Support Vector Machine: SVM

“Support Vector Machine” (SVM) is a supervised machine learning algorithm that can be used for both regression or classification challenges. However, it is mostly used in classification problems.

Support Vector Machine: SVM

1. Classification: In classification, SVM tries to find the hyperplane that best separates different classes in the feature space. This hyperplane is chosen in such a way that it maximizes the margin between the classes, which helps improve the generalization ability of the model.

2. Regression: SVM can also be used for regression tasks. In this case, it tries to find a hyperplane that best fits the data, while still maximizing the margin.

SVM: Key Concepts

1. Hyperplane: In a 2-dimensional space, a hyperplane is a line that separates the classes. In a higher-dimensional space, it's a subspace.

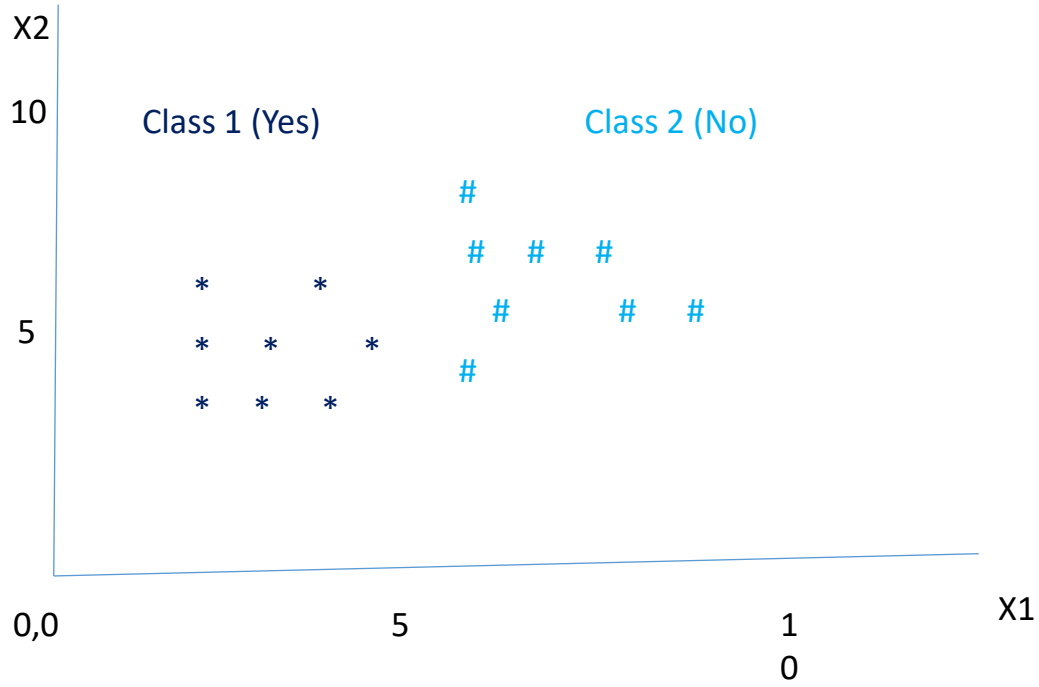
2. Support Vectors: These are the data points closest to the hyperplane and have a direct influence on the position and orientation of the hyperplane.

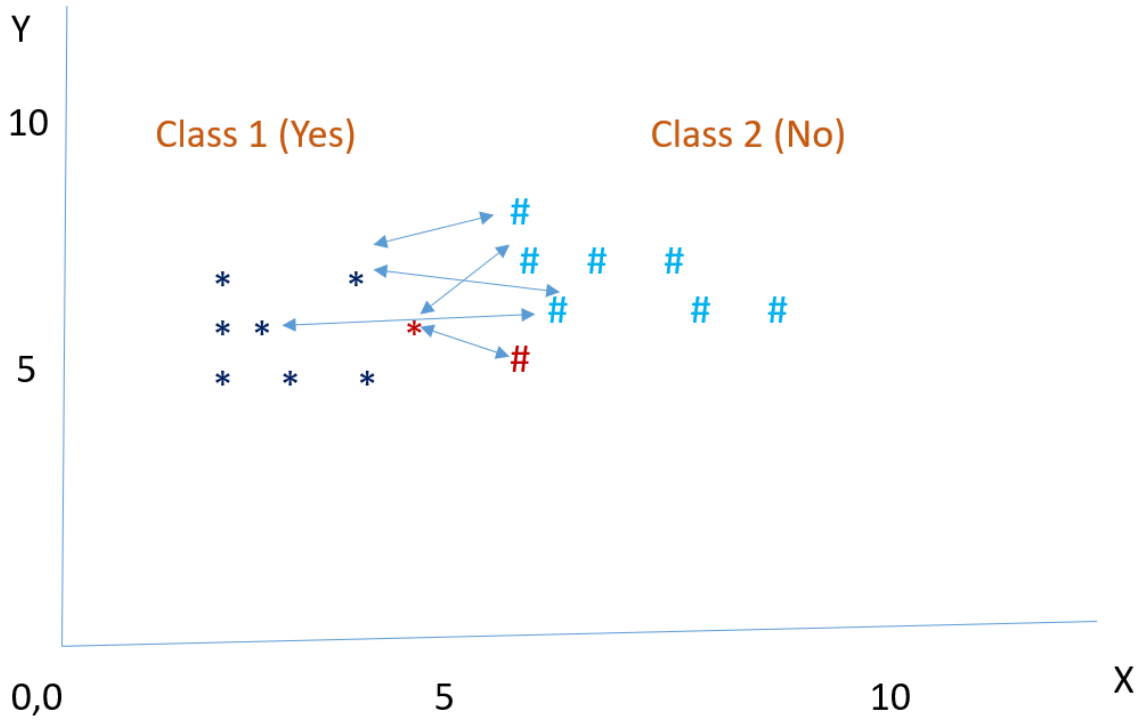
3. Kernel Trick: SVM can efficiently perform a non-linear classification/regression by mapping the original data into a higher-dimensional feature space. This is done using a kernel function, which computes the dot product in this higher-dimensional space. Common kernels include linear, polynomial, and radial basis functions (RBF).

4. Regularization Parameter (C): It controls the trade-off between maximizing the margin and minimizing the classification error. A small C encourages a larger margin, while a larger C allows for fewer misclassifications.

If you're dealing with a dataset where you believe the classes are well-separated and there is not much noise, using a larger value of C might lead to better performance. On the other hand, if the dataset is noisy or there's overlap between classes, using a smaller C to encourage a larger margin might lead to better generalization.

Let’s see…




Y
10
5
0,0
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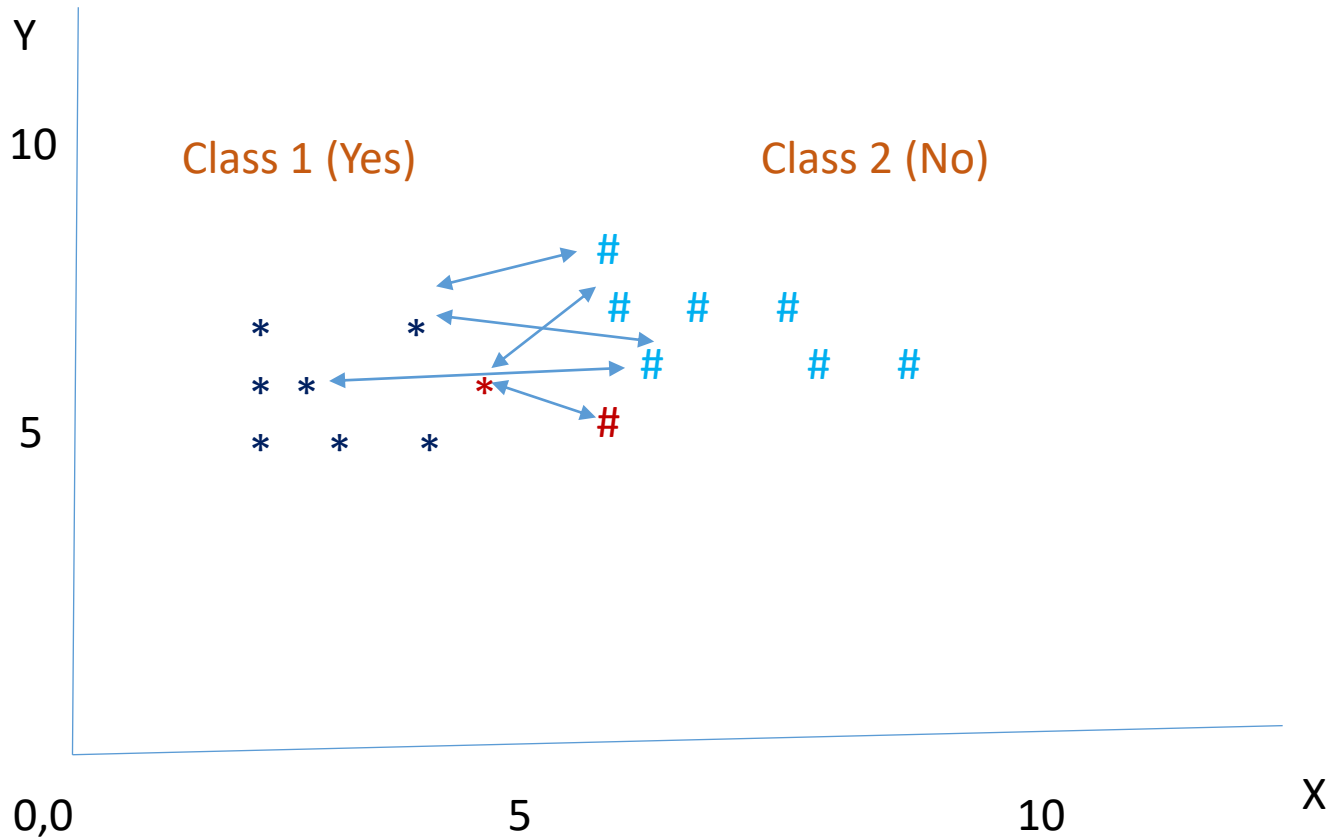
10
X
Class 1 (Yes)
Class 2 (No)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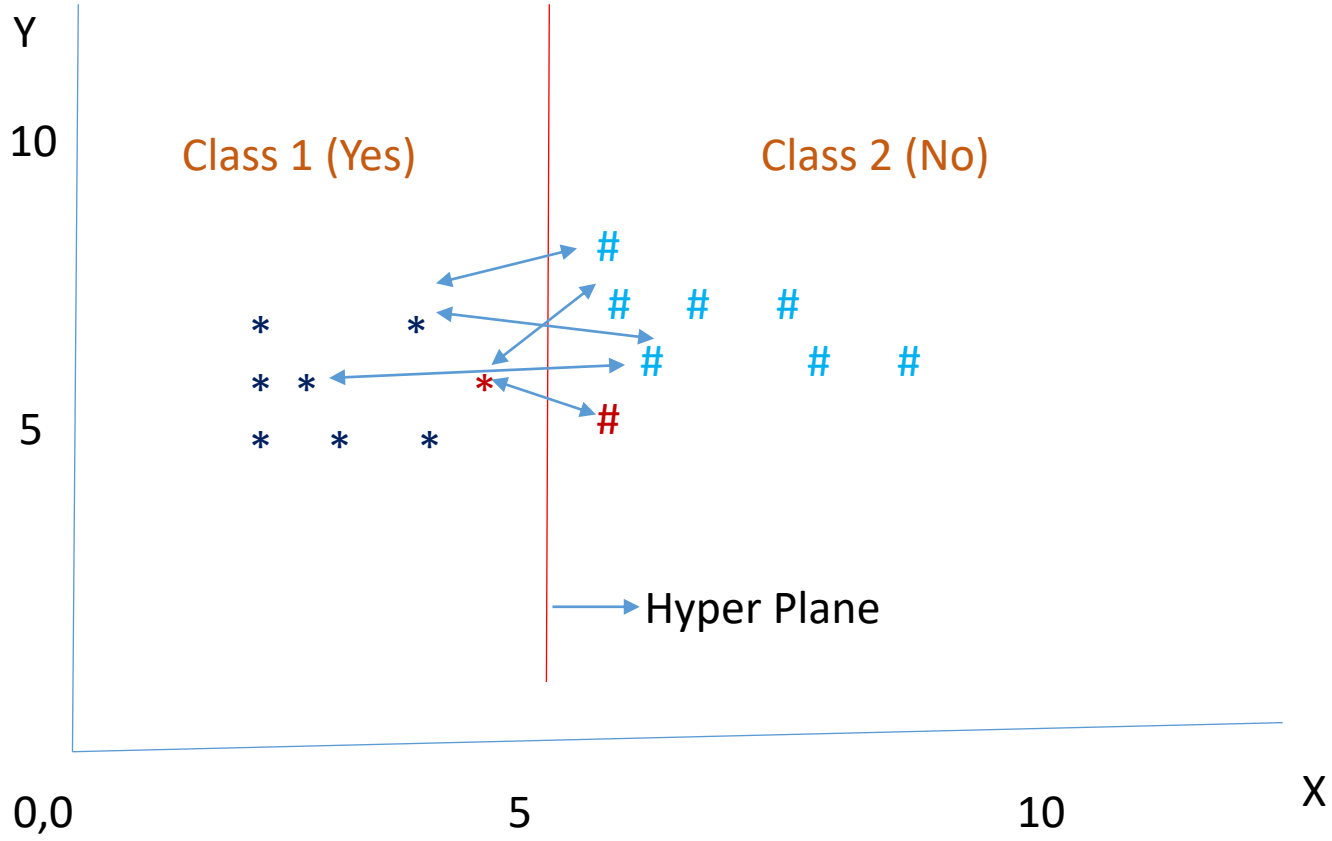
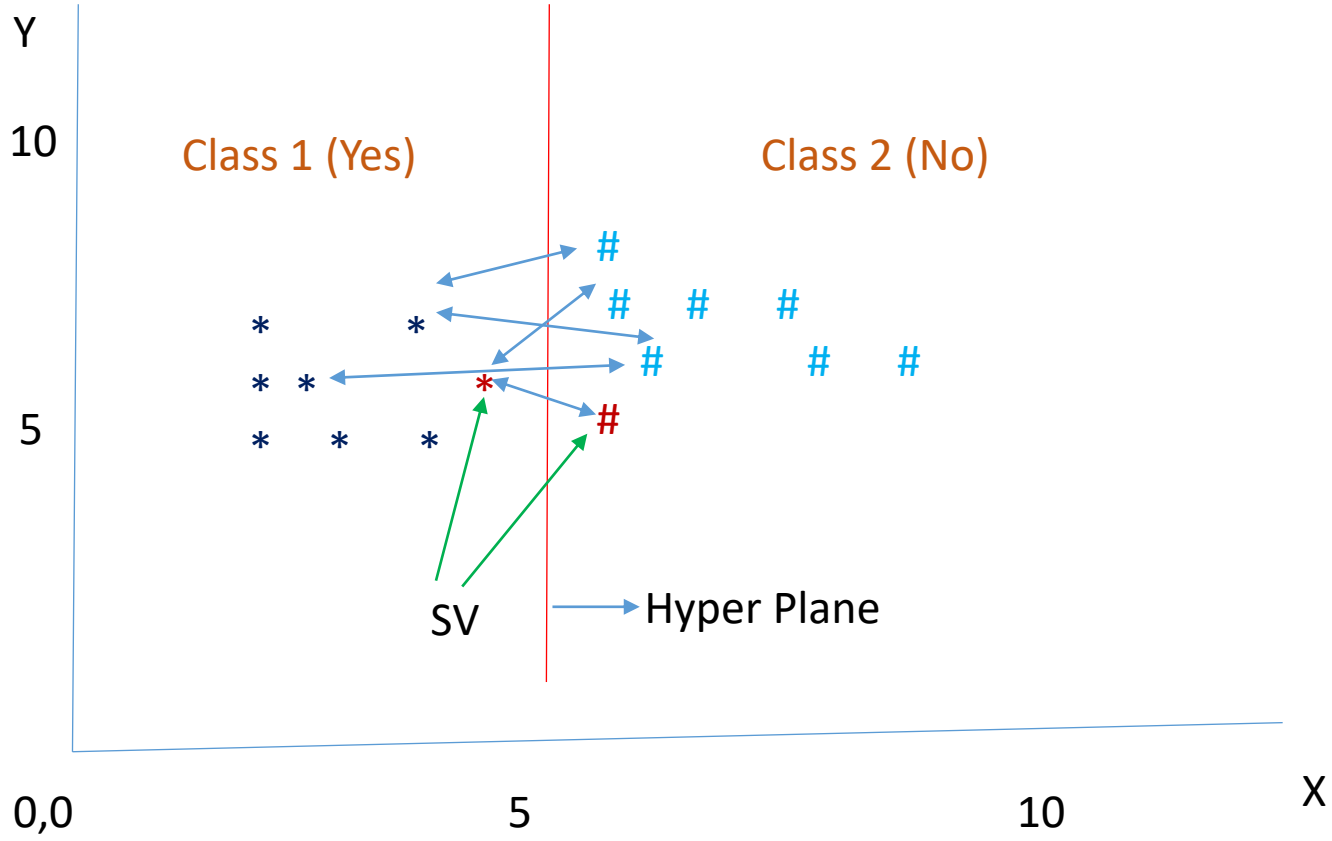
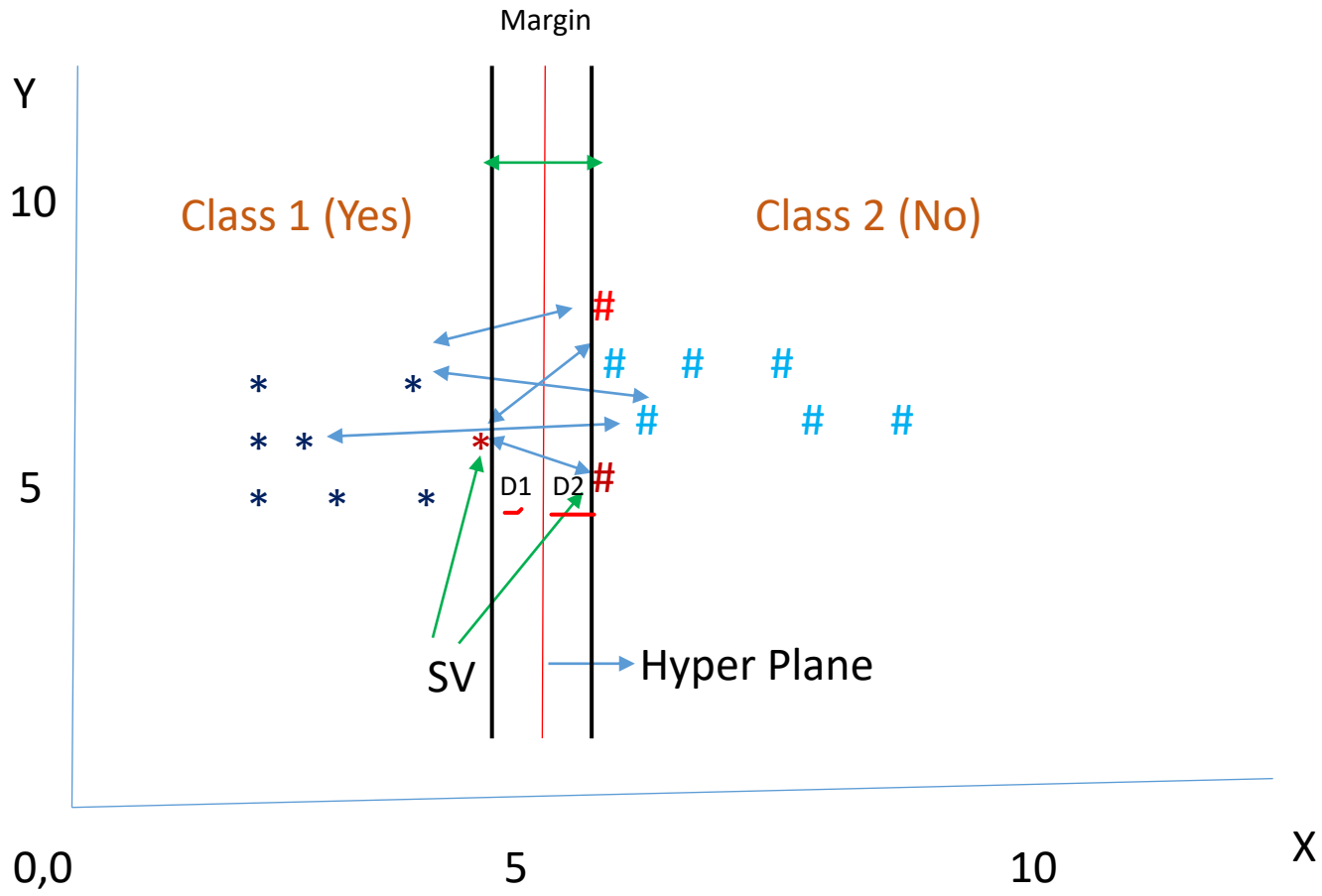
Support Vector Machine



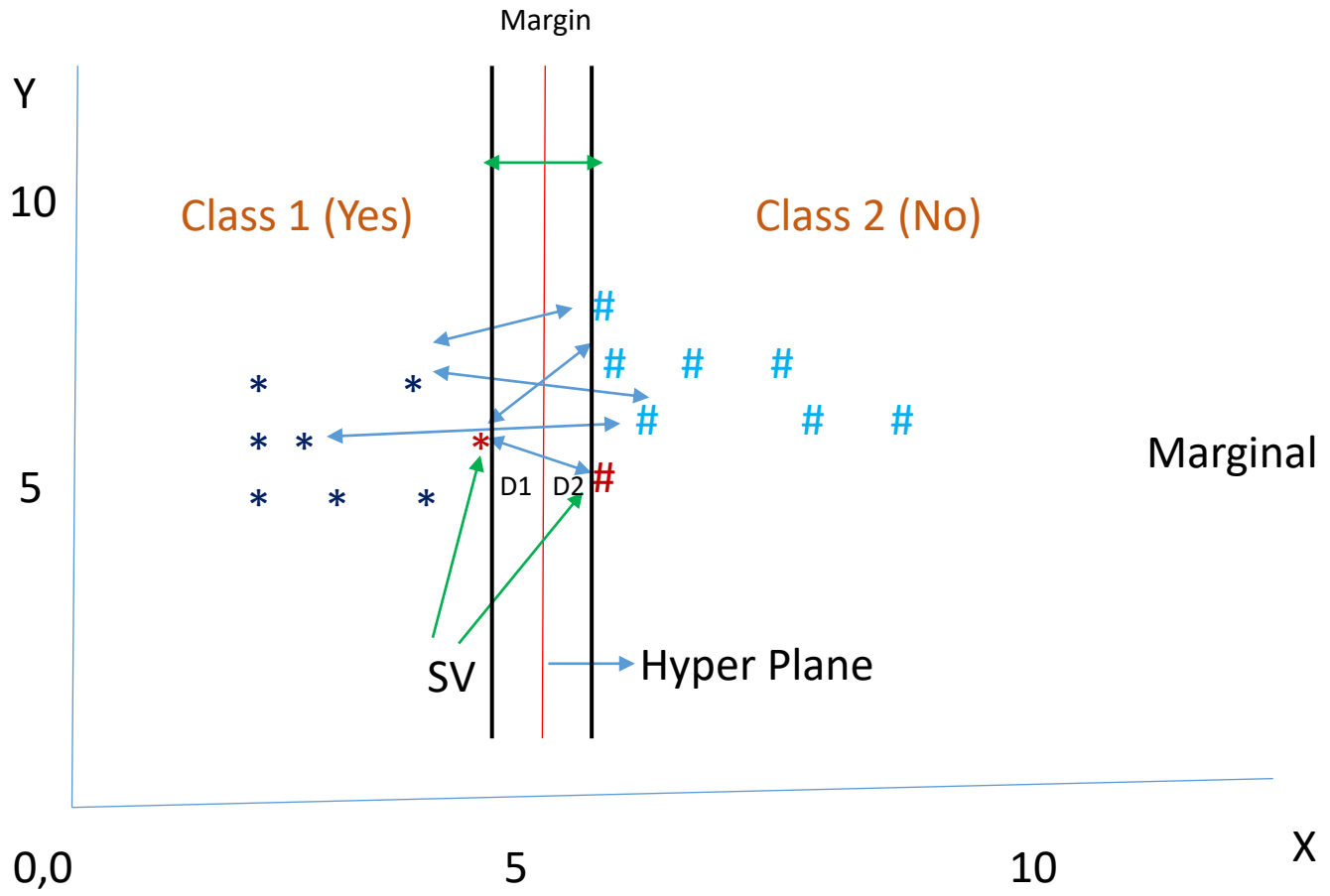
Support Vector Machine



Support Vector Machine

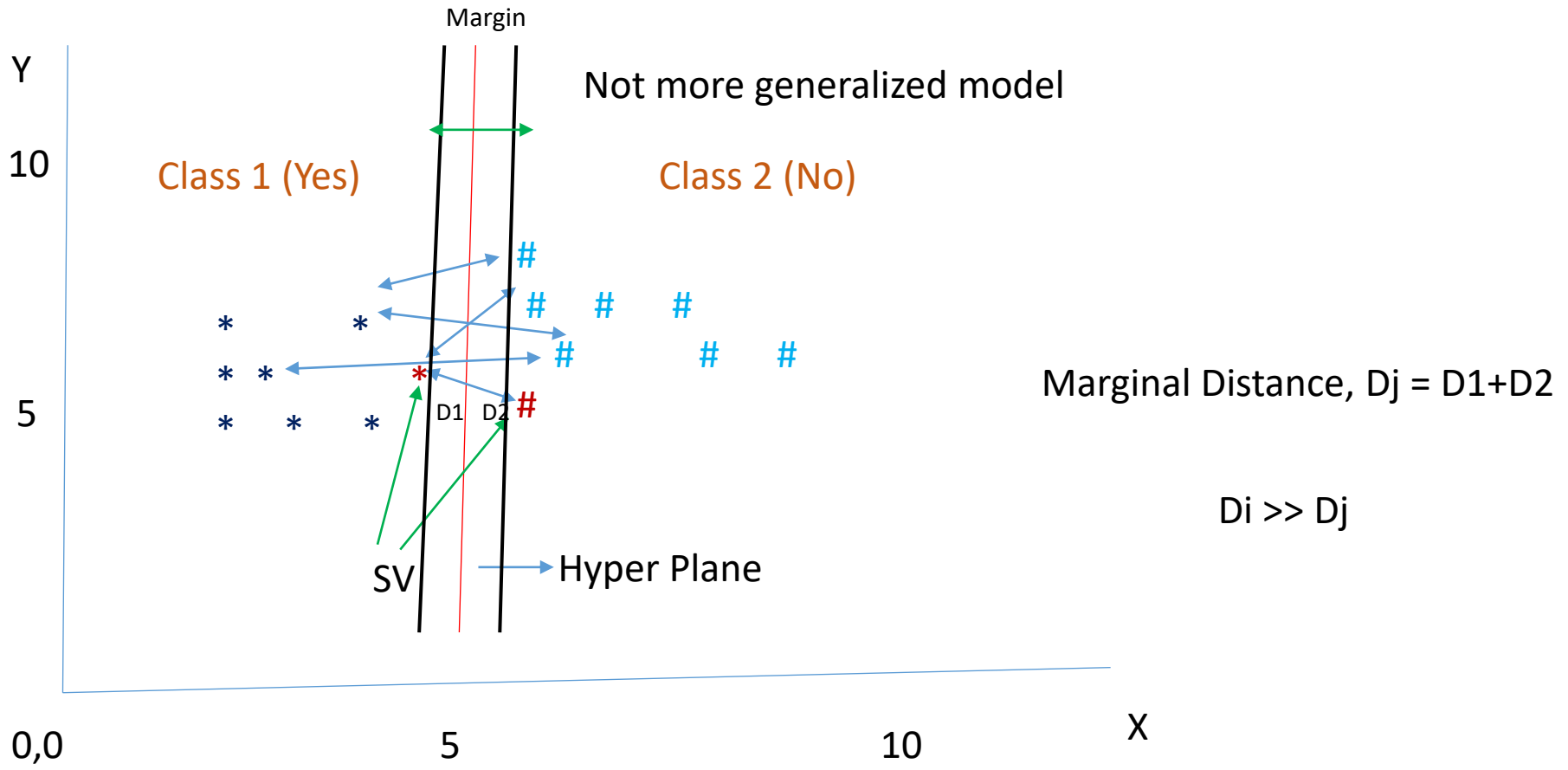


Support Vector Machine



Marginal Distance, Di = D1+D2

Support Vector Machine



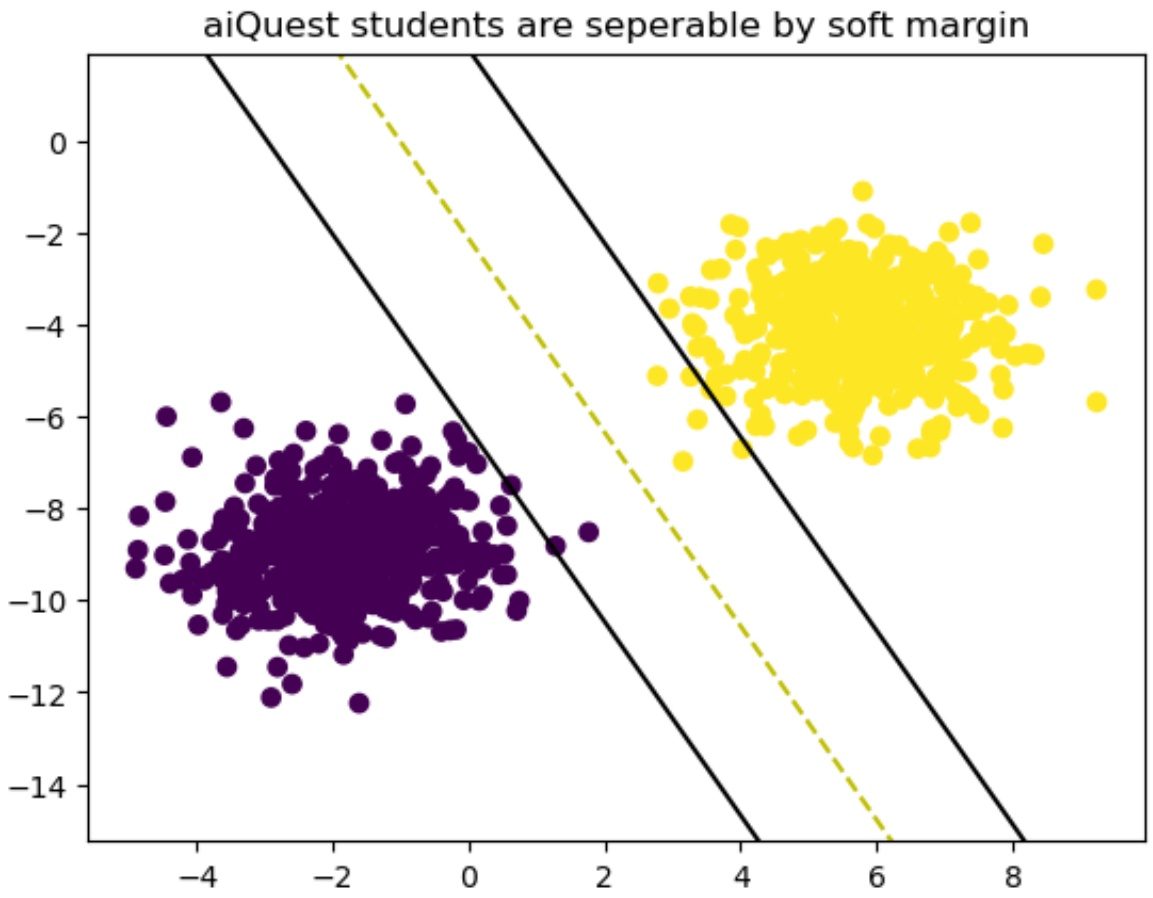
The Role of Margins in SVMs:

Sometimes, the data is linearly separable, but the margin is so small that the model becomes prone to overfitting or being too sensitive to outliers. Also, in this case, we can opt for a larger margin by using soft margin SVM in order to help the model generalize better.

Hard vs Soft Margin

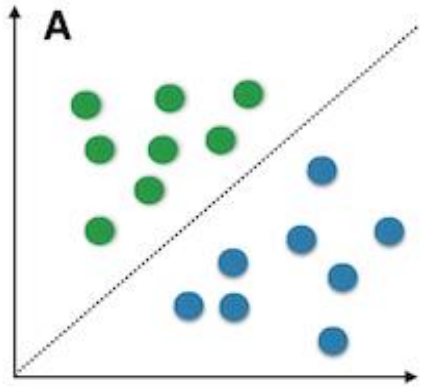
- When the data is linearly separable, and we don't want to have any misclassifications, we use SVM with a hard margin.

- When a linear boundary is not feasible, or we want to allow some misclassifications in the hope of achieving better generality, we can opt for a soft margin for our classifier.

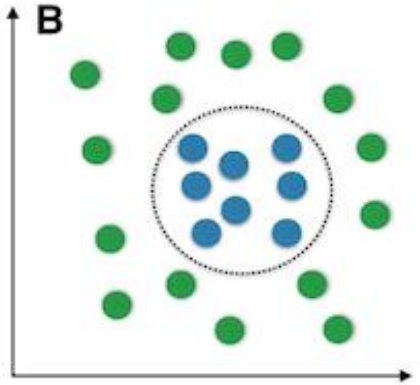


Support Vector Machine

Linearly Separable



Non-Linearly Separable

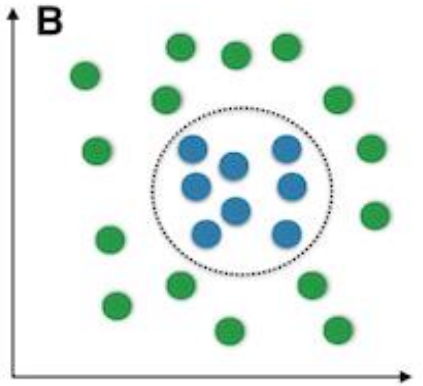


Support Vector Machine

SVM Kernels Trick: Non-Linear SVM

Low Dimension to High Dimensions
2D to Higher Dimensions

Non-Linearly Separable



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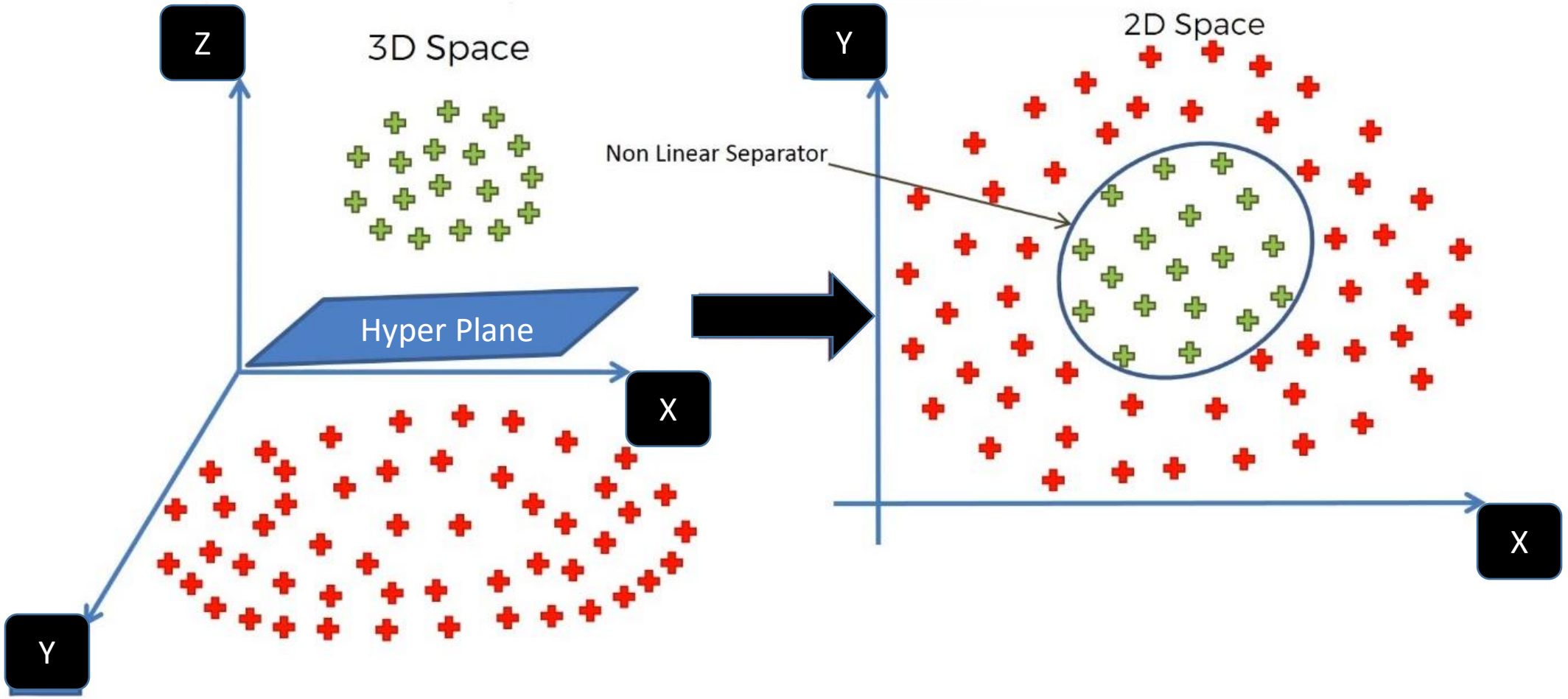

Support Vector Machine

SVM Kernels:

- **‘linear’,**
- **‘poly’,**
- **‘rbf’,**
- **‘sigmoid’,**
- **‘precomputed’**

Default : ‘rbf’