

$$L(\theta) = -y \log g_{\theta}(x) - (1-y) \log(1 - g_{\theta}(x))$$

$$g_{\theta}(x) = \sigma(f_{\theta}(x)) \quad \sigma(z) = \frac{\exp(z)}{1 + \exp(z)}$$

$$f_{\theta}(x) = \theta^T \cdot x \quad = \frac{1}{1 + \exp(-z)}$$

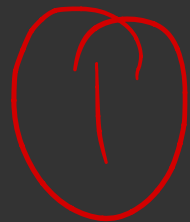
$$\frac{dL}{d\theta} = \frac{dL}{dg} \cdot \frac{dg}{df} \cdot \frac{df}{d\theta}$$

$$\frac{dL}{dg} = - \frac{y}{g_{\theta}(x)} + \frac{(1-y)}{1 - g_{\theta}(x)}$$

$$= \frac{-y(1 - g_{\theta}(x)) + (1-y)g_{\theta}(x)}{g_{\theta}(x) \cdot (1 - g_{\theta}(x))}$$

$$= \frac{g_{\theta}(x) - y}{g_{\theta}(x) \cdot (1 - g_{\theta}(x))}$$

$$\rightarrow g_{\theta}(x) \cdot (1 - g_{\theta}(x))$$



$$\frac{dg}{df} = \frac{\exp(f)}{(1 + \exp(f))^2}$$

$$g = \frac{1}{1 + \exp(-f)}$$

$$\Rightarrow g_{\theta}(x) \cdot (1 - g_{\theta}(x))$$

$$\exp(-f) = \frac{1}{g} - 1$$

$$\frac{df}{d\theta} = x^T$$

2

3

$$1 \times 2 \times 3 = [g_{\theta}(x) - y] \cdot x^T \checkmark$$

$x =$ $\begin{bmatrix} \text{how many minutes you exercise} \\ \text{apples you eat/day} \\ \text{cigarettes you smoke/day} \end{bmatrix}$

$y =$ $\begin{cases} 1 \rightarrow \text{cancer} \\ 0 \rightarrow \text{not cancer} \end{cases}$

$\theta = \begin{bmatrix} -1.4 \\ -1.2 \\ 1.3 \end{bmatrix}$

if we eat one more apple/day
risk of cancer reduced
by $\exp(+1.2)$

if we smoke one more cig
day
— increases by
 $\exp(-1.3)$

True

Predicted $y = -1$ $y = 1$
 $y = -1$ TN FN
 $\rightarrow y = 1$ FP TP

① Perfect $FP = FN = 0$

$$\text{Accuracy} = 1 = \frac{TN + TP}{N}$$

$$\text{Error} = 1 - \text{Acc} = 0$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{TP}{TP + 0} = 1$$

$$\text{Recall} = \frac{TP}{TP + \frac{FN}{0}} = 1$$

$$\text{TPR} = 1$$

$$\text{FPR} = 0$$

