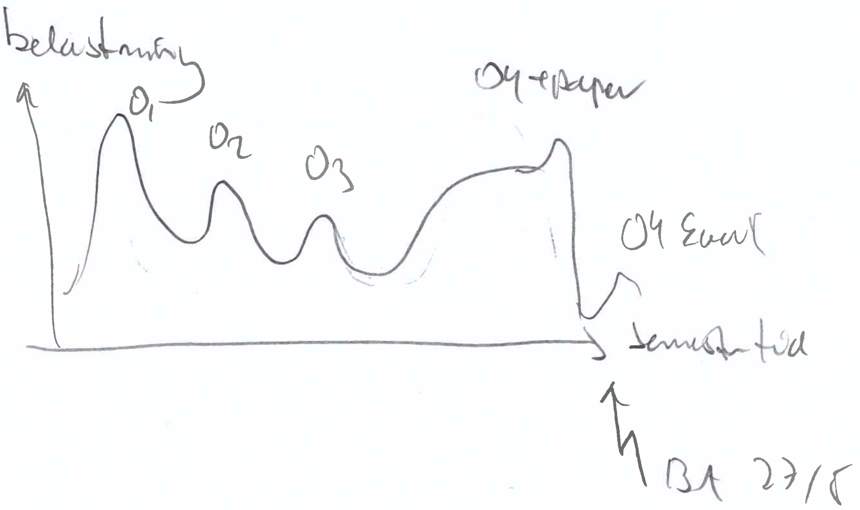
①

Ehsamen



MMS - recap

matrix (m x n) ⇒ rows x cols , l-indexed

$$\bar{\bar{X}} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & & \ddots & \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix}$$

⇒ size constraints well

$\bar{\bar{X}} + \bar{\bar{Y}} \rightarrow$?

$\bar{\bar{X}} \cdot \bar{\bar{Y}} \rightarrow$

$$m\overset{n}{\begin{bmatrix} & \end{bmatrix}} \cdot n\overset{p}{\begin{bmatrix} & \end{bmatrix}} = m\overset{p}{\begin{bmatrix} & \end{bmatrix}}$$

for $(3 \times 4) \cdot (4 \cdot 3) = (3 \cdot \times 3)$

Vector (d)

$$\bar{x} = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_d \end{bmatrix}$$

Demo

$$\bar{\bar{X}}_{demo} = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 10 & 20 & 30 & 40 \end{bmatrix}$$

size = (2×4) $m=2, n=4$, $\emptyset$-indexed

$\bar{\bar{X}}(0,1) \overset{?}{=} 2$

$\bar{\bar{X}}(0,-1) \overset{?}{=} 4$

$X(:,1) = \begin{bmatrix} 2 \\ 20 \end{bmatrix}$

ML Maturity

$\begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_d \end{bmatrix}$

Sample 1

$$\bar{X}^{(1)} = \begin{bmatrix} -118 \\ 33.9 \\ 1416 \\ 38000 \end{bmatrix}$$

x_0: long / °
x_2 = lat / °
x_3 = inhabitants / #
x_4 = median income / \$
Output: median house val / \$

$y^{(1)}_{true} = 156\,000$

Sample 2

$\bar{X}^{(2)} = [\ \ldots$

Sample 3

$\bar{X}^{(3)} = [\ \ldots$

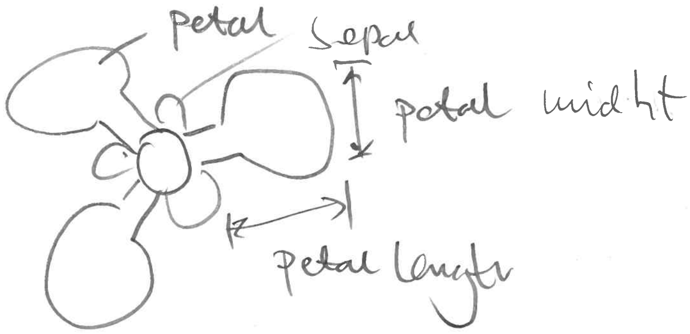
All samples:

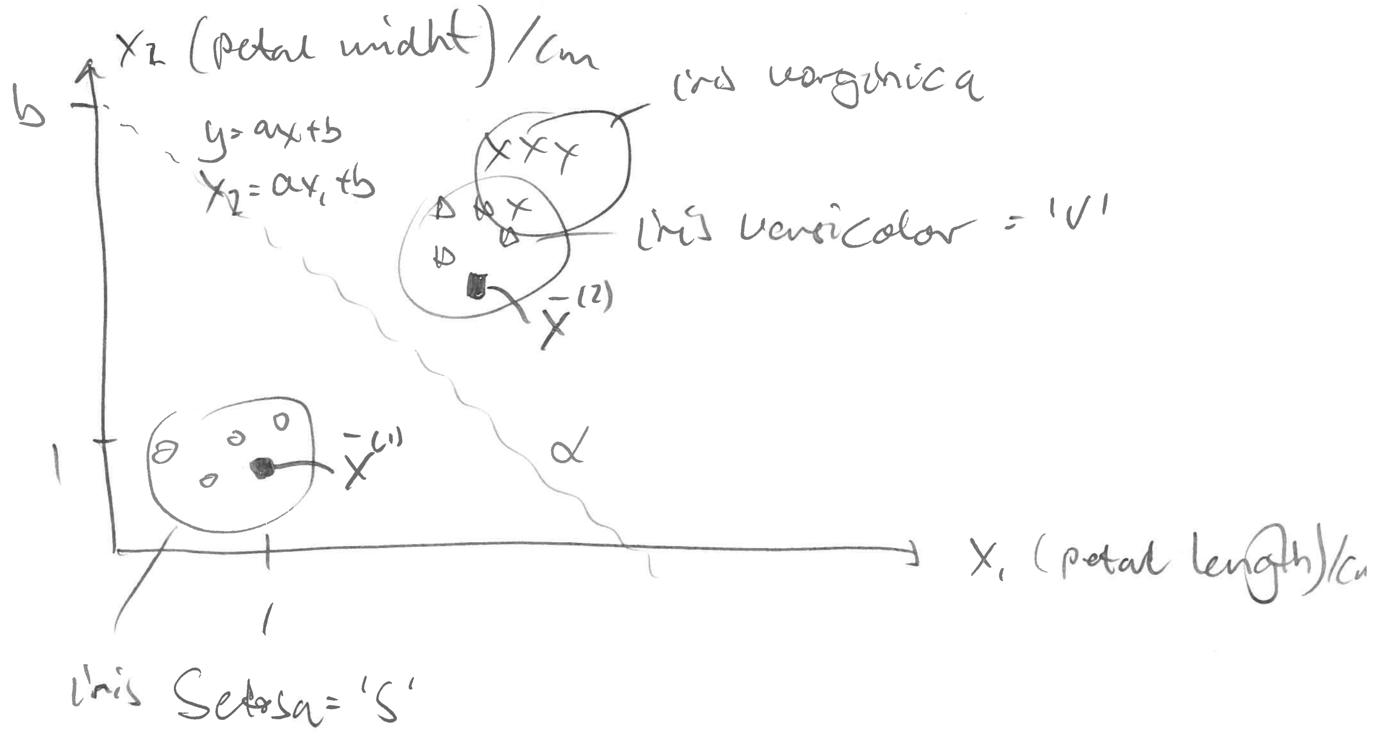
$$\bar{\bar{X}} = \begin{bmatrix} \bar{X}^{(1)T} \\ \bar{X}^{(2)T} \\ \bar{X}^{(3)T} \\ \vdots \\ \bar{X}^{(m)T} \end{bmatrix} = \begin{bmatrix} X_1^{(1)} & X_2^{(1)} & \dots & X_n^{(1)} \\ \vdots & & & \\ X_1^{(m)} & X_2^{(m)} & \dots & X_n^{(m)} \end{bmatrix}$$

$$= \begin{bmatrix} -118 & 33{,}9 & \cdot 1416 & 38000 \\ \vdots & & & \vdots \\ & & & \end{bmatrix}$$

$$\bar{y}_{true} = \begin{bmatrix} y^{(1)} \\ y^{(2)} \\ \vdots \\ y^{(m)} \end{bmatrix} = \begin{bmatrix} 150.000 \\ \\ \\ \end{bmatrix}$$

Iris Data





- 3 classer ⇒ kig på 'S' og 'V' ⇒ 2 klasser
- Data

$$\bar{x}^{(1)} = \begin{bmatrix} x_1^{(1)} \\ x_2^{(1)} \end{bmatrix} = \begin{bmatrix} 1,2 \\ 0,5 \end{bmatrix} \text{(cm)} \quad y_{true}^{(1)} = \text{'S'}$$

$$\bar{x}^{(2)} = \begin{bmatrix} x_1^{(2)} \\ x_2^{(2)} \end{bmatrix} = \begin{bmatrix} 4,5 \\ 1,2 \end{bmatrix} \quad y_{true}^{(2)} = \text{'V'}$$

$$\bar{\bar{X}} = \begin{bmatrix} X^{(1)T} \\ X^{(2)T} \end{bmatrix} = \begin{bmatrix} x_1^{(1)} & x_2^{(1)} \\ x_1^{(2)} & x_2^{(2)} \end{bmatrix} = \begin{bmatrix} 1{,}2 & 0{,}5 \\ 4{,}5 & 1{,}2 \end{bmatrix}$$

$$\bar{y}_{true} = \begin{bmatrix} y_{true}^{(1)} \\ y_{true}^{(2)} \end{bmatrix} = \begin{bmatrix} 'S' \\ 'V' \end{bmatrix}$$

Minimum Distance Classifier

$$y = ax + b$$

$$\Downarrow$$

$$x_2 = ax_1 + b$$

$$\Downarrow$$

$$\emptyset = \theta_2 x_2 + \theta_1 x_1 + \theta_0 \cdot 1$$

Parameters

$$\bar{\theta} = \begin{bmatrix} \theta_0 \\ \theta_1 \\ \theta_2 \end{bmatrix}$$

hypotesis fun:

$$h(\bar{X}^{(i)}; \bar{\theta}) \overset{\text{linear regression}}{=} \bar{\theta}^T \bar{X} = y_{pred}^{(i)}$$

$$= [\theta_0 \ \theta_1 \ \theta_2] \begin{bmatrix} 1 \\ x_1^{(i)} \\ x_2 \end{bmatrix}$$

$$= \theta_0 \cdot 1 + \theta_1 x_1^{(i)} + \theta_2 x_2^{(i)}$$

Short-hand: $h^{(i)}$ / $h(\bar{x}^{(i)})$ etc.

Cost Fun

$$J = \sum_i L^{(i)}$$ $i_{ind} = 1, 2$

$$= L^{(1)} + L^{(2)}$$

$$= L\left(y^{(1)}_{pred}; y^{(1)}_{true}\right) + L\left(y^{(2)}_{pred}; y^{(2)}_{true}\right)$$

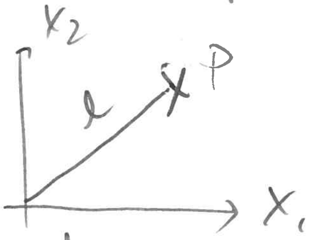
$$= L\left(h(\bar{x}^{(1)}; \bar{\theta}); y^{(1)}_{true}\right) + L\left(h(\bar{x}^{(2)}; \bar{\theta})\right)$$

$L^{(i)}$: individuel Loss / cost / error fun

('suc')

f.eks euklidisk afstand:

$L_2^{(i)}$



$$l = \sqrt{p_{x_1}^2 + p_{x_2}^2}$$

ML: minimum fit til J