Maximal Margin Classifier: The Math

The maximal margin classifier solves a constrained optimization problem:

$$\max_{\beta_0,\beta_1,\ldots,\beta_p} \; M$$

subject to:

$$||\beta|| = 1$$

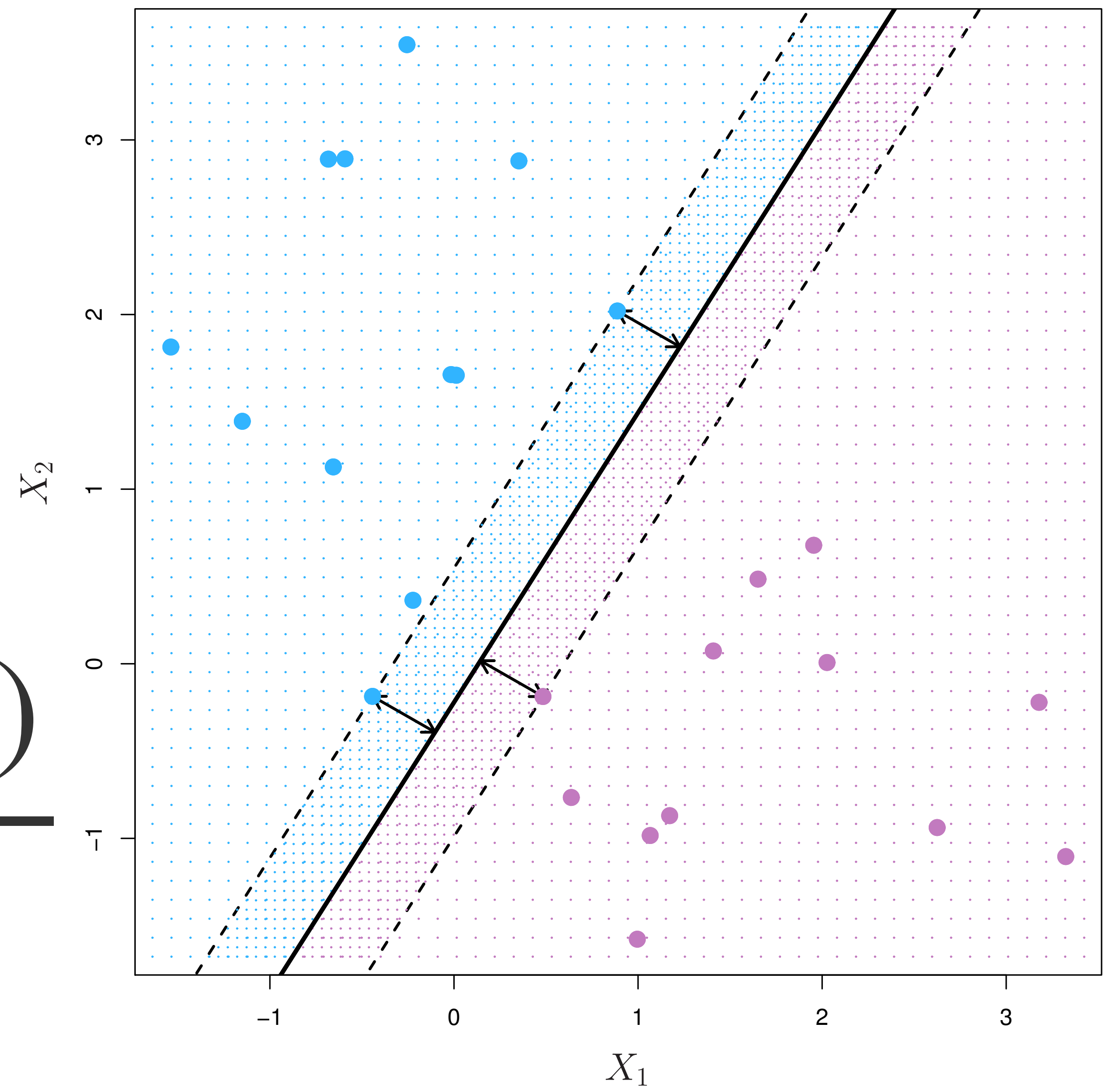
$$y_i(\beta_0 + \beta^T x_i) \geq M, \quad \forall i = 1,\ldots,n$$

ensured each observation is on the correct side of the hyperplane and at least a distance M from the hyperplane, i.e., M is the margin of the hyperplane

distance between x_i and line where

$||\beta|| = \sqrt{\sum_{j=1}^{p} \beta_j^2}$ is the Euclidean norm of β

$$\left\{ \frac{y_i(\beta_0 + \beta^T x_i)}{||\beta||} \right.$$



Maximal Margin Classifier: The Math

The maximal margin classifier solves a constrained optimization problem:

$$\underbrace{\arg\max_{\beta_0,\beta}\left\{\frac{1}{\|\beta\|}\min_i\left[y_i(\beta_0+\beta^T x_i)\right]\right\}}$$

easier to minimize

$$\arg\min_{\beta_0,\beta}\frac{1}{2}\|\beta\|^2$$

maximize the minimum distance between hyperplane and point

subject to: $y_i(\beta_0+\beta^T x_i)\geq 1,\quad \forall i=1,\ldots,n$

distance between x_i and line where $\left\{\dfrac{y_i(\beta_0+\beta^T x_i)}{\|\beta\|}\right.$

$\|\beta\|=\sqrt{\sum_{j=1}^{p}\beta_j^2}$ is the Euclidean norm of β