

# Backpropagation Equations

Leon Tepe

## 1 Component form

$$\frac{\partial C}{\partial b_j^l} = \delta_j^l \quad (1)$$

$$\frac{\partial C}{\partial w_{jk}^l} = a_k^{l-1} \delta_j^l \quad (2)$$

## 2 Vector form

$$\delta^L = \nabla_a C \odot \sigma'(z^L) \quad (3)$$

$$\delta^l = ((w^{l+1})^T \delta^{l+1}) \odot \sigma'(z^l) \quad (4)$$

$$\frac{\partial C}{\partial b^l} = \delta^l \quad (5)$$

$$\frac{\partial C}{\partial w^l} = \delta^l (a^{l-1})^T \quad (6)$$

## 3 Matrix form