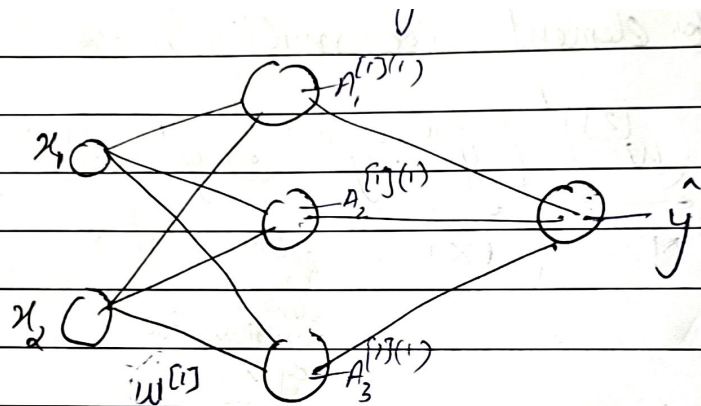


8



$$X = \begin{bmatrix} 0.5 = x_1 \\ 0.3 = x_2 \end{bmatrix}$$

$$w^{[1]} \in \mathbb{R}^{3 \times 2}$$

$$b^{[1]} \in \mathbb{R}^{3 \times 1}$$

$$w^{[2]} \in \mathbb{R}^{1 \times 3}$$

$$b^{[2]} \in \mathbb{R}^{1 \times 1}$$

Randomly initialize  $w^{[1]}$  with nos b/w -1 & 1  
& not 0,0 (it will create a problem)

$$w^{[1]} = \begin{bmatrix} 0.2 & 0.4 \\ 0.1 & 0.3 \\ 0.5 & -0.2 \end{bmatrix} \text{ will be given in exam.}$$

$$b^{[1]} = \begin{bmatrix} 0.1 \\ -0.1 \\ 0.05 \end{bmatrix} \quad w^{[2]} = \begin{bmatrix} 0.3 & -0.2 & 0.4 \end{bmatrix}$$

$$b^{[2]} = \begin{bmatrix} -0.2 \end{bmatrix}$$

Target  $\rightarrow$  get new value of  $w$  from old values.

$$z^{[1]}(1) = w^{[1]} x^{(1)} + b^{[1]}$$

$$= \begin{bmatrix} 0.2 & 0.4 \\ 0.1 & 0.3 \\ 0.5 & -0.2 \end{bmatrix}_{3 \times 2} \begin{bmatrix} 0.5 \\ 0.3 \end{bmatrix}_{2 \times 1} + \begin{bmatrix} 0.1 \\ -0.1 \\ 0.05 \end{bmatrix}_{3 \times 1}$$

$$= \begin{bmatrix} 0.22 \\ 0.14 \\ 0.19 \end{bmatrix} + \begin{bmatrix} 0.1 \\ -0.1 \\ 0.05 \end{bmatrix} = \begin{bmatrix} 0.32 \\ 0.04 \\ 0.24 \end{bmatrix}_{3 \times 1}$$

$$A^{[1]}(1) = \sigma(z^{[1]}(1)) = \sigma \begin{bmatrix} 0.32 \\ 0.04 \\ 0.24 \end{bmatrix} = \begin{bmatrix} \sigma(0.32) \\ \sigma(0.04) \\ \sigma(0.24) \end{bmatrix}$$

$$= \begin{bmatrix} \frac{1}{1+e^{-(0.32)}} \\ \frac{1}{1+e^{-(0.04)}} \\ \frac{1}{1+e^{-(0.24)}} \end{bmatrix} = \begin{bmatrix} 0.579 \\ 0.510 \\ 0.559 \end{bmatrix}_{0.560}$$



$$z^{[2]}(1) = w^{[2]} A^{[1]}(1) + b^{[2]}$$

$$= \begin{bmatrix} 0.3 & -0.2 & 0.4 \end{bmatrix}_{1 \times 3} \begin{bmatrix} 0.579 \\ 0.510 \\ 0.560 \end{bmatrix}_{3 \times 1} + \begin{bmatrix} -0.2 \end{bmatrix}$$

$$= \begin{bmatrix} 0.1737 + (-0.102) + 0.224 \end{bmatrix}$$

$$= \begin{bmatrix} 0.2957 \end{bmatrix} + \begin{bmatrix} -0.2 \end{bmatrix}$$

$$= 0.0957$$

$$A^{[2]}(1) = a(z^{[2]}(1))$$

$$= a(0.0957) = \frac{1}{1 + e^{-(0.0957)}}$$

$$\hat{y} = 0.0524 \quad (\text{it is not close to 1 (our goal)})$$

Now =

So now

$$\begin{aligned} d z^{[2]}(1) &= A^{[2]}(1) - y \\ &= 0.0524 - 1 = -0.9476 \end{aligned}$$

$$\begin{aligned} d w^{[2]} &= d(z^{[2]}(1)) (A^{[1]}(1))^T \\ &= -0.9476 \begin{bmatrix} 0.579 & 0.510 & 0.560 \end{bmatrix} \end{aligned}$$

$$\frac{\partial L^{(1)}}{\partial w^{[2]}} = d w^{[2]} = \begin{bmatrix} -0.275 & -0.243 & -0.267 \end{bmatrix}$$



$$d b^{[2]} = d z^{[2](1)} = (-0.476)$$

$$d w^{[2]} = (w^{[2]})^T \cdot d z^{[2](1)} \odot a'(z^{[1]}) (x^{(1)})^T$$

$$= \begin{bmatrix} 0.3 \\ -0.2 \\ 0.4 \end{bmatrix} (-0.476) \odot \begin{bmatrix} a(0.32)(1-a(0.32)) \\ a(0.04)(1-a(0.04)) \\ a(0.24)(1-a(0.24)) \end{bmatrix} \begin{bmatrix} 0.5 & 0.3 \end{bmatrix}$$

$$= \begin{bmatrix} -0.1428 \\ 0.0952 \\ -0.1904 \end{bmatrix} \odot \begin{bmatrix} \frac{1}{1+e^{-(0.32)}} \left(1 - \frac{1}{1+e^{-(0.32)}}\right) \\ \frac{1}{1+e^{-(0.04)}} \left(1 - \frac{1}{1+e^{-(0.04)}}\right) \\ \frac{1}{1+e^{-(0.24)}} \left(1 - \frac{1}{1+e^{-(0.24)}}\right) \end{bmatrix} \begin{bmatrix} 0.5 & 0.3 \end{bmatrix}$$

$$= \begin{bmatrix} -0.1428 \\ 0.0952 \\ -0.1904 \end{bmatrix} \odot \begin{bmatrix} 0.579(1-0.579) \\ 0.510(1-0.510) \\ 0.560(1-0.560) \end{bmatrix} \begin{bmatrix} 0.5 & 0.3 \end{bmatrix}$$

$$= \begin{bmatrix} -0.1428 \\ 0.0952 \\ -0.1904 \end{bmatrix} \odot \begin{bmatrix} 0.244 \\ 0.250 \\ 0.246 \end{bmatrix} \begin{bmatrix} 0.5 & 0.3 \end{bmatrix}$$

3x1                      3x1                      1x2

$$= \begin{bmatrix} -0.0348 \\ 0.0238 \\ -0.0468 \end{bmatrix} \begin{bmatrix} 0.5 & 0.3 \end{bmatrix}$$

3x1                      1x2

$$= \begin{bmatrix} -0.0175 & 0.0105 \\ 0.0120 & 0.0072 \\ -0.0235 & 0.0141 \end{bmatrix}$$



$$\delta b^{[1]} = (w^{[2]})' (\hat{y}^{(2)} - y^{(1)}) \odot g'(z^{[1]})$$

$$= \begin{bmatrix} 0.3 \\ -0.2 \\ 0.4 \end{bmatrix} (-0.476) \odot a(z^{[1]})$$

$$= \begin{bmatrix} -0.0348 \\ 0.0238 \\ -0.0468 \end{bmatrix}$$

$$w^{[1]} = w^{[1]} - \alpha \delta w^{[1]}$$

