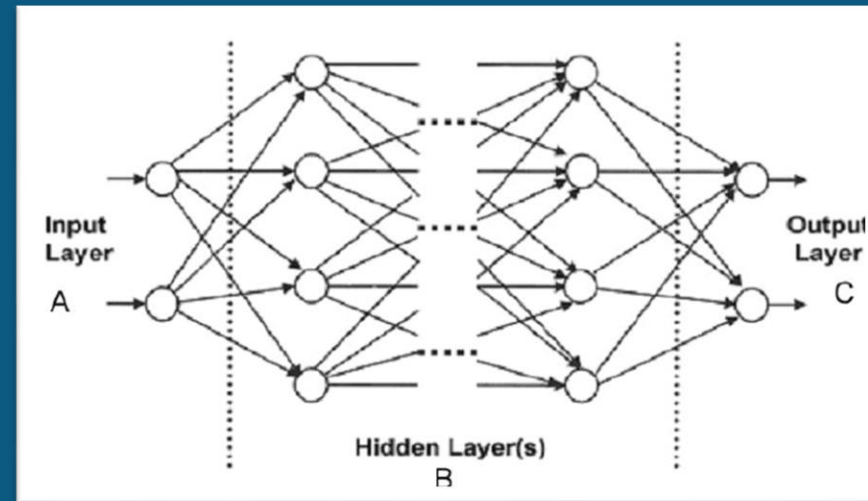
Single node with its own feedback

Single-layer recurrent network

Multilayer recurrent network

ANN Models

- Single Layer Feed Forward Network : This type of network consists of an input layer and an output layer with no hidden layer. Output layer is formed when different weights are applied on input nodes and the cumulative effect per node is taken.

- Multilayer Layer Feed Forward Network : This type of network consists of an input layer, an output layer with one or more hidden layers. Output layer is formed with the help of computations done by the hidden layers on the input.
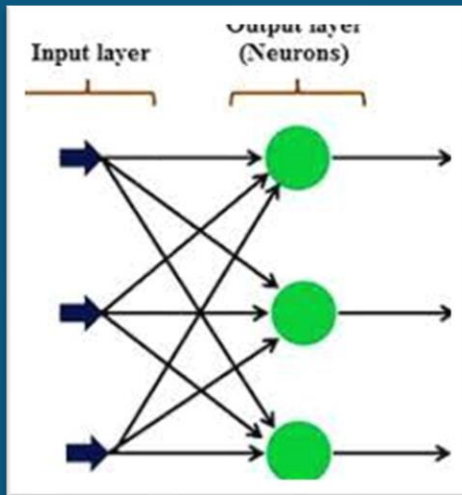
ANN Models

- Single Node with its own feedback: It consists of a single node wherein the output is directed back as inputs to the same layer.

- Single Layer Recurrent Network : A single layer network with feedback connection in which processing element's output can be directed back to itself or to other processing element or both residing in the dame layer.

- Multilayer Recurrent Network : In this type of network, processing element output can be directed to the processing element in the same layer and in the preceding layer forming a multilayer recurrent network. They perform the same task for every element of a sequence, with the output being depended on the previous computations. Inputs are not needed at each time step.
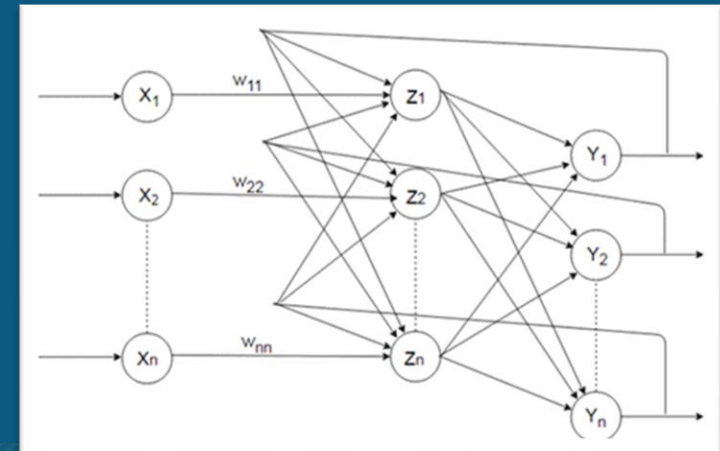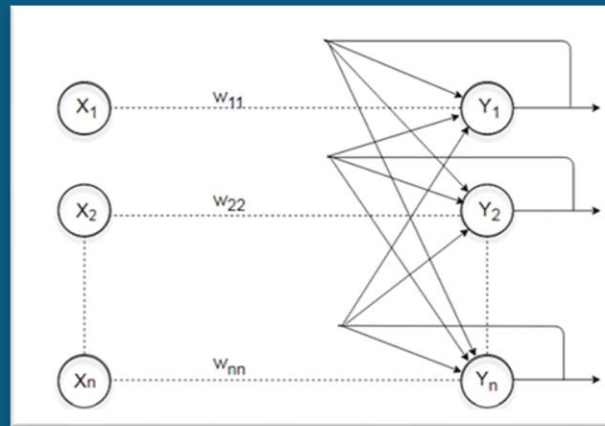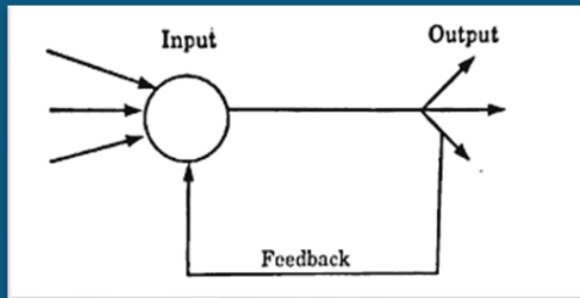
# What is a Perceptron?

What is a Perceptron ?

- It was invented in 1957 by Frank Rosenblatt at the Cornell Aeronautical Laboratory.

- A perceptron is the simplest neural network possible. It is a single layer neural network and a computational model of a single neuron. It consists of one or more inputs, a processor, and a single output.

- Perceptron is mainly used for Binary Classification.
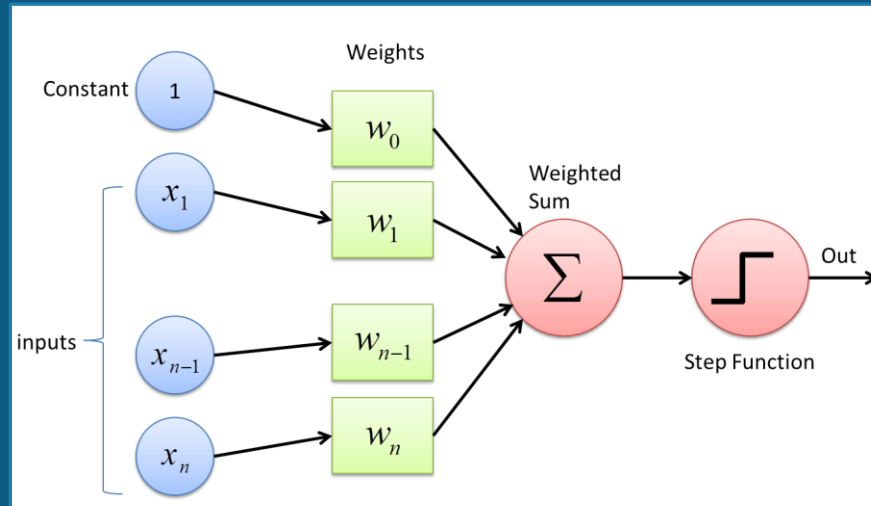
How does Perceptron work?

- The process begins by taking all the input values and multiplying them by their weights. Then, all of these multiplied values are added together to create the weighted sum. The weighted sum is then applied to the activation function, producing the perceptron's output.

- The activation function plays the integral role of ensuring the output is mapped between required values such as (0,1) or (-1,1). It is important to note that the weight of an input is indicative of the strength of a node. Similarly, an input's bias value gives the ability to shift the activation function curve up or down.

$$\hat{y} = 1 \text{ if } \sum_{i=1}^{n} w_i x_i \geq b$$
$$\hat{y} = 0 \text{ otherwise}$$

Perceptron Learning Algorithm

- Perceptron is a linear model used for binary classification. We use a linear function here.
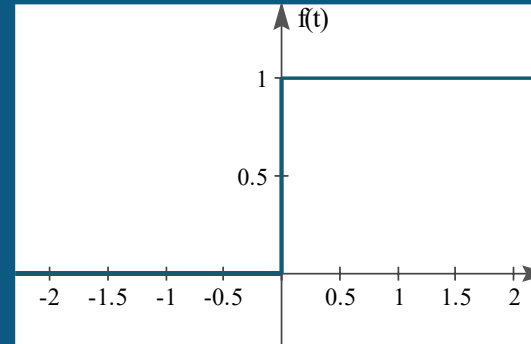
Linear Model

$$f(w, b) = w^T x + b$$

- For keeping things simple we use the unit step function as the activation function.

Unit step function

$$g(z) = \begin{cases} 1 & \text{if } z \geq \theta \\ 0 & \text{otherwise.} \end{cases}$$

Perceptron Learning Algorithm

- The output of the Perceptron after applying linear function and activation function is as follows :-

$$\hat{y} = g(f(w, b)) = g(w^T x + b)$$

- For Weights and Bias we use simple updating rule as follows :-

For each training sample x_i :

$$w := w + \Delta w$$

$$\Delta w := \alpha \cdot (y_i - \hat{y}_i) \cdot x_i$$

α : learning rate in $[0, 1]$

Perceptron Learning Algorithm

- During the update rule the weights are pushed towards positive or negative target class in case of misclassification.

$$
\begin{array}{ccc}
y & \hat{y} & y - \hat{y} \\
1 & 1 & 0 \\
1 & 0 & 1 \\
0 & 0 & 0 \\
0 & 1 & -1
\end{array}
$$

Weights Less

Weights High

Thank You