$$\tilde{E}(w) = \frac{1}{2}\sum_{n=1}^{N}\{t_n - w^T\phi(x_n)\}^2 + \frac{\lambda}{2}\|w\|^2$$

$$w^* = (\Phi^T\Phi)^{-1}\Phi^T t$$

$$\xrightarrow{} \text{pinv}(\Phi)$$

$$w^{*(reg)} = (\lambda I + \Phi^T\Phi)^{-1}\Phi^T t$$

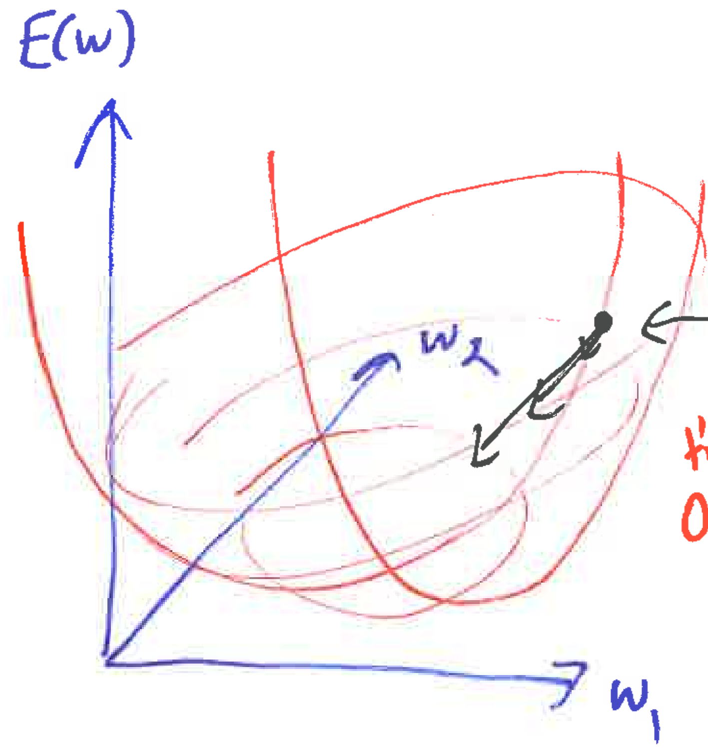
$$I = \begin{pmatrix} 1 & & 0 \\ & 1 & \\ 0 & & 1 \end{pmatrix}$$

$$\|w\|_2^2 = w^T w$$

$$\tilde{E}(w) = E(w) + \frac{\lambda}{2} \sum_{i=1}^{M} |w_i|^q$$

$q = 2$ "sum of squares of weights"

$q = 1$ "sum of absolute values of weights"



space

$O(M)$

$w^{(0)} \in \mathbb{R}^2$

time

$O(N \cdot M)$

$w^{(0)}$

$w^{(1)} = w^{(0)} + \eta \nabla E(w^{(0)})$

$w^{(2)} = w^{(1)} + \eta \nabla E(w^{(1)})$

$\vdots$

$w^{(T)} = w^{(T-1)} + \eta \nabla E(w^{(T-1)})$

$$\arg\min_{w} E(w) = \frac{1}{2} \sum_{n=1}^{N} \{ t_n - w^T \phi(x_n) \}^2$$

$O(N \cdot M \cdot T)$

$$w^{(0)}$$

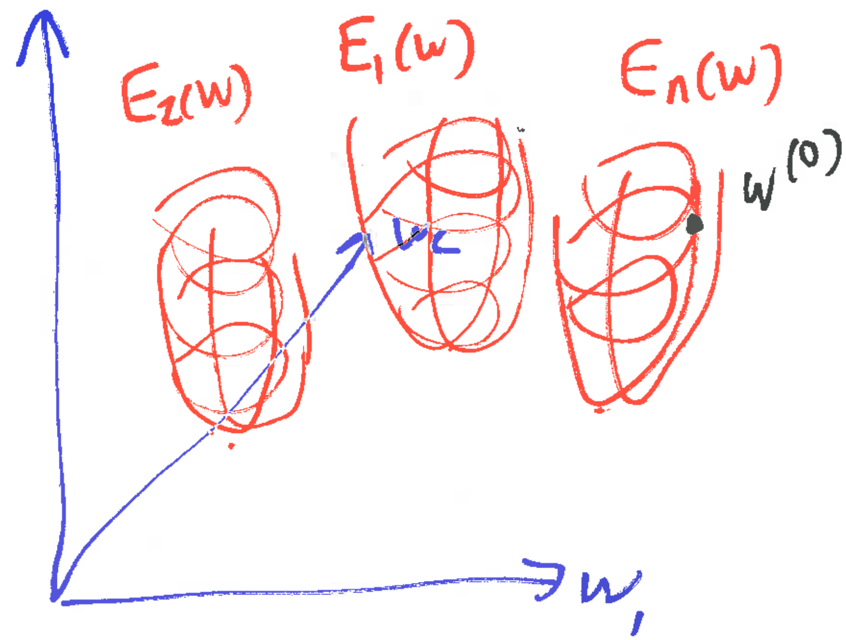
$$w^{(1)} = w^{(0)} + \eta \nabla E_1 (w^{(0)})$$

O(M) $$w^{(2)} = w^{(1)} + \eta \nabla E_2 (w^{(0)})$$

$$\vdots$$

$$E_n(w) = \{t_n - w^T \phi(x_n)\}^2$$

2% N



$$E_n(w) = \{t_n - w^T\phi(x_n)\}^2$$