Javid Sadr Deep learning assignment 2

Question One:

$\sigma(z) = \frac{1}{1+e^{-z}}$, $h_1 = \frac{1}{1+e^{-w_1x_1 - w_2x_2}}$, $L(y,\hat{y}) = \|\hat{y}-y\|^2$

$(x_1, x_2, x_3, x_4) = (0.7, 1.2, 1.1, 2)$, $y = 0.5$, $\frac{\partial L}{\partial w_1} = 2\|\hat{y}-y\|$

$\Rightarrow$ $s_1 = x_1w_1 + x_2w_2 = (0.7)(-1.7) + (1.2)(0.1) = -1.19 + 0.12 = -1.07$

$s_2 = x_3w_3 + x_4w_4 = (1.1)(0.6) + (-1.8)(2) = -4.26$

$h_1 = \frac{1}{1+e^{-s_1}} = \frac{1}{1+e^{1.07}} = 0.255$ $h_2 = \frac{1}{1+e^{-s_2}} = \frac{1}{1+e^{4.26}} = 0.0139$

$s_3 = h_1w_5 + h_2w_6 = (0.255)(-0.2) + (0.0139)(0.5) = -0.04441$

$\hat{y} = \frac{1}{1+e^{-s_3}} = \frac{1}{1+e^{0.0441}} = 0.4889$

Backpropagation:

$\frac{dE}{dw_1} = \frac{dE}{d\hat{y}} \frac{d\hat{y}}{ds_3} \frac{ds_3}{dh_1} \frac{dh_1}{ds_1} \frac{ds_1}{dw_1}$, $\frac{dE}{d\hat{y}} = 2\|\hat{y}-y\|$

$\sigma'(x) = \sigma(x)[1-\sigma(x)]$

$\rightarrow \frac{dE}{dw_1} = 2\|\hat{y}-y\| \times \sigma'(s_3) \times w_5 \times \sigma'(s_1) \times x_1 =$

$\sigma(s_3) = \frac{1}{1+e^{-s_3}} = 0.4889$, $\sigma(s_1) = \frac{1}{1+e^{-s_1}} = 0.2554$

$\frac{dE}{dw_1} = [2\|0.4889-0.5\|] \times [0.4889(1-0.4889)] \times (0.2) \times [(0.2554)(1-0.2554)] \times 0.7$

$= -1.4768 \times 10^{-4}$