Assignment - 10

* Aim → Implement SVM for performing classification and find its accuracy on the given data, using Python.

* Theory →

- Support Vector Machines :

Generally SVM is considered to be a classification approach, but it can be employed in both types of classifications and regression problems. SVM constructs a hyperplane in multi-dimensional space to seperate different cases. SVM generates optimal hyperplane in an iterative manner which is used to minimize an error. The core idea of SVM is to find a maximum marginal hyperplane, that best divides the dataset into classes.

Support vectors are the data points which are closest to the hyperplane. These points will define the separating line better by calculating margins

Hyperplane is a decision plane which separates between a set of objects having different class membership.

Margin is a gap between 2 lines on the closest class points. This is calculated as the $\perp^{ar}$ distance from the line to the support vectors or closest points. If the margin is larger in between the classes, then it is considered a good margin. A smaller margin is a bad margin.

- Process :

The main objective is to segregate the given dataset in the possible way. The objective is to select the hyperplane with maximum possible margins, between support vectors in the given dataset.

SVM searches for the maximum marginal hyperplane in the following steps →

1. Generate hyperplanes which segregates the classes in the best way.
2. Select the right hyperplane with maximum segregation

For non-linear and inseparable planes, SVM uses a kernel trick to transform the input space to a higher dimensional space.

- SVM Kernels:

The SVM algorithm is implemented in practice using a kernel. It converts non separable problem to separable problem by adding more dimension to it. Kernel trick helps you to build a more accurate classifier.

Linear Kernel - It can be used as normal dot product of any two given observations. The product between 2 vectors is the sum of the multiplication of each pair of input values

$$K(x, xi) = \text{sum}(x * xi)$$

Polynomial Kernel - It is a more generalized form of the linear kernel. The polynomial kernel can distinguish curved or non linear input space.

$$K(x, xi) = 1 + \text{sum}(x * xi)^{\wedge} d$$

where, d is the degree of the polynomial
d = 1 is similar to linear kernel. It needs to be specified

The objective of linear SVC is to fit to the data returning a best fit hyperplane that divides or categorizes dataset.

* Conclusion → In this assignment we implemented the support vector machine algorithm on the Bill authentication dataset.