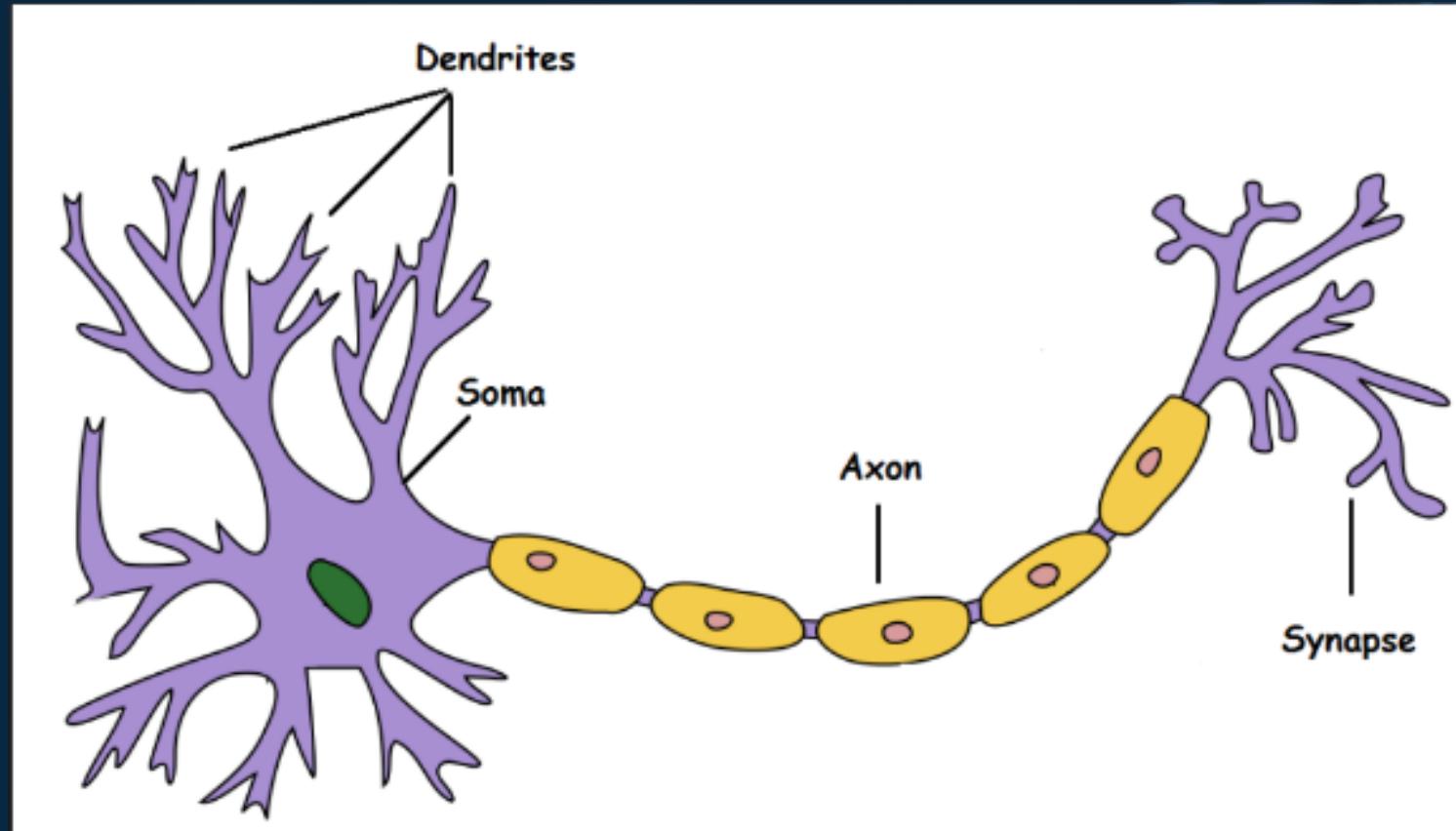


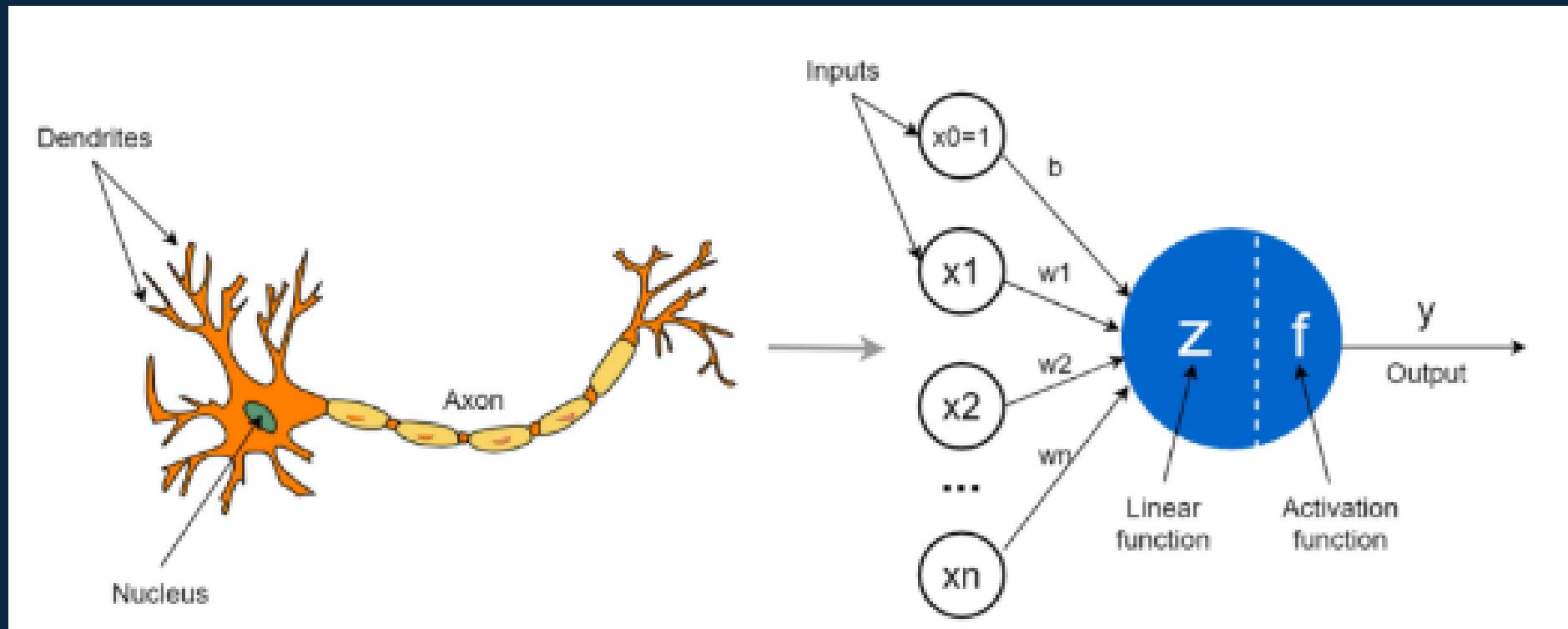
INTRODUCTION TO NEURAL NETWORKS

Biological Neurons



- A biological neuron takes in some input in the form of chemical signals and transmits output signals by processing these inputs.

McCulloch-Pitts Neuron



The McCulloch-Pitts Neuron is a mathematical version of the biological neuron.

It processes the inputs in two stages:

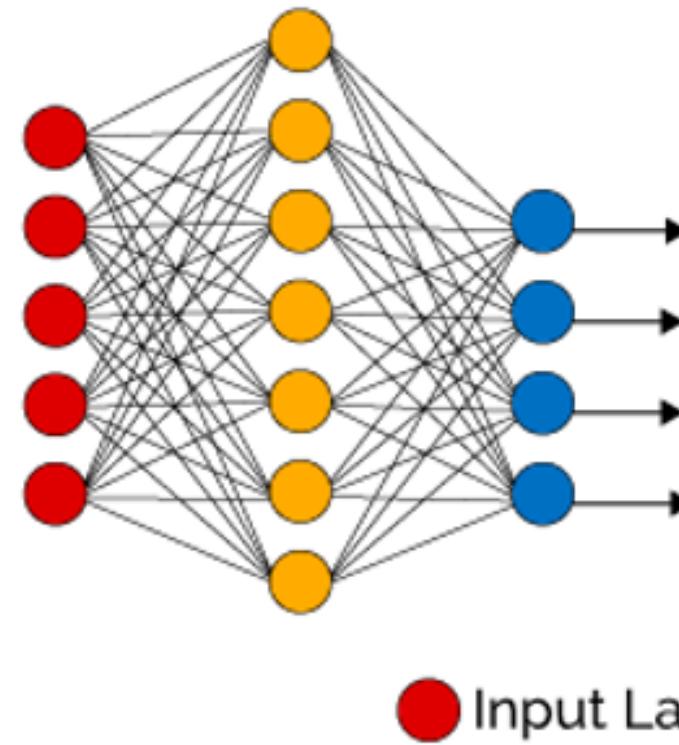
- A linear transformation
- An activation function

What is ANN?

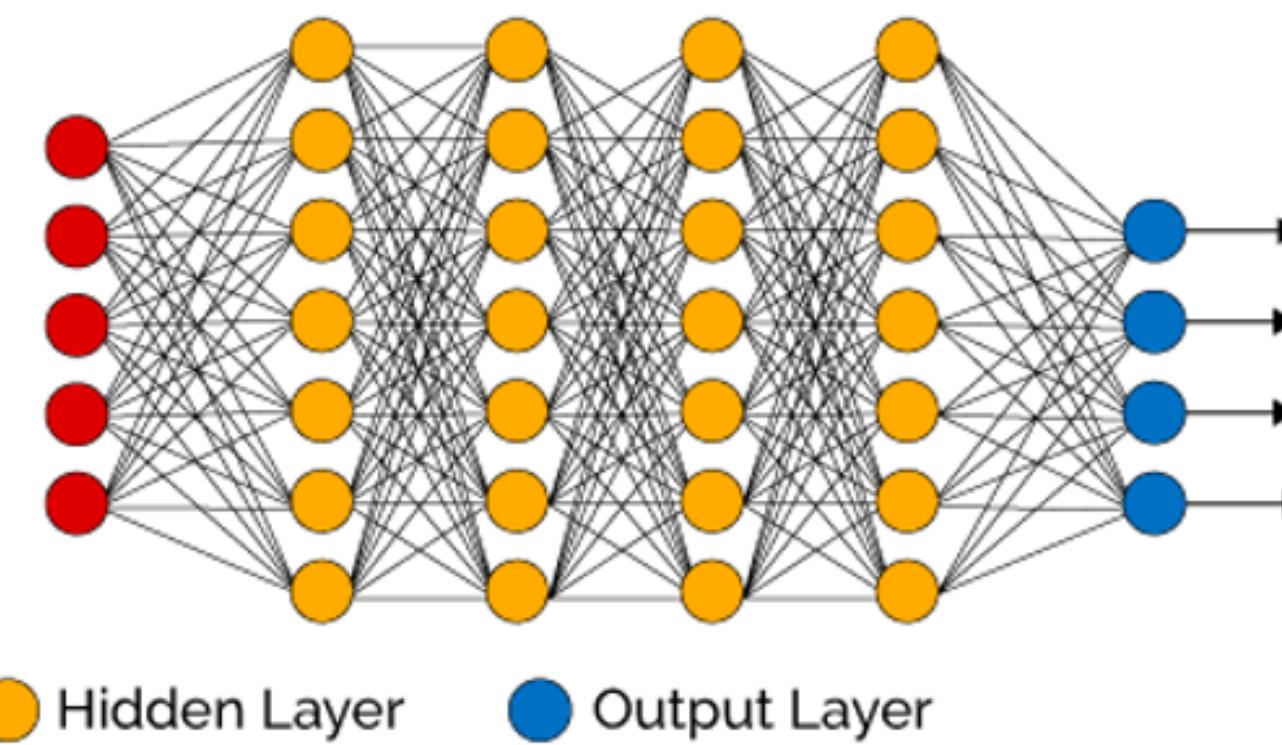
- Artificial neural networks (ANNs) are a class of machine learning models that are inspired by the structure and function of the human brain.
- ANNs consist of layers of interconnected nodes, or "artificial neurons," that process information by receiving inputs, applying weights to those inputs, and then applying an activation function to produce an output.
- ANNs are particularly well-suited to tasks such as image and speech recognition, natural language processing, and predictive modeling, as they can automatically learn hierarchical representations of data, without the need for handcrafted features.
- The strength of ANNs lies in their ability to learn from data, making them an important tool in modern artificial intelligence and data science applications.

What is ANN?

Simple Neural Network



Deep Learning Neural Network



Applications

- Image and speech recognition
- Natural language processing
- Predictive modeling
- Autonomous vehicles
- Robotics
- Fraud detection
- Drug discovery
- Financial forecasting
- Marketing analytics



Basic terms in ANN

- Input Layer: This is the layer of the neural network that receives the input data. Each input is typically represented by a separate neuron in this layer.
- Hidden Layers: These are the layers of the neural network that perform the intermediate computations between the input and output layers. These layers consist of interconnected neurons that process the input data and produce an output.
- Output Layer: This is the final layer of the neural network that produces the output of the model. The number of neurons in this layer is typically determined by the number of output classes or the number of regression targets.
- Neurons: Neurons are the basic building blocks of a neural network. Each neuron receives one or more inputs, applies weights to those inputs, and then passes the result through an activation function to produce an output.

- Weights: Weights are the parameters of the neural network that determine the strength of the connections between neurons. These weights are adjusted during the training process to improve the performance of the model.
- Activation Functions: Activation functions are applied to the output of each neuron to introduce non-linearity into the model. Common activation functions include sigmoid, ReLU, and tanh.
- Bias: Bias is an additional parameter that is added to each neuron to shift the output of the activation function.
- Loss Function: The loss function is used to measure the difference between the predicted output of the model and the actual output. The goal of training the neural network is to minimize the loss function.

Working of ANN

- An ANN consists of an input layer, one or more hidden layers, and an output layer.
- The input layer receives the input data and passes it to the first hidden layer.
- Each neuron in a hidden layer receives inputs from the previous layer, performs a weighted sum of the inputs, adds a bias term, and applies an activation function to produce an output.
- The output of each neuron in a hidden layer serves as input to the next layer, until the final layer produces the output of the model.
- During training, the weights and biases of the neurons are adjusted using backpropagation to minimize the difference between the predicted output of the model and the actual output.

- The backpropagation algorithm computes the gradient of the loss function with respect to the model parameters and adjusts them in the opposite direction of the gradient to minimize the loss.
- Once the ANN is trained, it can be used to make predictions on new input data by passing it through the network and generating the output.
- The performance of the ANN can be evaluated using various metrics, such as accuracy, precision, recall, or mean squared error, depending on the task at hand.