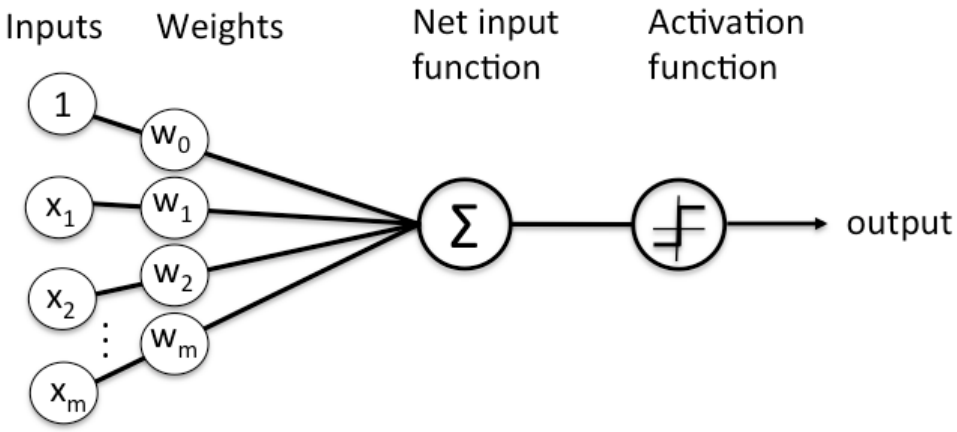
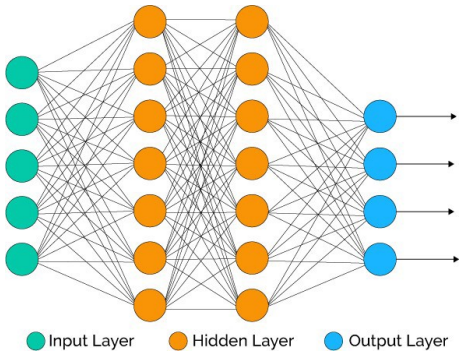
1 Neural Networks

Neural Networks are a key piece of some of the most successful machine learning algorithms. The development of neural networks has been key to teaching computers to think and understand the world in the way humans do. The basic building block for neural networks are artificial neurons, which imitate human brain neurons. These are simple, powerful computational units that have weighted input signals and produce an output signal using an activation function. These neurons are spread across several layers in the neural network.



1.1 How does Artificial Neural Network Works

Deep learning consists of artificial neural networks that are modeled on similar networks present in the human brain. As data travels through this artificial mesh, each layer processes an aspect of the data, filters outliers, spots familiar entities, and produces the final output.



Input Layer: This layer consists of the neurons that do nothing than receiving the inputs and pass it on to other layers. The number of layers in the input layer should be equal to the attributes or features in the dataset.

Hidden Layer: In between input and output layer there will be hidden layers based on the type of model. Hidden layers contain vast number of neurons. The neurons in the hidden layer apply transformations to the inputs before passing them. As the network is trained the weights get updated, to be more predictive.

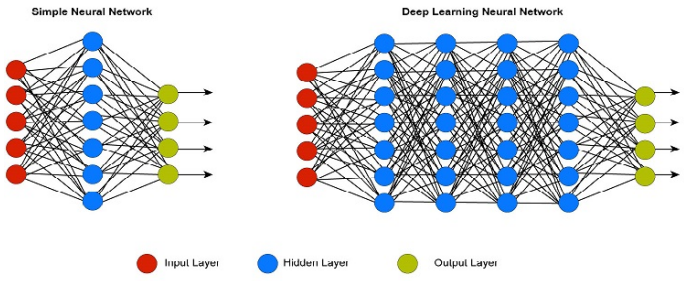
Output Layer: The data after processing is made available at the output layer.

1.2 Neuron Weights

Weights refer to the strength or amplitude of a connection between two neurons, if you are familiar with linear regression you can compare weights on inputs like coefficients we use in a regression equation. Weights are often initialized to small random values, such as values in the range 0 to 1.

2 Deep Neural Networks

What is a Deep Neural Network? A Deep Neural Network simply has more layers than smaller Neural Networks. A smaller Neural Network might have 1–3 layers of neurons. However, a Deep Neural Network (DNN) has more than a few layers of neurons. A DNN might have 20 or 1,000 layers of neurons.



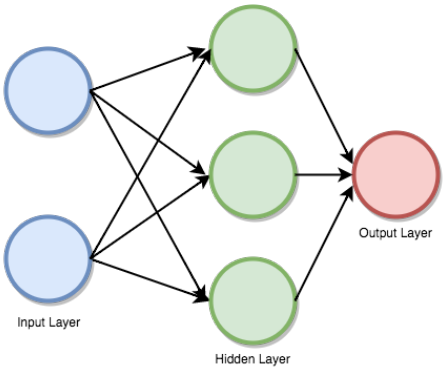
The above figure is a simple neural network which consists of two layers, three inputs, and one output. Any neural network can have any number of layers, inputs, or outputs. The layers between the input neurons and the final layer of output neurons are hidden layers of a deep neural network.

DNNs are typically feedforward networks in which data flows from the input layer to the output layer without looping back.

2.1 Feedforward Deep Networks

Feedforward supervised neural networks were among the first and most successful learning algorithms. They are also called deep networks. Each Neuron is associated with other neuron with some weight.

The network processes the input upward activating neurons as it goes to finally produce an output value.This is called a forward pass on the network.



2.2 Activation Function

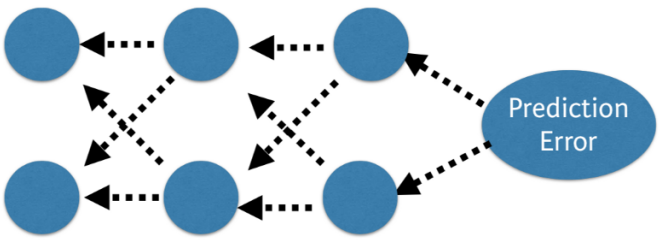
An activation function is a mapping of summed weighted input to the output of the neuron. It is called an activation/ transfer function because it governs the inception at which the neuron is activated and the strength of the output signal.Mathematically,

$$Y = \sum(weight * input) + bias$$

We have many activation functions, out of which most used are relu, tanh(will be discussed in further lectures).

2.3 Back Propagation

The predicted value of the network is compared to the expected output, and an error is calculated using a function. This error is then propagated back within the whole network, one layer at a time, and the weights are updated according to the value that they contributed to the error. This clever bit of math is called the Back-Propagation algorithm. The process is repeated for all of the examples in your training data. One round of updating the network for the entire training dataset is called an epoch. A network may be trained for tens, hundreds or many thousands of epochs. we will discuss this topic in detail in further lectures.



2.4 Multi Layer Perceptrons (Forward Propagation)

This class of networks consists of multiple layers of neurons, usually interconnected in a feed-forward way (moving in a forward direction). Each neuron in one layer has direct connections to the neurons of the subsequent layer. In many applications, the units of these networks apply a sigmoid or relu (Rectified Linear Activation) function as an activation function.

References

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