

Deep Learning Concepts

Lecture 11

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Numerical Methods, 2017-2018 Fall

Data

The amount of data that can be processed is increasing rapidly. To process this vast amount of data and to extract valuable information inside, more complex learning models are needed.

Recently, deep learning is becoming more and more popular learning technique because of its highly accurate results compared to shallow machine learning algorithms.

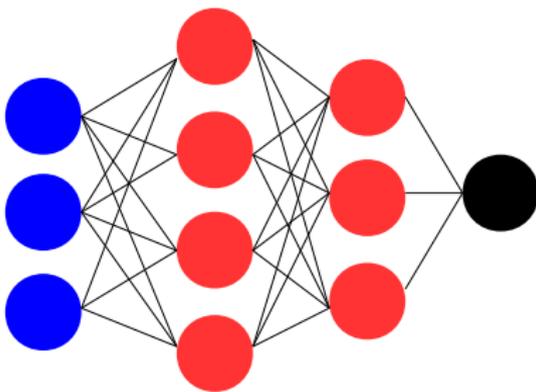
Neural Networks

Perhaps the first think that comes to our minds when we hear the word 'learning' is our brains. Hence, it is intuitive to apply the structure of a human brain when we develop learning algorithms.

We can think of neural network algorithms as a basic representation of human brain in computers.

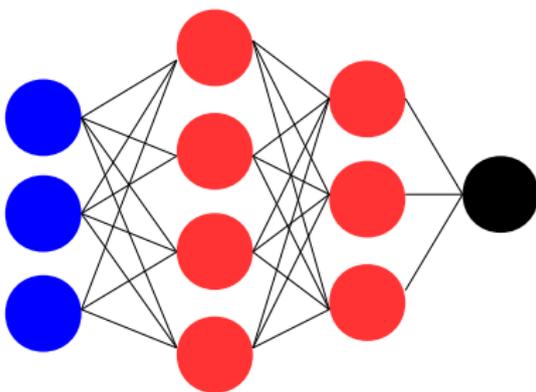
The power of neural networks comes from the number of layers and connections between its layers.

Deep Neural Networks



As shown in the figure above, deep neural networks are composed of layers. Each layer is connected to every neuron in the next layer and each connection has a weight. Through learning, these weights are optimized.

Deep Neural Networks



Each neuron has an activation function such as sigmoid, ReLu, hyperbolic tangent (tanh) etc.

The first layer (blue) is called the input layer.

The last layer (black) is called the output layer.

All the layers between the input and the output are called hidden layer(s).

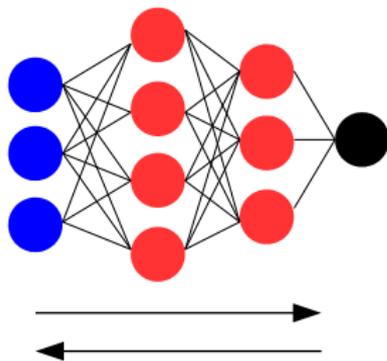
Layers

Input Layer: It is the first layer of the network. The features are inputted to the network in this layer.

Hidden Layer(s): These layers are between the input and the output layers. There is not a single optimum number denoting what should be the number of hidden layers and what is the optimum number of neurons in each layer. Those are the design parameters.

Output Layer: The final layer of the network where the output is provided. The activation function of the output layer neurons depends on whether the task of the network is classification or regression.

Epoch



Deep learning algorithms optimize their parameters in two steps:

- ▶ Forward propagation
- ▶ Backpropagation

These two steps applied iteratively several times and over all data. Each of these cycles is called an epoch.

Optimization

Similar to other machine learning algorithms, deep learning algorithms also optimize their parameters which are simply the weights between layers.

This optimization happens in backpropagation step. Stochastic Gradient Descent and Mini-Batch Gradient Descent are two commonly used optimization algorithms in backpropagation (remember previous lectures).

Types of NNs

There are different type of neural networks that can be used depending on our purpose.

- ▶ Artificial Neural Networks (ANN)
- ▶ Convolutional Neural Networks (CNN)
- ▶ Recurrent Neural Networks (RNN)

Why Deep Learning

In general, we need to extract relevant features for shallow learning algorithms in order to have highly accurate results. In contrast, deep learning algorithms such as CNNs extract such features through its layers.

Depending on the number of hidden layers, deep learning architectures can learn highly complex functions and can reveal highly complex relations between the input and the output.

Recently, it has been shown in many different applications that deep learning algorithms significantly outperforms shallow learning algorithms.