1 What is Linear Classifier

If you can draw a straight line between two classes of data such that most of the data points belonging to one class fall on one side of the line and most of the data points belonging to the second class fall on the other side of the line, then your straight line is your Linear Classifier.

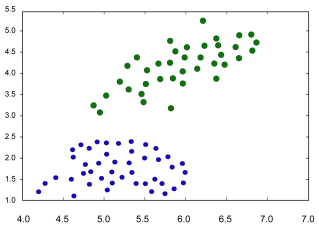

Figure 1

In Figure 1, we can have a linear function $y = 2.5$ separating the two features.

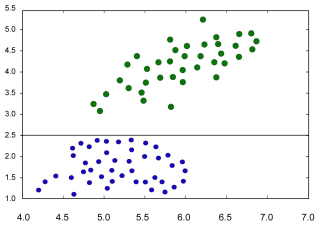

Figure 2

Through Linear classifiers, you can always see the relationship between your predictive variables and their outcomes. With numerical data, you have a quantifiable contribution.While making explanations of the model easier, using linear classifiers also makes the model operational easily and quickly with traditional programming skills. An eminent feature of linear classifiers is that they are accepting of all whole host of transformations to make your data linear. They are relatively speedy to run compared to some of the more involved "black box" methods.

2 Linear Models for Classifiers in Higher Dimensions

In $y = f(x)$, x, y can be either vector valued or scalar valued. When function f is a line, the model is said to be linear. In 2D, two parameters are used in the function and it is called a line.

In 3D, three parameters are used in the function and it is called a plane. In d dimensional space, d parameters are used in the function and is called a hyper plane. The following is the general equation for the hyper plane

$$y = ax + b \tag{1}$$

where a and b are parameters

$$y = w^T x = w.x \tag{2}$$

when x is a multivariate, we have $x = [1, x_1, x_2, \ldots, x_d]^T$ and vector w represents the parameters of the model.

$$y = f_w(x) = w^T x \tag{3}$$

Notation

$$x = \begin{bmatrix} 1 \\ x_1 \\ x_2 \\ \vdots \\ x_d \end{bmatrix} \quad w = \begin{bmatrix} w_0 \\ w_1 \\ w_2 \\ \vdots \\ w_d \end{bmatrix} \quad w.x = w^T x = w_0.1 + w_1 x_1 + w_2 x_1 + ... + w_d x_d$$

In machine learning, we will use this concept of linear classifiers for dealing problems in higher dimensions. The models which use linear regression[1], perceptron[2], SVM[3] etc., are based on linear classifiers.

3 References:

The following are the references:

[1]`https://en.wikipedia.org/wiki/Linear_regression`

[2]`https://en.wikipedia.org/wiki/Perceptron`

[3]`https://en.wikipedia.org/wiki/Support_vector_machine`