$$L_p = \frac{1}{2}\|w\|^2 + \frac{C}{2}\sum_i \left(\xi_i^2 + \hat{\xi}_i^2\right) + \sum_i \alpha_i\left(w^T\phi_i + b - y_i - \varepsilon - \xi_i\right) + \sum_i \hat{\alpha}_i\left(y_i - w^T\phi_i - b - \varepsilon - \hat{\xi}_i\right)$$

with wdr $w, b, \xi_i, \hat{\xi}_i$, we want only α and $\hat{\alpha}$ → DUAL!

how? we have to min L_p, so all deriv → 0

$$\frac{dL_p}{dw} = w + \sum_i \alpha_i\phi_i + \sum_i \hat{\alpha}_i(-\phi_i) = 0 \qquad \boxed{w = -\sum_i \alpha_i\phi_i - \hat{\alpha}_i\phi_i = \sum_i(\hat{\alpha}_i - \alpha_i)\phi_i}$$

$$\frac{dL_p}{db} = \sum_i \alpha_i(1) + \sum_i \hat{\alpha}_i(-1) = 0 \qquad \boxed{\sum_i(\alpha_i - \hat{\alpha}_i) = 0}$$

sul singolo ξ_i!

$$\frac{dL_p}{d\xi_i} = C\cancel{\sum}\xi_i + \cancel{\sum}\alpha_i(-1) = 0 \qquad \boxed{\xi_i = \alpha_i / C}$$

$$\frac{dL_p}{d\hat{\xi}_i} = \text{ANALOGOUS} \qquad \boxed{\hat{\xi}_i = \hat{\alpha}_i / C}$$

substitute everything back in

kernel!

$$L_p = \frac{1}{2}\sum_i\sum_j(\hat{\alpha}_i - \alpha_i)(\hat{\alpha}_j - \alpha_j)\phi_i\phi_j + \frac{C}{2}\sum_i\left(\frac{\alpha_i^2 + \hat{\alpha}_i^2}{C^2}\right) +$$

$$\sum_i \alpha_i\left(\sum_j(\hat{\alpha}_j - \alpha_j)\phi_j\phi_i + b - y_i - \varepsilon - \alpha_i/C\right) +$$

$$\sum_i \hat{\alpha}_i\left(y_i - \sum_j(\hat{\alpha}_j - \alpha_j)\phi_j\phi_i - b - \varepsilon - \hat{\alpha}_i/C\right)$$

$$L_p = \quad '' \quad + \frac{1}{2C}\sum_i(\alpha_i^2 + \hat{\alpha}_i^2) + \sum_i \alpha_i(-\alpha_i/C) + \sum_i \hat{\alpha}_i\left(-\frac{\hat{\alpha}_i}{C}\right) +$$

$$\sum_i(\alpha_i + \hat{\alpha}_i)(-\varepsilon) + \sum_i(\alpha_i - \hat{\alpha}_i)\left(\sum_j(\hat{\alpha}_j - \alpha_j)\phi_j\phi_i + b - y_i\right)$$

$$L_p = -1/2\sum_i\sum_j(\hat{\alpha}_i - \alpha_i)(\hat{\alpha}_j - \alpha_j)\phi_i\phi_j + \frac{1}{\cancel{2}C}\sum_i(\alpha_i^2 + \hat{\alpha}_i^2) - \frac{1}{C}\sum_i(\alpha_i^2 + \hat{\alpha}_i^2)$$

$$-\varepsilon\sum_i(\alpha_i + \hat{\alpha}_i) + \sum_i(\alpha_i - \hat{\alpha}_i)(b - y_i) \rightarrow \cancel{\sum_i \underbrace{(\alpha_i - \hat{\alpha}_i)}_{=0}\underbrace{b}_{\text{CONSTANT}}} - \sum_i(\alpha_i - \hat{\alpha}_i)\underbrace{y_i}_{\text{VECTOR}}$$

$$L_p = -1/2\sum_i\sum_j(\hat{\alpha}_i - \alpha_i)(\hat{\alpha}_j - \alpha_j)\phi_i\phi_j + \frac{1}{C}\sum_i(\alpha_i^2 + \hat{\alpha}_i^2) - \varepsilon\sum_i(\alpha_i + \hat{\alpha}_i) + \sum_i y_i(\hat{\alpha}_i - \alpha_i)$$

if $\beta_i = \hat{\alpha}_i - \alpha_i$ and $|\beta_i| = \hat{\alpha}_i + \alpha_i$

STO STRONZO!

$$L_p = -1/2\sum_i\sum_j\beta_i\beta_j\phi_i\phi_j + \boxed{\frac{1}{C}\sum_i(\hat{\alpha}_i^2 + \alpha_i^2)} - \varepsilon\sum_i|\beta_i| + \sum_i y_i\beta_i$$