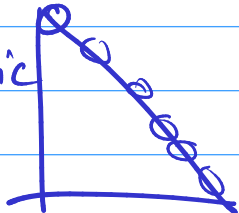


$$\begin{bmatrix} \quad \end{bmatrix}_{1 \times n} \begin{bmatrix} \quad \end{bmatrix}_{n \times n} \begin{bmatrix} \quad \end{bmatrix}_{n \times 1}$$

$$\begin{bmatrix} \quad \end{bmatrix}_{1 \times n} \begin{bmatrix} \quad \end{bmatrix}_{n \times 1} \quad \nabla E$$

$V \rightarrow \text{symmetric}$



$$\begin{bmatrix} 0 & x & y \\ x & 0 & x \\ y & x & 0 \end{bmatrix}$$

$$\left\lceil \frac{n}{2} \right\rceil \rightarrow \text{elements}$$

if  $E$  is continuous, differentiable  
 $E'$  is continuous, differentiable  
 @  $\omega = \bar{\omega}$

$$\sum t_n \ln y_n + (1 - t_n) \ln(1 - y_n)$$

$$\tanh = \frac{e^a - e^{-a}}{e^a + e^{-a}} = 2\sigma(2a) - 1$$

$$\frac{\tanh(a) + 1}{2} = \sigma(2a)$$

$$\sigma(2a) - (1 - \sigma(2a))$$

$$\tanh(a) = \sigma(2a) - \sigma(-2a)$$

2

$$-1 \leq \tanh(z) \leq 1$$

$$P(y=1/x) = \frac{1}{2}(1 + \tanh(z))$$

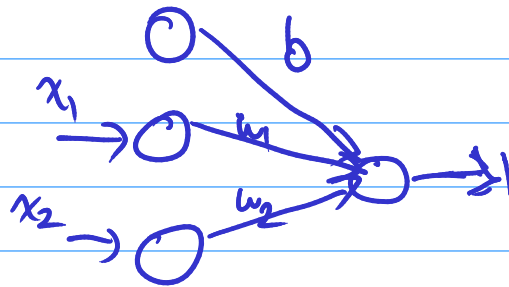
$$P(y=-1/x) = 1 - \frac{1}{2}(1 + \tanh(z))$$

$$\xrightarrow{\text{MLE}} \max = \left( \frac{1}{2}(1 + \tanh(z)) \right)^{\frac{1+y_i}{2}} \left( 1 - \frac{1}{2}(1 + \tanh(z)) \right)^{\frac{1-y_i}{2}}$$

$$\max \frac{1}{N} \left( \frac{1+y_i}{2} \log \left( \frac{1}{2}(1 + \tanh(z)) \right) + \left( \frac{1-y_i}{2} \right) \log \left( 1 - \frac{1}{2}(1 + \tanh(z)) \right) \right)$$

$$\min \sum_{i=1}^N \left( (1+y_i) \log \left( \frac{1}{2}(1 + \tanh(z)) \right) + (1-y_i) \log \left( 1 - \frac{1}{2}(1 + \tanh(z)) \right) \right) \frac{1}{N}$$

(3)



$$\left( X^T X \right)^{-1}_{D \times D} \left( X^T Y \right)_{D \times 1}$$

$$\begin{bmatrix} w_1 & \dots & w_n \end{bmatrix} \begin{bmatrix} x_1 + x_1^2 \\ x_2 + x_2^2 \\ \vdots \\ x_n + x_n^2 \end{bmatrix} + [w_0]$$

$$J = \frac{1}{2N} \sum (w^T x + b - y)^2 \quad \frac{\partial J}{\partial w_i} = \frac{1}{N} (w^T x + b - y) (x_i + x_i^2)$$

$$(5) \sigma(-a) = \frac{1}{1+e^a} = \frac{1}{1+\frac{1}{e^{-a}}} = \frac{e^{-a}}{1+e^{-a}} = \frac{1+e^{-a}-1}{1+e^{-a}} = 1 - \sigma(a)$$

$$y = \frac{1}{1+e^{-a}}$$

$$x = \frac{1}{y} - 1 = e^{-a}$$

$$\ln\left(\frac{1-y}{y}\right) = -a \quad \ln\left(\frac{y}{1-y}\right) = a$$

$$E(X) = -\frac{1}{n} \sum_{i=1}^n \left( y_i \log(\sigma(z)) + (1-y_i) \log(1-\sigma(z)) \right)$$

=

$$\frac{\tanh\left(\frac{a}{2}\right) + 1}{2} = \sigma(a) \quad \tanh(a) = 2\sigma(2a) - 1$$

$w \Rightarrow \frac{w}{2}$  ignoring bias outside & scaling up.