CSE 190: Neural Networks 2017

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Abstract

Machine learning programming practice on assignment 1.

Part I

1.

(a)

For $d = 2$, the activation rule is

$$y = \begin{cases} 1 & \text{if } w_1 x_1 + w_2 x_2 \geq \theta \\ 0 & \text{else} \end{cases}$$

The equation for the line representing the decision boundary is therefore

$$w_1 x_1 + w_2 x_2 = \theta$$

or simply

$$w^T x = \theta$$

(b)

Let y be the projection of the origin onto the decision boundary. We must have

$$y^T w = \theta \qquad (y \text{ must be on the boundary})$$
$$y^T w_\perp = 0 \quad \forall w_\perp . w_\perp^T w = 0 \quad (y \text{ must be perpendicular to any vector parallel to the boundary})$$

Thus, one can write,

$$y = \alpha w \qquad \text{for some } \alpha \in \mathbb{R}$$

So

$$\begin{aligned} & w^T y (w^T y)^T = \theta \theta^T \\ \iff \quad & w^T y y^T w = \theta^2 \\ \iff \quad & w^T (\alpha w)(\alpha w^T) w = \theta^2 \\ \iff \quad & (\alpha^2 w^T w)(w^T w) = \theta^2 \\ \iff \quad & \|y\|^2 \|w\|^2 = \theta^2 \\ \iff \quad & \|y\| = \frac{|w^T x|}{\|w\|} \end{aligned}$$

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