ML ↪ .

↕

rule / Pattern

↓

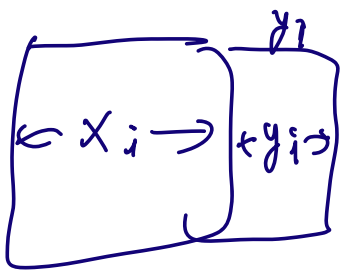
formulation $y = 10x$

Supervised

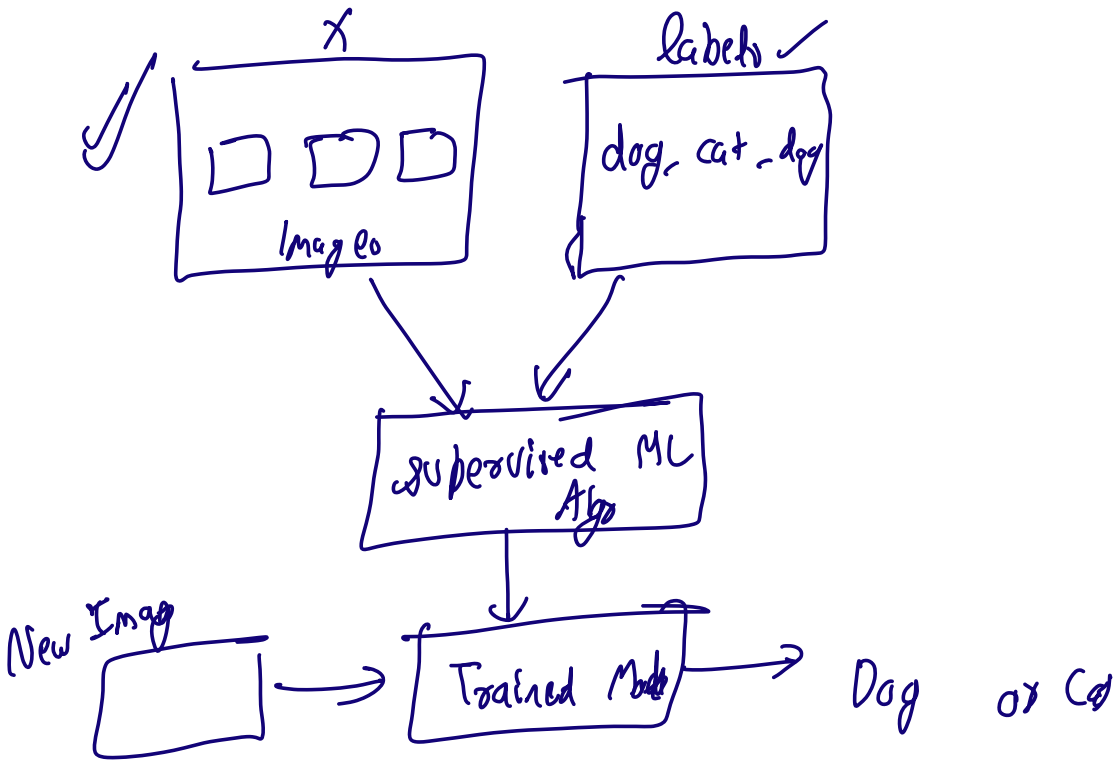
Classification

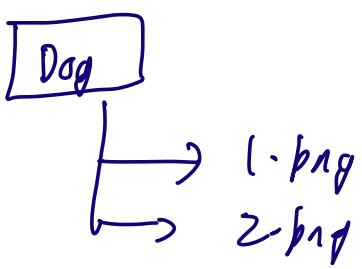
$$D = \{ (x_i, y_i) \}, \quad x_i \in R^d, \quad y_i \in \{0, 1\}$$

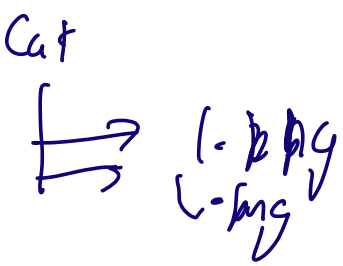
Regression



$$D = \{ (x_i, y_i), \quad x \in R^d, \quad y \in R \}$$



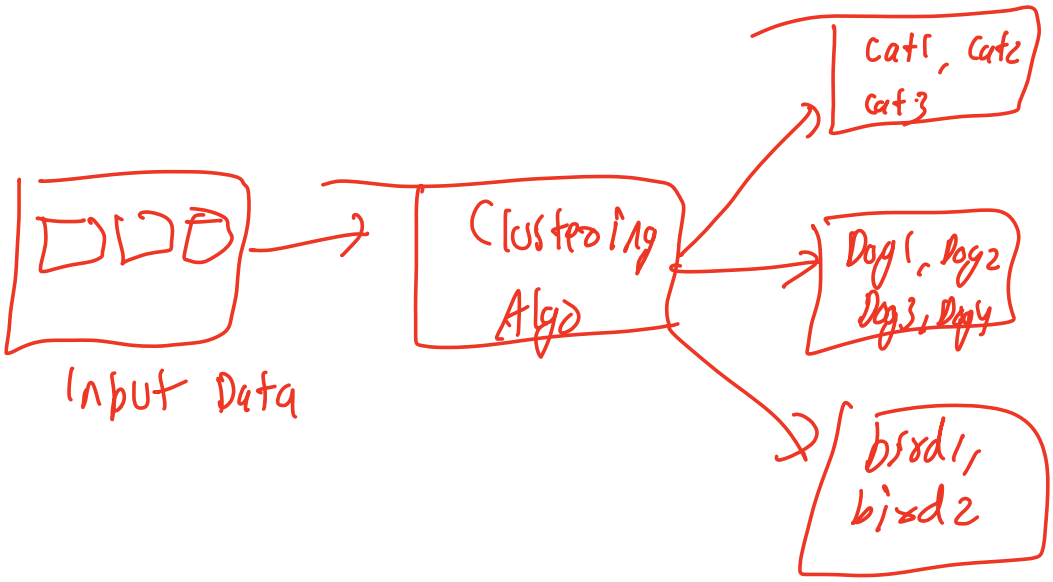




Clustering

$D = \{ x_i \}$

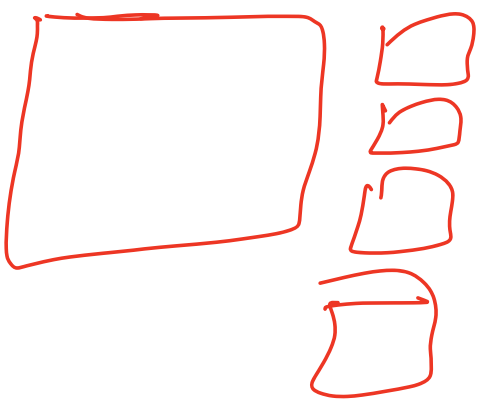
No y_i



Recomendation

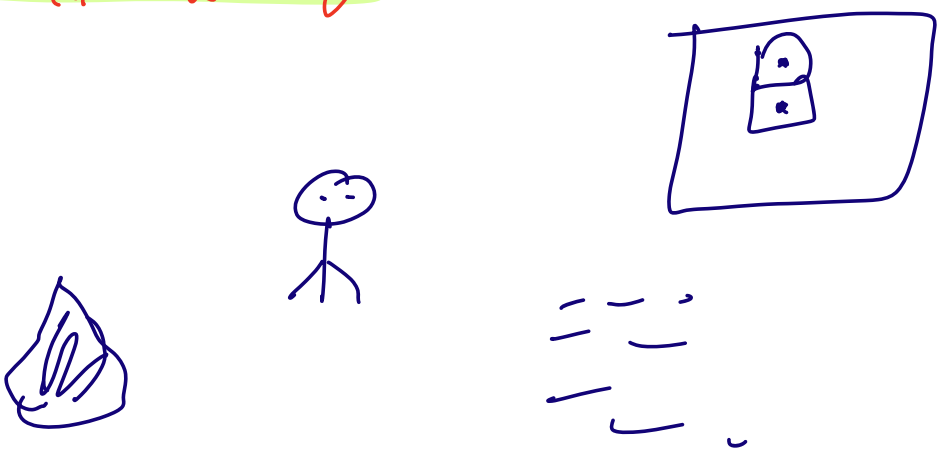
Uses

Youtube



Time series

Reinforcement Learning



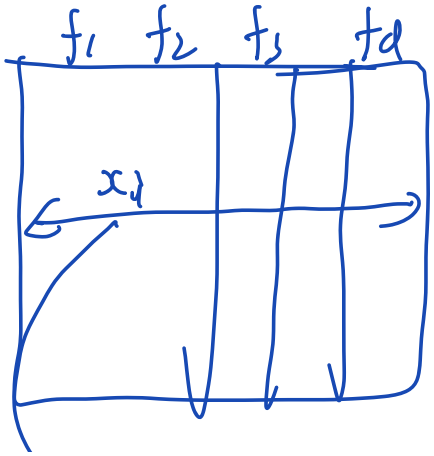
Linear Regression

Cars 24

age , odometer, make , model, ...

Predict resale Price

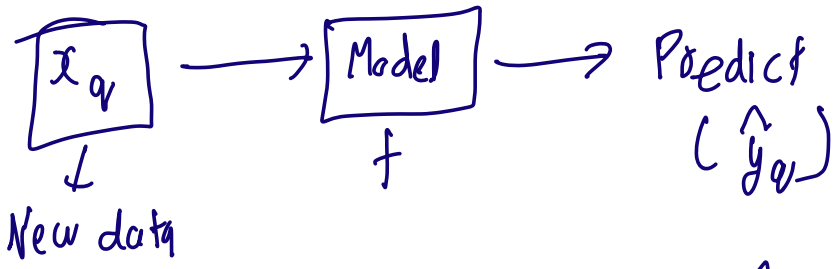
↳ Regression



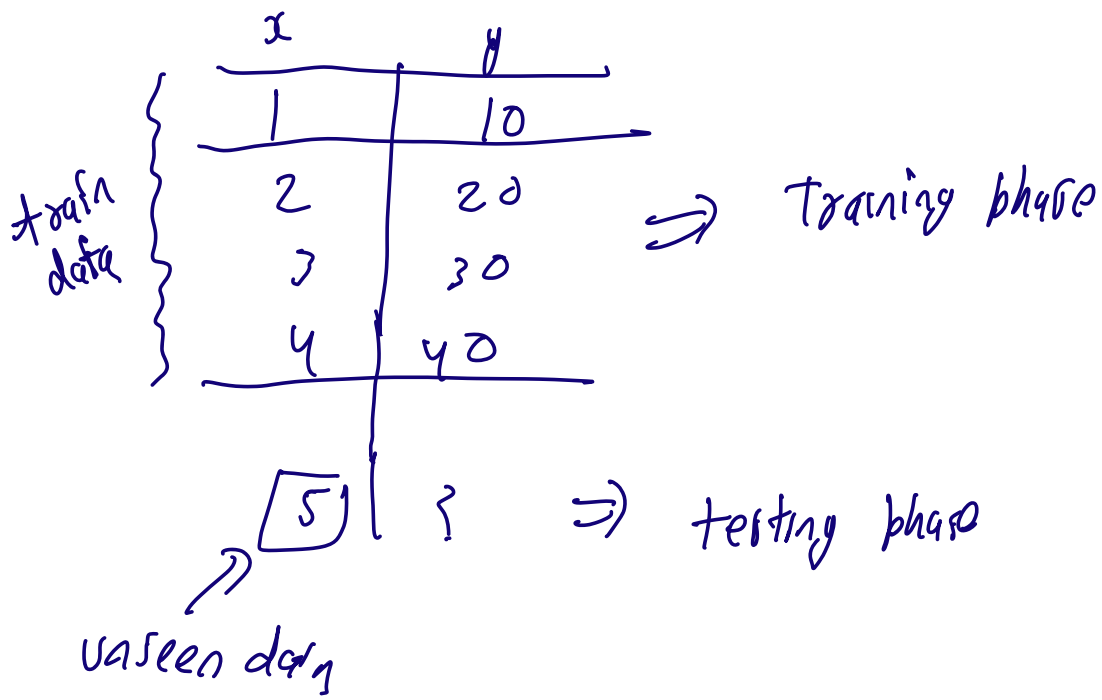
$y = f(x)$

$y \in R$, $x \in R^d$

$\rightarrow x_i = [x_{i1}, x_{i2}, \ldots, x_{id}]^T$



$y_q \approx \hat{y}_q$



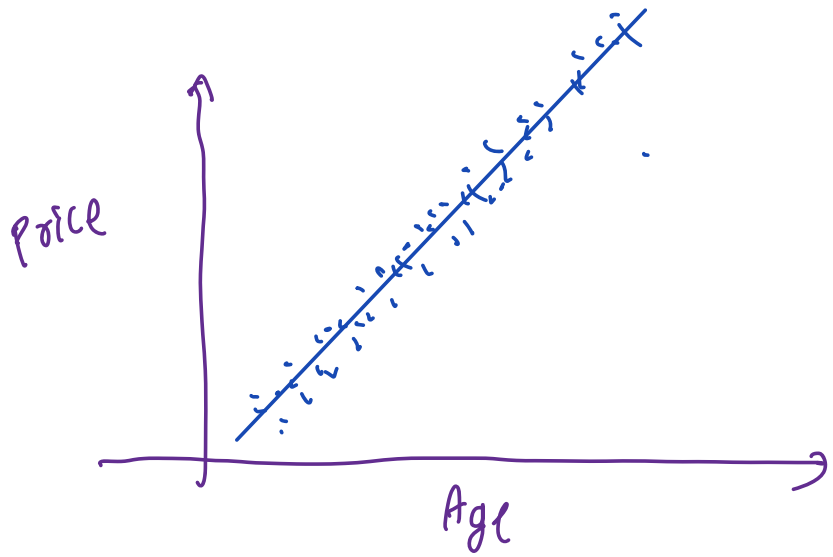
$\Rightarrow$ find $f(x)$ s.t. f is a linear func

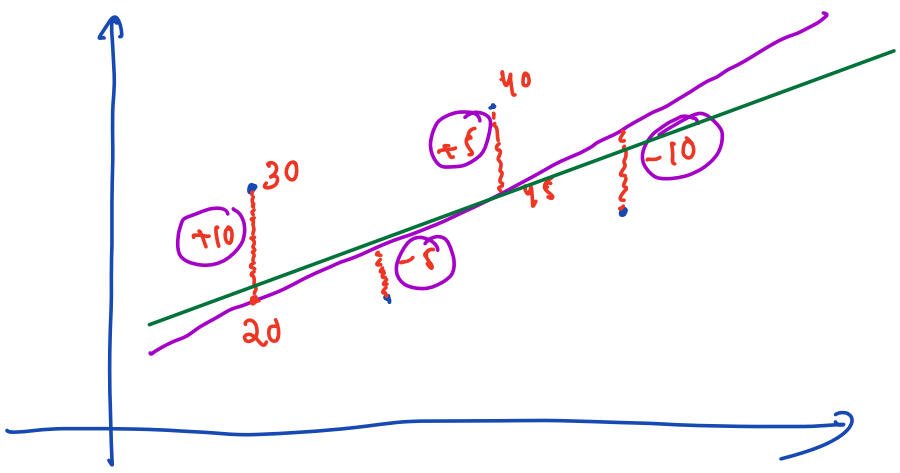
$y = 10x$

$\hat{y}_i = f(x_i)$

↳ $(x_{i1}, x_{i2}, \ldots x_{id})$

$\Rightarrow w_1 x_{i1} + w_2 x_{i2} + \ldots + w_d x_{id} + w_0$





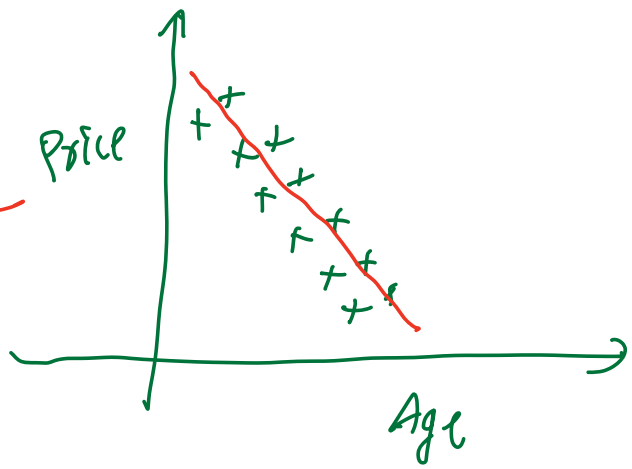
$SS = (10)^2 + (+5)^2 + (-5)^2 + (-10)^2$

$= 200$

$SS \Rightarrow 200$

$\hat{y} = f(x_i)$ ← agl

$\hat{y} = w_1 x_{i1} + w_0$



d col → (d+1) unknown

12:07 PM

$\hat{y} = w_1 x_{i1} + w_2 x_{i2} + w_0$

⇓

$\hat{y} = w_0 + w_1 x_{i1} + w_2 x_{i2} + \cdots + w_d x_{id}$

$< w_0, w_1, \cdots, w_d >$

⇓

optimize

Given $\{ (x_i, y_i) \quad x_i \in R^d , y_i \in R \}$

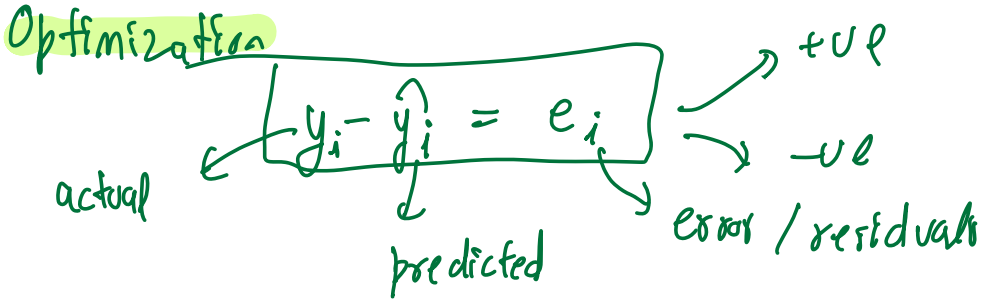
we want to find

$$\hat{y} = f(x_i) = w^T x_i + w_0$$

where $w^T = [w_1 \quad w_2 \ldots w_d]$

find w_i s.t.

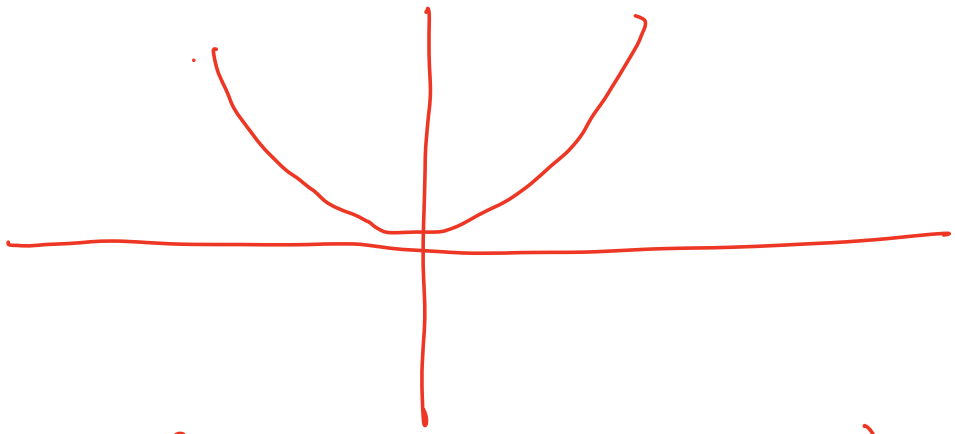
$$y_i \simeq w^T x_i + w_0$$



$$\min_{w_0, w_i} \Sigma (e_i)^2$$

$$\min_{w, w_0} \frac{1}{n} \sum_{i=1}^{n} [y_i - (w^T x_i + w_0)]^2$$

optimization functn



find → $(w_0, w_1, w_2 \cdots, w_d)$

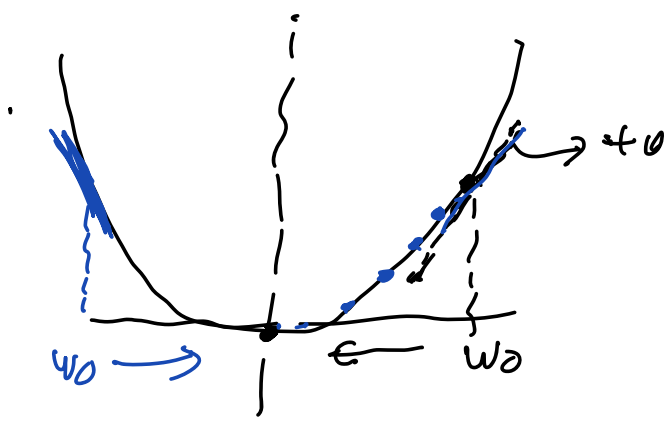
$$\frac{\partial L}{\partial w_0} = 0$$

$$\frac{\partial L}{\partial w_1} = 0$$

$$\vdots$$

$$\frac{\partial L}{\partial w_d} = 0$$

$$w_0 = w_0 - \alpha \frac{\partial L}{\partial w_0}$$



$$L(w_1, w_0) = (y - \hat{y})^2$$
$$= (y - (w_1 x + w_0))^2$$

$$\frac{\partial L}{\partial w_1} = \frac{\partial}{\partial w_1}(y - (w_1 x + w_0))^2$$

$$= 2(y - (w_1 x + w_0))(-x)$$

$$= -2(y - \hat{y})x$$

$$\frac{\partial L}{\partial w_0} = \frac{\partial}{\partial w_0}(y - (w_1 x + w_0))^2$$

$$= 2(y - (w_1 x + w_0))(-1)$$

$$= -2(y - \hat{y})$$

$e_i \Rightarrow y - y_i \Rightarrow +ve$

$\rightarrow -ve$

$10 - 10 = 0$

$|10| + |-10|$