**Support Vector Machines**

* SVM is a model, which can do linear classification as well as regression.
* SVM is based on the concept of a surface, called hyperplane, which draws a boundary between data instances plotted in the multi-dimensional feature space.
* In other words, the goal of the SVM analysis is to find a plane, or rather a hyperplane, which separates the instances on the basis of their classes.
* In summary, in the overall training process, the SVM algorithm analyses input data and identifies a surface in the multi-dimensional feature space called the hyperplane.

A diagram of a support vector

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**Support Vectors:** Support vectors are the data points (representing classes), the critical component in a data set, which are near the identified set of lines (hyperplane).

**Hyperplane and Margin:** For an *N*-dimensional feature space, hyperplane is a flat subspace of dimension (*N*−1) that separates and classifies a set of data.

**Identifying the correct hyperplane in SVM**

1. The hyperplane should segregate the data instances belonging to the two classes in the best possible way.

2. It should maximize the distances between the nearest data points of both the classes, i.e. maximize the margin.

3. If there is a need to prioritize between higher margin and lesser

misclassification, the hyperplane should try to reduce misclassifications.

**How to deal with Non-Seperable Data**

* one way to deal with nonlinearly separable data is by using a slack variable and an optimization function to minimize the cost value.
* However, this is not the only way to use SVM to solve machine learning problems involving non-linearly separable data sets.
* SVM has a technique called the **kernel trick** to deal with non-linearly separable data.
* In the process, it converts linearly non separable data to a linearly separable data. These functions are called **kernels**.
* Some of the common kernel functions for transforming from a lower dimension ‘*i*’ to a higher dimension ‘*j*’ used by different SVM implementations are as follows:

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A screenshot of a computer

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We will plot in dimensional space

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**Strengths of SVM**

* SVM can be used for both classification and regression.
* It is robust, i.e. not much impacted by data with noise or outliers.
* The prediction results using this model are very promising.

**Weaknesses of SVM**

* SVM is applicable only for binary classification, i.e. when there are only two classes in the problem domain.
* The SVM model is very complex – almost like a black box when it deals with a high-dimensional data set. Hence, it is very difficult and close to impossible to u nderstand the model in such cases.
* It is slow for a large dataset, i.e. a data set with either a large number of features or a large number of instances.
* It is quite memory-intensive.

**Application of SVM**

SVM is most effective when it is used for binary classification,

i.e. for solving a machine learning problem with two classes.

One common problem on which SVM can be applied is in the

field of bioinformatics – more specifically, in detecting cancer

and other genetic disorders.