$\bar{x} \in \mathbb{R}^d \quad y \in \mathbb{R}$

$$L(y, f(\bar{x})) = (y - f(\bar{x}))^2$$

$$\underbrace{EPE[f]}_{\min_f} = \mathbb{E}_{p(\bar{x}, y)}\left[L(y, f(\bar{x}))\right] =$$

$$= \int (y - f(\bar{x}))^2 \, p(\bar{x}, y) \, d\bar{x} \, dy =$$

$$= \iint (y - f(\bar{x}))^2 \, p(y|\bar{x}) \, p(\bar{x}) \, dy \, d\bar{x} =$$

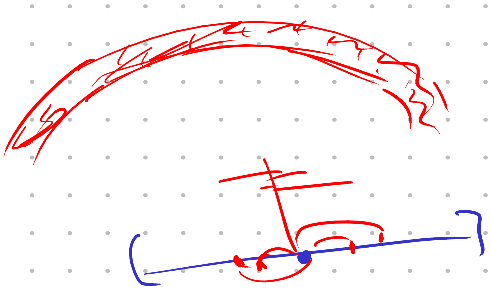
$$= \int p(\bar{x}) \cdot \Big(\underbrace{\int (y - f(\bar{x}))^2 \, p(y|\bar{x}) \, dy}_{\min_{f(\bar{x})}} \Big) \, d\bar{x}$$

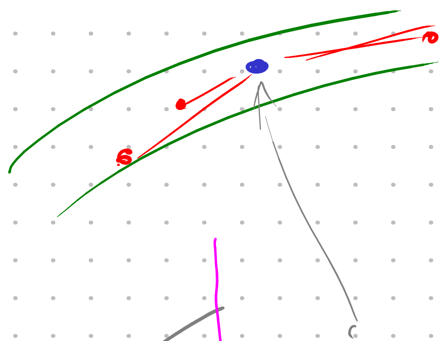
$$\int (y - a)^2 \, p(y) \, dy \xrightarrow[a]{} \min$$

$$a = \mathbb{E}_p[y]$$

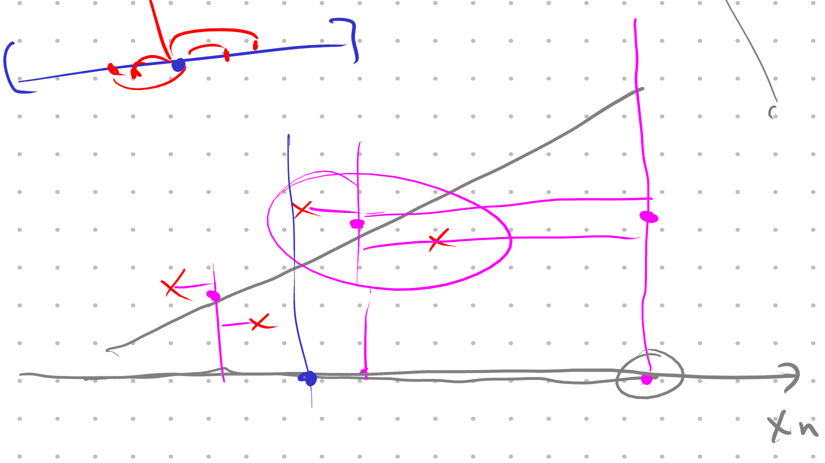
$$\boxed{\hat{f}(\bar{x}) = \mathbb{E}_{p(y|\bar{x})}[y]}$$

regression function



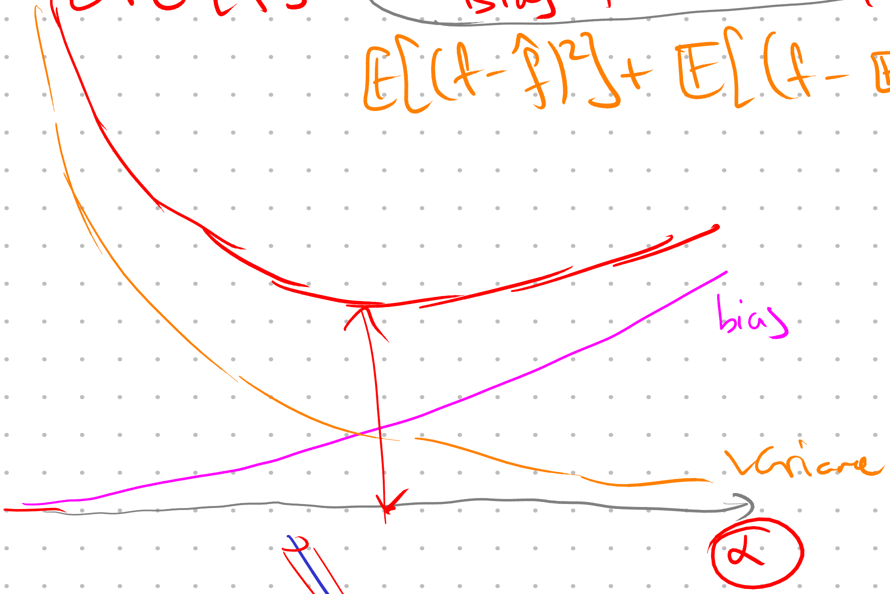


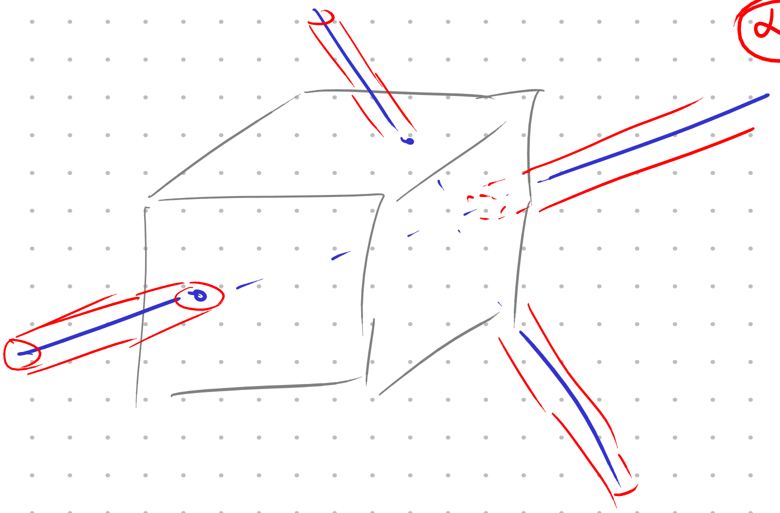
$[x_1, x_2, \ldots, x_n, \ldots, x_N]$

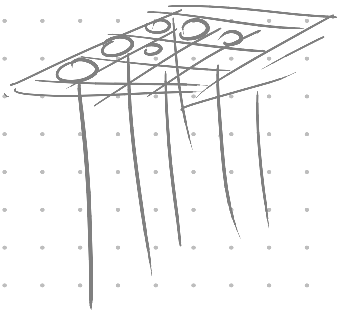


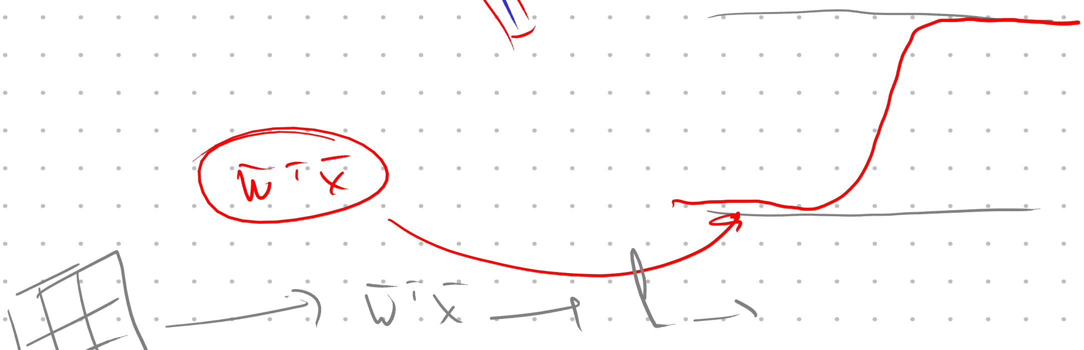
$$EPE[f] = \text{Bias}^2 + \text{Variance} + \text{Noise}$$

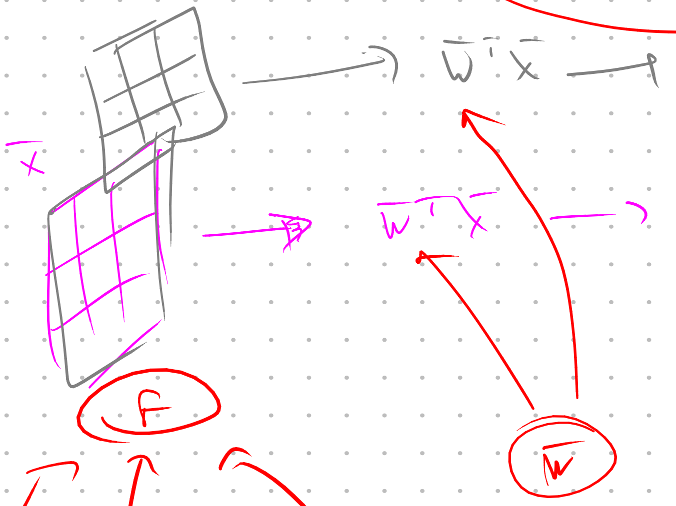
$$E[(f-\hat{f})^2] + E[(f - Ef)^2] + E[(y-\hat{f})^2]$$





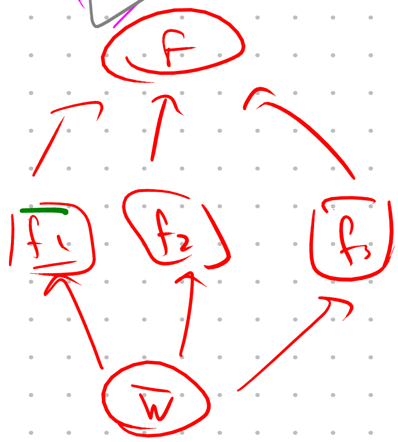






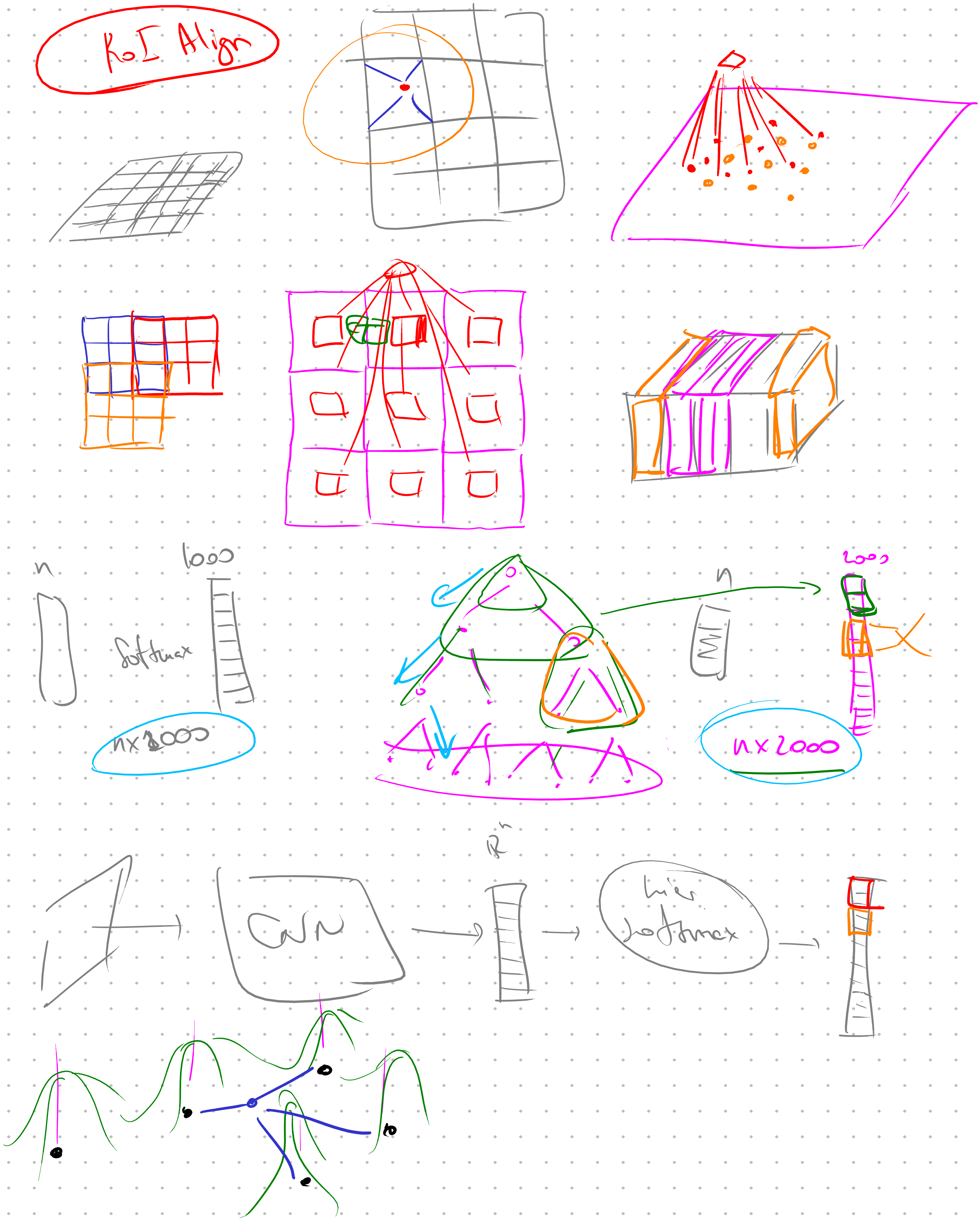
$$h \longrightarrow h(\bar{w}^T\bar{x})$$

$$\nabla_{\bar{w}} = h'(\bar{w}^T\bar{x}) \cdot \bar{x}$$



$$\nabla_{\bar{w}} = \sum h'(\bar{w}^T\bar{x})\,\bar{x}$$

$$\nabla_{\bar{w}} F = \frac{\partial F}{\partial f_1} \nabla_{\bar{w}} f_1 + \frac{\partial F}{\partial f_2} \nabla_{\bar{w}} f_2 + \frac{\partial F}{\partial f_3} \nabla_{\bar{w}} f_3$$


RoI Align
n
1000
softmax
n x 1000
n
2000
n x 2000
CNN
R^n
hier softmax