

$$\mathcal{L}(w_0, w_1) \approx -\nabla_{w\mathcal{L}} = \begin{pmatrix} -\frac{\partial \mathcal{L}}{\partial w_0} \\ -\frac{\partial \mathcal{L}}{\partial w_1} \end{pmatrix} \quad (1)$$

$$\underbrace{\begin{pmatrix} w_0 \\ w_1 \end{pmatrix}}_{\underline{w}} \leftarrow \underline{w} - \alpha \nabla_{w\mathcal{L}}$$

$$w_0 \leftarrow w_0 - \alpha \frac{\partial \mathcal{L}}{\partial w_0}$$


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$$\underbrace{\sum_{k=0}^1 x^k w_k}_{x^0 w_0 + x^1 w_1}$$

$$\underline{w}^T \underline{x} = (w_0 \ w_1) \begin{pmatrix} 1 \\ x \end{pmatrix} = w_0 \cdot 1 + w_1 \cdot x$$

$$\underline{x}_n = \begin{pmatrix} 1 \\ x_n \end{pmatrix}$$


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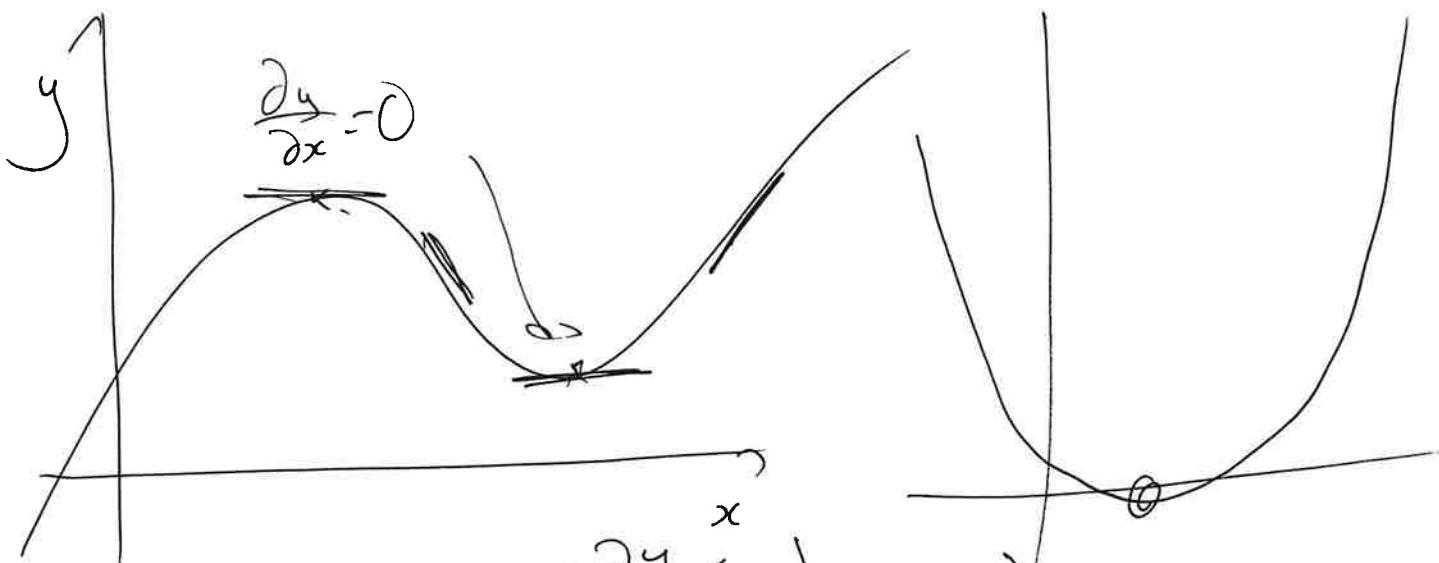
$$\underline{a} = \begin{pmatrix} a_0 \\ a_1 \\ \vdots \end{pmatrix} \Rightarrow \underline{a}^T \underline{a} = (a_0 \ a_1 \ \dots) \begin{pmatrix} a_0 \\ a_1 \\ \vdots \end{pmatrix}$$

$$= (a_0 \times a_0) + a_1 \times a_1 + \dots$$

$$= a_0^2 + a_1^2 \dots$$

$$= \sum_R a_R^2$$

$$\underline{X} \cdot \underline{w} = \underbrace{\begin{pmatrix} 1 & x_1 \\ 1 & x_2 \\ \vdots & \vdots \end{pmatrix}}_{N \downarrow} \cdot \begin{pmatrix} w_0 \\ w_1 \end{pmatrix} = \underbrace{\begin{pmatrix} 1 \cdot w_0 + x_1 w_1 \\ 1 \cdot w_0 + x_2 w_1 \\ \vdots \end{pmatrix}}_{(2)}$$



$$\nabla_{\underline{w}} \frac{\partial \mathcal{L}}{\partial \underline{w}} = \underline{0} \Rightarrow \begin{pmatrix} \frac{\partial \mathcal{L}}{\partial w_0} \\ \frac{\partial \mathcal{L}}{\partial w_1} \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$

$$\nabla_{\underline{w}} \left[ \frac{1}{N} (\underline{t} - \underline{X} \underline{w})^T (\underline{t} - \underline{X} \underline{w}) \right]$$

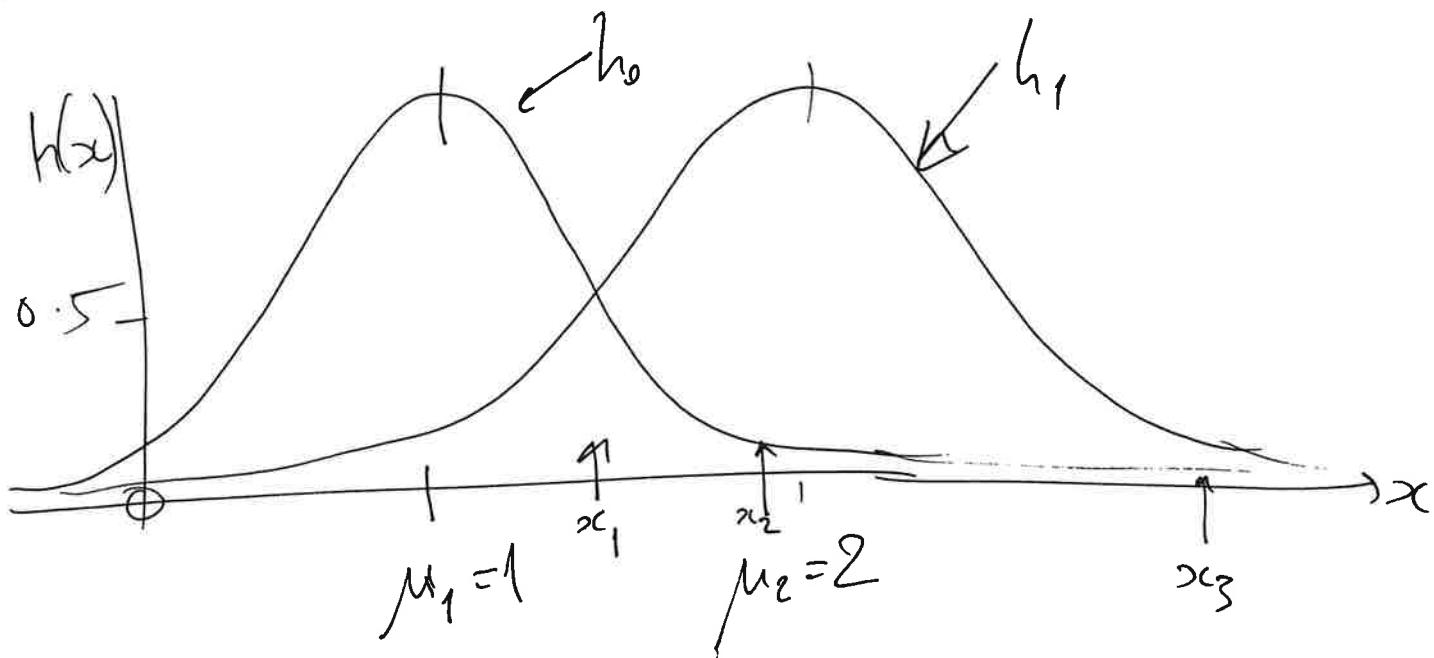
$$= \cancel{\frac{2}{N}} (\cancel{\underline{X}^T \underline{t}} - \cancel{\underline{X}^T \underline{X} \underline{w}}) = \underline{0}$$

$$\Rightarrow \cancel{\underline{X}^T \underline{t}} = \cancel{(\underline{X}^T \underline{X}) \underline{w}}$$

$$\Rightarrow (\cancel{\underline{X}^T \underline{X}})^{-1} \cancel{\underline{X}^T \underline{t}} = (\cancel{\underline{X}^T \underline{X}})^{-1} (\cancel{\underline{X}^T \underline{X}}) \underline{w}$$

$$\underline{\omega} = (\underline{X}^T \underline{X})^{-1} \underline{X}^T \underline{t}$$

(3)



$$\underline{X} = \begin{pmatrix} h_0 \\ 0.5 \\ 0.1 \\ NO \end{pmatrix} \leftarrow x_1$$

$$= \begin{pmatrix} h_1 \\ 0.5 \\ 0.9 \\ 0.1 \end{pmatrix} \leftarrow x_2$$

$$= \begin{pmatrix} h_1 \\ 0.5 \\ 0.9 \\ 0.1 \end{pmatrix} \leftarrow x_3$$