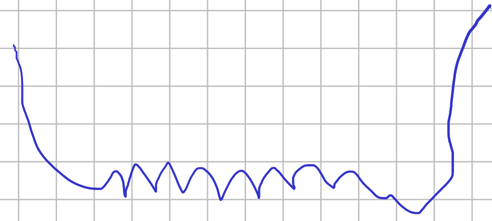
| id | Dry Weather | Low Temp | Homework Done | Team Members | Equipment | Ground | Played |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 4 | 0 | 1 | 0 | 1 | 1 | 1 | 0 |
| 5 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| 6 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |

| id | Dry Weather | Low Temp | Homework Done | Team Members | Equipment | Ground | Sum | Played |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 0 | 1 | 5 | 1 |
| 2 | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 1 |
| 3 | 1 | 1 | 1 | 1 | 1 | 1 | 6 | 1 |
| 4 | 0 | 1 | 0 | 1 | 1 | 1 | 4 | 0 |
| 5 | 0 | 0 | 1 | 1 | 1 | 0 | 3 | 0 |
| 6 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |

| id | Rains | Temp | Homework | Team Members | Equipment | Ground | Played |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 38 | 1 | 15 | 0 | 600 | 1 |
| 2 | 0 | 25 | 1 | 15 | 1 | 800 | 1 |
| 3 | 0 | 26 | 1 | 15 | 1 | 1000 | 1 |
| 4 | 5 | 27 | 1 | 10 | 1 | 600 | 0 |
| 5 | 20 | 23 | 0 | 8 | 1 | 1800 | 0 |
| 6 | 30 | 22 | 0 | 6 | 0 | 600 | 0 |

| Threshold | Team Members | | Ground | | Calculations | Likely | Played | Loss |
|---|---|---|---|---|---|---|---|---|
| w0 | x1 | w1 | x2 | w2 | w0+x1*w1+x2*w2 | (y_hat) | (y) | (y-y_hat)^2 |
| -1.00 | 1.00 | 1.10 | 1.00 | 1.00 | 1.10 | 1 | 1 | 0 |
| -1.00 | 1.00 | 1.10 | 0.83 | 1.00 | 0.93 | 1 | 1 | 0 |
| -1.00 | 1.00 | 1.10 | 0.67 | 1.00 | 0.77 | 1 | 1 | 0 |
| -1.00 | 0.44 | 1.10 | 1.00 | 1.00 | 0.49 | 1 | 0 | 1 |
| -1.00 | 0.22 | 1.10 | 0.00 | 1.00 | -0.76 | 0 | 0 | 0 |
| -1.00 | 0.00 | 1.10 | 1.00 | 1.00 | 0.00 | 1 | 0 | 1 |

Forward Pass

$\boxed{w_0, w_1, w_2}$

$\boxed{x_1}$ $\boxed{x_2}$

$\boxed{z = x_1 \cdot w_1 + x_2 \cdot w_2 + \cancel{w_0}\, b} \longrightarrow \boxed{\hat{y} = \sigma(z) = a} \longrightarrow \boxed{Loss(a, y)}$

Agg

fn

activation

$$Loss = -\left[y \cdot \log(a) + (1-y) \cdot \log(1-a)\right]$$

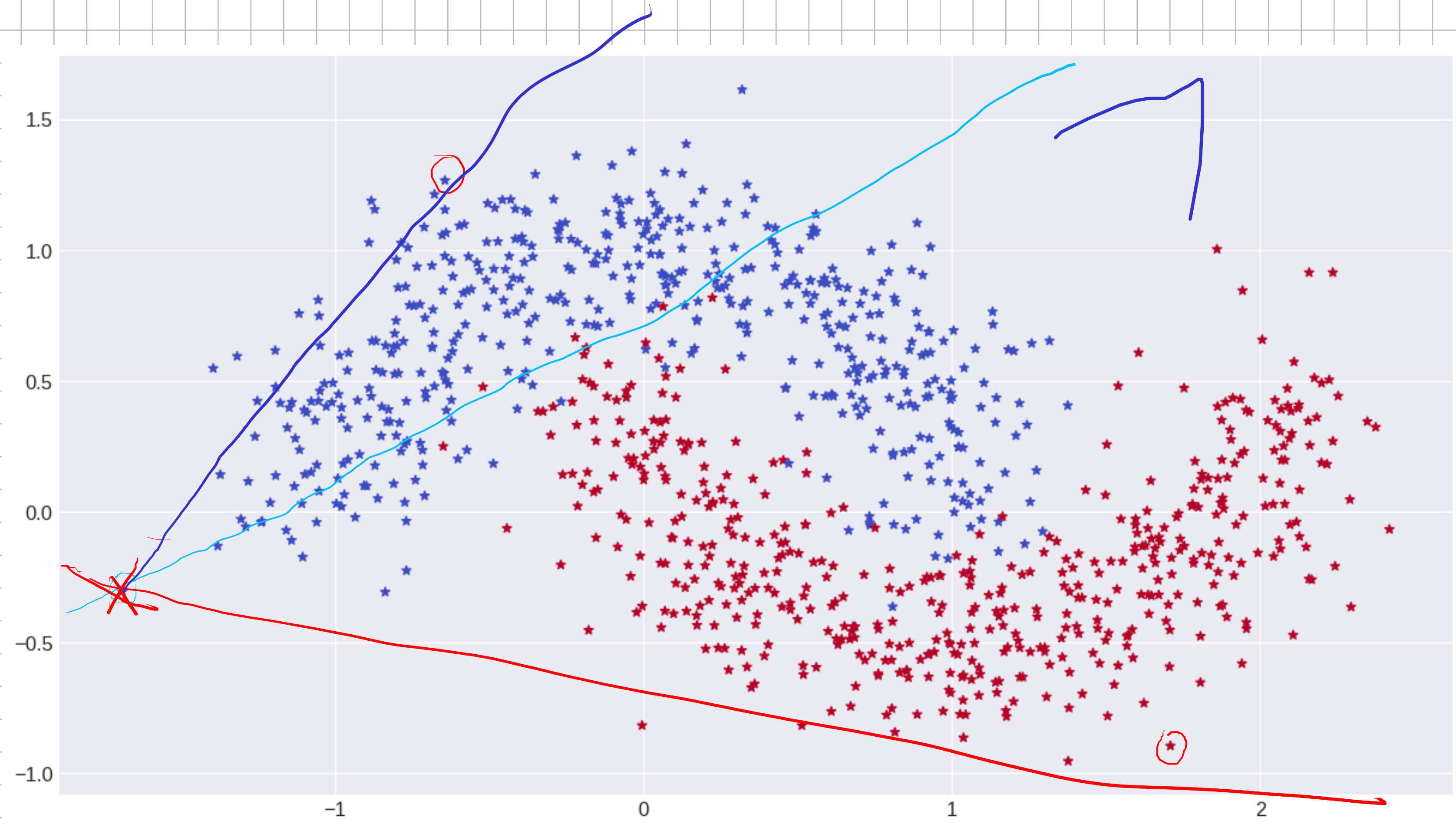
$$\frac{\partial Loss}{\partial z} = \frac{\partial Loss}{\partial a} \cdot \frac{\partial a}{\partial z}$$

$$\frac{\partial a}{\partial z} = \frac{\partial \sigma(z)}{\partial z} = \boxed{a \cdot (1-a)}$$

$$\frac{\partial Loss}{\partial a} = \boxed{-\frac{y}{a} + \frac{(1-y)}{(1-a)}}$$

$$a \cdot (1-a) \left[-\frac{y}{a} + \frac{(1-y)}{(1-a)}\right] = \boxed{(a-y) = \frac{\partial Loss}{\partial z}}$$

$$\frac{\partial Loss}{\partial w_1} = x_1 * \frac{\partial Loss}{\partial z} = x_1 \cdot (a-y)$$


1.5
1.0
0.5
0.0
−0.5
−1.0
−1
0
1
2

$$a = \sigma(z)$$
$$= \sigma[x_1 \cdot w_1 + x_2 \cdot w_2 + b)$$
$$= \sigma\left[ [x_1^{(0)}, x_2^{(0)}] \cdot \begin{bmatrix} w_1 \\ w_2 \end{bmatrix} + b \right]$$

$$a = \begin{bmatrix} \\ \\ \\ \end{bmatrix}_{m \times 1} \qquad y = \begin{bmatrix} \\ \\ \\ \end{bmatrix}$$

$$a = \sigma\left[ \begin{bmatrix} x_1^0 , & x_2^0 \\ x_1^1 , & x_2^1 \\ x_1^2 , & x_2^2 \\ \vdots & \\ x_1^m , & x_2^m \end{bmatrix}_{(m,2)} \cdot \begin{bmatrix} w_1 \\ w_2 \end{bmatrix}_{(2,1)} + b \right]$$

b — Scale

$$dz = [a - y]_{m\times1} \qquad dw = \begin{bmatrix} \\ \end{bmatrix}_{2\times1}$$

$$X_{m,2}^T \times dz$$

$$\frac{\partial Loss}{\partial w_1} = dw_1 = x_1 \cdot (a-y)$$

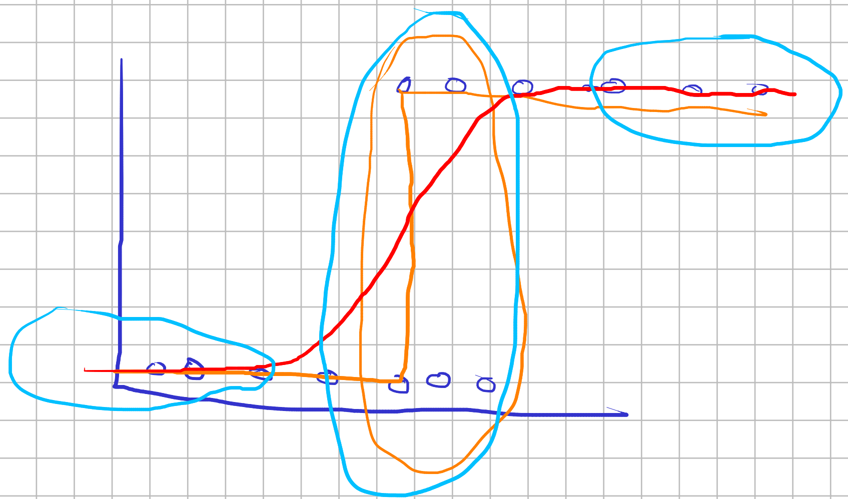
$$dw_2 = x_2 \cdot (a-y)$$

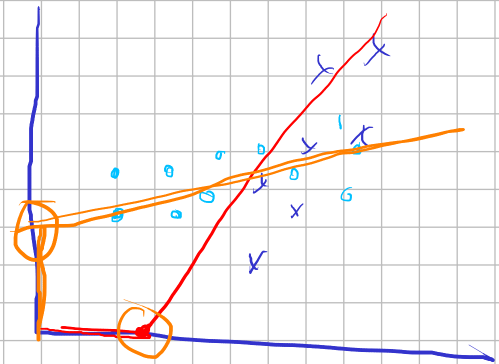
$$dw_0 = db = (a-y)$$

$$w_1 = w_1 - \alpha \, dw_1$$ Learning Rate

$$w_2 = w_2 - \alpha \, dw_2$$

$$b = b - \alpha \, db$$



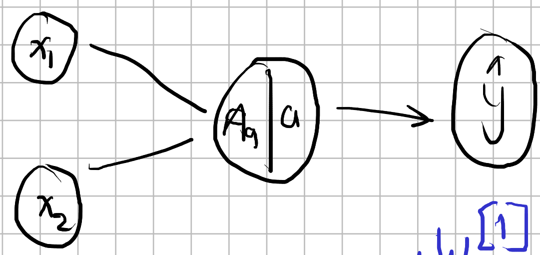


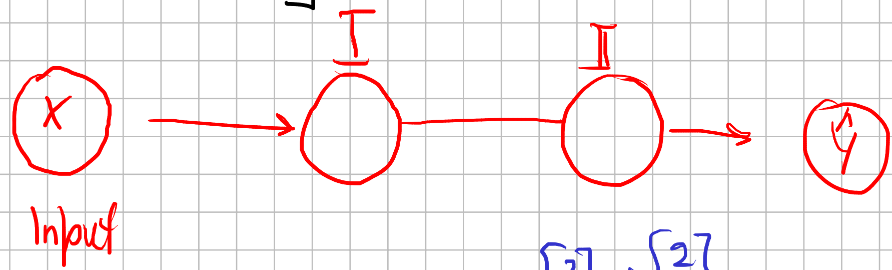
$y = 1 \rightarrow \hat{y} \approx 1.0$

$y = 0 \rightarrow \hat{y} \approx 0$

$$= \hat{y}^{(y)} \cdot (1-\hat{y})^{(1-y)}$$

$$a = \sigma\left[X_{(m,2)} \cdot W_{(2,1)} + b_{(1,1)}\right]$$




$$\begin{tikzcd} & W^{[1]}, b^{[1]} \arrow[d] & a^{[1]} & W^{[2]}, b^{[2]} \arrow[d] & \\ \boxed{X} \arrow[r] & \boxed{Z_1} \arrow[r] & \boxed{g(z_1)} \arrow[r] & \boxed{Z_2} \arrow[r] & \boxed{\sigma(z_2)} \end{tikzcd}$$

$$a^{[1]} = g\left(X_{m,2} \cdot W^{[1]}_{2,1} + b^{[1]}_{(1,1)}\right)$$

$$a^{[2]} = \sigma\left(a^{[1]} \cdot W^{[2]} + b^{[2]}\right)$$

$$\text{Cost} = y \cdot \log\left(a^{[2]}\right)$$

$X$

$W$

$b$

$$\text{Cost} = f(w, b)$$

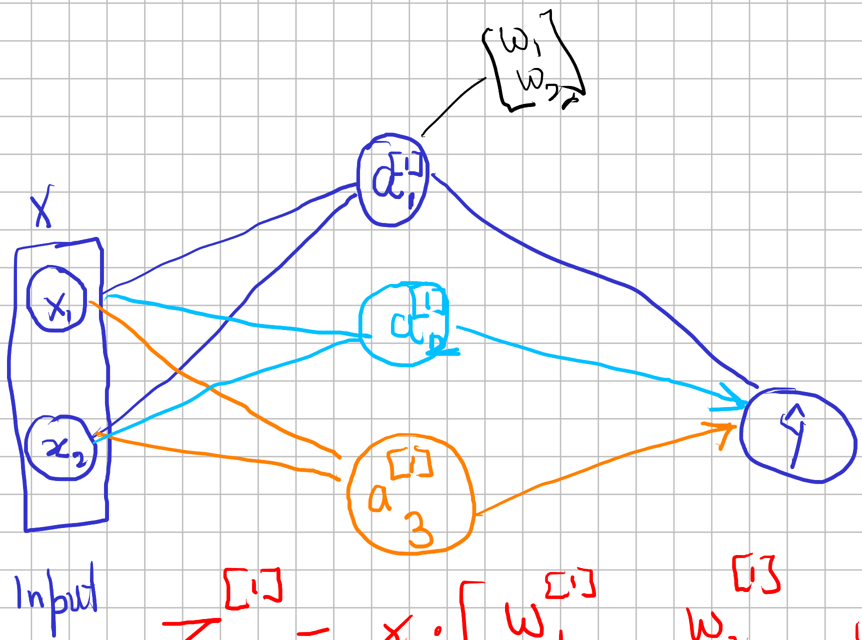
$$dz^{[1]} = \frac{\partial \text{Loss}}{\partial z^{[1]}} = \boxed{\frac{\partial \text{Loss}}{\partial z^{[2]}} \cdot \frac{\partial z^{[2]}}{\partial a^{[1]}}} \cdot \boxed{\frac{\partial a^{[1]}}{\partial z^{[1]}}}$$

$$g'\left(z^{[1]}\right)$$

$$x \rightarrow z^{[1]} \rightarrow a^{[1]} \rightarrow z^{[2]} \rightarrow a^{[2]} \rightarrow \text{Loss}(a^{[2]}, y)$$

$$dz^{[1]} = da^{[1]} \cdot g'(z^{[1]})$$
$$dw^{[1]} = x.T \; dz^{[1]}$$
$$db^{[1]} = dz^{[1]}$$
$$dx$$

$$dz^{[2]} = a^{[2]} - y$$
$$dw^{[2]} = a^{[1]}.T \; dz^{[2]}$$
$$db^{[2]} = dz^{[2]}$$
$$da^{[1]} = dz^{[2]} \cdot w^{[2]}.T$$




$$z_1^{[1]} = x . W_1^{[1]} + b_1^{[1]}$$
$$z_2^{[1]} = x \, W_2^{[1]} + b_2^{[1]}$$
$$z_3^{[1]} = x . W_3^{[1]} + b_3^{[1]}$$

$$Z^{[1]} = x \cdot \left[ W_1^{[1]}, W_2^{[1]}, W_3^{[1]} \;----\; W_n^{[1]} \right] + \left[ b_1^{[1]}, b_2^{[1]}, b_3^{[1]} \;---\; b_n^{[1]} \right]$$

$$\begin{bmatrix} w_1 \\ w_2 \end{bmatrix}_1^{[1]}, \begin{bmatrix} w_1 \\ w_2 \end{bmatrix}_2^{[1]}, \begin{bmatrix} w_1 \\ w_2 \end{bmatrix}_3^{[1]}$$

$$Z_n^{[1]} = x \, W_n^{[1]} + b_n^{[1]}$$

$$\underbrace{Z^{[1]}_{(m,3)} = X_{(m,2)} \cdot W^{[1]}_{(2,3)}} + b^{[1]}_{(1,3)}$$

$$a^{[1]}_{(m,3)}$$

$$Z^{[2]} = a^{[1]}_{(m,3)} \times W^{[2]}_{(3,1)} + b^{[2]}_{(1,1)}$$

$$a^{[2]} = \sigma\left[z^{[2]}\right)$$

$$\text{Loss} = f_1\left(a^{[2]}\right)$$

$$= f_2\left(z^{[2]}\right)$$

$$= f_3\left[a^{[1]}\right]$$

$$= f_4\left[z^{[1]}\right]$$

$$= f_5\left[x\right]$$

$$\frac{\partial \text{Loss}}{\partial z^{[1]}} = \frac{\partial \text{Loss}}{\partial z^{[2]}} \cdot \frac{\partial z^{[2]}}{\partial a^{[1]}} \cdot \frac{\partial a^{[1]}}{\partial z^{[1]}}$$

$$dz = \begin{bmatrix} \updownarrow \end{bmatrix} \; m,,$$

II

$$dz^{[2]} = a^{[2]} - y$$

$$dW^{[2]} = \frac{1}{m} \cdot a^{[1]}.T \cdot dz^{[2]}$$

$$db^{[2]} = \frac{1}{m} \cdot \text{np.Sum}(dz^{[2]}, \text{axis}=0, \text{keepdims}=\text{True})$$

I

$$dz^{[1]} = dz^{[2]} \cdot W^{[2]}.T * g'(a^{[1]})$$

$$dW^{[1]} = \frac{1}{m} \cdot X.T \cdot dz^{[1]}$$

$$db^{[1]} = \frac{1}{m} \cdot \text{np.Sum}(dz^{[1]}, \text{axis}=0\ \text{keepdims}=\text{True})$$