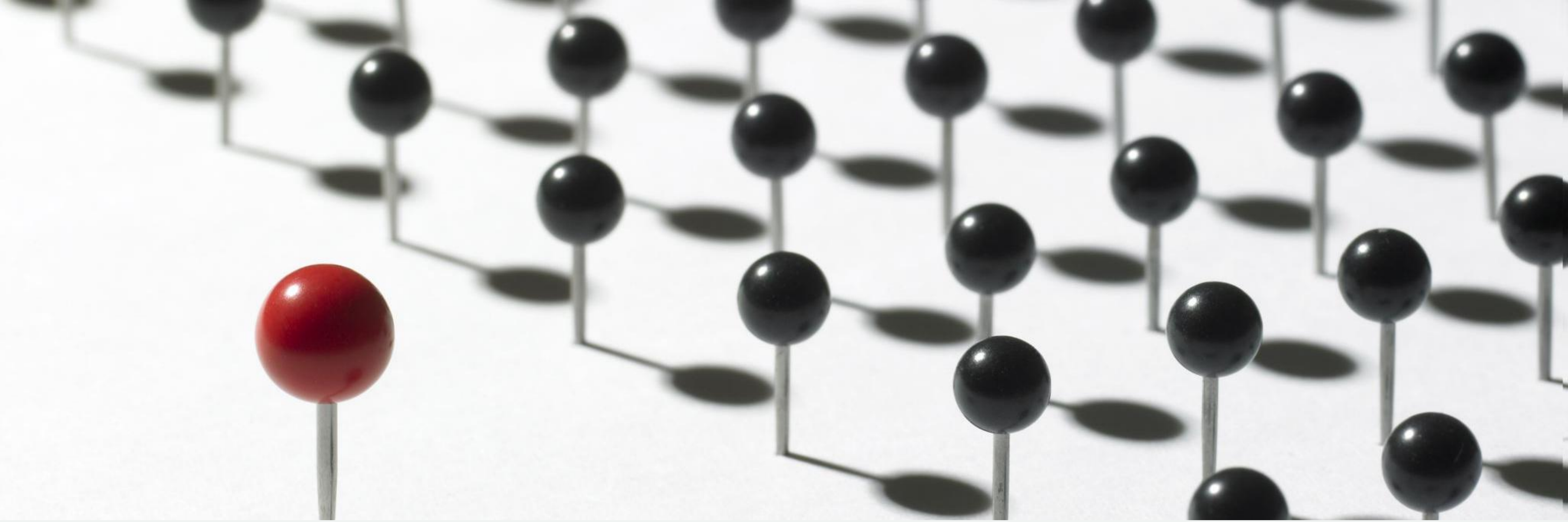


Classification

LOGISTIC
REGRESSION

Application	Input (X)	Output (Y)
Spam filter	email	Spam? (0/1)
Speech recognition	Audio	Text transcripts
Machine translation	English	Hindi
Online advertising	Ad, user info	Click? (0/1)
Self-driving car	Image, radar info	Position of the car
Visual inspection	Image of PCB	Defect? (0/1)

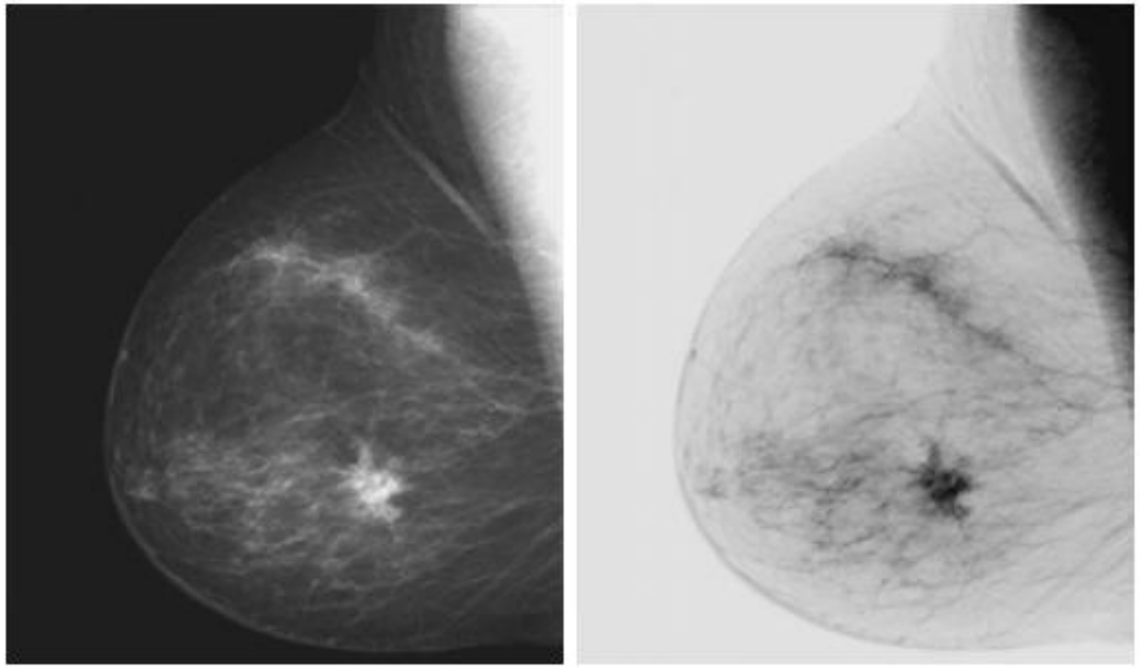
Classification

- Class/Category
  - Binary (0/1)
  - Multi class

Image Negatives

Denote [0, L-1] intensity levels of the image.

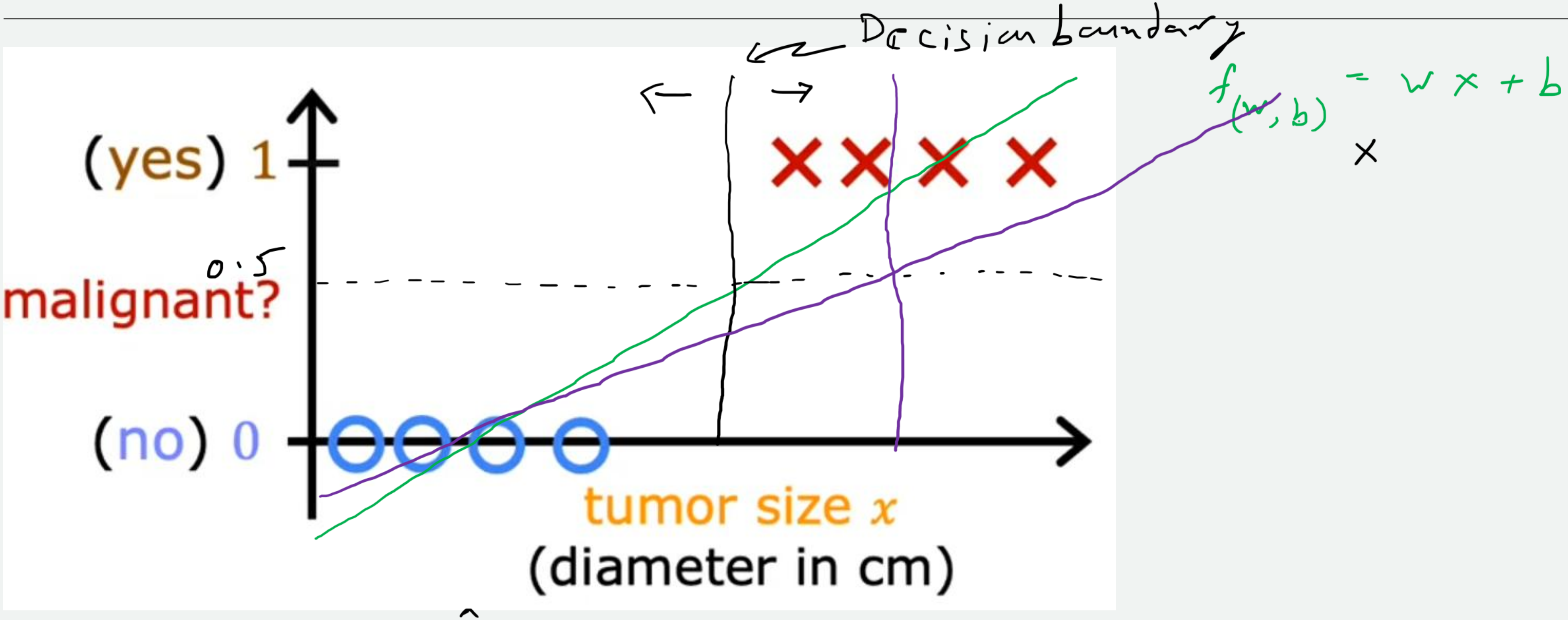
Image negative is obtained by ***s= L-1-r***



a b

FIGURE 3.4 (a) Original digital mammogram. (b) Negative image obtained using the negative transformation in Eq. (3.2-1). (Courtesy of G.E. Medical Systems.)

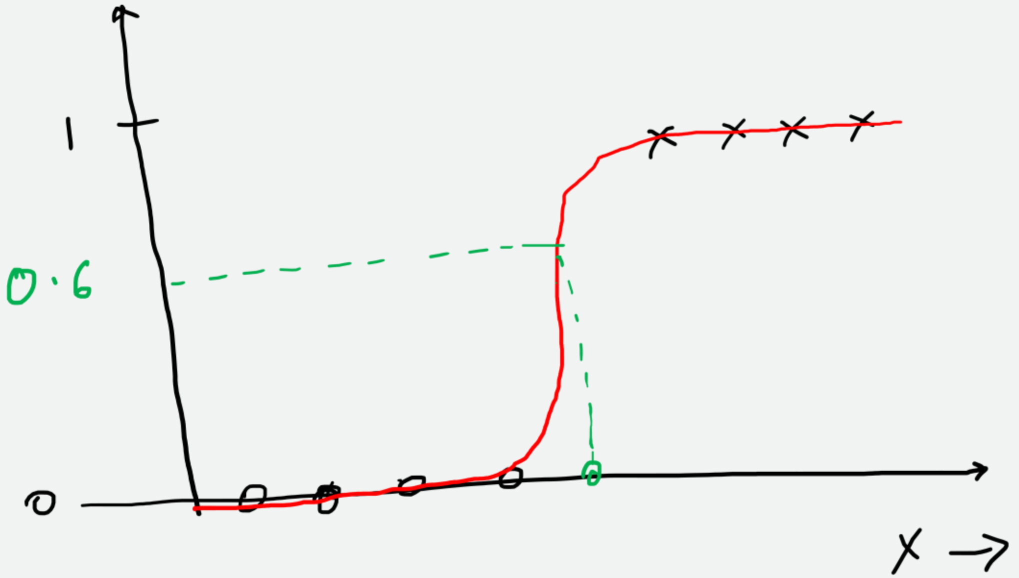
Classification (Tumor Malignant (1) or Benign (0)



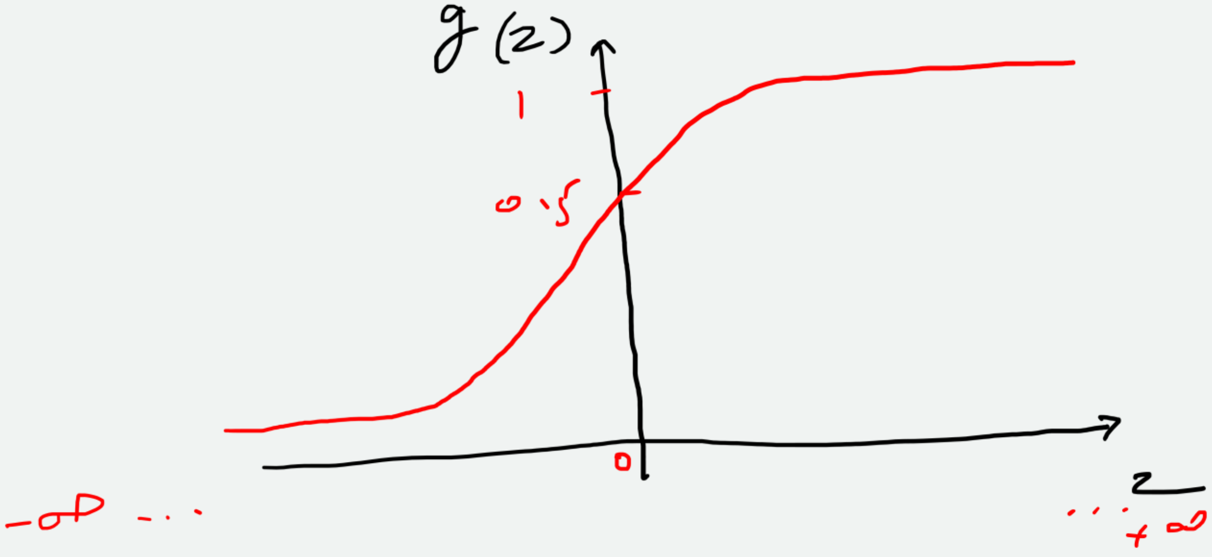
$f \geq 0.5 \Rightarrow \hat{y} = 1$

else $\hat{y} = 0$

Logistic regression (Sigmoid function)



$$g(z) = \frac{1}{1 + e^{-z}}$$



Logistic regression (Sigmoid function)

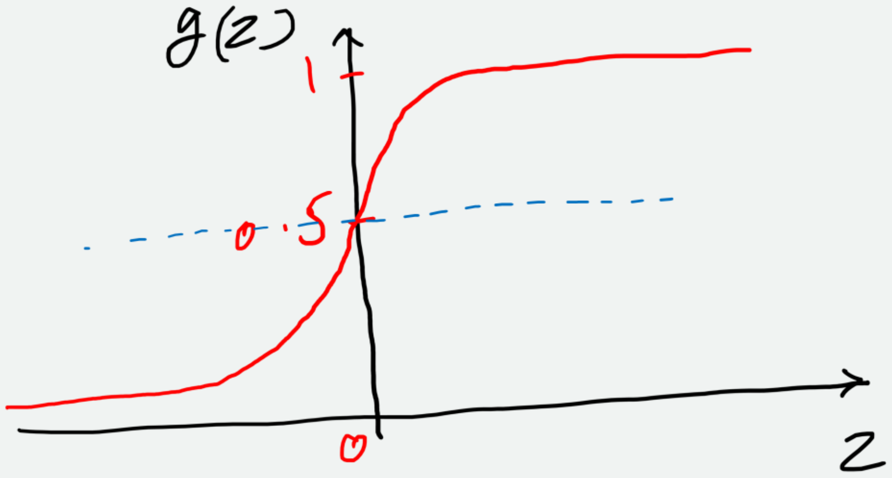
$$g(z) = \frac{1}{1+e^{-z}} \qquad 0 < g(z) < 1$$

$$f_{\vec{w},b}(\vec{x}) \qquad f_{\vec{w},b}(\vec{x}) = P(y=1 \mid \vec{x}; \vec{w}, b)$$

$$z = wx + b$$

$$= g(z) = \frac{1}{1+e^{-(\vec{w}\vec{x}+b)}} \qquad P(y=0) + P(y=1) = 1$$

Logistic regression (Sigmoid function)



$$f_{\vec{w},b}(\vec{x}) = g(\underbrace{\vec{w}\cdot\vec{x}+b}_{z}) = \frac{1}{1+e^{-(\vec{w}\cdot\vec{x}+b)}}$$

$$P(y=1 \mid x; \vec{w}, b) = 0.6$$

$$P(y=0 \mid x; \vec{w}, b) = 0.4$$

$f_{\vec{w},b}(\vec{x}) \geq 0.5$ when?

$g(z) \geq 0.5$

$z \geq 0$

$\vec{w}\cdot\vec{x}+b \geq 0$

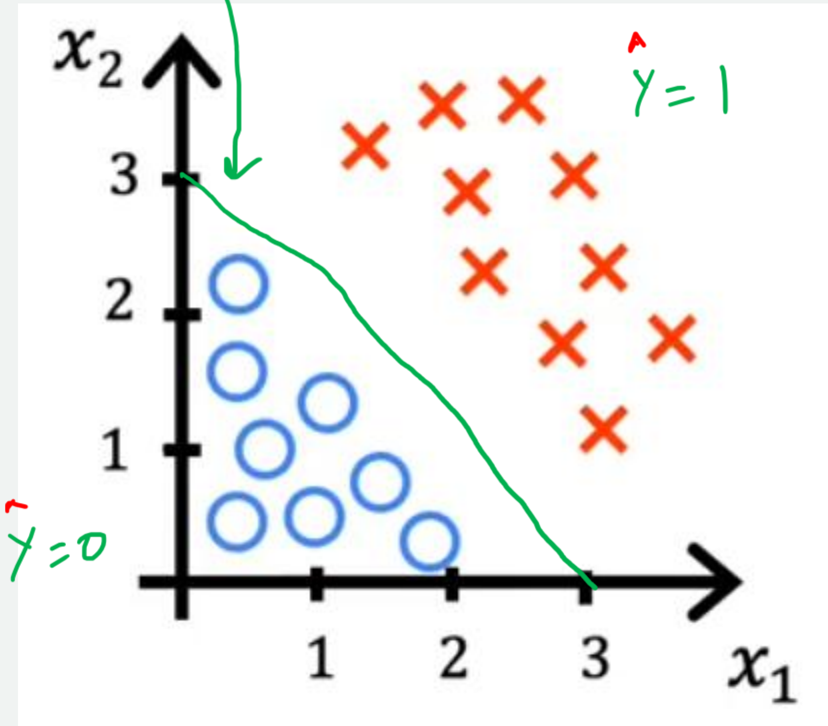
$f_{\vec{w},b}(\vec{x}) \geq 0.5$

Yes $\Rightarrow \hat{y}=1$ NO $\Rightarrow \hat{y}=0$

Decision Boundary

$f_{\vec{w},b}(\vec{x}) = g(z) = g(w_1 x_1 + w_2 x_2 + b)$

$\qquad\qquad\qquad\qquad\qquad\qquad\quad 1 \qquad\quad 1 \qquad -3$



$z = x_1 + x_2 - 3 = 0$

$x_1 + x_2 = 3$

Decision Boundary

$z = x_1^2 + x_2^2 - 1 = 0$

$\underline{x_1^2 + x_2^2 = 1}$