

Deep Learning is a subset of Artificial Intelligence (AI) that helps machines to learn from large datasets using multi-layered neural networks. It automatically finds patterns and makes predictions and eliminates the need for manual feature extraction. Deep Learning tutorial covers the basics to advanced topics making it perfect for beginners and those with experience.

Introduction to Neural Networks

Neural Networks are fundamentals of deep learning inspired by human brain. It consists of layers of interconnected nodes or "neurons" each designed to perform specific calculations. These nodes receive input data, process it through various mathematical functions and pass the output to subsequent layers.

- [Neural Networks](#)
- [Biological Neurons vs Artificial Neurons](#)
- [Single Layer Perceptron](#)
- [Multi-Layer Perceptron](#)
- [Artificial Neural Networks \(ANNs\)](#)
- [Types of Neural Networks](#)
- [Architecture and Learning process in neural network](#)

Basic Components of Neural Networks

The basic components of neural network are:

- [Layers in Neural Networks](#)
- [Weights and Biases](#)
- [Forward Propagation](#)
- [Activation Functions](#)
- [Loss Functions](#)
- [Backpropagation](#)
- [Learning Rate](#)

Optimization Algorithm in Deep Learning

Optimization algorithms in deep learning are used to minimize the loss function by adjusting the weights and biases of the model. The most common ones are:

- [Optimization algorithms in deep learning](#)
- [Gradient Descent](#)
- [Stochastic Gradient Descent \(SGD\)](#)
- [Batch Normalization](#)

- [Mini-batch Gradient Descent](#)
- [Adam \(Adaptive Moment Estimation\)](#)
- [Momentum-based Gradient Optimizer](#)
- [Adagrad Optimizer](#)
- [RMSProp Optimizer](#)

A deep learning framework provides tools and APIs for building and training models. Popular frameworks like TensorFlow, PyTorch and Keras simplify model creation and deployment.

Types of Deep Learning Models

Lets see various types of Deep Learning Models:

1. Convolutional Neural Networks (CNNs)

Convolutional Neural Networks (CNNs) are a class of deep neural networks that are designed for processing grid-like data such as images. They use convolutional layers to automatically detect patterns like edges, textures and shapes in the data.

- [Deep Learning Algorithms](#)
- [Convolutional Neural Networks \(CNNs\)](#)
- [Basics of Digital Image Processing](#)
- [Importance for CNN](#)
- [Padding](#)
- [Convolutional Layers](#)
- [Pooling Layers](#)
- [Fully Connected Layers](#)
- [Backpropagation in CNNs](#)
- [CNN based Image Classification using PyTorch](#)
- [CNN based Images Classification using TensorFlow](#)

****CNN Based Architectures:**** There are various architectures in CNNs that have been developed for specific kinds of problems such as:

- [Convolutional Neural Network \(CNN\) Architectures](#)
- [LeNet-5](#)
- [AlexNet](#)
- [VGGnet](#)
- [VGG-16 Network](#)
- [GoogLeNet/Inception](#)
- [ResNet \(Residual Network\)](#)
- [MobileNet](#)

2. Recurrent Neural Networks (RNNs)

Recurrent Neural Networks (RNNs) are a class of neural networks that are used for modeling sequence data such as time series or natural language.

- [Recurrent Neural Networks \(RNNs\)](#)
- [How RNN Differs from Feedforward Neural Networks](#)
- [Backpropagation Through Time \(BPTT\)](#)
- [Vanishing Gradient and Exploding Gradient Problem](#)
- [Training of RNN in TensorFlow](#)
- [Sentiment Analysis with RNN](#)

****Types of Recurrent Neural Networks:**** There are various types of RNN which are as follows:

- [Types of Recurrent Neural Networks](#)
- [Bidirectional RNNs](#)
- [Long Short-Term Memory \(LSTM\)](#)
- [Bidirectional Long Short-Term Memory \(Bi-LSTM\)](#)
- [Gated Recurrent Units \(GRU\)](#)

3. Generative Models in Deep Learning

Generative models generate new data that resembles the training data. The key types of generative models include:

- [Generative Adversarial Networks \(GANs\)](#)
- [Autoencoders](#)
- [GAN vs. Transformer Models](#)

****Types of Generative Adversarial Networks (GANs):**** GANs consist of two neural networks, the generator and the discriminator that compete with each other. Variants of GANs include:

- [Deep Convolutional GAN \(DCGAN\)](#)
- [Conditional GAN \(cGAN\)](#)
- [Cycle-Consistent GAN \(CycleGAN\)](#)
- [Super-Resolution GAN \(SRGAN\)](#)
- [StyleGAN](#)

****Types of Autoencoders:**** Autoencoders are neural networks used for unsupervised learning that learns to compress and reconstruct data. Various types of Autoencoders include:

- [Types of Autoencoders](#)
- [Sparse Autoencoder](#)
- [Denoising Autoencoder](#)

- [Convolutional Autoencoder](#)
- [Variational Autoencoder](#)

4. Deep Reinforcement Learning (DRL)

Deep Reinforcement Learning combines the representation learning power of deep learning with the decision-making ability of reinforcement learning. It helps agents to learn optimal behaviors in complex environments through trial and error using high-dimensional sensory inputs.

- [Deep Reinforcement Learning](#)
- [Reinforcement Learning](#)
- [Markov Decision Processes](#)

Key Algorithms in Deep Reinforcement Learning

- [Deep Q-Networks \(DQN\)](#)
- [REINFORCE](#)
- [Actor-Critic Methods](#)
- [Proximal Policy Optimization \(PPO\)](#)