Ex

prove Eqn BP3 & BP4.

Proof:- BP3 $\frac{\partial C}{\partial b_j^l} = \delta_j^l$

$$\frac{\partial C}{\partial b_j^l} = \frac{\partial C}{\partial z_j^l}\frac{\partial z_j^l}{\partial b_j^l} \qquad \left[\frac{\partial z_j^l}{\partial b_j^l} = \frac{\partial}{\partial b_j^l}(wa + b_j^l) = 1 \right.$$

$$\boxed{\frac{\partial C}{\partial b_j^l} = \delta_j^l}$$

BP4 $\frac{\partial C}{\partial w_{jk}^l} = a_k^{l-1}\delta_j^l$

$$\frac{\partial C}{\partial w_{jk}^l} = \frac{\partial C}{\partial z_j^l}\frac{\partial z_j^l}{\partial w_{jk}^l} \qquad \left[\frac{\partial z_j^l}{\partial w_{jk}^l} = \frac{\partial}{\partial w_{jk}^l}(w_{jk}^l a_k^{l-1} + b_j^l) = a_k^{l-1} \right.$$

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

Ex ① suppose we modify a single neuron in FF network so that o/p from a neuron is $f(\sum_j w_j x_j + b)$ f is some fn other than sigmoid. How should we modify BP algo?

Soln:- so, we need to check where we are using ~~the~~ activation function in BP.

so, $\frac{\partial a}{\partial z}$ should be changed from σ' to f' for that particular neuron.

(2) replace non linear σ with $\sigma(z) = z$. in all neurons.

Soln:- so, $\sigma(z) = z \Rightarrow \boxed{\sigma'(z) = 1}$

so, $a^l = w^l a^{l-1} + b^l$

$$\delta^L = \frac{\partial C}{\partial z^L}$$

$\boxed{\delta^L = \nabla C}$ since $\frac{\partial a^L}{\partial z^L} = 1$.

similarly, $\boxed{\delta^l = (w^{l+1})^T \delta^{l+1}}$

But $\frac{\partial C}{\partial w^l} = \delta^l a^{l-1}$ and $\frac{\partial C}{\partial b^l} = \delta^l$

since they don't depend on $\sigma(z)$ directly (we modified δ^L already).