Support Vector Machine

Support Vector Machines (SVM) is a data classification method that separates data using hyperplanes. The concept of SVM is very intuitive and easily understandable. If we have labeled data, SVM can be used to generate multiple separating hyperplanes such that the data space is divided into segments and each segment contains only one kind of data. SVM technique is generally useful for data which has non-regularity which means, data whose distribution is unknown.

The basics of Support Vector Machines and how it works are best understood with a simple example.

Let's imagine we have two classes i.e., circle and triangle, and our data has two features x and y. We want a classifier that, given a pair of (x, y) coordinates, outputs if it's either circle or triangle.

We plot our already labeled training data on a plane depicted in the below figure

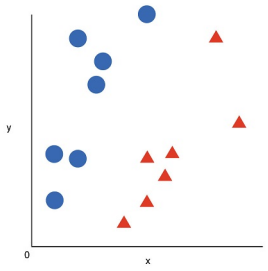

Figure 1

Support vector machine takes these data points and outputs the hyperplane (which in two dimensions it's simply a line) that best separates the two classes. This line is the decision boundary. Anything that falls to one side of the decision boundary we will classify as circle, and anything that falls to the other as triangle.

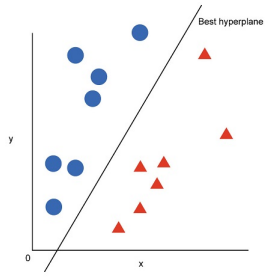

Figure 2

But, what exactly is the best hyperplane? For SVM, it's the one that maximizes the margins from both classes.

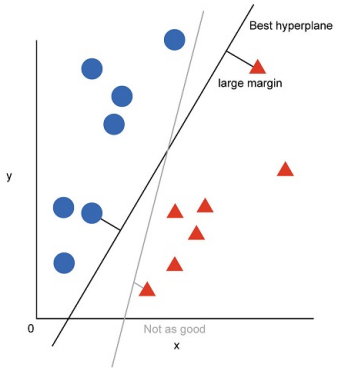

Figure 3

Nonlinear Data

In the scenario depicted the below figure, we can't have a linear hyper-plane between the two classes, so how does SVM classify these two classes? Till now, we have only looked at the linear hyper-plane.

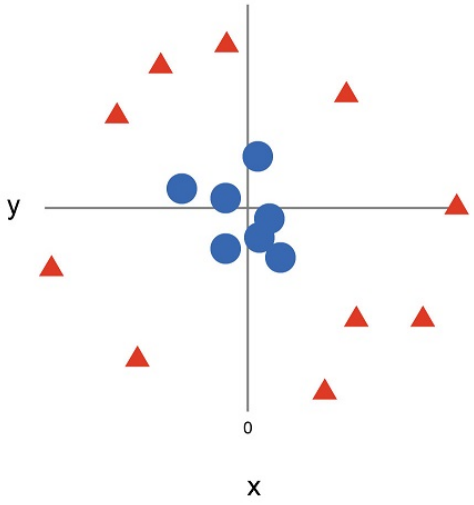

Figure 4

SVM solves this problem by introducing additional feature. Here, we will add a new feature $z = x^2 + y^2$. Now, let's plot the data points on axis x and z as shown in the below figure.

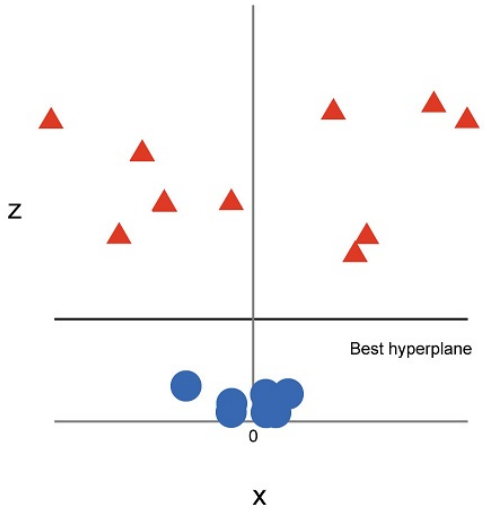

Figure 5

We can now find a best hyperplane as shown in the above figure after adding the new feature.

1 References:

For more details on SVM can refer to the following blog,
`https://machinelearningmastery.com/support-vector-machines-for-machine-learning/`