Question 11

Given the following loss function and activation function as well as the network parameters:

- **Loss function**

$$E = (\hat{y} - y_i)^2$$

- **Activation function**

$$Y = \frac{1}{1 + e^{-Z}}, Z = W \cdot X$$

- **Parameters**

$$W_t = 0,4$$

$$X = 3$$

$$Y_i = 0,9$$

$$\eta = 0,1$$

1. Compute the following intermediate values

- Z

$$Z = 0,4 * 3 = 1,2$$

- Y

$$Y = \frac{1}{1 + e^{-}Z} = \frac{1}{1 + e^{-}1,2} = 0,7685$$

- E

$$E = (0,7658 - 0,9)^2 = 0,0180$$

2. Compute the partial derivatives

- $\frac{\partial E}{\partial Y}$

$$\frac{\partial E}{\partial Y} = 2(\hat{y} - y_i)$$

- $\frac{\partial Y}{\partial Z}$

$$\frac{\partial Y}{\partial Z} = \frac{e^{-z}}{(1 + e^{-z})^2}$$

- $\frac{\partial Z}{\partial W}$

$$\frac{\partial Z}{\partial W} = X$$

3. Compute the gradient using the chain rule

$$\frac{\partial E}{\partial W} = \frac{\partial E}{\partial Y}\frac{\partial Y}{\partial Z}\frac{\partial Z}{\partial W} = \frac{2X(\hat{y} - y_i)(e^{-z})}{(1 + e^{-z})^2} = 0,1432$$

4. Update the weights

$$W_{t+1} = W_t - \eta\frac{\partial E}{\partial W}$$

$$W_{t+1} = 0,4 - 0,1 \cdot 0,1432 = 0,3856$$