

CSE427 ASSIGNMENT 2

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SECTION: 01

$$\bar{y}_i = w_1 x_{i,1} + w_2 x_{i,2} + \dots + w_n x_{i,n} + b$$

$$\bar{y}_i = w x_i + b$$

$$w \rightarrow \{w_1, w_2, \dots, w_n\}$$

$$x_{i,j} \rightarrow \{x_{i,1}, x_{i,2}, \dots, x_{i,n}\}$$

$$(1) E = \frac{1}{m} \sum_{i=1}^m (y_i - \bar{y}_i)^2$$

$$E = \frac{1}{m} \sum_{i=1}^m (y_i - w x_{i,j} - b)^2$$

$$\frac{\partial E}{\partial w_i} = \frac{1}{m} \sum_{i=1}^m (2)(y_i - w x_{i,j} - b)(-x_{i,j}) = -\frac{2x_{i,j}}{m} \sum_{i=1}^m (y_i - w x_{i,j} - b)$$

$$\frac{\partial E}{\partial b} = \frac{1}{m} \sum_{i=1}^m (2)(y_i - w x_{i,j} - b)(-1) = -\frac{2}{m} \sum_{i=1}^m (y_i - w x_{i,j} - b)$$

$$(2) E = \sum_{i=1}^m (y_i - \bar{y}_i)^2$$

$$E = \sum_{i=1}^m (y_i - w x_{i,j} - b)^2$$

$$\frac{\partial E}{\partial w_i} = \sum_{i=1}^m (2)(y_i - w x_{i,j} - b)(-x_{i,j}) = -2x_{i,j} \sum_{i=1}^m (y_i - w x_{i,j} - b)$$

$$\frac{\partial E}{\partial b} = \sum_{i=1}^m (2)(y_i - w x_{i,j} - b)(-1) = -2 \sum_{i=1}^m (y_i - w x_{i,j} - b)$$

$$(3) E = \frac{1}{n} \sum_{i=1}^m (\log y_i - \log x_i)^2$$

$$E = \frac{1}{n} \sum_{i=1}^m (\log y_i - \log (w x_i - b))^2$$

$$\frac{\partial E}{\partial w_i} = \frac{1}{n} \sum_{i=1}^m (2) (\log y_i - \log (w x_i - b)) \left(\frac{-1}{w x_i - b} \right) (x_i)$$

$$= \frac{-2 x_i}{n (w x_i - b)} \sum_{i=1}^m (\log y_i - \log (w x_i - b))$$

$$\frac{\partial E}{\partial b} = \frac{1}{n} \sum_{i=1}^m (2) (\log y_i - \log (w x_i - b)) \left(\frac{-1}{w x_i - b} \right) (1)$$

$$= \frac{-2}{n (w x_i - b)} \sum_{i=1}^m (\log y_i - \log (w x_i - b))$$

$$(4) E = \frac{1}{n} \sum_{i=1}^m |y_i - \bar{y}_i|$$

$$E = \frac{1}{n} \sum_{i=1}^m |y_i - w x_i - b|$$

$$\frac{\partial E}{\partial w_i} = \frac{1}{n} \sum_{i=1}^m \frac{y_i - w x_i - b}{|y_i - w x_i - b|} (-x_i) = -\frac{x_i}{n} \sum_{i=1}^m \frac{y_i - w x_i - b}{|y_i - w x_i - b|}$$

$$\frac{\partial E}{\partial b} = \frac{1}{n} \sum_{i=1}^m \frac{y_i - w x_i - b}{|y_i - w x_i - b|} (-1) = -\frac{1}{n} \sum_{i=1}^m \frac{y_i - w x_i - b}{|y_i - w x_i - b|}$$

$$(b) E = \frac{1}{m} \sum_{i=1}^m \begin{cases} \frac{1}{2} (y_i - \bar{y}_i)^2, & \text{if } |y_i - \bar{y}_i| \leq \delta \\ \delta (|y_i - \bar{y}_i| - \frac{1}{2}\delta), & \text{if } |y_i - \bar{y}_i| > \delta \end{cases}$$

$$\text{if } |y_i - \bar{y}_i| \leq \delta,$$

$$E = \frac{1}{m} \sum_{i=1}^m \frac{1}{2} (y_i - \bar{y}_i)^2$$

$$E = \frac{1}{m} \sum_{i=1}^m \frac{1}{2} (y_i - \omega x_{i,j} - b)^2$$

$$\frac{\partial E}{\partial \omega_i} = \frac{1}{m} \sum_{i=1}^m \frac{1}{2} (2) (y_i - \omega x_{i,j} - b) (-x_{i,j}) = -\frac{x_{i,j}}{m} \sum_{i=1}^m (y_i - \omega x_{i,j} - b)$$

$$\frac{\partial E}{\partial b} = \frac{1}{m} \sum_{i=1}^m \frac{1}{2} (2) (y_i - \omega x_{i,j} - b) (-1) = -\frac{1}{m} \sum_{i=1}^m (y_i - \omega x_{i,j} - b)$$

$$\text{if } |y_i - \bar{y}_i| > \delta,$$

$$E = \frac{1}{m} \sum_{i=1}^m \delta |y_i - \bar{y}_i| - \frac{1}{2}\delta$$

$$E = \frac{1}{m} \sum_{i=1}^m \delta |y_i - \omega x_{i,j} - b| - \frac{1}{2}\delta$$

$$\frac{\partial E}{\partial \omega_i} = \frac{1}{m} \sum_{i=1}^m \delta \frac{(y_i - \omega x_{i,j} - b)}{|y_i - \omega x_{i,j} - b|} (-x_{i,j}) = -\frac{\delta x_{i,j}}{m} \sum_{i=1}^m \frac{y_i - \omega x_{i,j} - b}{|y_i - \omega x_{i,j} - b|}$$

$$\frac{\partial E}{\partial b} = \frac{1}{m} \sum_{i=1}^m \delta \frac{(y_i - \omega x_{i,j} - b)}{|y_i - \omega x_{i,j} - b|} (-1) = -\frac{\delta}{m} \sum_{i=1}^m \frac{y_i - \omega x_{i,j} - b}{|y_i - \omega x_{i,j} - b|}$$

$$(b) E = \frac{1}{m} \sum_{i=1}^m \log(\cosh(y_i - \bar{y}_i))$$

$$E = \frac{1}{m} \sum_{i=1}^m \log(\cosh(y_i - w k_{i,j} - b))$$

$$\frac{\partial E}{\partial w_i} = \frac{1}{m} \sum_{i=1}^m \frac{1}{\cosh(y_i - w k_{i,j} - b)} \sinh(y_i - w k_{i,j} - b) (-k_{i,j})$$

$$= -\frac{k_{i,j}}{m} \sum_{i=1}^m \tanh(y_i - w k_{i,j} - b)$$

$$\frac{\partial E}{\partial b} = \frac{1}{m} \sum_{i=1}^m \frac{1}{\cosh(y_i - w k_{i,j} - b)} \sinh(y_i - w k_{i,j} - b) (-1)$$

$$= -\frac{1}{m} \sum_{i=1}^m \tanh(y_i - w k_{i,j} - b)$$