

Maximal Margin Classifier: The Math



The maximal margin classifier solves a constrained optimization problem:

$$\max_{\beta_0, \beta_1, \dots, \beta_p} M$$

subject to:

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

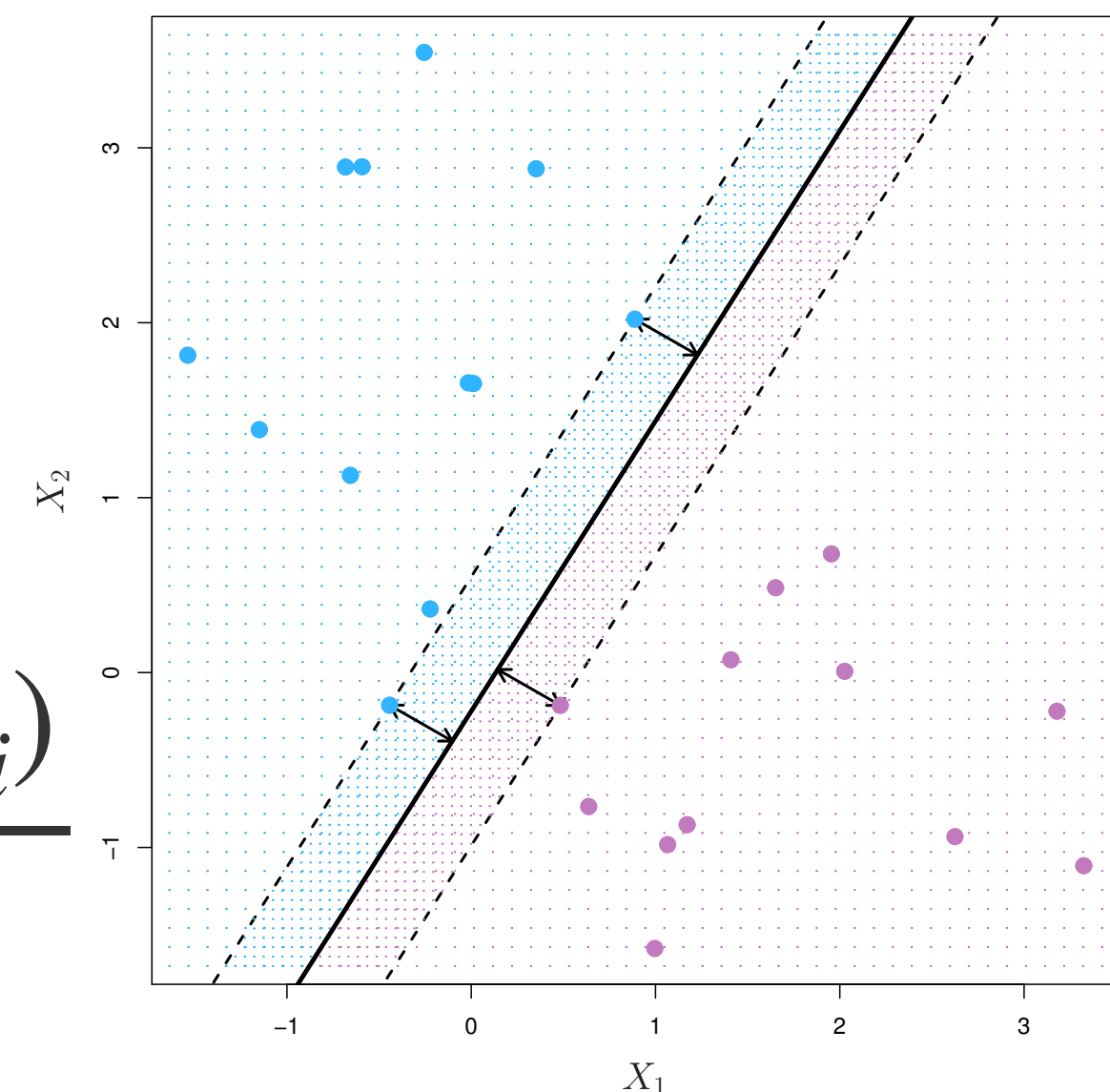
$$y_i(\beta_0 + \beta^T x_i) \geq M, \quad \forall i = 1, \dots, n$$

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

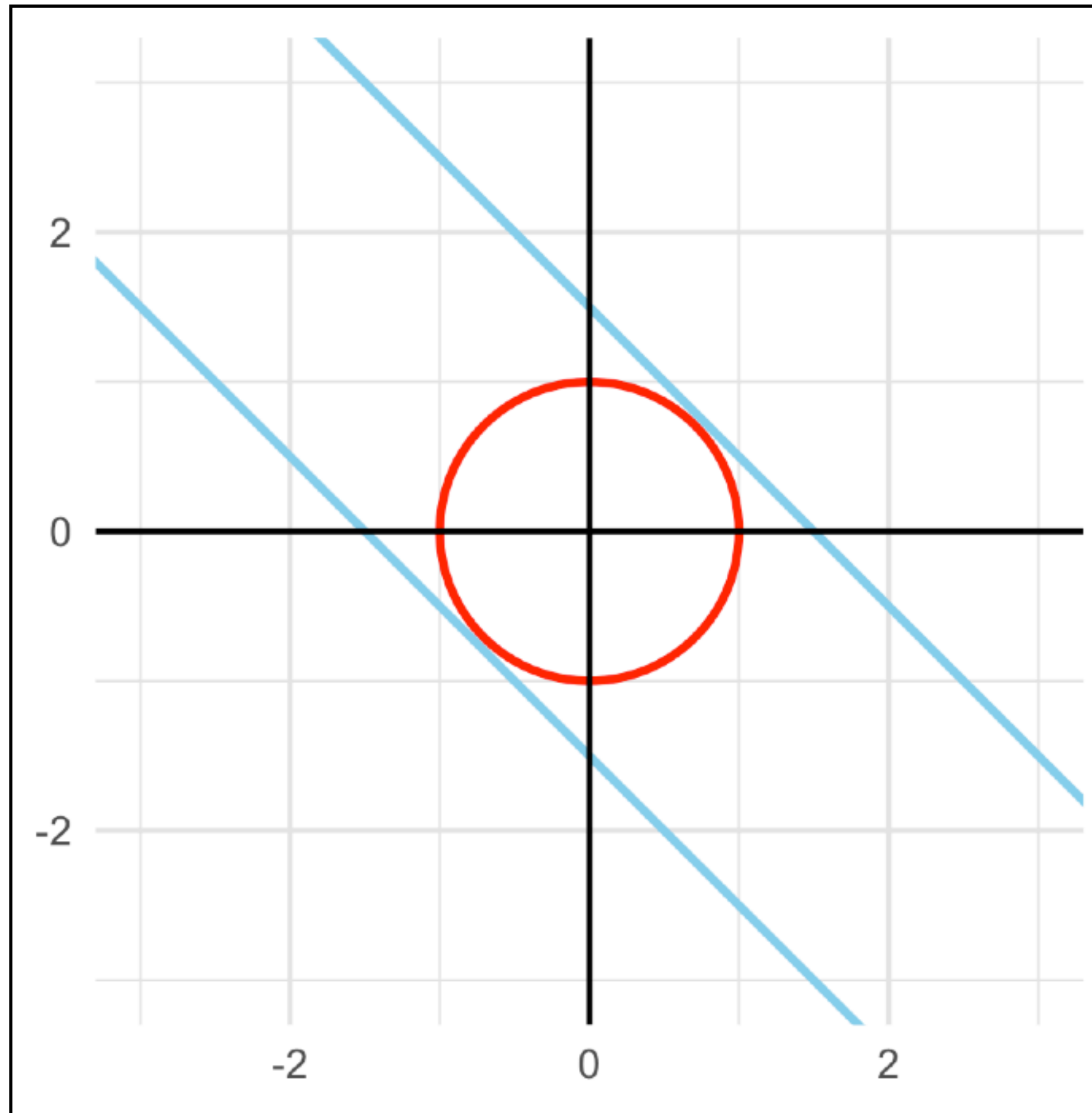
$$\|\beta\| = \sqrt{\sum_{j=1}^p \beta_j^2} \text{ is the Euclidean norm of } \beta$$

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



What is a Constrained Optimization Problem?

Optimize $f(x, y)$ subject to $g(x, y) = k$



$$f(x, y) = 2x + y$$

$$g(x, y) = x^2 + y^2 = 1$$