

CHAPTER 22

Support Vector Machines

Support vector machine (SVM) is a machine learning algorithm for learning classification and regression models. To build intuition, we will consider the case of learning a classification model with SVM. Given a dataset with two target classes that are linearly separable, it turns out that there exists an infinite number of lines that can discriminate between the two classes (see Figure 22-1). The goal of the SVM is to find the best line that separates the two classes. In higher dimensions, this line is called a hyperplane.

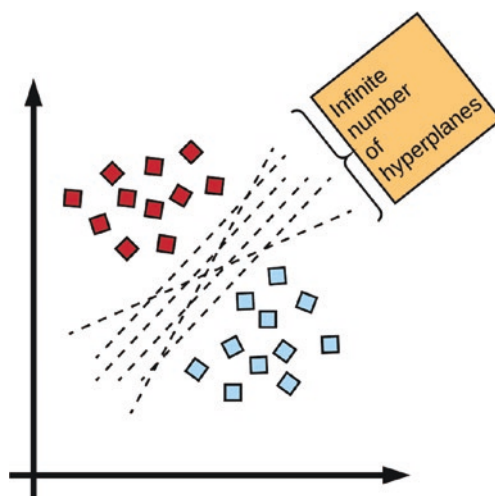


Figure 22-1. *Infinite set of discriminants*

What Is a Hyperplane?

A hyperplane is a line or more technically called a discriminant that separates two classes in n -dimensional space. When a hyperplane is drawn in 2-D space, it is called a line. In 3-D space, it is called a plane, and in dimensions greater than 3, the discriminant is called a hyperplane (see Figure 22-2). For any n -dimensional world, we have $n-1$ hyperplanes.

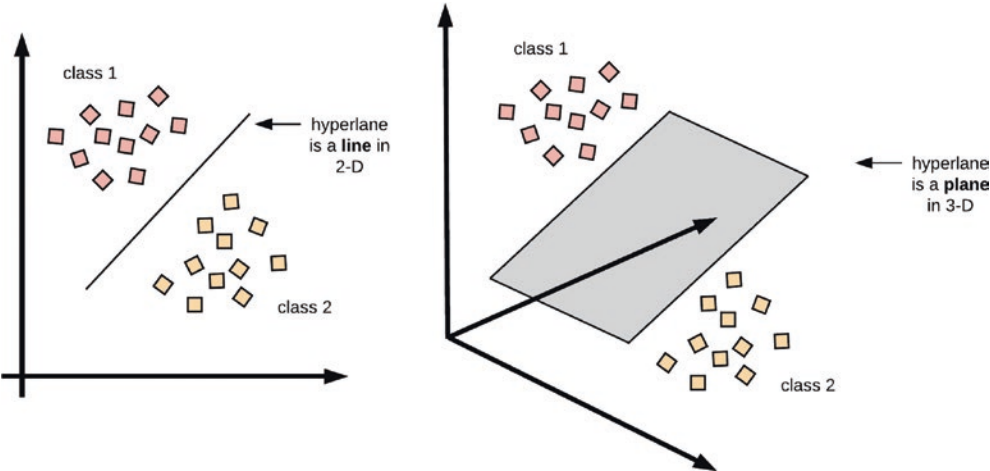


Figure 22-2. Left: A hyperplane in 2-D is a line. Right: A hyperplane in 3-D is a plane. For dimension greater than 3, visualization becomes difficult.

Finding the Optimal Hyperplane

The best hyperplane that linearly separates two classes is identified as the line lying at the largest margin from the nearest vectors at the boundary of the two classes.

In Figure 22-3, we observe that the best hyperplane is the line at the exact center of the two classes and constitutes the largest margin between both classes. Hence, this optimal hyperplane is also known as the largest margin classifier.

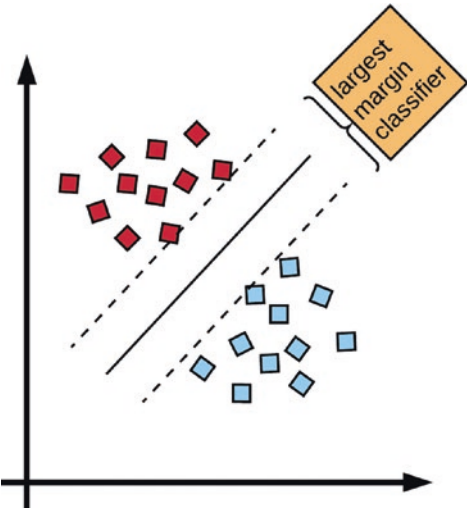


Figure 22-3. The largest margin classifier