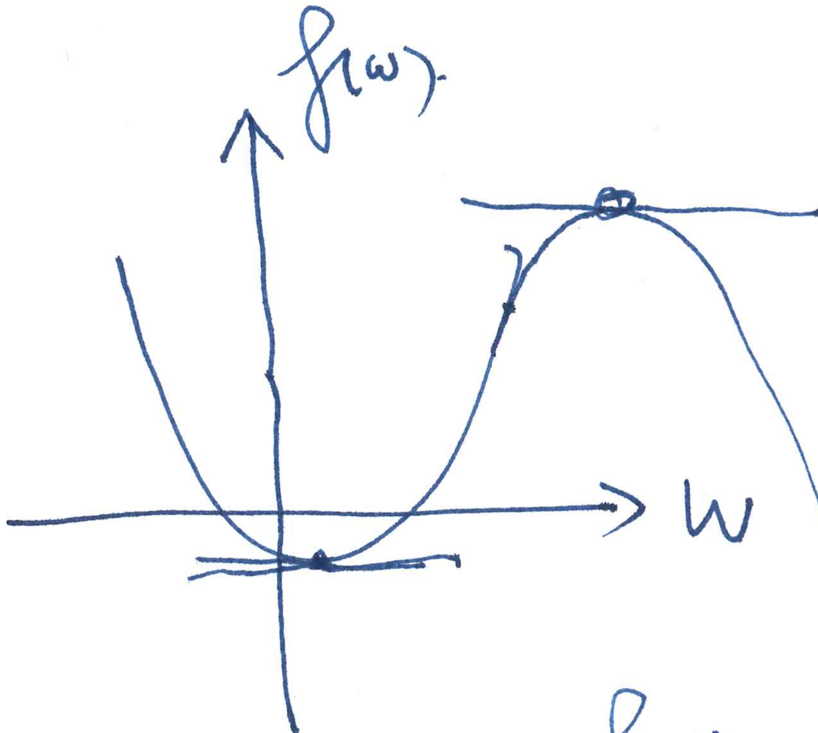
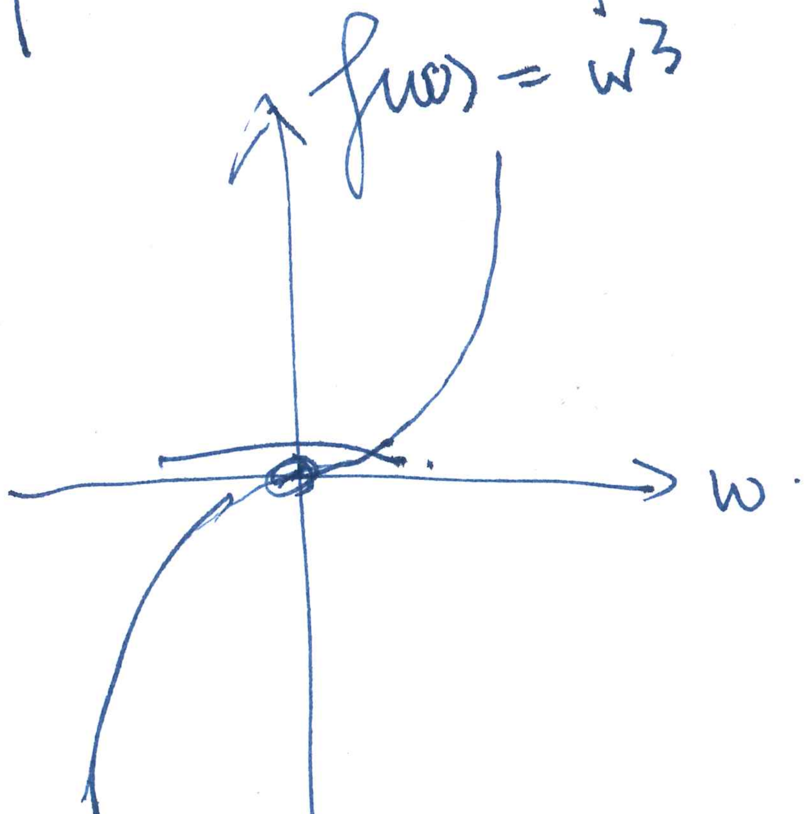

f(w)
w


f(w) = w³
w

$$w = \sum_{i=1}^{n} \alpha_i y_i x_i.$$

Dual problem:

$$D(\alpha) = \frac{1}{2} \| \underline{w} \|_2^2 + \sum_{i=1}^{n} \alpha_i (1 - y_i w^T x_i).$$

$$= \underline{\frac{1}{2} \left(\sum_{i=1}^{n} \alpha_i y_i x_i \right)^T \left(\sum_{i=1}^{n} \alpha_i y_i x_i \right)}$$

$$+ \sum_{i=1}^{n} \alpha_i - \underline{\left(\sum_{i=1}^{n} \alpha_i y_i x_i \right)^T \left(\sum_{i=1}^{n} \alpha_i y_i x_i \right)}$$

$$= \sum_{i=1}^{n} \alpha_i - \frac{1}{2} \left(\sum_{i=1}^{n} \alpha_i y_i x_i \right)^T \left(\sum_{i=1}^{n} \alpha_i y_i x_i \right).$$

$$= \sum_{i=1}^{n} \alpha_i - \frac{1}{2} \sum_{i,j=1}^{n} \alpha_i \alpha_j \boxed{y_i y_j \, x_i^T x_j}.$$

$$\alpha = \begin{pmatrix} \alpha_1 \\ \vdots \\ \alpha_n \end{pmatrix} \in \mathbb{R}^n. \quad 1_n = \begin{pmatrix} 1 \\ \vdots \\ 1 \end{pmatrix} \in \mathbb{R}^n.$$

$$K_{ij} = y_i y_j \cdot x_i^T x_j.$$

$$= \underline{\alpha^T 1_n} - \underline{\frac{1}{2}\alpha^T K \alpha}, \quad K \in \mathbb{R}^{n \times n}$$

$$\left(\sum_{i,j=1}^{n} \alpha_i \alpha_j k_{ij} = \alpha^T K \alpha \right)$$

$$k_{ij} = (y_i x_i)^T (y_j x_j)$$