

Intro. to Machine Learning / Deep Learning

shpre1236

shpre1236

2025.12.01

Previously

- ▶ Machine Learning and Deep Learning concept
- ▶ What is Gradient Descent?
- ▶

Today's Topic

- ▶ Regression Problem
- ▶ multi-variable regression problem
- ▶ Difference between regression and machine learning

Learn model from data

Data with noise presents. We want to know the best argument that fits data well.

Distance

Mean Square Error (MSE), in other words, L2-norm

Linear model

$$y = ax$$

Line with offset

$$y = ax + b$$

In matrix form

Gradient descent

Apply gradient descent to get the minimum point.

Conventional Regression Problem

Optimization problem with L2-norm has analytic solution.

Machine Learning technique

Gradient Descent makes difference compared to traditional (statistical) method.

Interim Summary

What we learned so far...

- ▶ Gradient descent is the tool for obtaining function in machine learning.

Linearity

Linearity should satisfy two conditions.

- ▶ Superposition: $f(x + y) = f(x) + f(y)$
- ▶ Homogeneity: $f(ax) = af(x)$

Gradient Descent Concept

Derivates always points to the local (perhaps global) minimum point. why?

Because, gradient $\frac{dy}{dx}$ at minimum point is 0.

The idea of gradient descent, in order to find minimum point, is an iterative process until the gradient becomes zero.

function with nonlinearity

nonlinear function can be periodic function or many of activation function...

- ▶ $\cos x$, $\sin x$, e^x , $\log(x)$
- ▶ ReLU(Rectified Linear Unit): $f(x) = \max(0, x)$
- ▶ Sigmoid: $f(x) = \frac{1}{1+e^{-x}}$

Gradient descent with non-linearity

Does gradient descent work in nonlinear function?

YES

Multi-layered network

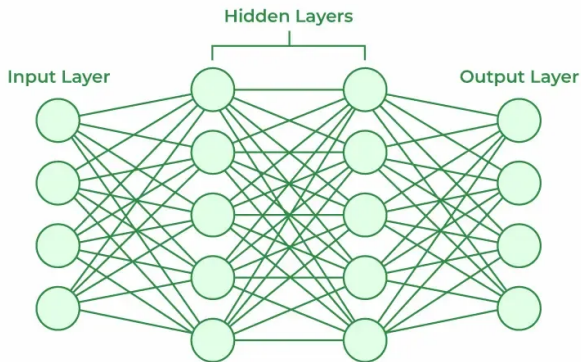


Figure 1: Neural Network stacks layer by layer

What is Deep Learning

Deep Learning is Machine Learning framework whose model is Neural Network.

Today's summary

- ▶ Analytical solution can be obtained in regression problem
- ▶ Gradient descent makes Machine Learning different from traditional approach
- ▶ Deep Learning is distinguished from Machine Learning using Neural Network