

# Support Vector Classifier

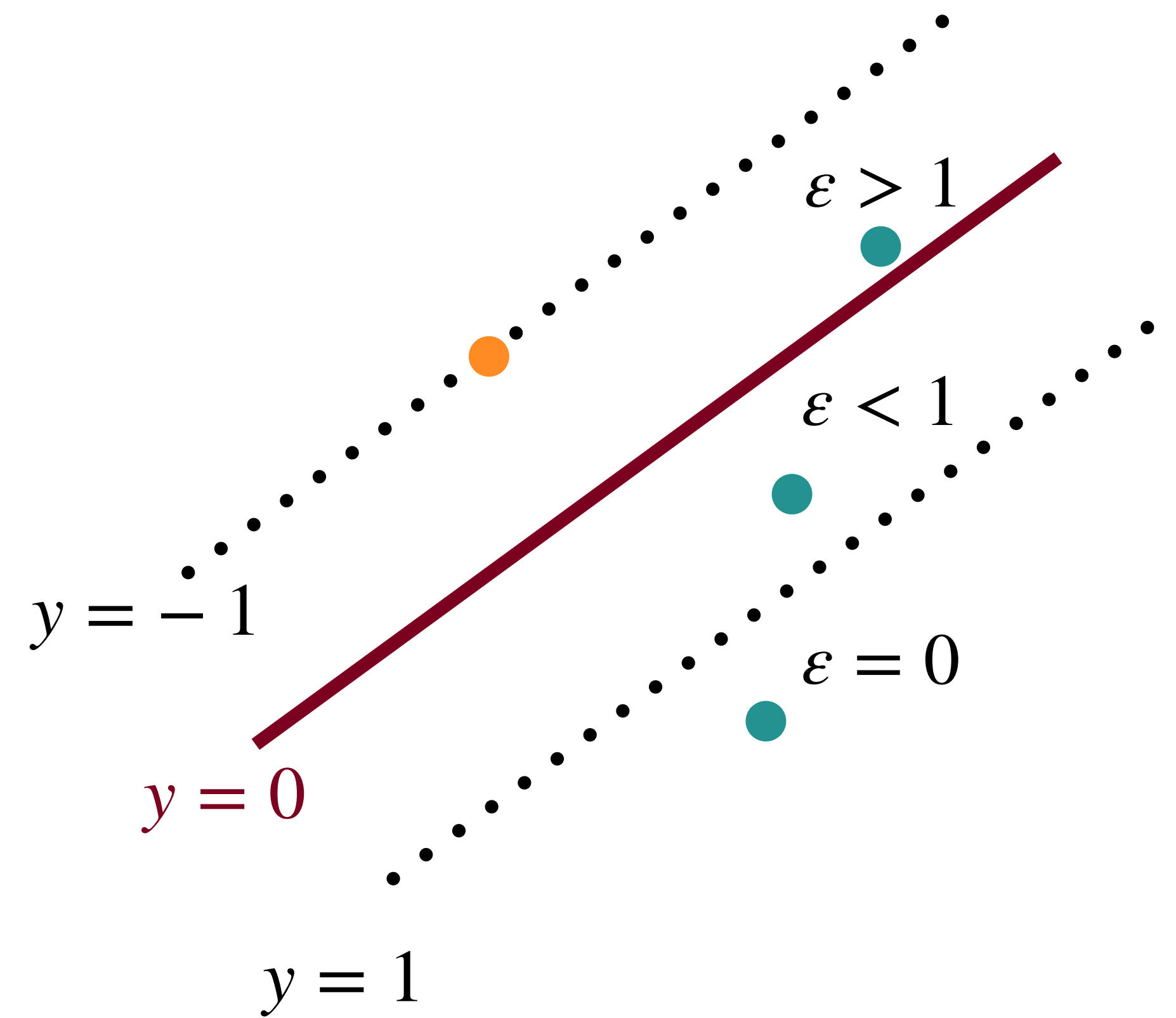
$$\max_{\beta_0, \beta_1, \dots, \beta_p, \varepsilon_1, \varepsilon_2, \dots, \varepsilon_n} M$$

subject to:

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

$$y_i(\beta_0 + \beta^T x_i) \geq M(1 - \varepsilon_i)$$

$$\varepsilon_i \geq 0, \sum_{i=1}^n \varepsilon_i \leq C$$



$\varepsilon_1, \dots, \varepsilon_n$  are **slack variables** where  $\varepsilon_i = 0$  means  $i^{\text{th}}$  observation is on correct side of margin  
 $< 1$  means  $i^{\text{th}}$  observation is on wrong side of margin  
 $> 1$  means  $i^{\text{th}}$  observation is on wrong side of hyperplane

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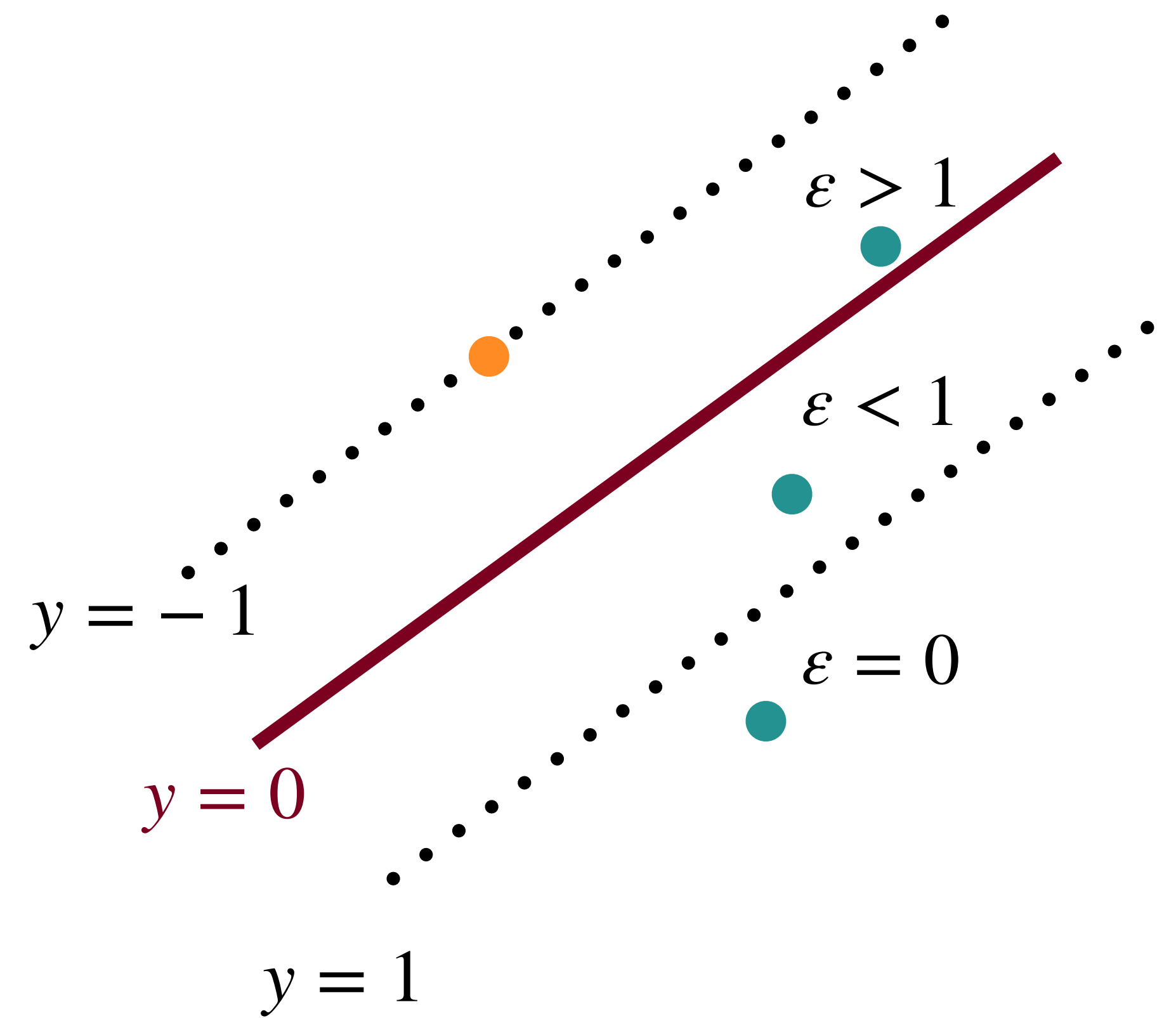
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$C$  is the tuning parameter/penalty on error:

$C = 0$  implies maximal margin hyperplane (superposed it exists)

$C > 0$  is the total violations to the margin that we can tolerate

$\implies$  max  $C$  observations can be on the wrong side of hyperplane