16 Linear Regression

$$\mathcal{L} = (w @ x - y)^2$$

$$= (w_1 x_1 + w_2 x_2 + b - y)^2$$

$$\frac{\partial \mathcal{L}}{\partial w_2} = 2(w_1 x_1 + w_2 x_2 + b - y) \frac{\partial (w_1 x_1 + w_2 x_2 + b - y)}{\partial w_2}$$

$$= 2(w_1 x_1 + w_2 x_2 + b - y) x_2$$

$$= 2 \epsilon x$$

where $\epsilon = w @ x - y$

17 Linear classifier

$$f_k = \frac{\exp(\xi_k)}{\sum_j \exp(\xi_j)}$$

$$\frac{\partial f_5}{\partial \xi_3} = \frac{1}{DEN} \cdot \frac{\partial NUM}{\partial \xi_3} - \frac{NUM}{DEN^2} \cdot \frac{\partial DEN}{\partial \xi_3}$$

$$= \frac{1}{\sum_j \exp(\xi_j)} \cdot \cancel{\frac{\partial \exp(\xi_5)}{\partial \xi_3}}^{\,0} - \frac{\exp(\xi_5)}{\left(\sum_j \exp(\xi_j)\right)^2} \frac{\partial DEN}{\partial \xi_3}$$

$$= 0 - \frac{\exp(\xi_5)}{\left(\sum_j \exp(\xi_j)\right)^2} \frac{\partial \left(\sum_j \exp(\xi_j)\right)}{\partial \xi_3}$$

$$\frac{\partial e^{\xi_3}}{\partial \xi_3} = e^{\xi_3}$$

$$\frac{\partial f_5}{\partial \xi_3} = -\frac{\exp(\xi_5)\exp(\xi_3)}{\left(\sum_j \exp(\xi_j)\right)^2} = -f_5 f_3$$

10 PRIVACY