10	Aim	Implement and demonstrate classification algorithm using Support vector machine Algorithm.
	Program	Implement and demonstrate the working of SVM algorithm for classification.

CONCEPT - Support Vector Machine

- A Support Vector Machine (SVM) is a very powerful and versatile Machine Learning model, capable of performing linear or nonlinear classification, regression, and even outlier detection.
- SVMs are well suited for classification of complex but small- or medium-sized datasets.

Linear SVM Classification

Hyperplane

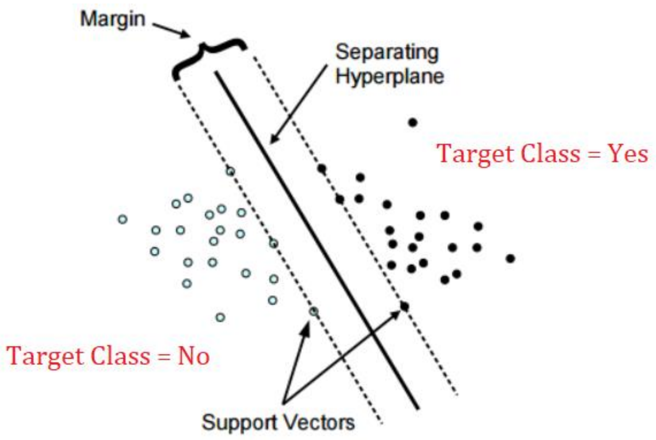
A hyperplane is a decision boundary which separates between given set of data points having different class labels. The SVM classifier separates data points using a hyperplane with the maximum amount of margin. This hyperplane is known as the maximum margin hyperplane and the linear classifier it defines is known as the maximum margin classifier.

Margin

A margin is a separation gap between the two lines on the closest data points. It is calculated as the perpendicular distance from the line to support vectors or closest data points. In SVMs, we try to maximize this separation gap so that we get maximum margin.

Support Vectors

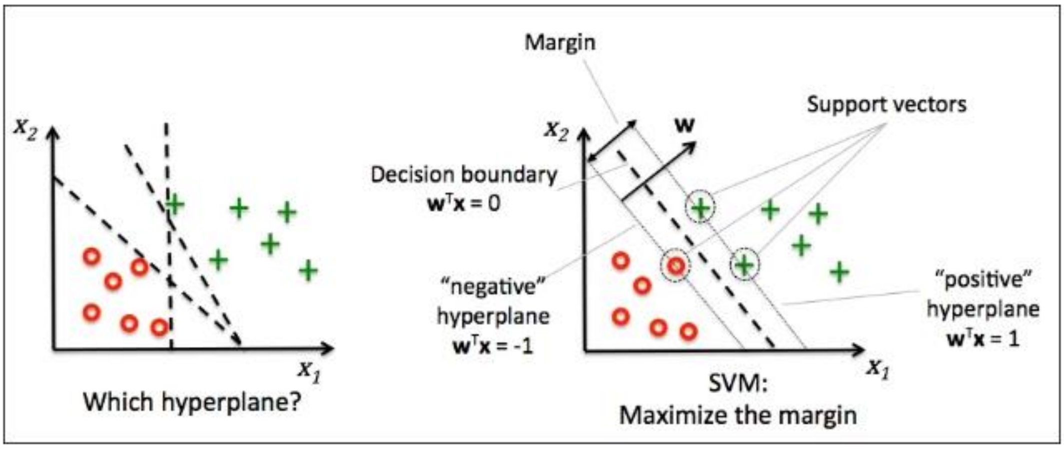
Support vectors are the sample data points, which are closest to the hyperplane. These data points will define the separating line or hyperplane better by calculating margins.



In SVMs, the main objective is to select a hyperplane with the maximum possible margin between support vectors in the given dataset.
SVM searches for the maximum margin hyperplane in the following 2 step process –

1. Generate hyperplanes which segregates the classes in the best possible way. There are many hyperplanes that might classify the data. We should look for the best hyperplane that represents the largest separation, or margin, between the two classes.
2. So, choose the hyperplane so that distance from it to the support vectors on each side is maximized. If such a hyperplane exists, it is known as the ***maximum margin hyperplane*** and the linear classifier it defines is known as a ***maximum margin classifier***.

The following diagram illustrates the concept of maximum margin and maximum margin hyperplane.



source: https://www.kaggle.com/code/prashant111/svm-classifier-tutorial#1.-Introduction-to-Support-Vector-Machines-

Program:

```
import numpy as np
import matplotlib.pyplot as plt
from sklearn import datasets
from sklearn.model_selection import train_test_split
from sklearn.svm import SVC
from sklearn.metrics import classification_report, confusion_matrix, accuracy_score
from sklearn.decomposition import PCA

# Step 1: Load the Iris dataset
iris = datasets.load_iris()
X = iris.data
y = iris.target

# Step 2: Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Step 3: Train the SVM classifier
svm_classifier = SVC(kernel='linear', C=1.0, random_state=42)
svm_classifier.fit(X_train, y_train)

# Step 4: Make predictions
y_pred = svm_classifier.predict(X_test)

# Step 5: Evaluate the model
print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))
print("\nClassification Report:")
print(classification_report(y_test, y_pred))
print(f"Accuracy: {accuracy_score(y_test, y_pred):.2f}")
```

Output

```
Confusion Matrix:
[[10  0  0]
 [ 0  8  1]
 [ 0  0 11]]

Classification Report:
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        10
           1       1.00      0.89      0.94         9
           2       0.92      1.00      0.96        11

    accuracy                           0.97        30
   macro avg       0.97      0.96      0.97        30
weighted avg       0.97      0.97      0.97        30

Accuracy: 0.97
```