

$$W^1_{(3*4)} = \begin{bmatrix} w^1_{11} & w^1_{12} & w^1_{13} & w^1_{14} \\ w^1_{21} & w^1_{22} & w^1_{23} & w^1_{24} \\ w^1_{31} & w^1_{32} & w^1_{33} & w^1_{34} \end{bmatrix} \qquad W^2_{(4*2)} = \begin{bmatrix} w^2_{11} & w^2_{12} \\ w^2_{21} & w^2_{22} \\ w^2_{31} & w^2_{32} \\ w^2_{41} & w^2_{22} \end{bmatrix} \qquad W^3_{(2*3)} = \begin{bmatrix} w^3_{11} & w^3_{12} & w^3_{13} \\ w^3_{21} & w^3_{23} & w^3_{24} \end{bmatrix}$$

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

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

$$b^1_{(1*4)} = egin{bmatrix} b^1_1 & b^1_2 & b^1_3 & b^1_4 \end{bmatrix}$$

$$b_{(1*2)}^2 = \begin{bmatrix} b_1^2 & b_2^2 \end{bmatrix}$$

$$b^3_{(1*3)} = egin{bmatrix} b^3_1 & b^3_2 & b^3_3 \end{bmatrix}$$

Forware: Layer 1

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

Layer 2

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

Layer 3

$$Z^3_{(1*3)} = egin{bmatrix} z_1^3 & z_2^3 & z_3^3 \end{bmatrix}$$

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

Loss Function

$$L(Y^3_{(1*3)}) = L(y^3_1, y^3_2, y^3_3) = y^3_1 + y^3_2 + y^3_3$$