



$$W_{(3*4)}^1 = \begin{bmatrix} w_{11}^1 & w_{12}^1 & w_{13}^1 & w_{14}^1 \\ w_{21}^1 & w_{22}^1 & w_{23}^1 & w_{24}^1 \\ w_{31}^1 & w_{32}^1 & w_{33}^1 & w_{34}^1 \end{bmatrix}$$

$$W_{(4*2)}^2 = \begin{bmatrix} w_{11}^2 & w_{12}^2 \\ w_{21}^2 & w_{22}^2 \\ w_{31}^2 & w_{32}^2 \\ w_{41}^2 & w_{42}^2 \end{bmatrix}$$

$$W_{(2*3)}^3 = \begin{bmatrix} w_{11}^3 & w_{12}^3 & w_{13}^3 \\ w_{21}^3 & w_{23}^3 & w_{24}^3 \end{bmatrix}$$

$$b_{(1*4)}^1 = [b_1^1 \quad b_2^1 \quad b_3^1 \quad b_4^1]$$

$$b_{(1*2)}^2 = [b_1^2 \quad b_2^2]$$

$$b_{(1*3)}^3 = [b_1^3 \quad b_2^3 \quad b_3^3]$$

Forward:

Layer 1

$$\begin{aligned} Z_{(1*4)}^1 &= [z_1^1 \quad z_2^1 \quad z_3^1 \quad z_4^1] \\ &= X_{(1*3)} W_{(3*4)}^1 + b_{(1*4)}^1 \\ &= [x_1 \quad x_2 \quad x_3 \quad x_4] \begin{bmatrix} w_{11}^1 & w_{12}^1 & w_{13}^1 & w_{14}^1 \\ w_{21}^1 & w_{22}^1 & w_{23}^1 & w_{24}^1 \\ w_{31}^1 & w_{32}^1 & w_{33}^1 & w_{34}^1 \end{bmatrix} + [b_1^1 \quad b_2^1 \quad b_3^1 \quad b_4^1] \\ Y_{(1*4)}^1 &= [y_1^1 \quad y_2^1 \quad y_3^1 \quad y_4^1] = A^1(Z_{(1*4)}^1) \\ &= [A^1(z_1^1) \quad A^1(z_2^1) \quad A^1(z_3^1) \quad A^1(z_4^1)] \end{aligned}$$

Layer 2

$$\begin{aligned} Z_{(1*2)}^2 &= [z_1^2 \quad z_2^2] \\ &= Y_{(1*4)}^1 W_{(4*2)}^2 + b_{(1*2)}^2 \\ &= [y_1^1 \quad y_2^1 \quad y_3^1 \quad y_4^1] \begin{bmatrix} w_{11}^2 & w_{12}^2 \\ w_{21}^2 & w_{22}^2 \\ w_{31}^2 & w_{32}^2 \\ w_{41}^2 & w_{42}^2 \end{bmatrix} + [b_1^2 \quad b_2^2] \\ Y_{(1*2)}^2 &= [y_1^2 \quad y_2^2] = A^2(Z_{(1*2)}^2) \\ &= [A^2(z_1^2) \quad A^2(z_2^2)] \end{aligned}$$

Layer 3

$$Z_{(1*3)}^3 = [z_1^3 \quad z_2^3 \quad z_3^3]$$

$$\begin{aligned}
 &= Y_{(1*2)}^2 W_{(2*3)}^3 + b_{(1*3)}^3 \\
 &= \begin{bmatrix} y_1^2 & y_2^2 \end{bmatrix} \begin{bmatrix} w_{11}^3 & w_{12}^3 & w_{13}^3 \\ w_{21}^3 & w_{23}^3 & w_{24}^3 \end{bmatrix} + \begin{bmatrix} b_1^3 & b_2^3 & b_3^3 \end{bmatrix} \\
 Y_{(1*3)}^3 &= \begin{bmatrix} y_1^3 & y_2^3 & y_3^3 \end{bmatrix} = A^2(Z_{(1*3)}^3) \\
 &= \begin{bmatrix} A^2(z_1^3) & A^2(z_2^3) & A^2(z_3^3) \end{bmatrix}
 \end{aligned}$$

Loss Function

$$L(Y_{(1*3)}^3) = L(y_1^3, y_2^3, y_3^3) = y_1^3 + y_2^3 + y_3^3$$