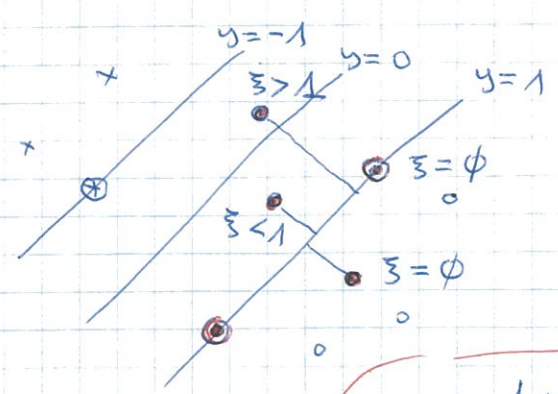


# OVERLAPPING CLASSES

PENALTY FOR BEING ON WRONG SIDE OF THE DECISION BOUNDARY

→ SLACK VARIABLES



$\xi_n \geq \phi$   
 $(= \phi \text{ IF OUTSIDE MARGIN})$   
 $(> 1 \text{ MISCLASSIFIED})$

$$t_n y(x_n) \geq 1 - \xi_n \quad n=1 \dots N$$

$$\xi_n \geq \phi$$

$$\text{MIN: } \frac{1}{2} \|\underline{w}\|^2 + C \sum_{n=1}^N \xi_n$$

$C > \phi$  TRADEOFF: PENALTY ↔ MARGIN  
 (LIKE REGULARIZATION)

$$L(\underline{w}, b, \underline{\xi}) = \frac{1}{2} \|\underline{w}\|^2 + C \sum_{n=1}^N \xi_n - \sum_{n=1}^N a_n \{ t_n y(x_n) - 1 + \xi_n \} - \sum_{n=1}^N \mu_n \xi_n$$

LAGRANGE MULTIPLIERS  $a_n \geq \phi$   
 $\mu_n \geq \phi$

KKT CONDITIONS:

$$a_n \geq \phi$$

$$t_n y(x_n) - 1 + \xi_n \geq \phi \quad n=1 \dots N$$

$$a_n (t_n y(x_n) - 1 + \xi_n) = \phi$$

$$\mu_n \geq \phi$$

$$\xi_n \geq \phi$$

$$\mu_n \xi_n = \phi$$

$$\frac{\partial L}{\partial \underline{w}} = 0$$

$$\frac{\partial L}{\partial b} = 0$$

$$\frac{\partial L}{\partial \xi_n} = 0$$

$$\underline{w} = \sum_{n=1}^N a_n t_n \phi(x_n)$$

$$\sum_{n=1}^N a_n t_n = \phi$$

$$a_n = C - \mu_n$$

$$\tilde{L}(\underline{a}) = \sum_{n=1}^N a_n - \frac{1}{2} \sum_{n=1}^N \sum_{m=1}^N a_n a_m t_n t_m k(x_n, x_m)$$

$$0 \leq a_n \leq C$$

$$\sum_{n=1}^N a_n t_n = \phi$$

$0 < a_n < C$   $\xi_n = \phi$  ON MARGIN  
 $a_n = C$  INSIDE MARGIN  
 $\xi_n \leq 1$  CORRECT  
 $> 1$  MISCLASSIFIED