



SNS COLLEGE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION)

COIMBATORE – 35

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

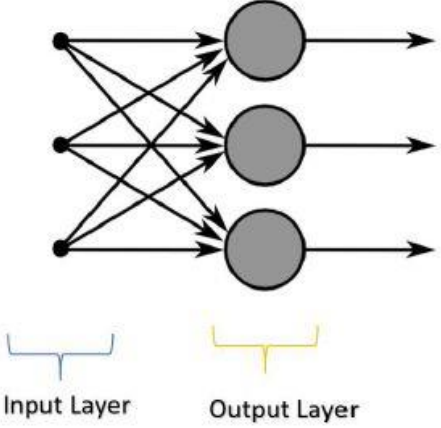
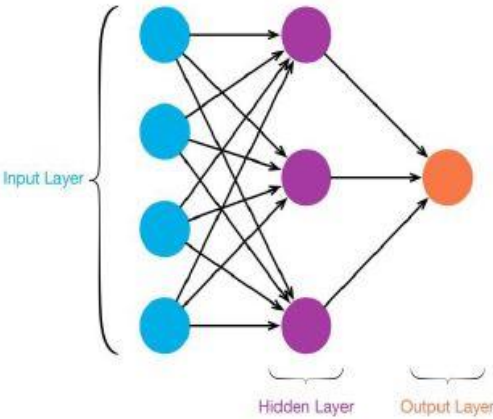


UNIT III DEEP LEARNING

Multilayer Networks

A Multi-layered Neural Network is a typical example of the Feed Forward Neural Network. **The number of neurons and the number of layers consists of the hyperparameters of Neural Networks which need tuning.** In order to find ideal values for the hyperparameters, one must use some cross-validation techniques



Single Layer Feed-Forward Neural Network	Multi Layer Feed-Forward Neural Network
Layer is formed by taking processing element & combining it with other processing element.	It is formed by interconnection of several layers.
Input & output are linked with each other.	There are multiple layers between input & output layers which are known as hidden layers.
Inputs are connected to the processing nodes with various weights resulting series of output one per node.	Input layers receives input & buffers input signal, output layer generates output.
Zero hidden layers are present.	Zero to several hidden layers are in a network.
Not efficient in certain areas.	More the hidden layers, more the complexity of networks, but efficient output is produced.
	

Back Propagation Algorithms

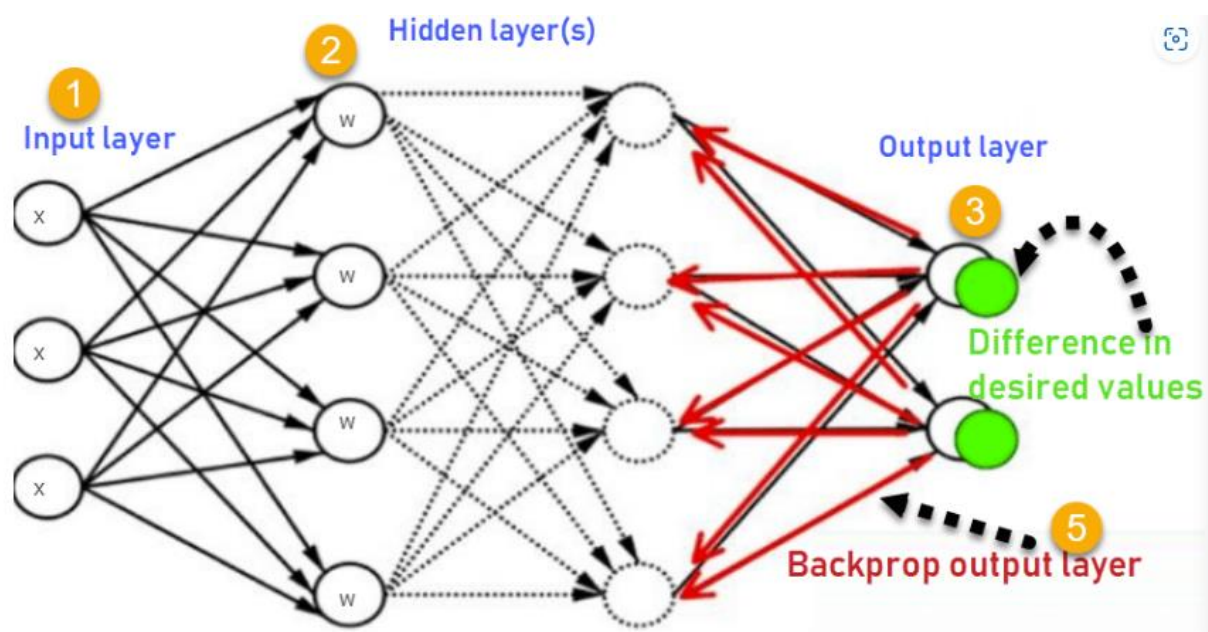
Backpropagation:

Backpropagation is the essence of neural network training. It is the method of fine-tuning the weights of a neural network based on the error rate obtained in the previous epoch (i.e., iteration). Proper tuning of the weights allows you to reduce error rates and make the model reliable by increasing its generalization.

Backpropagation in neural network is a short form for “backward propagation of errors.” It is a standard method of training artificial neural networks. This method helps calculate the gradient of a loss function with respect to all the weights in the network.

Working of Backpropagation Algorithm

The Back propagation algorithm in neural network computes the gradient of the loss function for a single weight by the chain rule. It efficiently computes one layer at a time, unlike a native direct computation. It computes the gradient, but it does not define how the gradient is used. It generalizes the computation in the delta rule.



1. Inputs X, arrive through the preconnected path
2. Input is modeled using real weights W. The weights are usually randomly selected.
3. Calculate the output for every neuron from the input layer, to the hidden layers, to the output layer.
4. Calculate the error in the outputs

Error_B = Actual Output – Desired Output

5. Travel back from the output layer to the hidden layer to adjust the weights such that the error is decreased.

Keep repeating the process until the desired output is achieved

Need of Backpropagation

Most prominent advantages of Backpropagation are:

- Backpropagation is fast, simple and easy to program
- It has no parameters to tune apart from the numbers of input
- It is a flexible method as it does not require prior knowledge about the network
- It is a standard method that generally works well
- It does not need any special mention of the features of the function to be learned.

Feed Forward Network:

A feedforward neural network is an artificial neural network where the nodes never form a cycle. This kind of neural network has an input layer, hidden layers, and an output layer. It is the first and simplest type of artificial neural network.

Types of Backpropagation Networks

Two Types of Backpropagation Networks are:

- Static Back-propagation
- Recurrent Backpropagation

Static back-propagation:

It is one kind of backpropagation network which produces a mapping of a static input for static output. It is useful to solve static classification issues like optical character recognition.

Recurrent Backpropagation:

Recurrent Back propagation in data mining is fed forward until a fixed value is achieved. After that, the error is computed and propagated backward.

The main difference between both of these methods is: that the mapping is rapid in static back-propagation while it is nonstatic in recurrent backpropagation.

History of Backpropagation

- In 1961, the basics concept of continuous backpropagation were derived in the context of control theory by J. Kelly, Henry Arthur, and E. Bryson.
- In 1969, Bryson and Ho gave a multi-stage dynamic system optimization method.
- In 1974, Werbos stated the possibility of applying this principle in an artificial neural network.
- In 1982, Hopfield brought his idea of a neural network.
- In 1986, by the effort of David E. Rumelhart, Geoffrey E. Hinton, Ronald J. Williams, backpropagation gained recognition.
- In 1993, Wan was the first person to win an international pattern recognition contest with the help of the backpropagation method.

Handwriting recognition case study:

[Online Handwriting Recognition Deep Learning : The Studies | slayculture.com](#)

[Download PDF | Handwritten Character Recognition using Deep Learning \(researchgate.net\)](#)

Reference Links:

[Back Propagation in Neural Network: Machine Learning Algorithm \(guru99.com\)](#)