Introduction to Basic Machine Learning and Deep Learning

BCS Weekend Workshop

Brain and Cognitive Society, IITK
Jan 22 2022

Based on slides by Shashi Kant

Outline

- We will talk about some basic concepts in Machine Learning (Supervised) and Deep Learning.
- Have a tutorial on basic Neuroscience using python and Google Colab, where we'll simulate a LIF neuron model.
- An assignment for you to work on.

What is Machine Learning?

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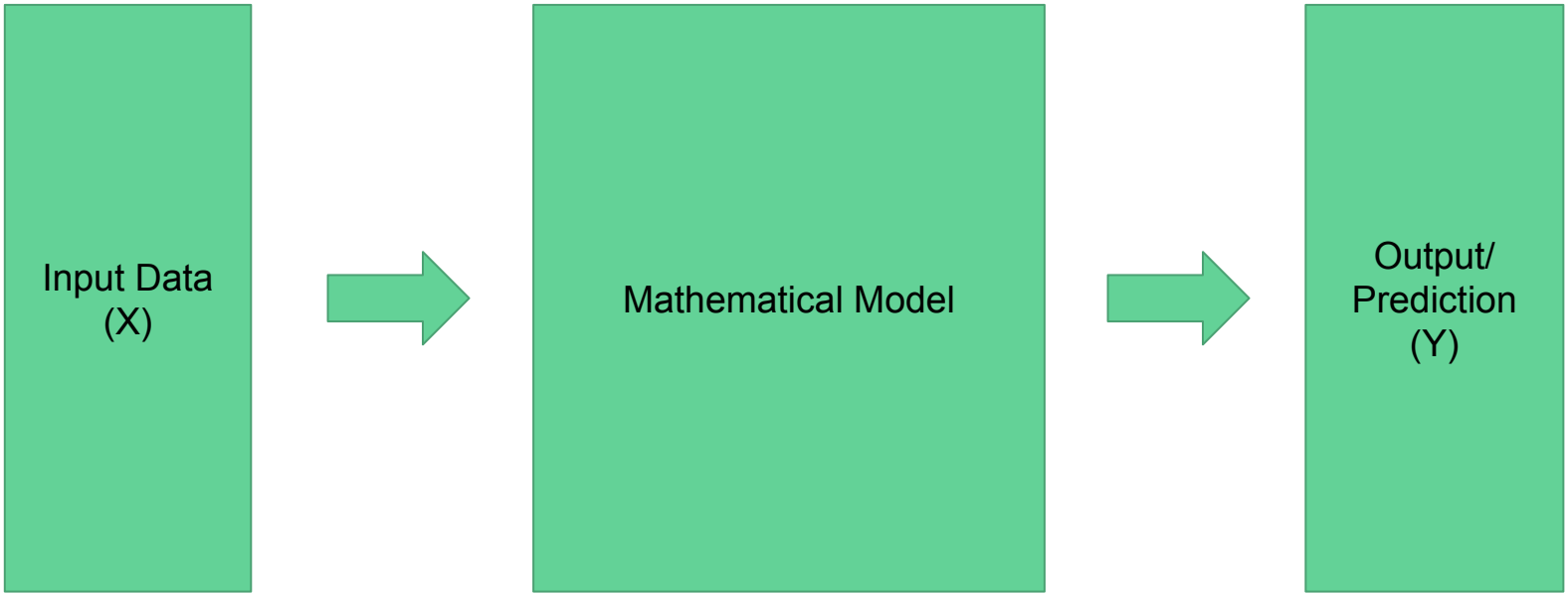


What is Machine Learning?

- Fitting a suitable mathematical model to the given data
- Minimising the error between expected and actual output of the model
- Everything is about optimising the mathematical model to reduce the error in training datas.

ML Ex: Linear Regression

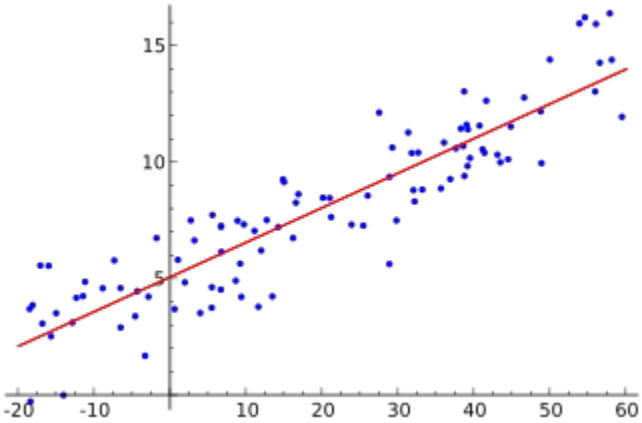
Problem: Assume you have to predict prices for a house for which you have got some features of house such as **size, location, age.** And you have data's for 100 houses for which you know their **prices, size, location, age. (Note:** We assume prices of houses are linearly dependent on the given three features)

Solution: We will try to find a **Linear Model** which can fit to the given data.

Model Can Be Taken As

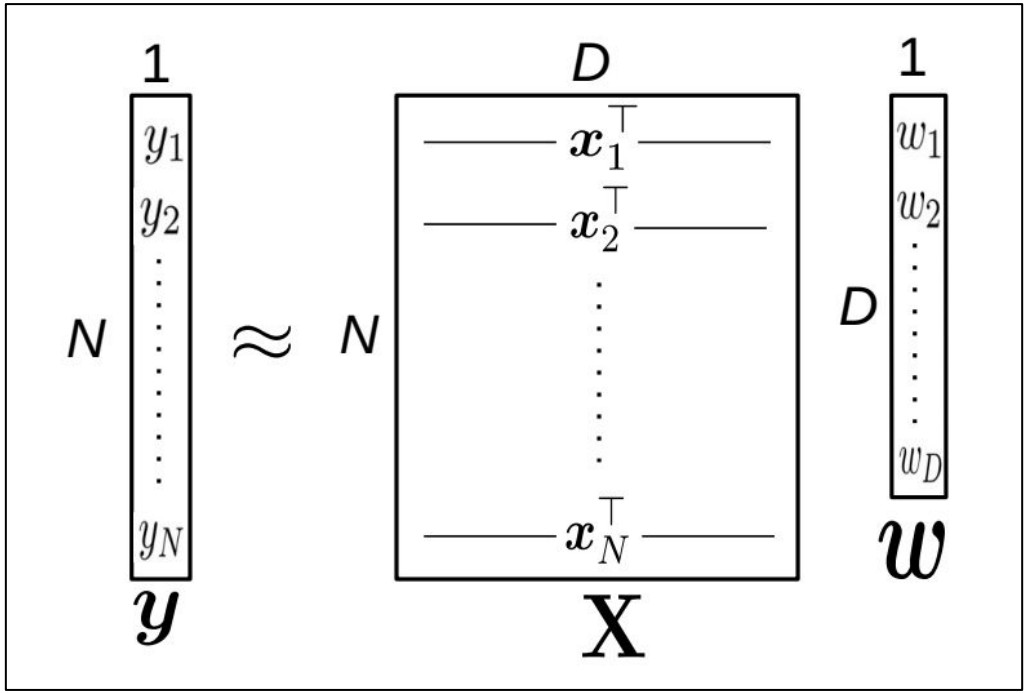
$$y = w_1x_1 + w_2x_2 + w_3x_3$$

Where: y = price, x_1 = size, x_2 = location and x_3 = age



Source: https://en.wikipedia.org/wiki/Linear_regression

ML Ex: Linear Regression



N = 100
D = 3

ML Ex: Linear Regression

- Let's find out **W**
- To find **W** minimise the error between expected and predicted value.
- Therefore, minimise this: $\mathbf{E(W) = (Y - XW)^2}$
- So, find **W for dE/dW = 0** (Minimising a function, **E(W)**)
- Then, predict prices $\mathbf{y_p = xW}$

$$\mathbf{dE/dW = -X^T(Y - XW) = 0}$$

$$\mathbf{=> X^TY = (X^TX)W}$$

$$\mathbf{=> W = (X^TX)^{-1}X^TY}$$

ML Ex: Linear Regression

- What if inverse of $\mathbf{X^TX}$ don't exist or is too costly.
- Use **Gradient Descent,** which we talked about in the last lecture.

$$dE/dW = -X^T(Y - XW)$$

$$\text{Update: } W = W - \eta(dE/dW)$$

Find Y and then Iterate

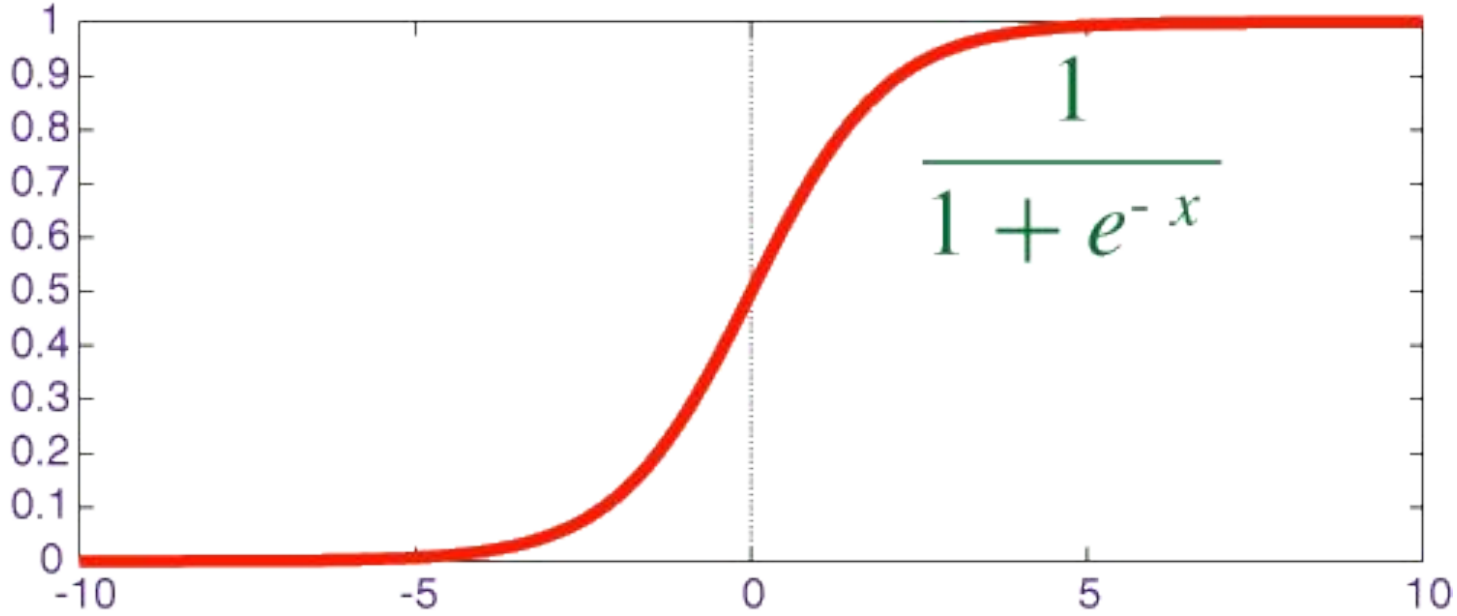
ML Ex: Linear Classification (Logistic Regression)

x

Sigmoid (Wx)

Cat or Dog?

Sigmoid Function



- > 0.5 => Cat
- < 0.5 => Dog

What for Non-Linear Cases?

- Kernel Method (transforming linear model to non-linear model)
- Deep Neural Networks adding non linearity (activation functions) after performing some linear operation.

Credits

Leaders:

- Shivanshu
- Mohit Kulkarni

Secretaries:

- Shashwat Gupta
- Sahil Bansal
- Rashmi Sharma
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