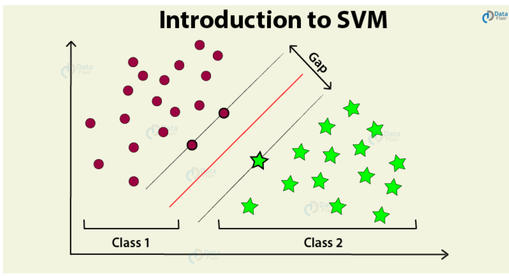
Support Vector Machine | Classfiction done with the support point or vector of nearest point from the Hyperplan.

- A support vector machine is widely known as SVM is a type of supervised machine learning classification algorithm.
- SVM introduce since 1960 and it was later redefine in 1990.However it becomes extremly popular owing their accurcy to achieve the brilliant result.



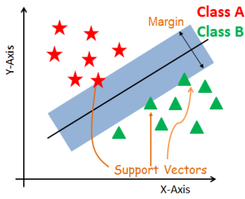
- SVM can implemented in unique way when compare to the other machine learning model .
- Let's consider we having the hyperplan which is seperating the class A and Class B.

- Moreover the classifier would attempt to draw a staright line and seperating two subset of the data thereby create a model for the classification.
- for the class 2 it is handy to do that by manually also but very difficult when we have multiple classes.
- The SVM classifier would attempt to draw a straight line by seperating two set of the data,thereby it creating model for classification.

- For the two class we can draw the line by hand also but when immdediatly we see the problem:-there is more than one possible dividing line that can perfecly descriminate between the two classes.

- It is very difficult task to find that line which bisect the two classes in better manner with low error.
- For that SVM come into the role.
- If we having the scatter plot in that one class and onother class is divided by the one plan or line i.e.Hyperplan .This hyperplan drawn in such way that the margine that means the distance between the nearest point and hyperplan would be the maximum.
- The distance between the hyperplan and the neraest point of each classes is known as margine.
- Either side of the plan would have same distance e.g.One side having d and onther side also having the d means plan bisecting them in such way the margine will get the equal for all classes.

- The line which touches the nearet point from the hyperplane this line is called suppoet vector line and nearest points also known as support vector those are come accross the line.



- Support Vector.
- Hyperplan.
- Margin.

Support Vector.

- The support vector are the datapoints,which are closest to the hyperplan.Thses points will define the seperating line by calculating the margine.
- These points are more relevant to the construction of a classifier.

Hyperplan.

- A hyperplan is the decision plane which seperates between the set of objects having the diffrent class membership.

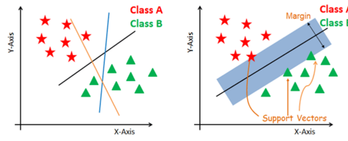
Margin

- The margine is the gap between the two lines on the closest class points.This is calculated perpandicular 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 or good classification,a smaller margine is a bad margin means bad classification.
- Higher the margin it means there is the good classification is happen and vice versa.

How the SVM works ?

- In the SVM it is always necessary to seperate the two or more classes with mimimum error or minimum misclasification.

- If we set line inside the data at random fashion then there is highest chances of the error occuranace but if we bisecting th data point in such manner that it will be give us the minimum error with best segmentation between two class with high margine.



Seperation Plan.

- We having the two types of plan that are the :-
  - **Linear**
  - **Non-Linear**
- If we have a data in that it is very easy to seperable by simply drawing the straight line.

- But when we get the at random fashion data and it is not seperable by simply drawing the straight line at that condition we will be use the non-linear seperation plan.
- In this kind of situation SVM uses the **Kernal-Tricks** to trasform the input space to the higher dimensional subspace and then the datapoints ploted on the x axis and z axis and higher subspace. there so that we classify the two class A and class B very easily.

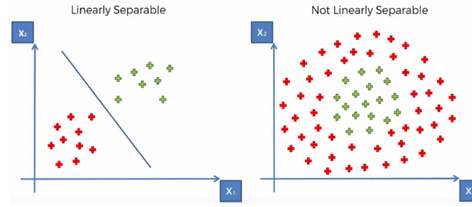
- In this case SVM convert the low dimensional space high dimensional space by using the kernal trick.It helps to create circlr,hyperbola,parabola to classify the data at good level.

- Supppose we having the x and y at the round round fashion that we could not classify the datapoint by using simple line.Threfore we required the high dimensional curve to classified that points.

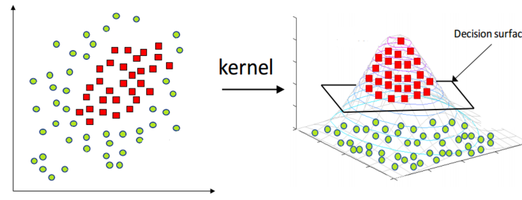
- like for circle,z = x2 + y2

- SVM karnal trick trasform the data into a higher dimensional and then it apply simple SVM algorithm.
- Here in the circle the x and y are fit in the z plan.

Fig.3 Fig.4



How to make the Non-linear Data Seperation.



SVM Kernal.

- **Linear**
- **Polynomial**
- **Radial Basis Function.(RBF)**
- **Sigmoid**

  - The SVM is implemented in practice using a kernal.Kernal helps us to build more accurate classifier.
  - Kernal transform to the input dataspace into the required form.SVM uses the techique called Kernal trick here.

  - Kernal takes the low dimenstional input sapce and transform into the higher dimenstional space.In the other we can say that it convert the non seperable problem to seperable problem by adding more dimension to it.

  - It is most usefull in non-linear seperable problem .Kernal trick help us to build the more accurate classifier.

  - The linear kernal can be use as normal dot product any two given obeservations.

  - The product between the two vectors is the sum of the multiplication of each pair of input values.

  - A polynomial kernal is more generalized form of linear kernal,The polynomial kernal distinguish curved and non-linear input space.If we put the polynomial degree =1 that time it will become normal linear kernal

  - The radial based function (RBF) kernal is a popular kernal function commonly use in support vector machine classification.

  - RBF can map an input space in infinite dimensional space.