Basics of Neural Network Programming

Vectorizing Logistic Regression

deeplearning.ai

Vectorizing Logistic Regression

$$z^{(1)} = \boxed{w^T x^{(1)} + b}$$
$$a^{(1)} = \sigma(z^{(1)})$$

$$z^{(2)} = \boxed{w^T x^{(2)} + b}$$
$$a^{(2)} = \sigma(z^{(2)})$$

$$z^{(3)} = w^T x^{(3)} + b$$
$$a^{(3)} = \sigma(z^{(3)})$$

$$X = \begin{bmatrix} | & | & & | \\ x^{(1)} & x^{(2)} & \cdots & x^{(m)} \\ | & | & & | \end{bmatrix}$$

(n_x, m)

$\mathbb{R}^{n_x \times m}$

$$[\text{———}] \quad w^T \begin{bmatrix} | & | & & | \\ x^{(1)} & x^{(2)} & \cdots & x^{(m)} \\ | & | & & | \end{bmatrix}$$

$$Z = \boxed{[z^{(1)} \; z^{(2)} \; \cdots \; z^{(m)}]} = \underbrace{w^T X + \underbrace{[b \; b \cdots b]}_{1\times m}} = \underbrace{[\boxed{w^T x^{(1)} + b} \quad \boxed{w^T x^{(2)} + b} \quad \cdots \quad w^T x^{(m)} + b]}_{1 \times m}$$

$$Z = \text{np.dot}(w.T, X) + b$$

$(1,1)$ $\mathbb{R}$

"Broadcasting"

$$A = [a^{(1)} \; a^{(2)} \; \cdots \; a^{(m)}] = \sigma(Z)$$

Andrew Ng

deeplearning.ai

Basics of Neural Network Programming

Vectorizing Logistic Regression’s Gradient Computation

Vectorizing Logistic Regression

$dz^{(1)} = a^{(1)} - y^{(1)}$ $\quad dz^{(2)} = a^{(2)} - y^{(2)}$ $\quad \cdots$

$$\boxed{dZ = [dz^{(1)} \; dz^{(2)} \cdots dz^{(m)}]} \leftarrow$$

$1 \times m$

$A = [a^{(1)} \cdots a^{(m)}]$, $\quad Y = [y^{(1)} \cdots y^{(m)}]$

$\rightarrow dZ = A - Y = [a^{(1)} - y^{(1)} \quad a^{(2)} - y^{(2)} \quad \cdots]$

$\rightarrow dw = 0$

$dw \mathrel{+}= x^{(1)} dz^{(1)}$

$dw \mathrel{+}= x^{(2)} dz^{(2)}$

$\vdots$

$dw \mathrel{/}= m$

$\cancel{dw_1}$

$\cancel{dw_2}$

$\vdots$

$db = 0$

$db \mathrel{+}= dz^{(1)}$

$db \mathrel{+}= dz^{(2)}$

$\vdots$

$db \mathrel{+}= dz^{(m)}$

$db \mathrel{/}= m.$

$$db = \frac{1}{m} \sum_{i=1}^{m} dz^{(i)}$$

$$= \frac{1}{m} \text{np.sum}(dZ)$$

$$\boxed{dw = \frac{1}{m} X dZ^T}$$

$$= \frac{1}{m} \begin{bmatrix} | & & | \\ x^{(1)} & \cdots & x^{(m)} \\ | & & | \end{bmatrix} \begin{bmatrix} dz^{(1)} \\ \vdots \\ dz^{(m)} \end{bmatrix}$$

$$= \frac{1}{m} \left[x^{(1)} dz^{(1)} + \cdots + x^{(m)} dz^{(m)} \right]$$

$n \times 1$

Andrew Ng

Implementing Logistic Regression

$J = 0, \; dw_1 = 0, \; dw_2 = 0, \; db = 0$

for i = 1 to m:

$$z^{(i)} = w^T x^{(i)} + b$$

$$a^{(i)} = \sigma(z^{(i)})$$

$$J \mathrel{+}= -[y^{(i)} \log a^{(i)} + (1 - y^{(i)}) \log(1 - a^{(i)})]$$

$$dz^{(i)} = a^{(i)} - y^{(i)}$$

$$dw_1 \mathrel{+}= x_1^{(i)} dz^{(i)}$$

$$dw_2 \mathrel{+}= x_2^{(i)} dz^{(i)}$$

$dw \mathrel{+}= x^{(i)} * dz^{(i)}$

$$db \mathrel{+}= dz^{(i)}$$

$J = J/m, \; dw_1 = dw_1/m, \; dw_2 = dw_2/m$

$db = db/m$

for iter in range(1000):

$Z = w^T X + b$

$= np.dot(w.T, X) + b$

$A = \sigma(Z)$

$dZ = A - Y$

$dw = \frac{1}{m} X dZ^T$

$db = \frac{1}{m} np.sum(dZ)$

$w := w - \alpha dw$

$b := b - \alpha db$