



## Backpropagation Implementation

- For each node  $i$  in output layer  $L$ 
  - $\delta_i^{(L)} = (\alpha_i^{(L)} - y_n) f'(z_i^{(L)})$
- For each node  $i$  in layer  $l = L - 1, L - 2, \dots, 2$ 
  - Hidden nodes:  $\delta_i^{(l)} = \left( \sum_{j=1}^{s_{l+1}} W_{ji}^{(l)} \delta_j^{(l+1)} \right) f'(z_i^{(l)})$
- Compute the desired partial derivatives as:
 
$$\frac{\partial J(\mathbf{W}, \mathbf{b})}{\partial W_{ij}^{(l)}} = \alpha_j^{(l)} \delta_i^{(l+1)}$$

$$\frac{\partial J(\mathbf{W}, \mathbf{b})}{\partial b_i^{(l)}} = \delta_i^{(l+1)}$$
- Update the weights as:
 
$$W_{ij}^{(l)} := W_{ij}^{(l)} - \alpha \frac{\partial J(\mathbf{W}, \mathbf{b})}{\partial W_{ij}^{(l)}}$$

$$b_i^{(l)} := b_i^{(l)} - \alpha \frac{\partial J(\mathbf{W}, \mathbf{b})}{\partial b_i^{(l)}}$$