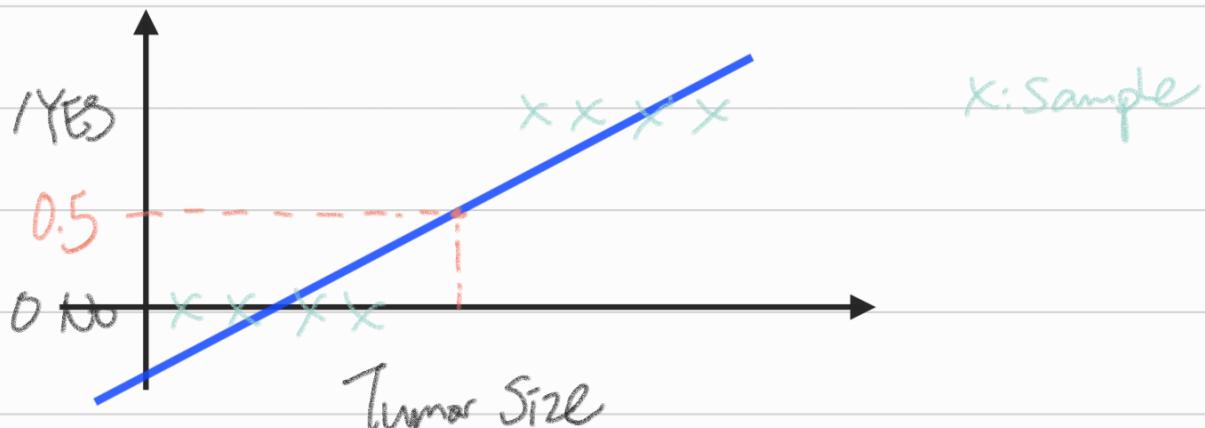


Classification

ex. Email (Spam / Not Spam), Online Transactions, Tumor...

$y \in \{0, 1\}$ 0: Negative 음성
1: Positive 양성 <이진 분류>



$$h_\theta(x) = \theta^T x$$

$h_\theta(x)$ 의 결과값이 0.5가 되는 곳에 수직 임계값 경계선
(threshold)

경계선 기준으로 크면 양성, 작으면 음성

If $h_\theta(x) \geq 0.5$, predict "y=1"

If $h_\theta(x) < 0.5$, predict "y=0"

향후적으로 흔히나 샘플 분포에 따라 악화된 모델

Thus, Not a good idea to use
Linear Regression on Classification Prob.

Classification: $y=0$ or 1

but $h_\theta(x)$ can be >1 or <0

* Logistic Regression: $0 \leq h_\theta(x) \leq 1$

Hypothesis Representation

Logistic Regression Model

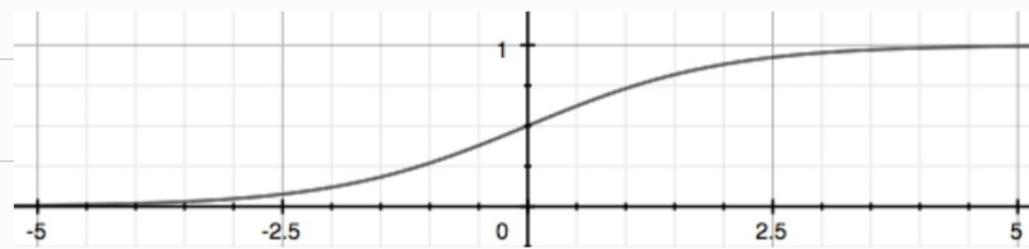
Want $0 \leq h_{\theta}(x) \leq 1$

$$h_{\theta}(x) = g(\theta^T x)$$

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

$$h_{\theta}(x) = \frac{1}{1+e^{-\theta^T x}}$$

Sigmoid function (Logistic function)



1로 수렴

0 으로 수렴

$h_{\theta}(x)$ = estimated probability that
 $y=1$ on input x

$$h_{\theta}(x) = P(y=1 | x; \theta)$$

"probability that $y=1$, given x , param by θ

$$y \geq 0 \text{ 일 가능성} = 1 - y \geq 1 \text{ 일 가능성}$$

ex. 양성 가능성) 70% 면 음성 가능성) 30%

Decision boundary

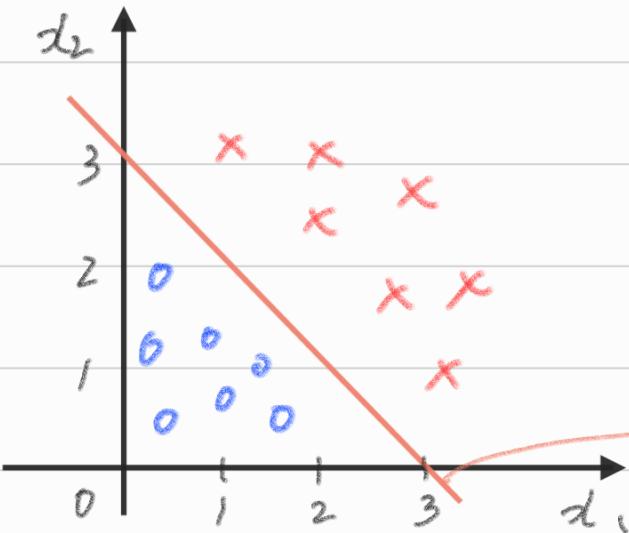
$$h_{\theta}(x) = g(\theta^T x), \quad g(z) = \frac{1}{1+e^{-z}}$$

$$h_{\theta}(x) \geq 0.5 \rightarrow y=1$$

$$h_{\theta}(x) < 0.5 \rightarrow y=0$$

$g(z) \geq 0.5$ when $z \geq 0$

$g(z) < 0.5$ when $z < 0$



$$y=1 \text{ if } z \geq 0,$$

$$-3x_1 + x_2 \geq 0$$

$$x_1 + x_2 \geq 3$$

$$x_1 + x_2 = 3$$

(Decision Boundary)

θ

$$h_{\theta}(x) = \theta_0 + \theta_1 x_1 + \theta_2 x_2$$

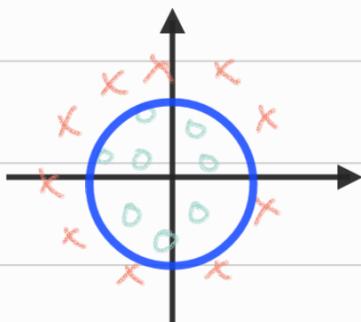
$$= 5 - x_1 + 0$$

$$y=1 \text{ if }$$

$$5 - x_1 \geq 0$$

$$5 \geq x_1$$

Non-linear decision boundaries



$$h_{\theta}(x) = g(\theta_0 + \theta_1 x_1 + \theta_2 x_2 + \theta_3 x_1^2 + \theta_4 x_2^2)$$

$$\begin{matrix} -1 & 0 & 0 \\ 1 & 1 \end{matrix}$$

$$\begin{matrix} 1 & 1 \end{matrix}$$

Predict $y=1$ if $g(z) \geq 0$

$$-1 + x_1^2 + x_2^2 \geq 0$$

$$\Rightarrow x_1^2 + x_2^2 \geq 1$$

\therefore Decision Boundary: $x_1^2 + x_2^2 = 1$

$$g(z) = \frac{1}{1+e^{-z}} \quad e^{-z} \geq 0 \therefore y=1$$

$$< 0 : y=0$$