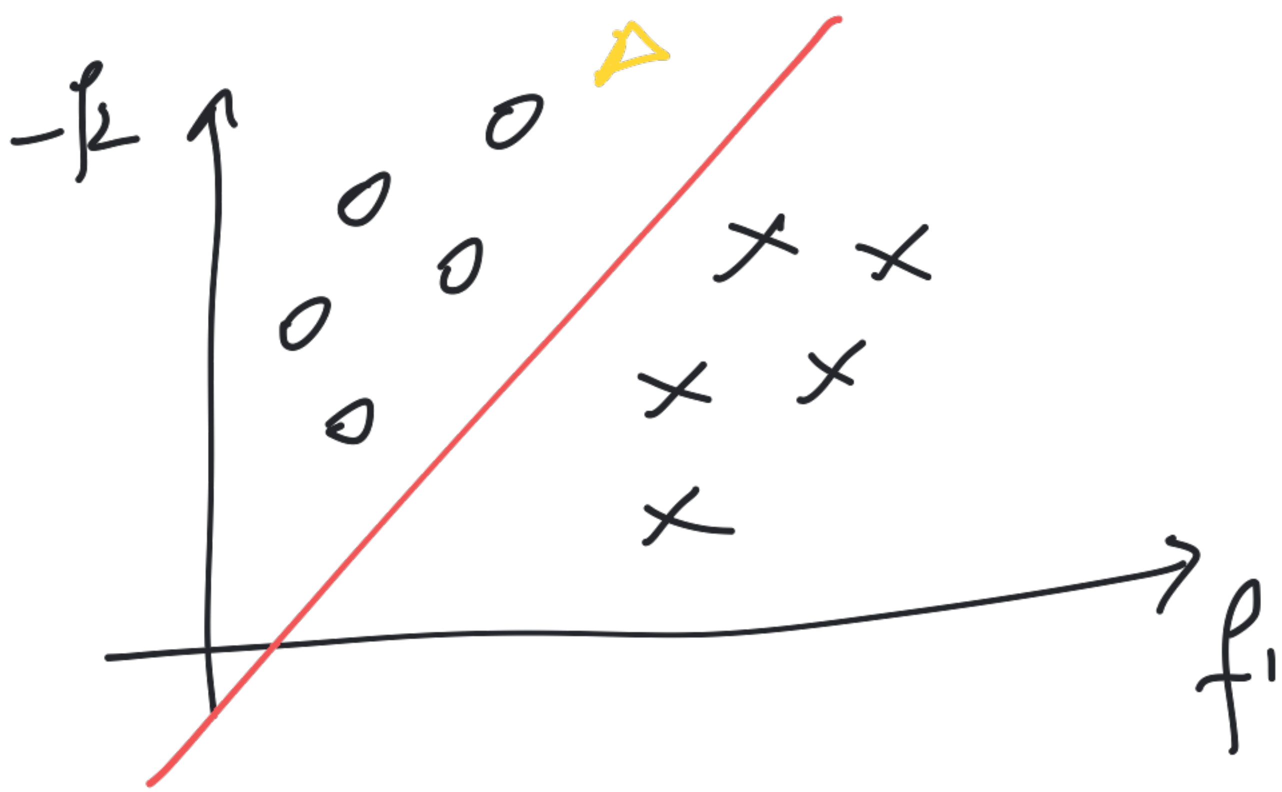
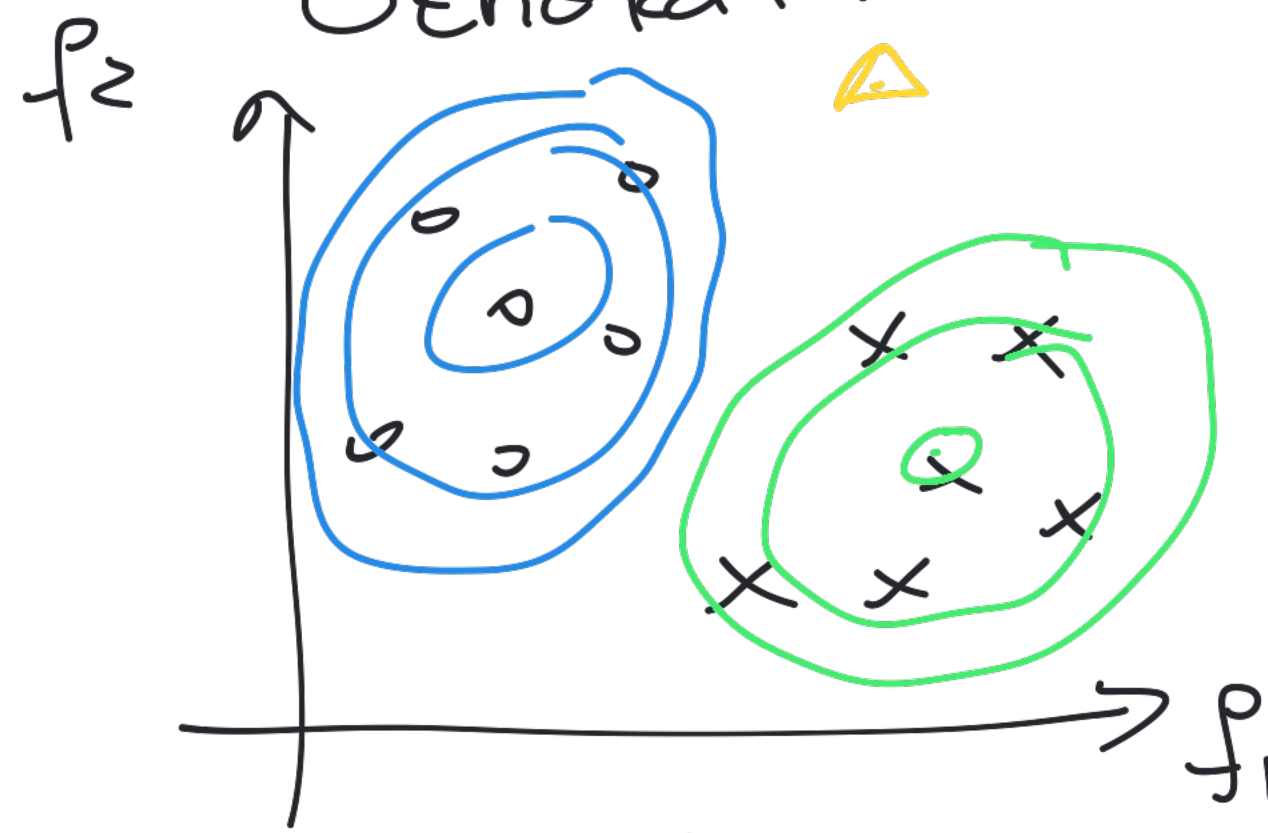
Δ : test point w/out label

Classification

Discriminative



Generative

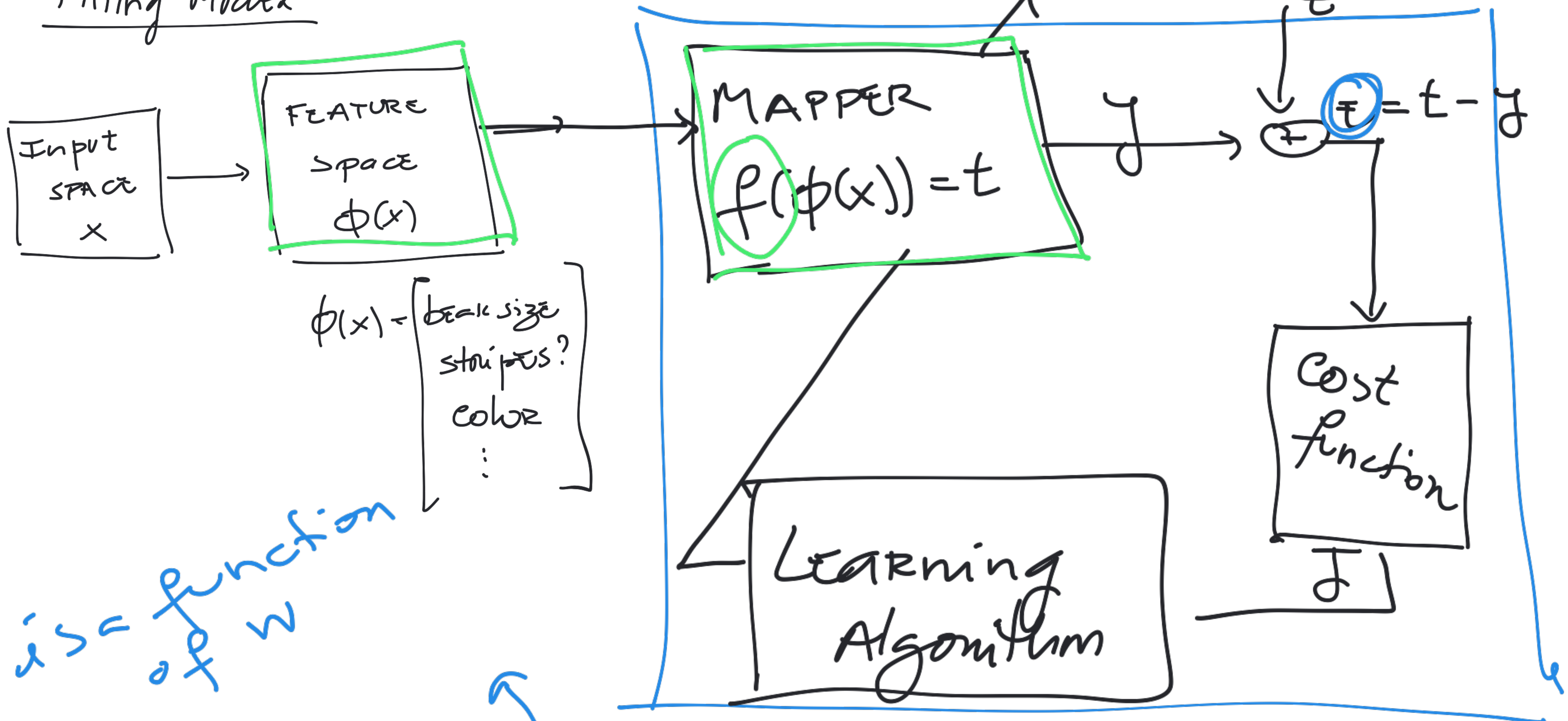


$p(\Delta \mid f_o)$

$p(\Delta \mid f_x)$

"Fitting Model"

t: labels
x: input
$\phi(x)$: features



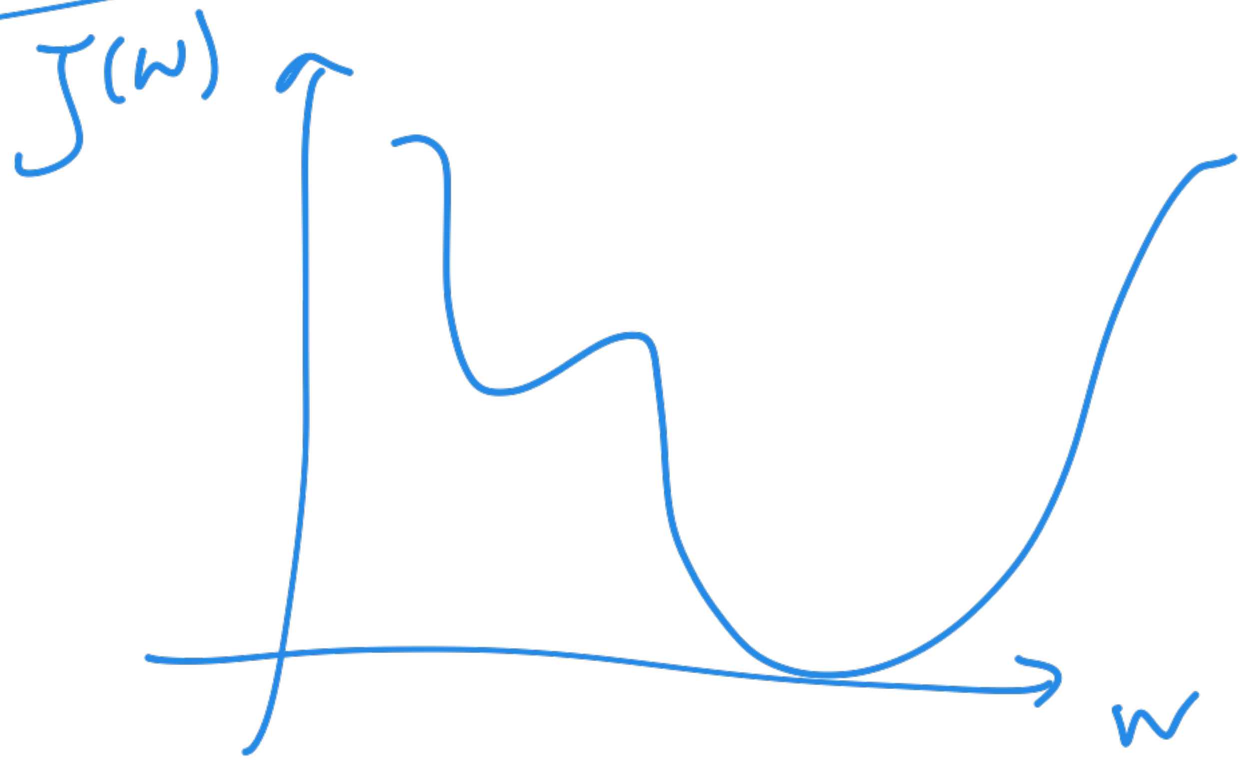
is a function of w

f: neural network, linear regression, SVM

w: unknown model parameters

$\arg\min_w J(w)$

Cost function



$$\arg\min_{w} J(w)$$

typically an ERROR function

Input data:

$$\{x_i, t_i\}_{i=1}^{N}$$

images   labels

Polynomial Regression:

Linear regression w/ polynomial features

$$x \longrightarrow \phi(x) = [x^0 \; x^1 \; x^2 \ldots x^M]^T \longrightarrow y = w_0 \cdot x^0 + w_1 x^1 + \ldots + w_M x^M$$

input data

polynomial features

M: model order

$$= \sum_{i=0}^{M} w_i \cdot x^i$$

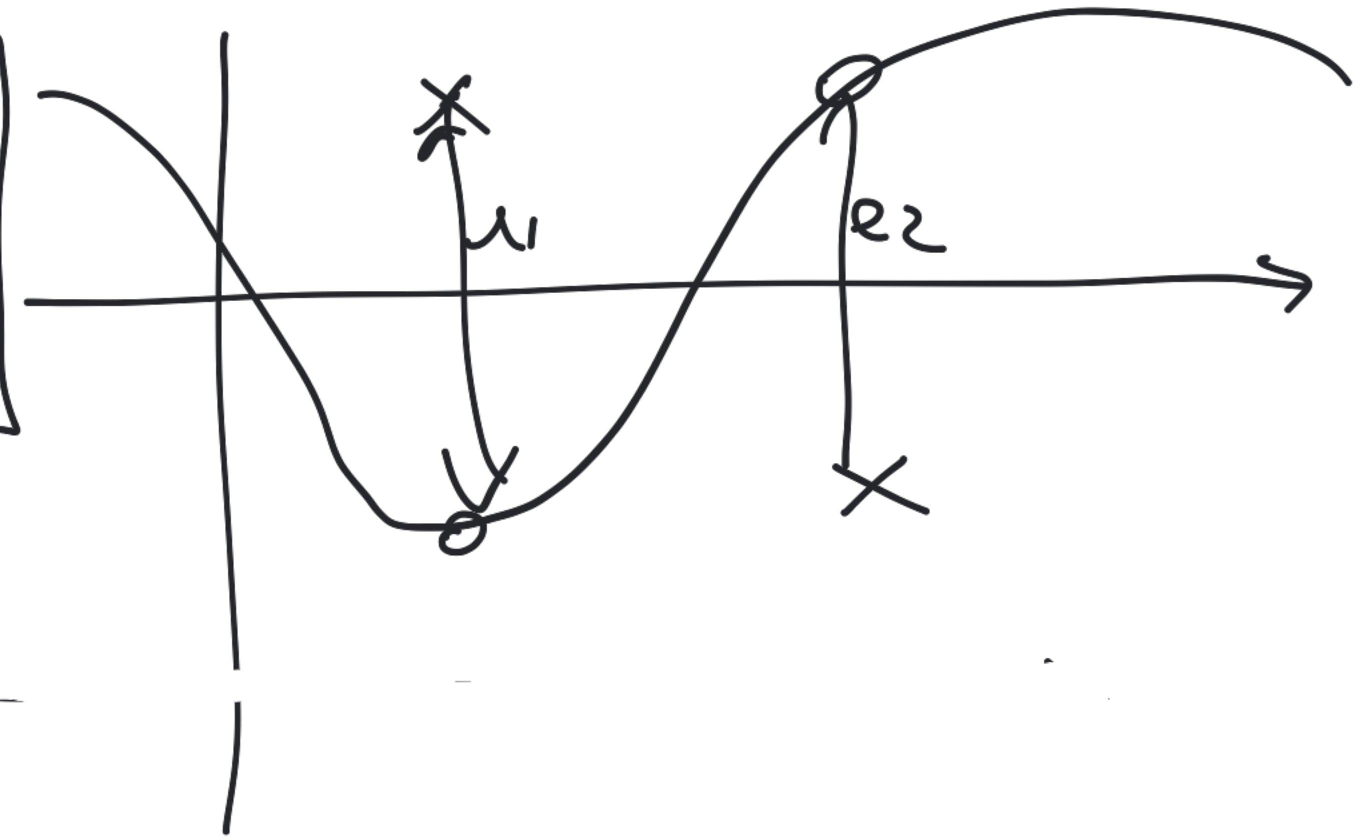
unknown parameters

$$\boxed{X = \begin{bmatrix} \phi(x_1)^T \\ \phi(x_2)^T \\ \vdots \\ \phi(x_N)^T \end{bmatrix}} = \underbrace{\begin{bmatrix} x_1^0 & x_1^1 & \ldots & x_1^M \\ x_2^0 & x_2^1 & \ldots & x_2^M \\ \vdots & & & \\ x_N^0 & x_N^1 & \ldots & x_N^M \end{bmatrix}}_{N \times (M+1)}, \quad W = \begin{bmatrix} w_0 \\ w_1 \\ \vdots \\ w_M \end{bmatrix}_{(M+1) \times 1}$$

$$y = \sum_{i=0}^{M} w_i \cdot x^i = X \cdot w_{(N \times 1)}$$

y is our estimate of labels t

$$E = t - y = \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_N \end{bmatrix}$$



$$J(w) = \frac{1}{2} \sum_{i=1}^{N} e_i^2$$