EE660 Oct 17, 2018

Discussion 9

Today:

- Comment on HW5
- Midterm review:

suggested exercises: Murphy 7.2, 7.3, 8.6, 8.7, 13.7
AML Ex 2.4, Problems 2.8, 2.17, 2.18, 4.5

HW5

Pr 1 coins $M=1$ because there's a single hypotheses

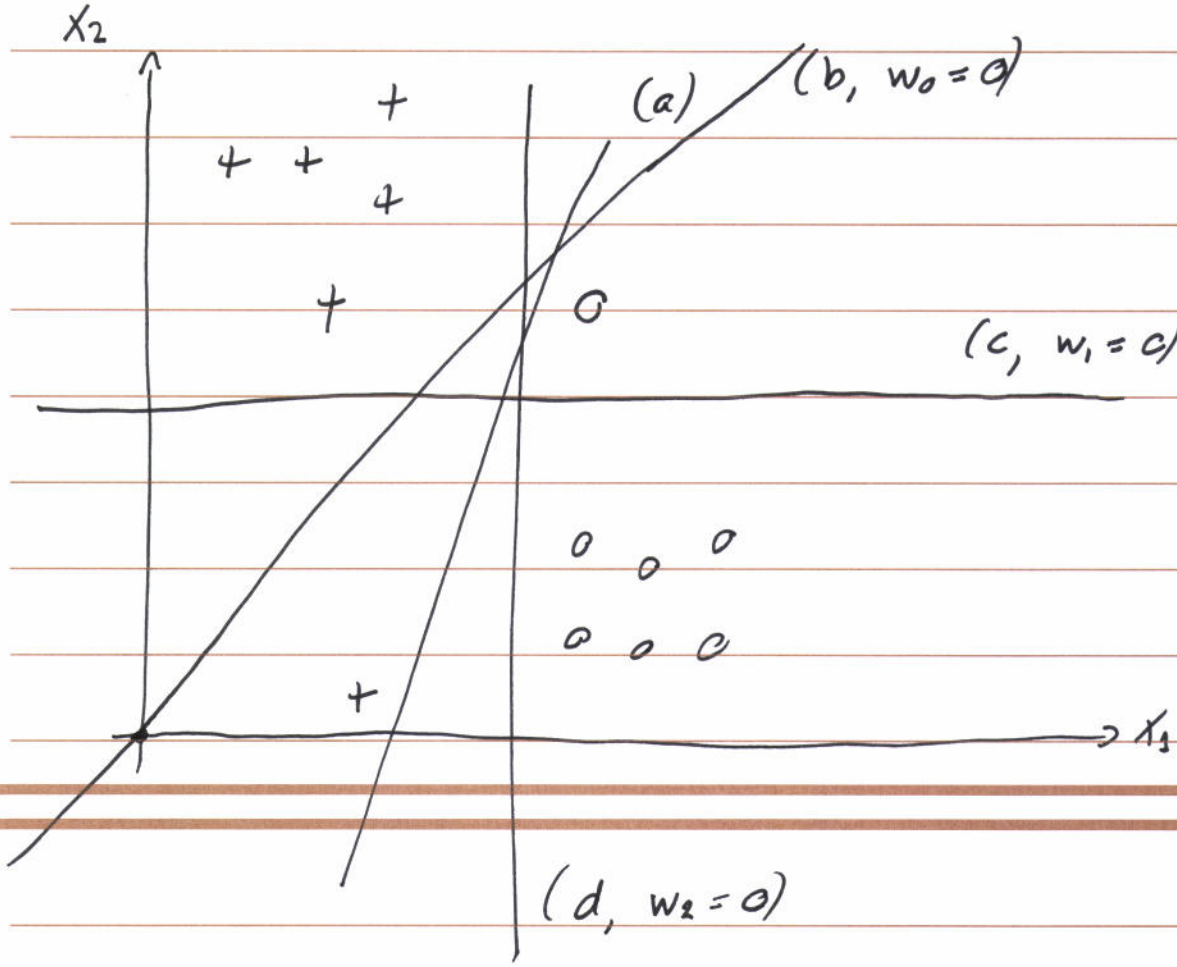
Murphy 7.2) $\hat{y} = W^T \phi(x)$

$$\begin{bmatrix} -1 & -1 & -2 & 1 & 1 & 2 \\ -1 & -2 & -1 & 1 & 2 & 1 \end{bmatrix} = W^T \begin{bmatrix} 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 \end{bmatrix}$$

$$\begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \\ 0 & 1 \end{bmatrix} w_1 = \begin{bmatrix} -1 \\ -1 \\ -2 \\ 1 \\ 1 \\ 2 \end{bmatrix} \Rightarrow w_i = \left(\phi(x)\phi^T(x)\right)^{-1} \phi(x) y_i$$

$$w_i = \begin{bmatrix} 3 & 0 \\ 0 & 3 \end{bmatrix}^{-1} \begin{bmatrix} -4 \\ 4 \end{bmatrix} = \begin{bmatrix} -4/3 & 0 \\ 0 & 4/3 \end{bmatrix} \quad i=1,2$$

Murphy 8.7 $\qquad \sigma(w_0 + w_1 x_1 + w_2 x_2)$



AML. Ex. 2.4

(a) $d_{vc} \geq d+1$

$$\underline{x}_i = \begin{bmatrix} 1 \\ x_{i,1} \\ \vdots \\ x_{i,d} \end{bmatrix} \quad \text{and} \quad \underline{\underline{X}} = \begin{bmatrix} x_1^T \\ x_2^T \\ \vdots \\ x_{d+1}^T \end{bmatrix}$$

Perceptron: $h(\underline{x}) = \text{sign}\{X w\}$

We choose X to be nonsingular

$$Xw = b \Rightarrow w = X^{-1} b$$

b) $d_{vc} \leq d+1$

We can define one vector as:

$$x_K = \sum_{i \neq K} \alpha_i x_i$$

Perceptron: $h(x_K) = \text{sign}(w^T x_K) = \text{sign}\left(\sum_{i \neq K} \alpha_i w^T x_i\right)$

Choose $h(x_i) = \text{sign}(\alpha_i)$ so all terms $\alpha_i w^T x_i > 0$

Then $h(x_K) = 1$! The dichotomy with $h(x_K) = -1$ is not possible.

AML 4.5

(i) ~~min~~ $h_g = \underset{h \in H}{\arg\min}\, E_{in}(h)$ s.t. $w^T w \leq C$

from lecture $\qquad w^T w - C \leq 0$

(iii) $h_g = \underset{h \in H}{\arg\min} \min_{\lambda_c \geq 0} \left[E_{in}(h) + \lambda_c (w^T w - C) \right]$

Let's change to $\lambda \leq 0$

$$h_g = \underset{h \in H}{\arg\min} \min_{\lambda \leq 0} \left[E_{in}(h) + \lambda (w^T w - C) \right]$$

We choose $\lambda' = -\lambda$

$C - w^T w \leq 0$

$\boxed{w^T w \geq C}$

$$h_g = \underset{h \in H}{\arg\min} \min_{\lambda' \geq 0} \left[E_{in}(h) + \lambda' (C - w^T w) \right]$$