

Quiz 2

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1. Find the vector and offset that defines the line (2D-hyperplane) $y = -2x + 10$.
2. Suppose we have a test point $(2,3)$. What would it be classified regarding the hyperplane in 1.
3. Find the vector and offset that defines the plane (3D-hyperplane) $2x + 4y - 5z = -10$.
4. Suppose we have a test point $(-5, -25, -2)$. What would it be classified regarding the hyperplane in 2.

① Hyperplane
 $y = -2x + 10$

x-offset

when $y = 0$

$$0 = -2x + 10$$

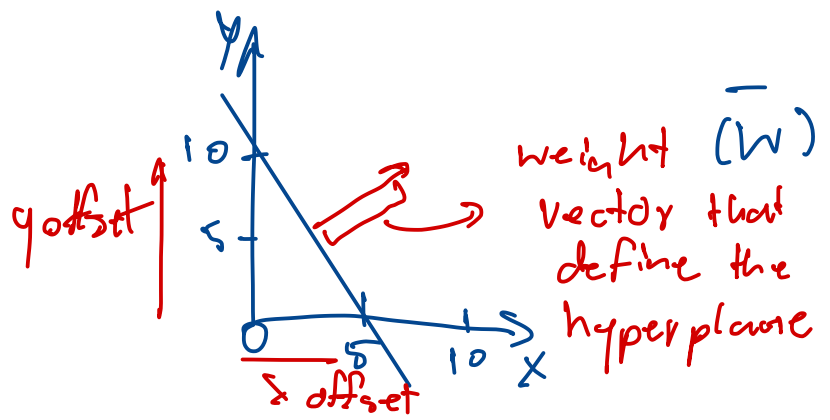
$$2x = 10$$

$$x = 5 \quad \#$$

y-offset

when $x = 0$

$$y = 10 \quad \#$$



then $H = \{x : \text{dot}(x, w) + b = 0\}$

$y = -2x + 10$ when $\#$

$$2x + y - 10 = 0$$

$$\bar{w} = \begin{bmatrix} 2 \\ 1 \\ -10 \end{bmatrix} \quad \bar{x} = \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

let $x = 0, y = 10$

$$w^T x = [2 \ 1 \ -10] \begin{bmatrix} 0 \\ 10 \\ 1 \end{bmatrix}$$

$$= 0 \quad \#$$

$\therefore \bar{w}$ is vector that define Hyperplane

$$y = -2x + 10$$

② test point (2,3)
 on
 $h(x_1) = \text{sign}(w^T x + b)$

$$\bar{w} = \begin{bmatrix} 2 \\ 1 \\ -10 \end{bmatrix} \quad \bar{x} = \begin{bmatrix} 2 \\ 3 \\ 1 \end{bmatrix}$$

$$w^T x = 4 + 3 - 10 = -3$$

\therefore test point (2,3)
 classify with Negative $\#$

6610402230 23/5/2020

③ Hyperplane

$$2x + 4y - 5z = -10$$

x - offset

$$\text{in } y = 0, z = 0$$

$$2x = -10$$

$$x = -5 \quad \#$$

y - offset

$$\text{in } x = 0, z = 0$$

$$4y = -10$$

$$y = -2.5 \quad \#$$

z - offset

$$\text{in } x = 0, y = 0$$

$$-5z = -10$$

$$z = 2$$

④ test point $(-5, -2.5, -2)$

$$\text{in } h(x_i) = \text{sign}(w^T x + b)$$

$$\bar{w} = \begin{bmatrix} 2 \\ 4 \\ -5 \\ 10 \end{bmatrix} \quad \bar{x} = \begin{bmatrix} -5 \\ -2.5 \\ -2 \\ 1 \end{bmatrix}$$

$$w^T x = \begin{bmatrix} 2 & 4 & -5 & 10 \end{bmatrix} \begin{bmatrix} -5 \\ -2.5 \\ -2 \\ 1 \end{bmatrix}$$

$$= -10 - 10 + 10 + 10$$

$$= -90 \quad \#$$

$$mH = \{x : \text{dist}(x, H) + b = 0\}$$

$$2x + 4y - 5z = -10 \quad \text{in } H$$

$$2x + 4y - 5z + 10 = 0$$

$$\bar{w} = \begin{bmatrix} 2 \\ 4 \\ -5 \\ 10 \end{bmatrix} \quad \bar{x} = \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

$$\text{dist}(x, y, z) = (-5, 0, 0)$$

$$w^T x = \begin{bmatrix} 2 & 4 & -5 & 10 \end{bmatrix} \begin{bmatrix} -5 \\ 0 \\ 0 \\ 1 \end{bmatrix}$$

$$= -10 + 10$$

$$= 0$$

$\therefore \bar{w}$ is ~~not~~ vector that define Hyperplane

$$2x + 4y - 5z = -10$$

\therefore test point $(-5, -2.5, -2)$

classify it
Negative