Linear Machines and SVM – Part 2: The Concept of Margins

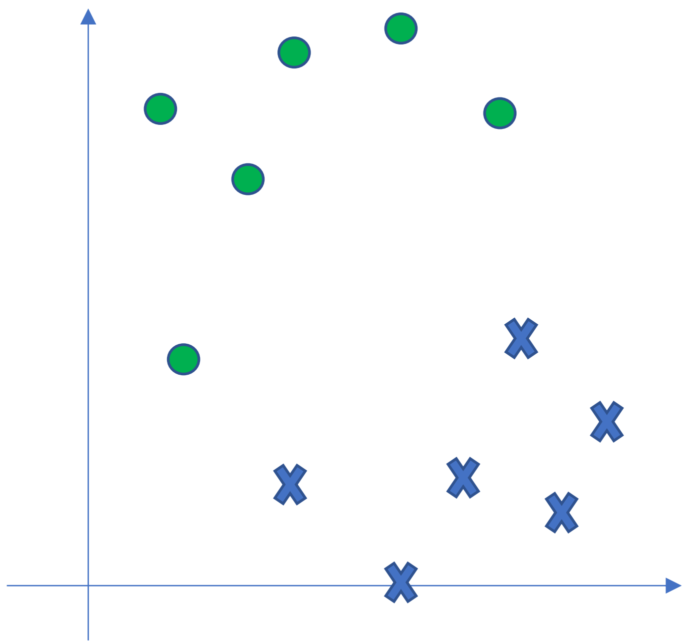
Ira A. Fulton Schools of Engineering
Arizona State University

Objective

Objective

Illustrate Margins in Classifier

Illustrating Linear Boundaries

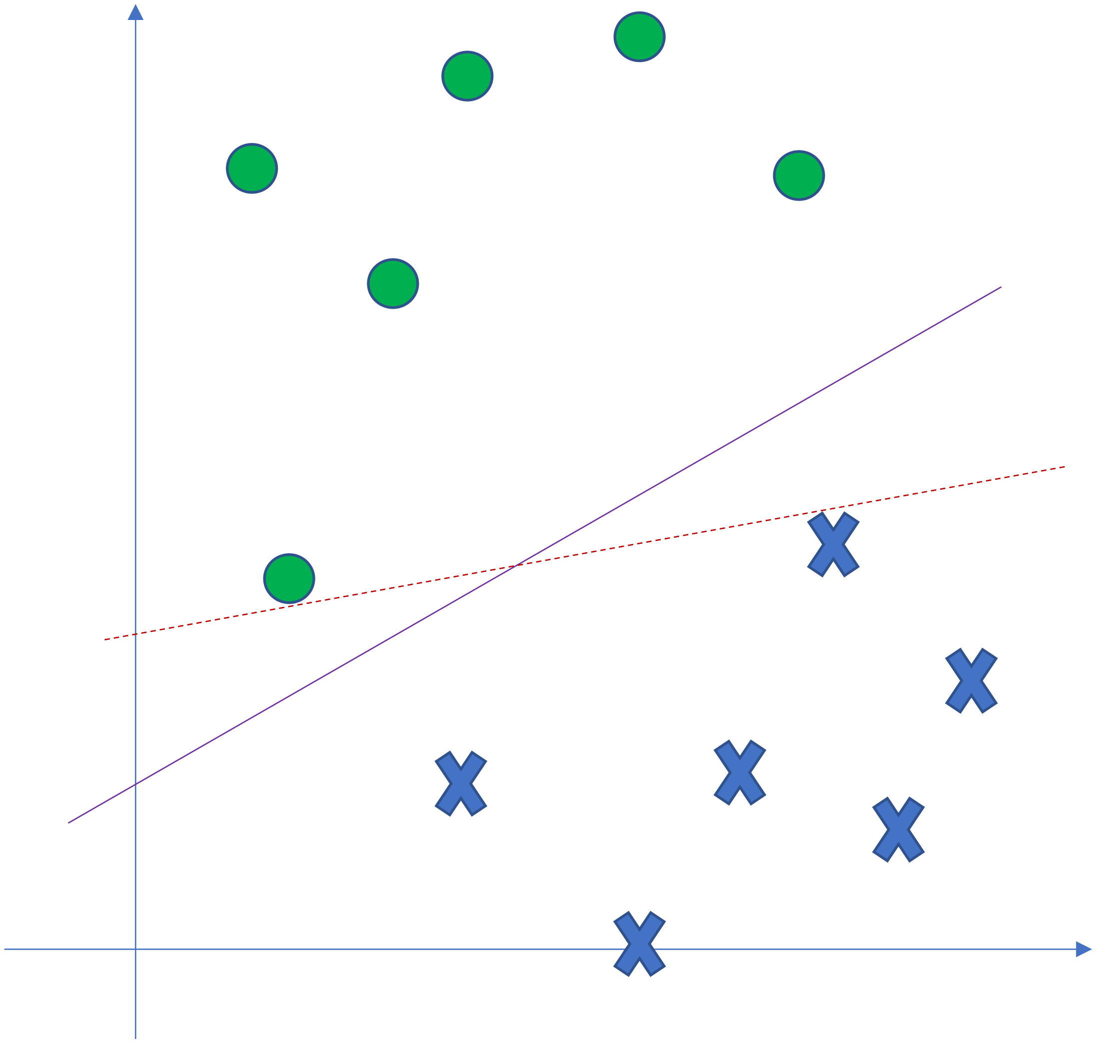


- The decision boundaries is given by the line $g(\mathbf{x}) = 0$.
  - For appreciating a geometric interpretation, we will write w_0 explicitly, i.e., we have

$$g(\mathbf{x}) = \mathbf{w}^t\mathbf{x} + w_0$$

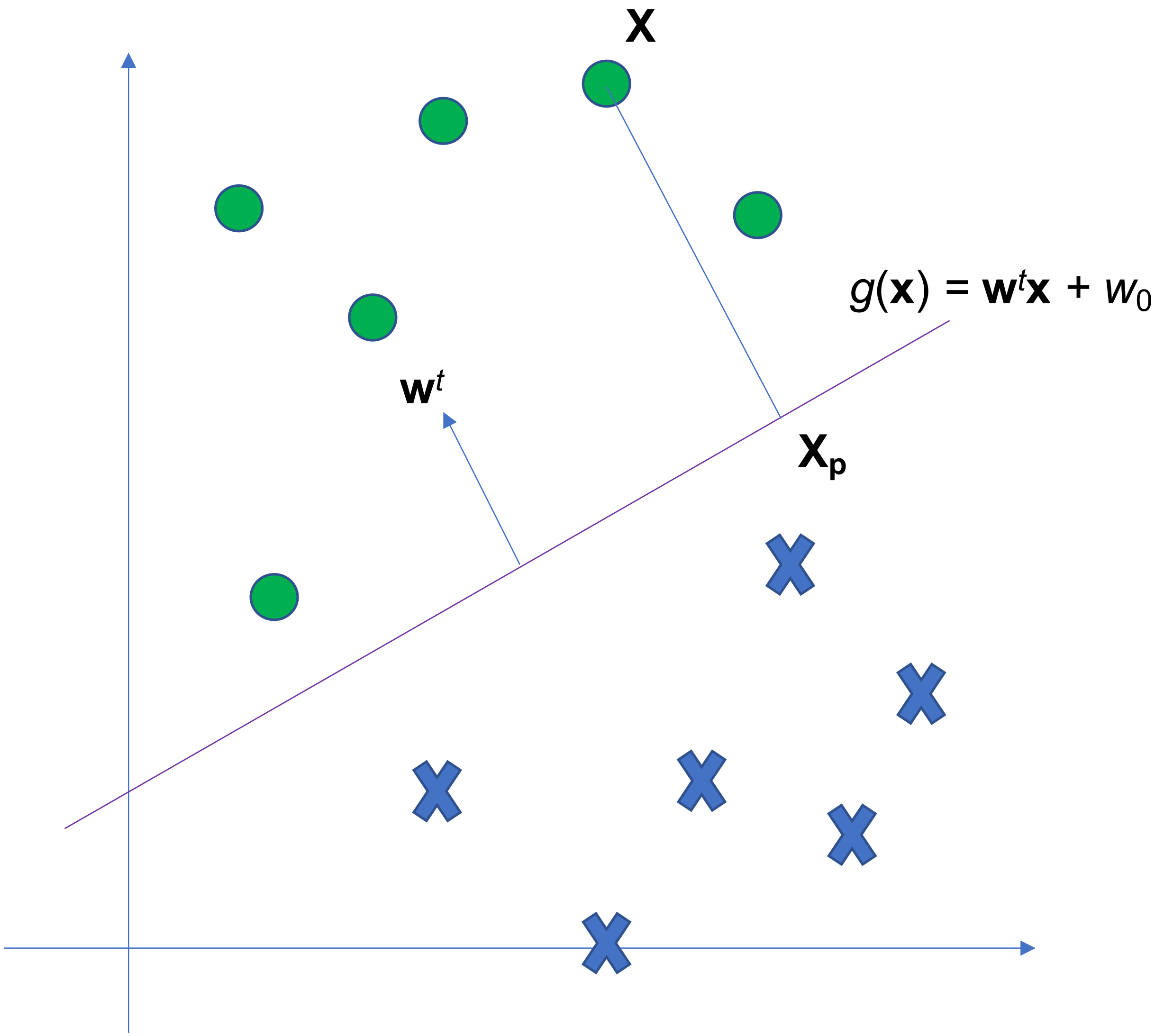
- The normal vector of the decision line/plane is ____

Which one is better?

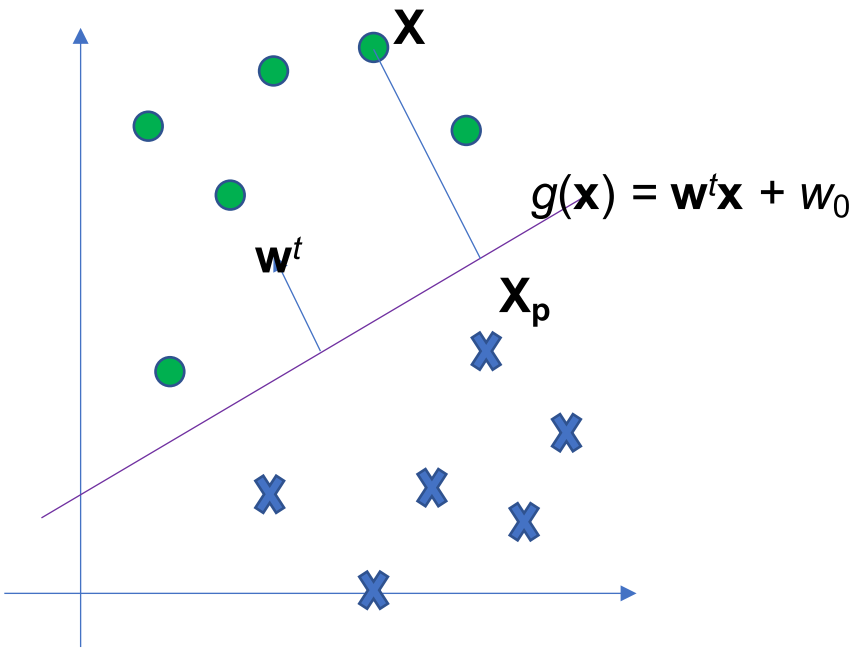


➔ Consider the distances of the samples to the decision plane.

Distance to the Decision Plane



Distance to the Decision Plane



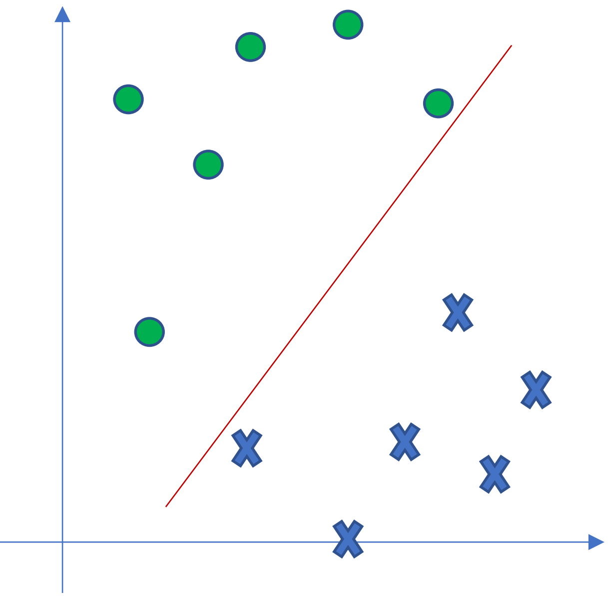
$g(\mathbf{x})$ gives an algebraic measure of the distance from x to the decision plane.

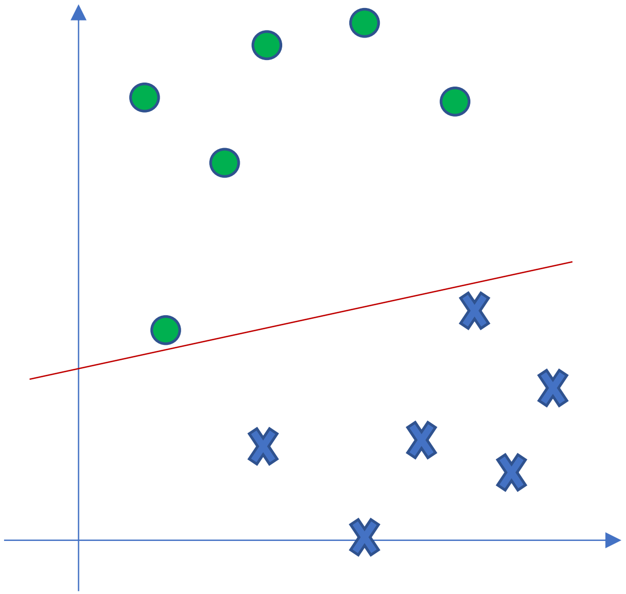
The Concept of Margins

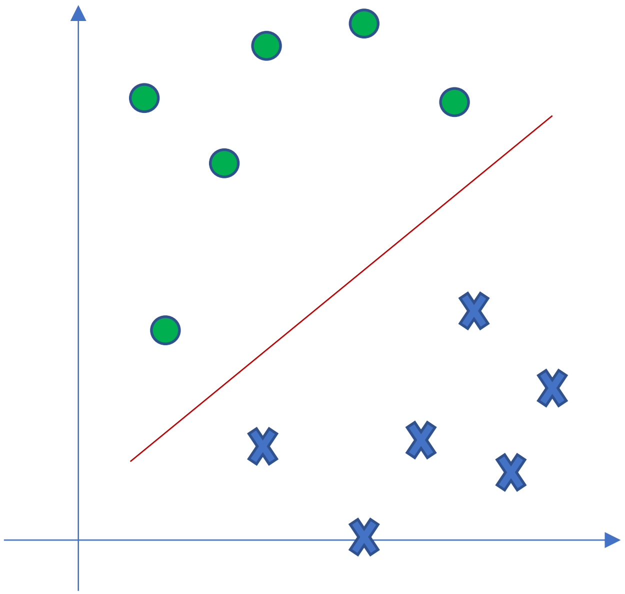
- Let $g(\mathbf{x}) = 0$ be a decision plane
  - The **margin** of a sample **x** (w.r.t. the decision plane) is the distance from **x** to the plane.
  - For a given set of samples *S*, the margin (w.r.t a decision plane) is the smallest margin over all **x** in *S*.

- For a given set, a classifier that gives rise to a larger margin will be better.

Use Margins to Compare Solutions







- Max margin
- SVM