$$\min \frac{1}{2} \bar{w}^T \bar{w}$$

αυτά δε γνωρίζω

$$\boxed{L(\bar{w}, b, \bar{a}) = \frac{1}{2} \bar{w}^T \bar{w} - \sum a_k \left\{ y_k (\bar{w}^T x_k + 1) - 1 \right\}}$$

$$\text{s.t. } \underbrace{y_k}_{\text{τα γνωρίζω}} (w^T x_k + b) - 1 \geq 0, \quad \forall k$$

$\boxed{\text{KKT conditions}}$

$$- \sum_k a_k y_k \bar{w}^T \bar{x}_k - \cancelto{0}{\sum_k a_k y_k b} + \sum_i a_k$$

$$\frac{\partial L}{\partial \bar{w}} = \bar{w} - \sum_{k=1}^{M} a_k y_k \bar{x}_k = 0 \Rightarrow \boxed{\underline{w} = \sum^{M} a_k y_k \bar{x}_k}$$

λυσεις γραμμικούς συνδυασμούς

$$\frac{\partial L}{\partial b} = - \sum_{k=1}^{M} a_k y_k = 0$$

$$\frac{\partial L}{\partial a_k} = - \sum_{k=1}^{0} \left\{ y_k (w^T x_k + b) - 1 \right\} = 0$$

Τώρα πάμε στο <u>Dual</u> <u>πρόβλημα</u>

$$W(a) = \frac{1}{2} \left(\sum_{k=1}^{M} a_k y_k \bar{x}_k \right)^T \left(\sum_{j=1}^{M} a_j y_j x_j \right) - \sum_k a_k y_k \left(\sum_j a_j y_j \bar{x}_j \right)^T \bar{x}_k + \sum_{k=1}^{M} a_k$$

$$= \frac{1}{2} \sum_k \sum_j a_k y_k y_j \bar{x}_k^T \bar{x}_j - \sum_k \sum_j a_k a_j y_k y_j \bar{x}_j^T x_k + \sum_{k=1}^{M} a_k$$

$$= -\frac{1}{2} \sum_k \sum_j a_k a_j y_k y_j \bar{x}_k^T x_j + \sum_{k=1}^{M} a_k \qquad \boxed{\text{S.A. } a_k \geq 0}$$

$$-\frac{1}{2} \bar{a}^T H \bar{a} + \underbrace{\bar{a}^T \bar{1} \quad [H]_{kj} = y_k y_j \bar{x}_k^T x_j}_{\text{Quadratic Programming Problem}}$$

Keywords: KKT conditions