ECE 449 In-class exercise #8 **Fall 2019**

Convert the following classification problem into an equivalent problem definition using inequalities constraining weight and bias values.

$$\left\{x(1)=\begin{bmatrix}0\\2\end{bmatrix}, t(1)=1\right\}\left\{x(2)=\begin{bmatrix}1\\0\end{bmatrix}, t(2)=1\right\}\left\{x(3)=\begin{bmatrix}0\\-2\end{bmatrix}, t(3)=0\right\}\left\{x(4)=\begin{bmatrix}2\\0\end{bmatrix}, t(4)=0\right\}$$

Each target value indicates whether or not the total input *tot* in response to $x(k)$ must be less or equal to 0, or greater than 0. For example, since $t(1)=1$, the corresponding $tot(1)$ must be greater than 0, i.e.

$$\mathbf{wx}(1) + \theta > 0$$

$$0w_1 + 2w_2 + \theta > 0$$

$$2w_2 + \theta > 0$$

Using the same approach for all pairs of $\mathbf{x}(k)$, $t(k)$, called *patterns*, we obtain the following set of inequalities

$$2w_2 + \theta > 0 \qquad \text{(a)}$$

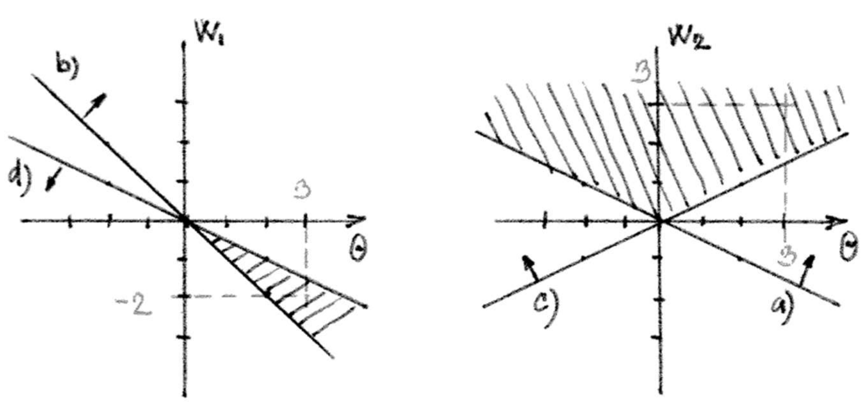
$$w_1 + \theta > 0 \qquad \text{(b)}$$

$$-2w_2 + \theta \le 0 \qquad \text{(c)}$$

$$2w_1 + \theta \le 0 \qquad \text{(d)}$$

Solving a set of inequalities is more difficult than the case of equations. Added complexity is that there are often infinite number of solutions.

Because of the simplicity of this problem, one can solve it graphically. Note that w_1 only appears in (b) and (d), while w_2 only in (a) and (c).



Any weights and bias within both hatched regions will solve our classification problem, e.g.

$$\mathbf{w} = [-2, 3], \ \theta = 3$$