Support Vector Machines and its Applications in Business Management

Seminar Presentation

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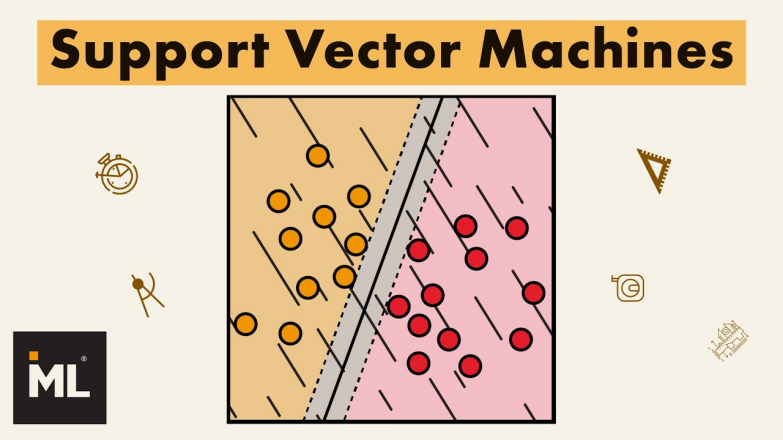
Introduction

Introduction

Machine learning has become an essential tool in business management, allowing companies to analyze vast amounts of data and make informed decisions based on those insights. As the volume of data continues to grow, businesses are increasingly turning to machine learning algorithms to identify patterns, trends, and correlations that can be used to optimize processes, reduce costs, and increase profitability. One of the most popular machine learning algorithms used in business management is Support Vector Machines (SVM).



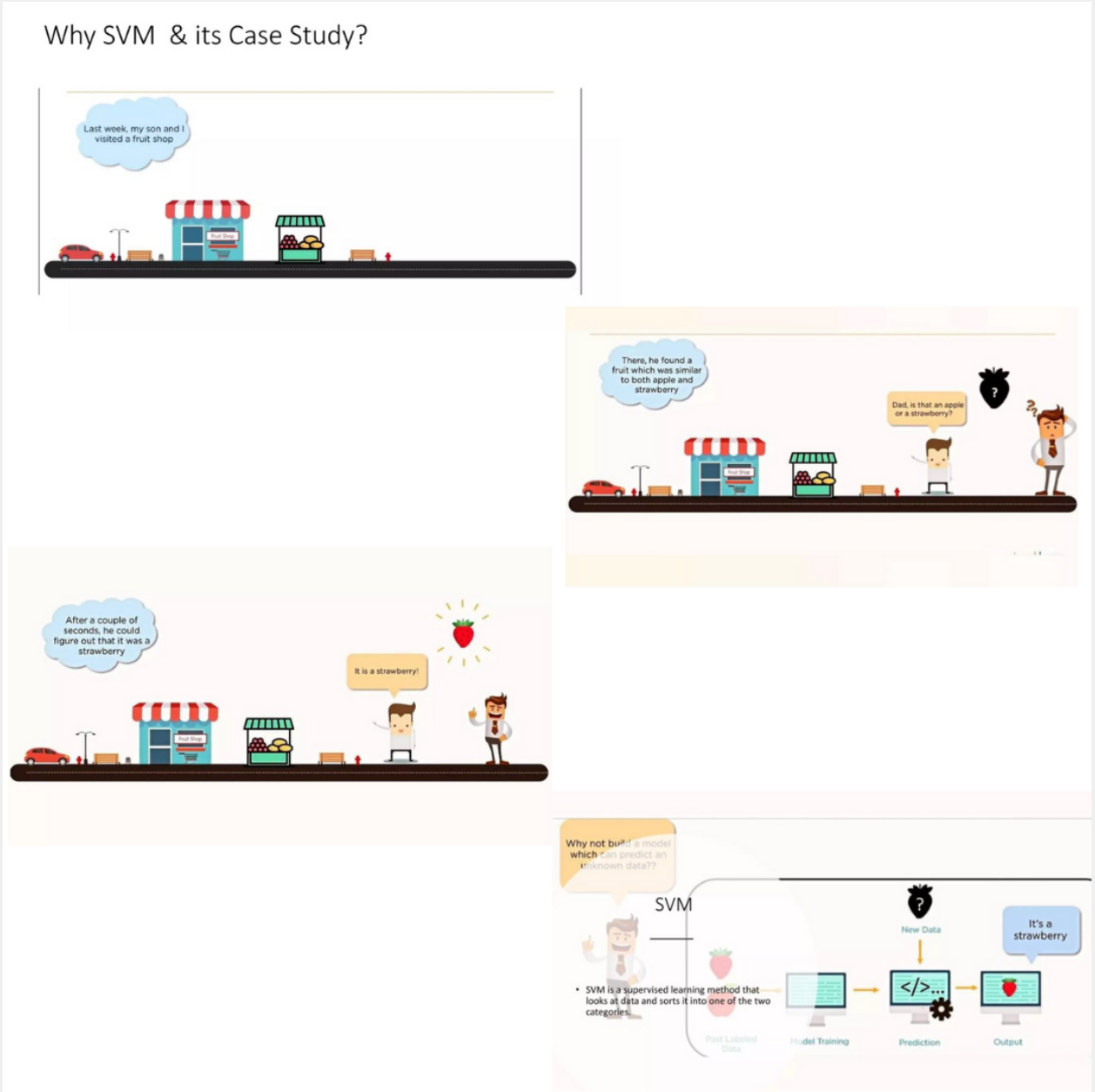


Figure – A fun Example

What are Support Vector Machines?

- Support Vector Machines (SVMs) are a type of supervised learning algorithm that is used for classification and regression analysis. The idea behind SVMs is to find a hyperplane (a line or a plane in high-dimensional space) that best separates the data into different classes. They are widely used in variety of fields, such as computer vision, natural language processing, and bio-informatics, due to their ability to handle high-dimensional data and their robustness to outliers.
- The goal of the SVM algorithm is to create the best line or decision boundary that can segregate n-dimensional space into classes so that we can easily put the new data point in the correct category in the future. This best decision boundary is called a hyperplane.

Why Support Vector Machines?

A Logistic Regression model identifies different decision boundaries with different weights that are near the optimal point whereas, a SVM tries to find the “best” margin (distance between the line and the support vectors) that separates the classes and thus reduces the risk of error on the data.

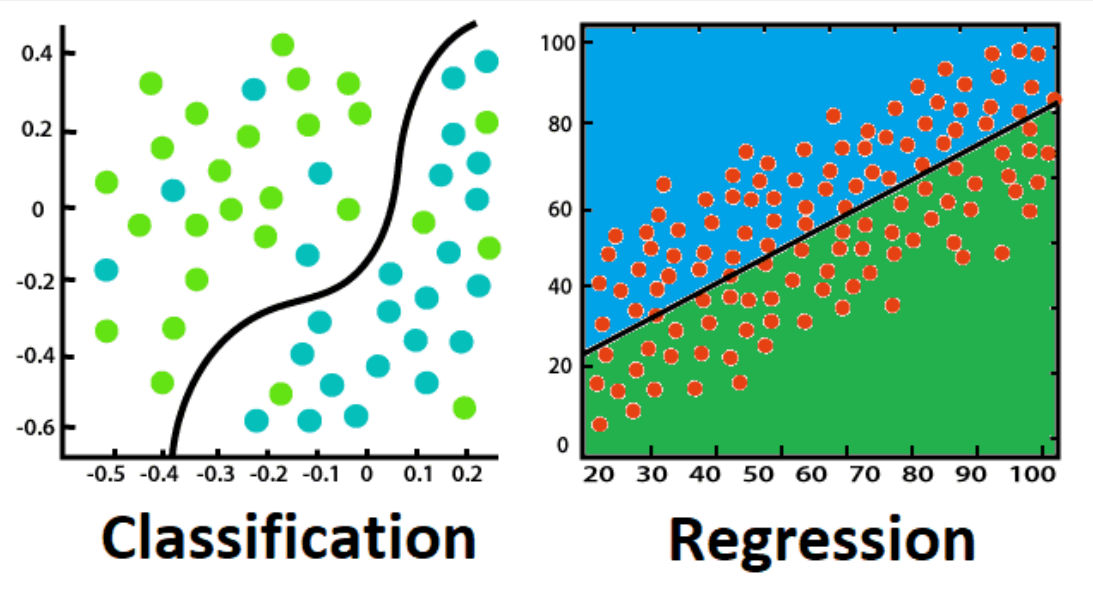


Figure – Regression vs SVM model

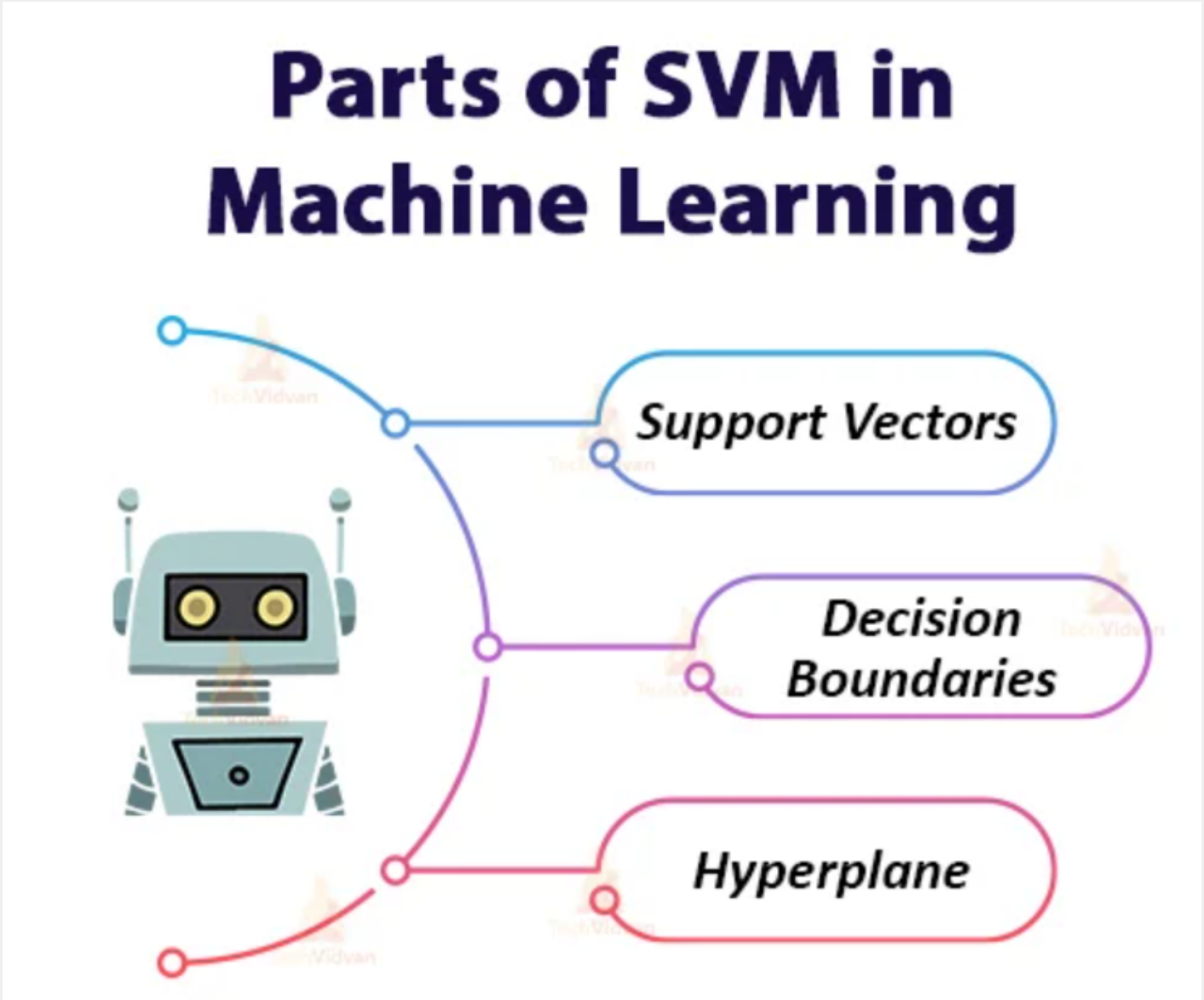


Figure – Parts of SVM in Machine Learning

Types of SVM

There are two main types of SVM :

- Linear SVM :

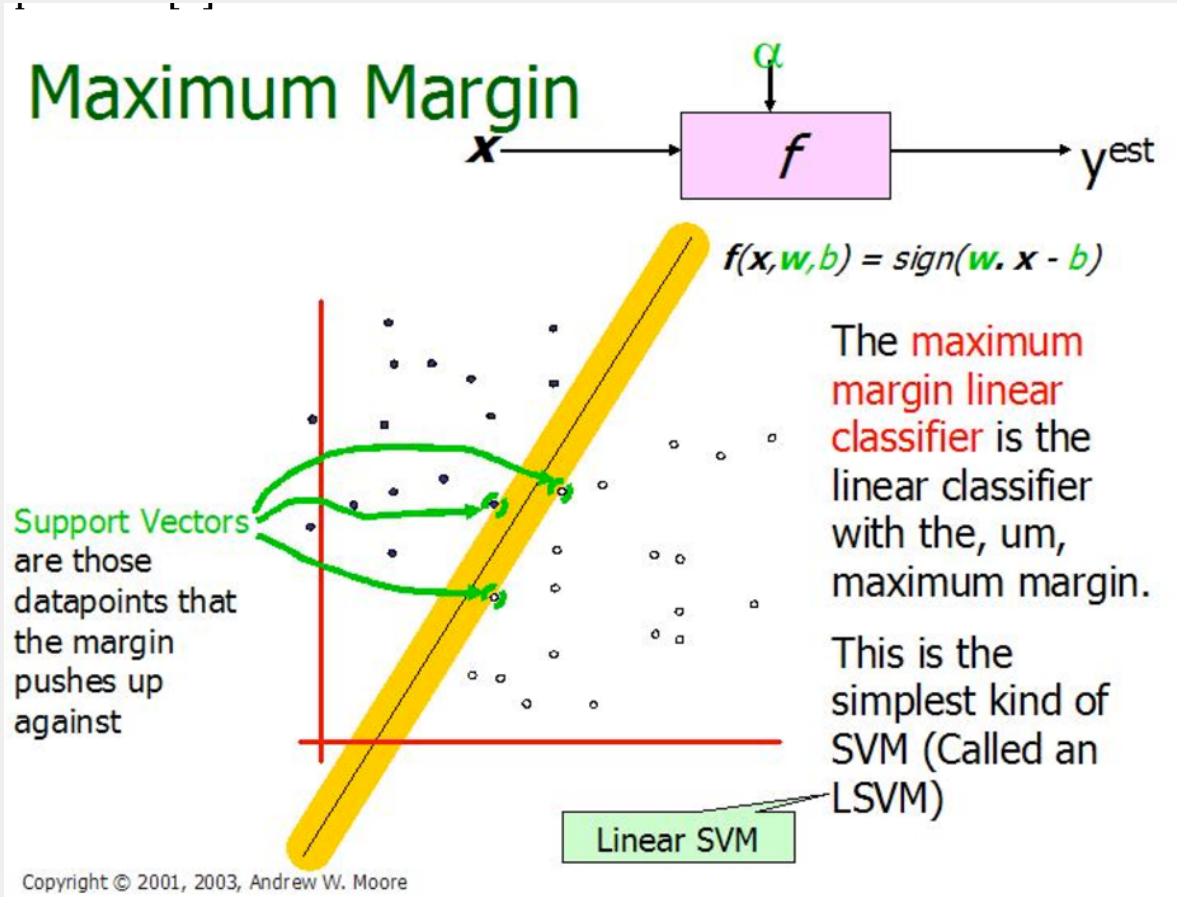


Figure – Linear Support Vector model

- Non-linear SVM :

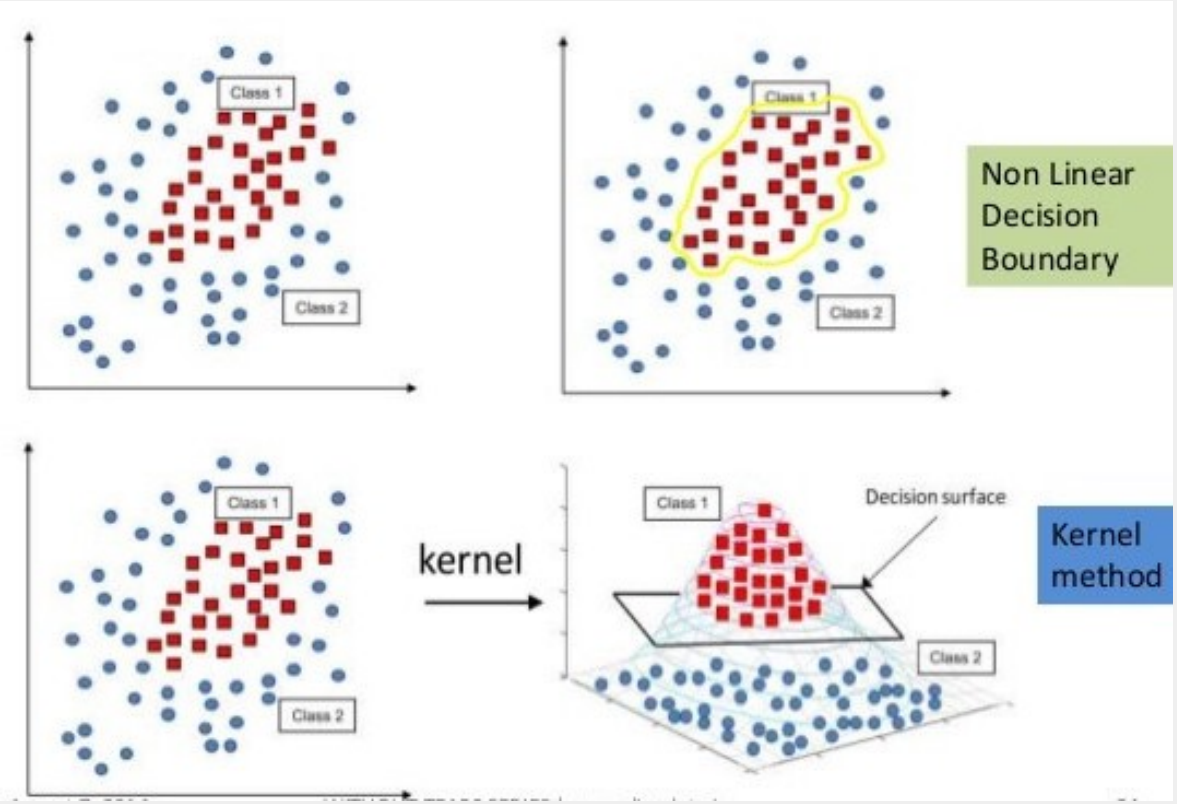


Figure – Non-Linear Support Vector Model

Training SVM using Kernel

SVM algorithms use a set of mathematical functions that are defined as the kernel. The function of kernel is to take data as input and transform it into the required form. Different SVM algorithms use different types of kernel functions. These functions can be different types. For example linear, polynomial, radial basis function (RBF), and sigmoid. Introduce Kernel functions for sequence data, graphs, text, images, as well as vectors. The most used type of kernel function is RBF. Because it has localized and finite response along the entire x-axis.
SVM helps in identifying the hyperplane that best separates the input space according to the class labels. Performance of a SVM model often depends on the choice of the kernel selection which helps in separating the data both linearly as well non-linear(by separating the data linearly in higher dimensional space). Polynomial and RBF are particularly useful when the data points are not linearly separable. However, polynomial function are difficult to control and can get computationally expensive.

Types of Algorithms

Types of Algorithm

There are several types of algorithm. The most commonly used are as follows :

- Sequential Minimal Optimization (SMO)
- Stochastic Gradient Descent (SGD) Algorithm

Sequential Minimal Optimization (SMO)

Repeat until convergence

1. Heuristically choose a pair of i and j
2. Keeping all other ’s fixed, optimize W() with respect to i and j . The convergence of SMO is tested by checking if the KKT complementary conditions of (1) are satisfied within some tolerance around 103 . The KKT complementary conditions are : i = 0 yi(x T i w + b) 1 i = C yi(x T i w + b) 1 0 < i < C yi(x T i w + b) = 1

Repeat until convergence {

1. Heuristically choose a pair of α_i and α_j
2. Keeping all other α's fixed, optimize $W(\alpha)$ with respect to α_i and α_j.

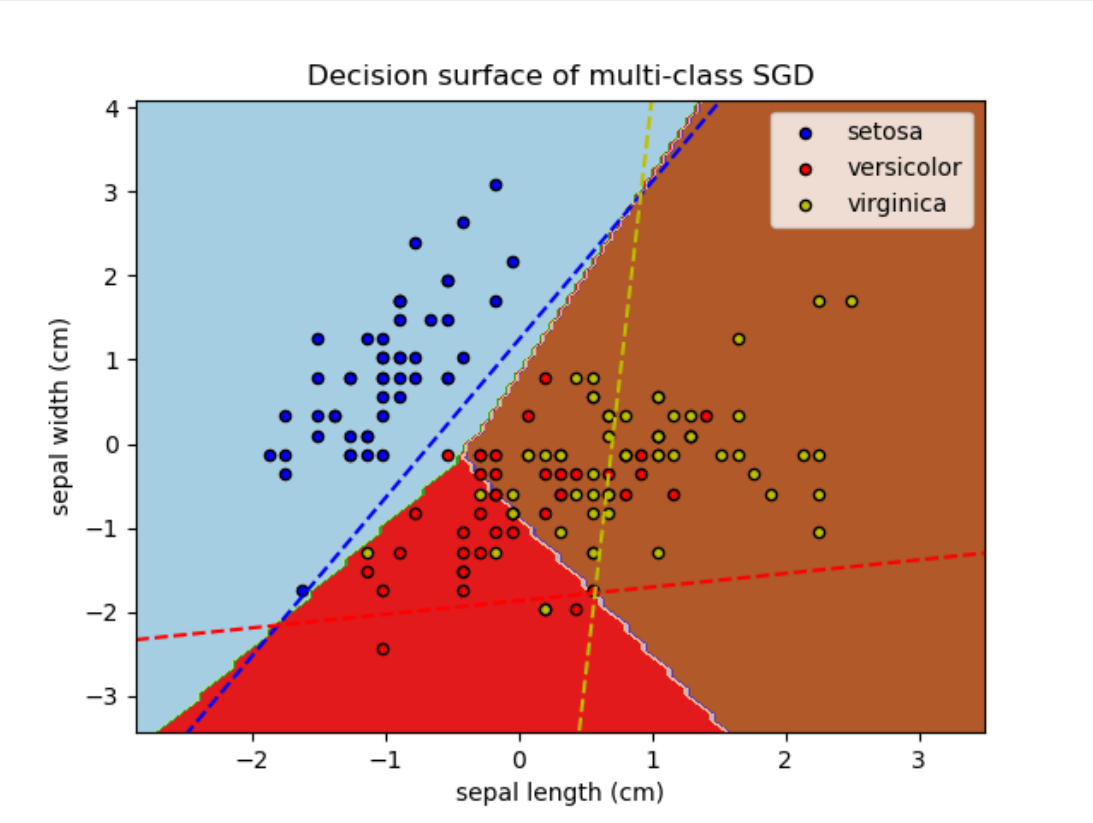
}

The convergence of SMO is tested by checking if the KKT complementary conditions of (1) are satisfied within some tolerance around 10^{-3}. The KKT complementary conditions are:

$$\begin{aligned} \alpha_i = 0 &\Rightarrow y_i(x_i^T w + b) \geq 1 \\ \alpha_i = C &\Rightarrow y_i(x_i^T w + b) \leq 1 \\ 0 < \alpha_i < C &\Rightarrow y_i(x_i^T w + b) = 1 \end{aligned}$$

Stochastic Gradient Descent (SGD)

Stochastic Gradient Descent (SGD) is a simple yet very efficient approach to fitting linear classifiers and regressors under convex loss functions such as (linear) Support Vector Machines and Logistic Regression. Even though SGD has been around in the machine learning community for a long time, it has received a considerable amount of attention just recently in the context of large-scale learning. SGD has been successfully applied to large-scale and sparse machine learning problems often encountered in text classification and natural language processing.



Suppose, you have a million samples in your dataset, so if you use a typical Gradient Descent optimization technique, you will have to use all of the one million samples for completing one iteration while performing the Gradient Descent, and it has to be done for every iteration until the minima are reached. Hence, it becomes computationally very expensive to perform. This problem is solved by Stochastic Gradient Descent. In SGD, it uses only a single sample, i.e., a batch size of one, to perform each iteration. The sample is randomly shuffled and selected for performing the iteration.

Case Study on SMO

Case Study

Iris Setosa

Iris Versicolor

Iris Virginica

Application in Business Management

Applications :

Support Vector Machines are a type of machine learning algorithm that can be used in a variety of ways to aid business management. Here are some potential applications of SVM in business management :

- Stock market prediction
- Fraud detection
- Customer segmentation
- Churn prediction
- Credit risk assessment

1)Stock market prediction :

Stock market prediction using Support Vector Machines involves building a machine learning model that uses historical stock price data to predict future prices.
SVMs are a popular choice for this task because they are good at handling complex, high-dimensional data and can learn non-linear relationships between features and targets.
steps to build a stock market prediction model using SVMs :

- objective : Using SVM model to forecast the trend for the upcoming day.
- Dataset source :
  Data of Reliance Industries Trading taken from yahoo finance website (1996-2020)
  STOCK MARKET ANALYSIS USING SVM

2)Fraud detection :
SVMs can be used to detect fraudulent activities in business transactions, such as credit card fraud, insurance fraud, or online scams. The algorithm can analyze patterns in historical data to identify potential fraudsters and flag suspicious activities for further investigation.

3)Customer segmentation :
SVMs can help segment customers into different groups based on their purchasing behaviors, demographic information, or other characteristics. This can help businesses to target their marketing efforts more effectively and create tailored products or services to meet specific customer needs.

4)Churn prediction :
SVMs can be used to predict customer churn, or the likelihood of customers leaving a business. This can help businesses to take proactive steps to retain customers, such as offering loyalty programs, personalized incentives, or other retention strategies.

5)Credit risk assessment :
SVMs can help financial institutions to assess the creditworthiness of loan applicants. By analyzing historical data on borrowers' credit histories, income, and other financial factors, SVMs can predict the likelihood of loan default and help lenders make more informed decisions on lending.

Our Findings

Findings

- In conclusion, Support Vector Machines (SVM) is a powerful machine learning technique that has been widely used in various fields, including business management.
- SVM has proven to be effective in solving complex classification and regression problems, making it a valuable tool for businesses seeking to improve their decision-making processes.
- By leveraging SVM, businesses can develop more accurate predictive models, reduce the risk of errors, and ultimately, enhance their overall performance.
- SVM's ability to handle large and diverse datasets makes it suitable for a wide range of applications in business, such as customer segmentation, fraud detection, and risk management.
- As businesses continue to face increasingly complex challenges, the use of SVM is expected to become even more prevalent in the years ahead, as it enables them to make informed and data-driven decisions.

Merits/Demerits

MERITS

- Accurate Predictions
- Robustness
- Generalization
- Non-Linear Classification

DEMERITS

- Computationally Intensive
- Sensitive to Parameters
- Data Scaling

Bibliography

- A Fast Algorithm for Training Support Vector Machines
- SVM in Machine Learning
- Kernels Functions- Introduction
- CLassification of Kernels
- Working of Kernels
- Support Vector training models
- STOCK MARKET ANALYSIS USING SVM