

 $C_0 = \frac{1}{2} \left\{ \left(a_1^l - y_1 \right)^2 + \left(a_2^l - y_2 \right)^2 + \left(a_3^l - y_3 \right)^2 + \left(a_4^l - y_4 \right)^2 + \left(a_5^l - y_5 \right)^2 \right\}$

 $\frac{\partial C_0}{\partial w_{34}^{l-1}} = \delta_3^{L-1} \left(a_4^{l-2} \right)$

 $\frac{d^{l-1}}{dt} = \sigma \left(a_1^{l-2} w_{11}^{l-1} + a_2^{l-2} w_{12}^{l-1} + a_3^{l-2} w_{13}^{l-1} + \frac{a_4^{l-2}}{4} w_{14}^{l-1} + a_5^{l-2} w_{15}^{l-1} + b_1^{l-1} \right)$ $a_{2}^{l-1} = \sigma \left(a_{1}^{l-2} w_{21}^{l-1} + a_{2}^{l-2} w_{22}^{l-1} + a_{3}^{l-2} w_{23}^{l-1} + a_{4}^{l-2} w_{24}^{l-1} + a_{5}^{l-2} w_{25}^{l-1} + b_{2}^{l-1} \right)$ $a_3^{l-1} = \sigma \left(a_1^{l-2} w_{31}^{l-1} + a_2^{l-2} w_{32}^{l-1} + a_3^{l-2} w_{33}^{l-1} + a_4^{l-2} w_{34}^{l-1} + a_5^{l-2} w_{35}^{l-1} + b_3^{l-1} \right)$ $a_{4}^{l-1} = \sigma \left(a_{1}^{l-2} w_{41}^{l-1} + a_{2}^{l-2} w_{42}^{l-1} + a_{3}^{l-2} w_{43}^{l-1} + a_{4}^{l-2} w_{44}^{l-1} + a_{5}^{l-2} w_{45}^{l-1} + b_{4}^{l-1} \right)$ $\frac{a_5^{l-1}}{a_5^{l-1}} = \sigma \left(a_1^{l-2} w_{51}^{l-1} + a_2^{l-2} w_{52}^{l-1} + a_3^{l-2} w_{53}^{l-1} + \frac{a_4^{l-2}}{a_4^{l-2}} w_{54}^{l-1} + a_5^{l-2} w_{55}^{l-1} + b_5^{l-1} \right)$ $a_{1}^{l-2} = \sigma \left(a_{1}^{l-3} w_{11}^{l-2} + a_{2}^{l-3} w_{12}^{l-2} + a_{3}^{l-3} w_{13}^{l-2} + a_{4}^{l-3} w_{14}^{l-2} + a_{5}^{l-3} w_{15}^{l-2} + b_{1}^{l-2} \right)$ $a_2^{l-2} = \sigma \left(a_1^{l-3} w_{21}^{l-2} + a_2^{l-3} w_{22}^{l-2} + a_3^{l-3} w_{23}^{l-2} + a_4^{l-3} w_{24}^{l-2} + a_5^{l-3} w_{25}^{l-2} + b_2^{l-1} \right)$ $a_3^{l-2} = \sigma \left(a_1^{l-3} w_{31}^{l-2} + a_2^{l-3} w_{32}^{l-2} + a_3^{l-3} w_{33}^{l-2} + a_4^{l-3} w_{34}^{l-2} + a_5^{l-3} w_{35}^{l-2} + b_3^{l-2} \right)$

 $C_0 = \frac{1}{2} \left\{ \left(a_1^l - y_1 \right)^2 + \left(a_2^l - y_2 \right)^2 + \left(a_3^l - y_3 \right)^2 + \left(a_4^l - y_4 \right)^2 + \left(a_5^l - y_5 \right)^2 \right\}$

 $\frac{\partial C_{0}}{\partial w_{34}^{l-1}} = \begin{pmatrix} w_{13}^{l} \\ w_{23}^{l} \\ w_{33}^{l} \\ w_{43}^{l} \\ w_{53}^{l} \end{pmatrix}^{T} \cdot \begin{bmatrix} a_{1}^{l} - y_{1} \\ a_{2}^{l} - y_{2} \\ a_{3}^{l} - y_{3} \\ a_{4}^{l} - y_{4} \\ a_{5}^{l} - y_{5} \end{bmatrix} \odot \begin{pmatrix} \sigma' \left(z_{1}^{l} \right) \\ \sigma' \left(z_{2}^{l} \right) \\ \sigma' \left(z_{3}^{l} \right) \\ \sigma' \left(z_{4}^{l} \right) \\ \sigma' \left(z_{5}^{l} \right) \end{bmatrix} \mathbf{1} \left[\sigma' \left(z_{3}^{l-1} \right) \left(a_{4}^{l-2} \right) \right]$

 $\frac{\partial C_0}{\partial w_{34}^{l-1}} = \left[w_{33}^l \right] \cdot \delta^L \left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right]$

 $\frac{\partial C_0}{\partial w_{34}^{l-1}} = \frac{\partial C_{01}}{\partial a_1^l} \frac{\partial a_1^l}{\partial z_1^l} \frac{\partial z_1^l}{\partial a_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial w_{34}^{l-1}} + \frac{\partial C_{01}}{\partial a_2^l} \frac{\partial a_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial w_{34}^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial w_{34}^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial w_{34}^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial w_{34}^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial w_{34}^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial w_{34}^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial w_{34}^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial z_3^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial z_3^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial z_3^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial z_3^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial z_3^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial z_3^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial z_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l$

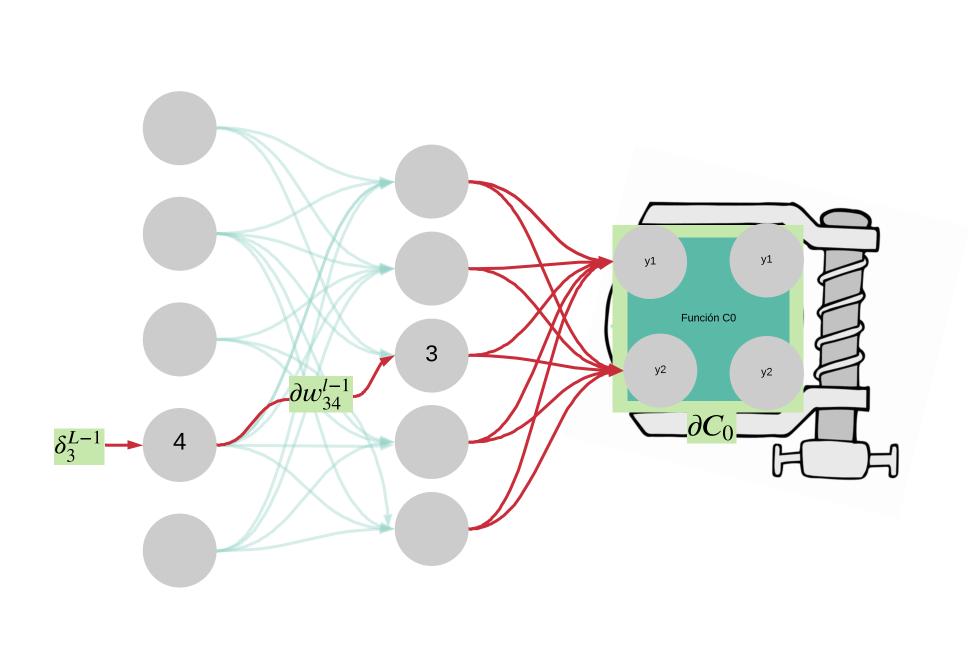
 $\frac{\partial C_0}{\partial w_{34}^{l-1}} = \frac{\partial C_{01}}{\partial a_1^l} \frac{\partial a_1^l}{\partial z_1^l} \frac{\partial z_1^l}{\partial a_3^{l-1}} \frac{\partial a_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_2^{l-1}}{\partial w_{34}^{l-1}} + \frac{\partial C_{01}}{\partial a_2^l} \frac{\partial a_2^l}{\partial z_2^l} \frac{\partial z_3^{l-1}}{\partial a_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial w_{34}^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^l}{\partial z_3^l} \frac{\partial z_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial w_{34}^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^l}{\partial z_3^l} \frac{\partial z_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial w_{34}^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^l}{\partial z_3^l} \frac{\partial z_3^{l-1}}{\partial z_3^{l-1}} \frac{\partial z_3^{l-1}}{\partial w_{34}^{l-1}} + \frac{\partial C_{01}}{\partial a_3^l} \frac{\partial a_3^l}{\partial z_3^l} \frac{\partial z_3^l}{\partial z_3^l} \frac{\partial z_3^l}{\partial z_3^l} + \frac{\partial z_3^l}{\partial z_3^l} + \frac{\partial z_3^l}{\partial z_3^l} \frac{\partial z_3^l}{\partial z_3^l$

 $\frac{\partial C_0}{\partial w_{34}^{l-1}} = \left[\left(a_1^l - y_1 \right) \left(w_{13}^l \right) \sigma' \left(z_1^l \right) + \left(a_2^l - y_2 \right) \right. \\ \left. \left(w_{23}^l \right) \sigma' \left(z_2^l \right) + \left(a_3^l - y_3 \right) \right. \\ \left. \left(w_{33}^l \right) \sigma' \left(z_3^l \right) + \left(a_4^l - y_4 \right) \right. \\ \left. \left(w_{43}^l \right) \sigma' \left(z_4^l \right) + \left(a_5^l - y_5 \right) \right. \\ \left. \left(w_{53}^l \right) \sigma' \left(z_5^l \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a_4^{l-2} \right) \right] \right] \left[\left[\sigma' \left(z_3^{l-1} \right) \left(a$

 $a_4^{l-2} = \sigma \left(a_1^{l-3} w_{41}^{l-2} + a_2^{l-3} w_{42}^{l-2} + a_3^{l-3} w_{43}^{l-2} + a_4^{l-3} w_{44}^{l-2} + a_5^{l-3} w_{45}^{l-2} + b_4^{l-2} \right)$

 $a_5^{l-2} = \sigma \left(a_1^{l-3} w_{51}^{l-2} + a_2^{l-3} w_{52}^{l-2} + a_3^{l-3} w_{53}^{l-2} + a_4^{l-3} w_{54}^{l-2} + a_5^{l-3} w_{55}^{l-2} + b_5^{l-2} \right)$

 $\delta^{L-1} = \left(\left\{ \overrightarrow{w^L} \right\} \cdot \left\{ \overrightarrow{\delta^L} \right\} \right) \odot \left[\sigma' \left(z^{l-1} \right) \right]$



$$\frac{\partial C_0}{\partial w_{34}^{l-1}} = \delta_3^{L-1} \left(a_4^{l-2} \right)$$

 $C_0 = \frac{1}{2} \left\{ \left(a_1^l - y_1 \right)^2 + \left(a_2^l - y_2 \right)^2 + \left(a_3^l - y_3 \right)^2 + \left(a_4^l - y_4 \right)^2 + \left(a_5^l - y_5 \right)^2 \right\}$

 $\frac{\partial C_{01}}{\partial w_{34}^{l-2}} = \frac{\partial C_{01}}{\partial a_5^l} \frac{\partial a_5^l}{\partial z_5^l} \left(\frac{\partial z_5^l}{\partial a_1^{l-1}} \frac{\partial a_1^{l-1}}{\partial z_1^{l-1}} \frac{\partial z_1^{l-1}}{\partial a_3^{l-2}} \frac{\partial a_3^{l-2}}{\partial z_3^{l-2}} \frac{\partial z_2^{l-1}}{\partial z_3^{l-2}} \frac{\partial a_3^{l-2}}{\partial z_3^{l-2}} \frac{\partial z_3^{l-2}}{\partial z_3^{l-2}} + \frac{\partial z_5^l}{\partial a_3^{l-2}} \frac{\partial a_3^{l-2}}{\partial z_3^{l-2}} \frac{\partial z_3^{l-2}}{\partial z_3^{l-2}} \frac{\partial z_3^{l-2}}{\partial$

 $\frac{\partial z_5^l}{\partial a_2^{l-1}} \frac{\partial a_2^{l-1}}{\partial z_2^{l-1}} \frac{\partial z_2^{l-1}}{\partial a_3^{l-2}} \frac{\partial a_3^{l-2}}{\partial w_{34}^{l-2}} = (w_{52}^l) \sigma' (z_2^{l-1}) (w_{23}^{l-1}) \sigma' (z_3^{l-2}) (a_4^{l-3})$ $\frac{\partial z_{1}^{l}}{\partial a_{1}^{l-1}} \frac{\partial a_{1}^{l-1}}{\partial z_{1}^{l-1}} \frac{\partial z_{1}^{l-1}}{\partial a_{3}^{l-2}} \frac{\partial a_{3}^{l-2}}{\partial z_{3}^{l-2}} \frac{\partial z_{3}^{l-2}}{\partial w_{34}^{l-2}} = (w_{11}^{l}) \sigma' (z_{1}^{l-1}) (w_{13}^{l-1}) \sigma' (z_{3}^{l-2}) (a_{4}^{l-3})$

 $\frac{\partial C_{01}}{\partial w_{34}^{l-2}} = \left(a_1^l - y_1\right)\sigma'\left(z_1^l\right)\left[\left(w_{11}^l\right)\sigma'\left(z_1^{l-1}\right)\left(w_{13}^{l-1}\right) + \left(w_{12}^l\right)\sigma'\left(z_2^{l-1}\right)\left(w_{23}^{l-1}\right) + \left(w_{13}^l\right)\sigma'\left(z_3^{l-1}\right)\left(w_{33}^{l-1}\right) + \left(w_{14}^l\right)\sigma'\left(z_4^{l-1}\right)\left(w_{43}^{l-1}\right) + \left(w_{15}^l\right)\sigma'\left(z_5^{l-1}\right)\left(w_{53}^{l-1}\right)\right]\sigma'\left(z_3^{l-2}\right) \left(a_4^{l-3}\right)$ $\frac{\partial C_{01}}{\partial w_{34}^{l-2}} = \left(a_2^l - y_2\right)\sigma'\left(z_2^l\right)\left[\left(w_{21}^l\right)\sigma'\left(z_1^{l-1}\right)\left(w_{13}^{l-1}\right) + \left(w_{22}^l\right)\sigma'\left(z_2^{l-1}\right)\left(w_{23}^{l-1}\right) + \left(w_{23}^l\right)\sigma'\left(z_3^{l-1}\right)\left(w_{33}^{l-1}\right) + \left(w_{24}^l\right)\sigma'\left(z_4^{l-1}\right)\left(w_{43}^{l-1}\right) + \left(w_{25}^l\right)\sigma'\left(z_5^{l-1}\right)\left(w_{53}^{l-1}\right)\right]\sigma'\left(z_3^{l-2}\right) \left(a_4^{l-3}\right)$ $\frac{\partial C_{02}}{\partial w_{24}^{l-2}} = \left(a_3^l - y_3\right)\sigma'\left(z_3^l\right)\left[\left(w_{31}^l\right)\sigma'\left(z_1^{l-1}\right)\left(w_{13}^{l-1}\right) + \left(w_{32}^l\right)\sigma'\left(z_2^{l-1}\right)\left(w_{23}^{l-1}\right) + \left(w_{33}^l\right)\sigma'\left(z_3^{l-1}\right)\left(w_{33}^{l-1}\right) + \left(w_{34}^l\right)\sigma'\left(z_4^{l-1}\right)\left(w_{43}^{l-1}\right) + \left(w_{35}^l\right)\sigma'\left(z_5^{l-1}\right)\left(w_{53}^{l-1}\right)\right]\sigma'\left(z_3^{l-2}\right) \left(a_4^{l-3}\right)$ $\frac{\partial C_{03}}{\partial w_{34}^{l-2}} = \left(a_4^l - y_4\right)\sigma'\left(z_4^l\right)\left[\left(w_{41}^l\right)\sigma'\left(z_1^{l-1}\right)\left(w_{13}^{l-1}\right) + \left(w_{42}^l\right)\sigma'\left(z_2^{l-1}\right)\left(w_{23}^{l-1}\right) + \left(w_{43}^l\right)\sigma'\left(z_3^{l-1}\right)\left(w_{33}^{l-1}\right) + \left(w_{44}^l\right)\sigma'\left(z_4^{l-1}\right)\left(w_{43}^{l-1}\right) + \left(w_{45}^l\right)\sigma'\left(z_5^{l-1}\right)\left(w_{53}^{l-1}\right)\right]\sigma'\left(z_3^{l-2}\right) \left(a_4^{l-3}\right)$ $\frac{\partial C_{05}}{\partial w_{34}^{l-2}} = \left(a_5^l - y_5\right)\sigma'\left(z_5^l\right)\left[\left(w_{51}^l\right)\sigma'\left(z_{11}^{l-1}\right)\left(w_{13}^{l-1}\right) + \left(w_{52}^l\right)\sigma'\left(z_{21}^{l-1}\right)\left(w_{23}^{l-1}\right) + \left(w_{53}^l\right)\sigma'\left(z_{31}^{l-1}\right)\left(w_{33}^{l-1}\right) + \left(w_{54}^l\right)\sigma'\left(z_{41}^{l-1}\right)\left(w_{43}^{l-1}\right) + \left(w_{55}^l\right)\sigma'\left(z_{51}^{l-1}\right)\left(w_{53}^{l-1}\right)\left(a_{41}^{l-1}\right) + \left(a_{41}^l\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right) + \left(a_{42}^l\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right) + \left(a_{42}^l\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right) + \left(a_{42}^l\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right) + \left(a_{42}^l\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right) + \left(a_{42}^l\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right) + \left(a_{42}^l\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right) + \left(a_{42}^l\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right) + \left(a_{42}^l\right)\left(a_{42}^{l-1}\right)\left(a_{42}^{l-1}\right) + \left(a_{42}^l\right)\left(a_{42}^{l-1}\right) + \left(a_{42}^l\right)\left(a_{42}^{l-1}\right) + \left(a_{42}^l\right)\left(a_{42}^l\right) + \left(a_{42}^l$

 $\frac{\partial C_{01}}{\partial w_{34}^{l-2}} = \delta_1^l \left[\left(w_{11}^l \right) \sigma' \left(z_1^{l-1} \right) \left(w_{13}^{l-1} \right) + \left(w_{12}^l \right) \sigma' \left(z_2^{l-1} \right) \left(w_{23}^{l-1} \right) + \left(w_{13}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{14}^l \right) \sigma' \left(z_4^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{15}^l \right) \sigma' \left(z_5^{l-1} \right) \left(w_{53}^{l-1} \right) \left(a_4^{l-3} \right) - \left(a_4^{l-3} \right) \left(a_4^{l-3} \right) \left(a_4^{l-1} \right) \left($

- $\frac{\partial C_{01}}{\partial w_{34}^{l-2}} = \delta_2^l \left[\left(w_{21}^l \right) \sigma' \left(z_1^{l-1} \right) \left(w_{13}^{l-1} \right) + \left(w_{22}^l \right) \sigma' \left(z_2^{l-1} \right) \left(w_{23}^{l-1} \right) + \left(w_{23}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{24}^l \right) \sigma' \left(z_4^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{25}^l \right) \sigma' \left(z_5^{l-1} \right) \left(w_{53}^{l-1} \right) \left(a_4^{l-3} \right) \right]$
- $\frac{\partial C_{02}}{\partial w_{34}^{l-2}} = \delta_3^l \left[\left(w_{31}^l \right) \sigma' \left(z_1^{l-1} \right) \left(w_{13}^{l-1} \right) + \left(w_{32}^l \right) \sigma' \left(z_2^{l-1} \right) \left(w_{23}^{l-1} \right) + \left(w_{33}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{34}^l \right) \sigma' \left(z_4^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{53}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{53}^{l-1} \right) \left($
- $\frac{\partial C_{03}}{\partial w_{34}^{l-2}} = \delta_4^l \left[\left(w_{41}^l \right) \sigma' \left(z_1^{l-1} \right) \left(w_{13}^{l-1} \right) + \left(w_{42}^l \right) \sigma' \left(z_2^{l-1} \right) \left(w_{23}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{44}^l \right) \sigma' \left(z_4^{l-1} \right) \left(w_{45}^{l-1} \right) + \left(w_{53}^l \right) \left(w_{53}^{l-1} \right) \left(a_4^{l-3} \right) + \left(w_{42}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{42}^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{42}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left(z_3^{l-1} \right) + \left(w_{43}^l \right) \sigma' \left$
- $\frac{\partial C_{05}}{\partial w_{34}^{l-2}} = \delta_5^l \left[\left(w_{51}^l \right) \sigma' \left(z_1^{l-1} \right) \left(w_{13}^{l-1} \right) + \left(w_{52}^l \right) \sigma' \left(z_2^{l-1} \right) \left(w_{23}^{l-1} \right) + \left(w_{53}^l \right) \sigma' \left(z_3^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{54}^l \right) \sigma' \left(z_4^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{55}^l \right) \sigma' \left(z_5^{l-1} \right) \left(w_{53}^{l-1} \right) \left(a_4^{l-3} \right) + \left(a_{45}^l \right) \left(a_{45}^{l-1} \right) \left(a_{45$

 $\left[\left(w_{11}^{l} \right) \sigma' \left(z_{1}^{l-1} \right) \left(w_{13}^{l-1} \right) + \left(w_{12}^{l} \right) \sigma' \left(z_{2}^{l-1} \right) \left(w_{23}^{l-1} \right) + \left(w_{13}^{l} \right) \sigma' \left(z_{3}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{14}^{l} \right) \sigma' \left(z_{4}^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{15}^{l} \right) \sigma' \left(z_{5}^{l-1} \right) \left(w_{53}^{l-1} \right) \right] \right] \\ \left[\left(w_{21}^{l} \right) \sigma' \left(z_{1}^{l-1} \right) \left(w_{13}^{l-1} \right) + \left(w_{22}^{l} \right) \sigma' \left(z_{2}^{l-1} \right) \left(w_{23}^{l-1} \right) + \left(w_{23}^{l} \right) \sigma' \left(z_{3}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{24}^{l} \right) \sigma' \left(z_{4}^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{53}^{l} \right) \sigma' \left(z_{5}^{l-1} \right) \left(w_{53}^{l-1} \right) \right] \right] \\ \left[\left(w_{31}^{l} \right) \sigma' \left(z_{1}^{l-1} \right) \left(w_{13}^{l-1} \right) + \left(w_{32}^{l} \right) \sigma' \left(z_{2}^{l-1} \right) \left(w_{23}^{l-1} \right) + \left(w_{33}^{l} \right) \sigma' \left(z_{3}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{34}^{l} \right) \sigma' \left(z_{4}^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{43}^{l-1} \right) \sigma' \left(z_{5}^{l-1} \right) \left(w_{53}^{l-1} \right) \right] \right] \right] \left[\left[\sigma' \left(z_{3}^{l-2} \right) \left(w_{23}^{l-1} \right) + \left(w_{33}^{l} \right) \sigma' \left(z_{3}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{34}^{l} \right) \sigma' \left(z_{4}^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{35}^{l} \right) \sigma' \left(z_{5}^{l-1} \right) \left(w_{53}^{l-1} \right) \right] \right] \right] \left[\left[\sigma' \left(z_{3}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{34}^{l-1} \right) \sigma' \left(z_{4}^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{35}^{l-1} \right) \sigma' \left(z_{5}^{l-1} \right) \left(w_{53}^{l-1} \right) \right] \right] \left[\left[\sigma' \left(z_{3}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{34}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{35}^{l-1} \right) \sigma' \left(z_{5}^{l-1} \right) \left(w_{53}^{l-1} \right) \right] \right] \left[\left[\sigma' \left(z_{3}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{34}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{35}^{l-1} \right) \left(w_{35}^{l-1} \right) + \left(w_{35}^{l-1} \right) \left(w_{35}^{l-1} \right) \right] \right] \left[\left[\sigma' \left(z_{3}^{l-1} \right) \left(w_{35}^{l-1} \right) + \left(w_{35}^{l-1} \right) \left(w_{35}^{l-1} \right) \right] \right] \left[\left[\left(w_{31}^{l-1} \right) \left(w_{35}^{l-1} \right) + \left(w_{35}^{l-1} \right)$ $\left[\left(w_{41}^{l}\right)\sigma'\left(z_{1}^{l-1}\right)\left(w_{13}^{l-1}\right)+\left(w_{42}^{l}\right)\sigma'\left(z_{2}^{l-1}\right)\left(w_{23}^{l-1}\right)+\left(w_{43}^{l}\right)\sigma'\left(z_{3}^{l-1}\right)\left(w_{33}^{l-1}\right)+\left(w_{44}^{l}\right)\sigma'\left(z_{4}^{l-1}\right)\left(w_{43}^{l-1}\right)+\left(w_{45}^{l}\right)\sigma'\left(z_{5}^{l-1}\right)\left(w_{53}^{l-1}\right)\right]$ $\left(\left[\left(w_{51}^{l}\right)\sigma'\left(z_{1}^{l-1}\right)\left(w_{13}^{l-1}\right)+\left(w_{52}^{l}\right)\sigma'\left(z_{2}^{l-1}\right)\left(w_{23}^{l-1}\right)+\left(w_{53}^{l}\right)\sigma'\left(z_{3}^{l-1}\right)\left(w_{33}^{l-1}\right)+\left(w_{54}^{l}\right)\sigma'\left(z_{4}^{l-1}\right)\left(w_{43}^{l-1}\right)+\left(w_{55}^{l}\right)\sigma'\left(z_{5}^{l-1}\right)\left(w_{53}^{l-1}\right)\right]\right)$

 $\left(\left[\left(w_{11}^{l}\right)\sigma'\left(z_{1}^{l-1}\right)\left(w_{13}^{l-1}\right)+\left(w_{12}^{l}\right)\sigma'\left(z_{2}^{l-1}\right)\left(w_{23}^{l-1}\right)+\left(w_{13}^{l}\right)\sigma'\left(z_{3}^{l-1}\right)\left(w_{33}^{l-1}\right)+\left(w_{14}^{l}\right)\sigma'\left(z_{4}^{l-1}\right)\left(w_{43}^{l-1}\right)+\left(w_{15}^{l}\right)\sigma'\left(z_{5}^{l-1}\right)\left(w_{53}^{l-1}\right)\right]\right)$ $\left[\left(w_{21}^{l}\right)\sigma'\left(z_{1}^{l-1}\right)\left(w_{13}^{l-1}\right)+\left(w_{22}^{l}\right)\sigma'\left(z_{2}^{l-1}\right)\left(w_{23}^{l-1}\right)+\left(w_{23}^{l}\right)\sigma'\left(z_{3}^{l-1}\right)\left(w_{33}^{l-1}\right)+\left(w_{24}^{l}\right)\sigma'\left(z_{4}^{l-1}\right)\left(w_{43}^{l-1}\right)+\left(w_{25}^{l}\right)\sigma'\left(z_{5}^{l-1}\right)\left(w_{53}^{l-1}\right)\right]$ $\left[\left(\delta_{1}^{l} \ \delta_{2}^{l} \ \delta_{3}^{l} \ \delta_{4}^{l} \ \delta_{5}^{l} \right) \cdot \right] \left[\left(w_{31}^{l} \right) \sigma' \left(z_{1}^{l-1} \right) \left(w_{13}^{l-1} \right) + \left(w_{32}^{l} \right) \sigma' \left(z_{2}^{l-1} \right) \left(w_{23}^{l-1} \right) + \left(w_{33}^{l} \right) \sigma' \left(z_{3}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{34}^{l} \right) \sigma' \left(z_{4}^{l-1} \right) \left(w_{43}^{l-1} \right) + \left(w_{53}^{l} \right) \sigma' \left(z_{3}^{l-1} \right) \left(w_{53}^{l-1} \right) \right] \left[\left[\sigma' \left(z_{3}^{l-2} \right) \left(w_{23}^{l-1} \right) + \left(w_{32}^{l} \right) \sigma' \left(z_{3}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{33}^{l} \right) \sigma' \left(z_{3}^{l-1} \right) \left(w_{53}^{l-1} \right) \right] \right] \left[\left[\sigma' \left(z_{3}^{l-2} \right) \left(w_{33}^{l-1} \right) + \left(w_{33}^{l} \right) \sigma' \left(z_{3}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{33}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{33}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{33}^{l-1} \right) \left(w_{33}^{l-1} \right) \left(w_{33}^{l-1} \right) + \left(w_{33}^{l-1} \right) + \left(w_{33}^{l-1} \right) \left(w_{33}^{l-1} \right)$ $\left[\left(w_{41}^{l}\right)\sigma'\left(z_{1}^{l-1}\right)\left(w_{13}^{l-1}\right)+\left(w_{42}^{l}\right)\sigma'\left(z_{2}^{l-1}\right)\left(w_{23}^{l-1}\right)+\left(w_{43}^{l}\right)\sigma'\left(z_{3}^{l-1}\right)\left(w_{33}^{l-1}\right)+\left(w_{44}^{l}\right)\sigma'\left(z_{4}^{l-1}\right)\left(w_{43}^{l-1}\right)+\left(w_{45}^{l}\right)\sigma'\left(z_{5}^{l-1}\right)\left(w_{53}^{l-1}\right)\right]$ $\left[\left(w_{51}^{l}\right)\sigma'\left(z_{1}^{l-1}\right)\left(w_{13}^{l-1}\right)+\left(w_{52}^{l}\right)\sigma'\left(z_{2}^{l-1}\right)\left(w_{23}^{l-1}\right)+\left(w_{53}^{l}\right)\sigma'\left(z_{3}^{l-1}\right)\left(w_{33}^{l-1}\right)+\left(w_{54}^{l}\right)\sigma'\left(z_{4}^{l-1}\right)\left(w_{43}^{l-1}\right)+\left(w_{55}^{l}\right)\sigma'\left(z_{5}^{l-1}\right)\left(w_{53}^{l-1}\right)\right]\right]$

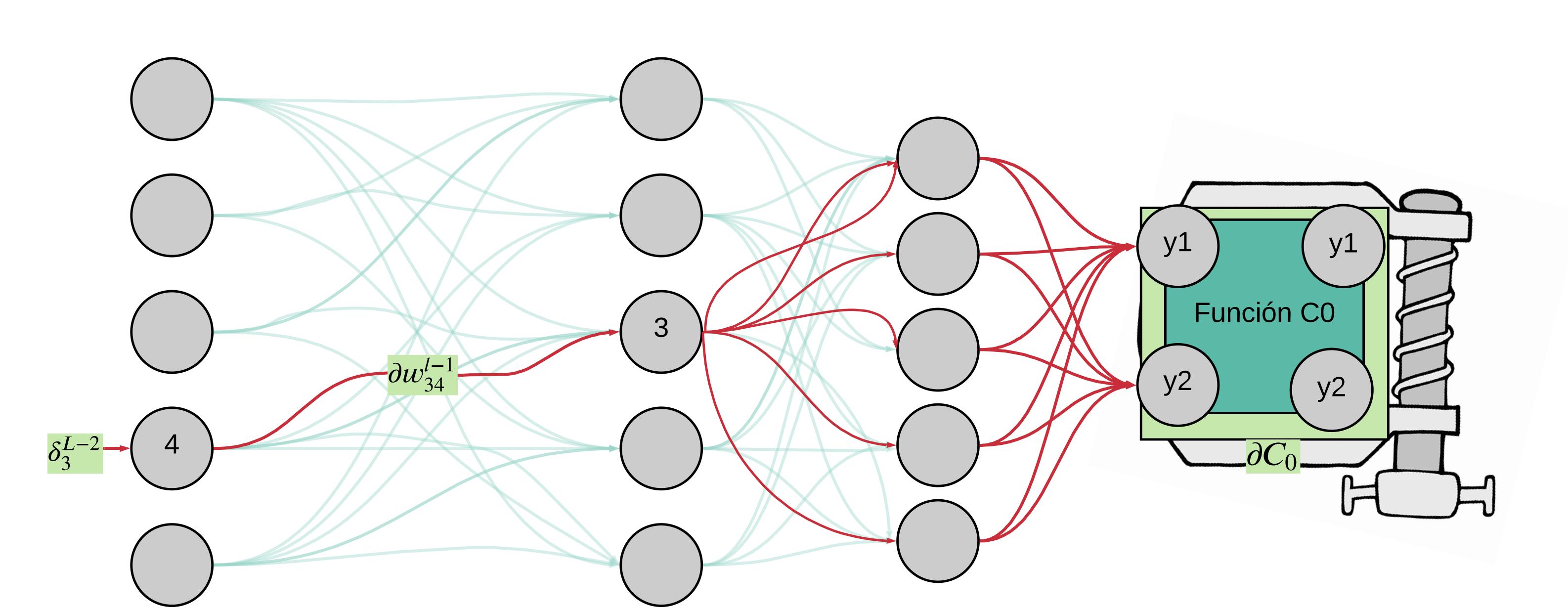
 $\left[\left[w_3^{l-1} \right]^T \cdot \left\{ \left[\left(w^l \right)^T \cdot \delta^l \right] \odot \sigma'(z^{l-1}) \right\} \right] \left[\sigma' \left(z_3^{l-2} \right) \left(a_4^{l-3} \right) \right]$

 $\left[\left(w_3^{l-1}\right)^T\cdot\left\{\delta^{l-1}\right\}\right]\sigma'\left(z_3^{l-2}\right)\left(a_4^{l-3}\right)$

 $\{\delta_3^{l-2}\}\ (a_4^{l-3})$

$$\delta_3^{L-2} = \left[\left(w_3^{l-1} \right)^T \cdot \left\{ \delta^{l-1} \right\} \right] \sigma' \left(z_3^{l-2} \right)$$

$$\delta^{L-2} = \left[\left(w^{l-1} \right)^T \cdot \left\{ \delta^{l-1} \right\} \right] \sigma' \left(z^{l-2} \right)$$



 $\delta_2^L = \left(a_2^l - y_2\right) \sigma' \left(z_2^l\right)$

$$\delta^L = \left[\left(\overrightarrow{a_L} - \overrightarrow{y_L} \right) \odot \sigma' \left(z^L \right) \right]$$

$$\delta_3^{L-1} = \begin{pmatrix} w_{13}^l \\ w_{23}^l \\ w_{33}^l \\ w_{43}^l \\ w_{53}^l \end{pmatrix}^T \cdot \delta^L \left[\sigma' \left(z_3^{l-1} \right) \right]$$

$$\delta^{L-1} = \left(\left\{ \overrightarrow{w^L} \right\} \cdot \left\{ \overrightarrow{\delta^L} \right\} \right) \odot \left[\sigma' \left(z^{l-1} \right) \right]$$

$$\delta_3^{L-2} = \left[\left(w_3^{l-1} \right)^T \cdot \left\{ \delta^{l-1} \right\} \right] \sigma' \left(z_3^{l-2} \right)$$

$$\delta^{L-2} = \left[\left(w^{l-1} \right)^T \cdot \left\{ \delta^{l-1} \right\} \right] \sigma' \left(z^{l-2} \right)$$