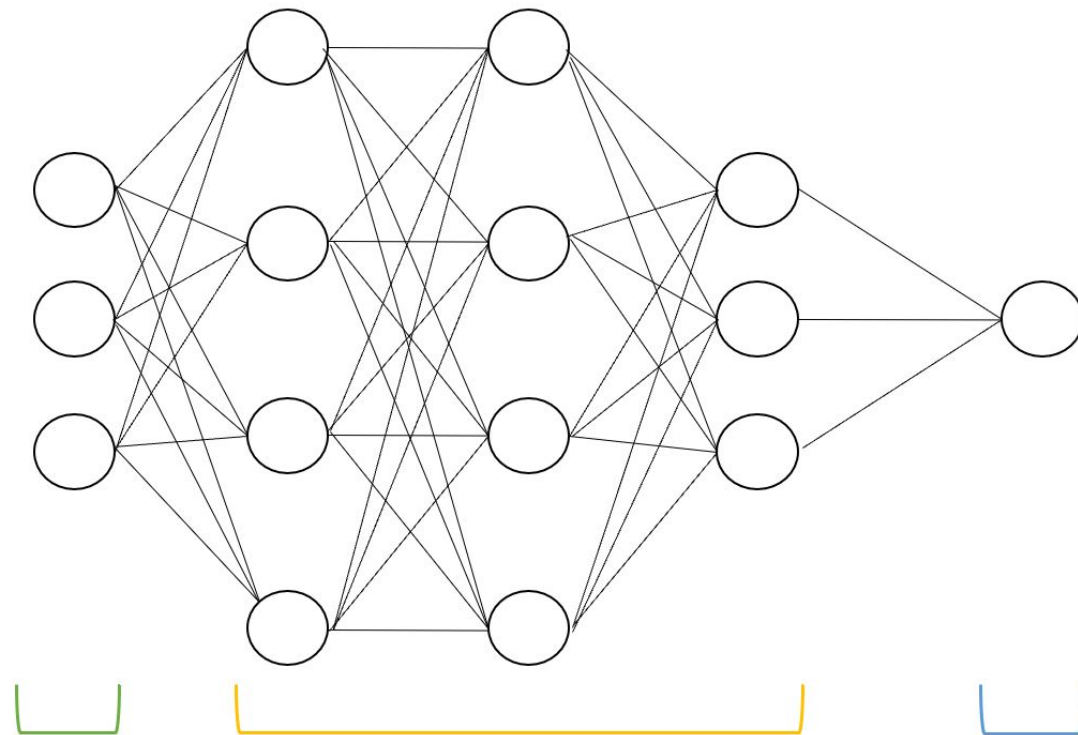


# BACKPROPAGATION

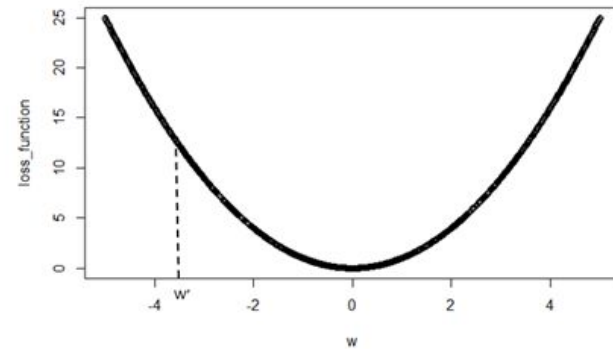
**Dr. Ernesto Lee**



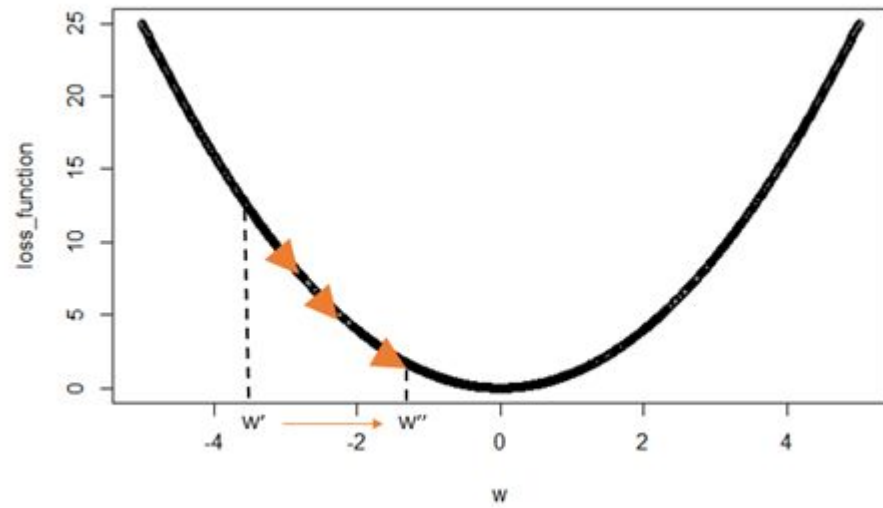
Input  
Layer

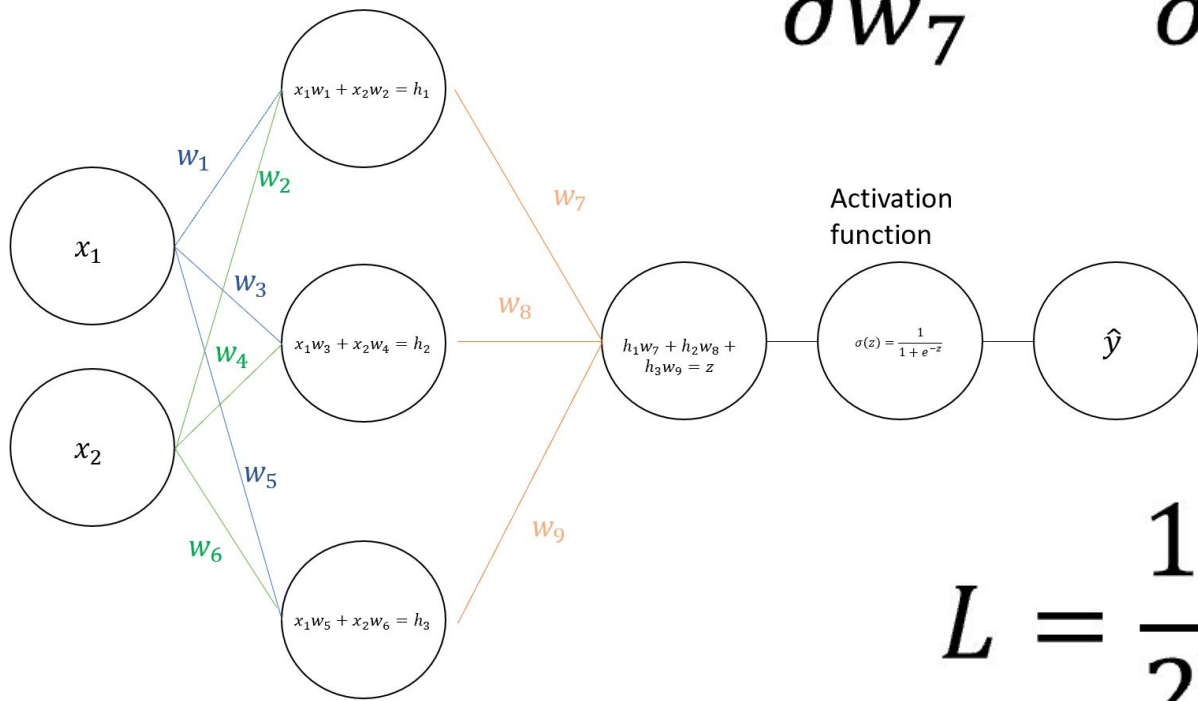
Hidden Layers

Output  
Layer



$$w'_i = w_i - \frac{\delta L}{\delta w_i}$$





$$\frac{\partial L}{\partial w_7} = \frac{\partial L}{\partial \hat{y}} * \frac{\partial \hat{y}}{\partial z} * \frac{\partial z}{\partial w_7}$$

$$L = \frac{1}{2} (y - \hat{y})^2$$

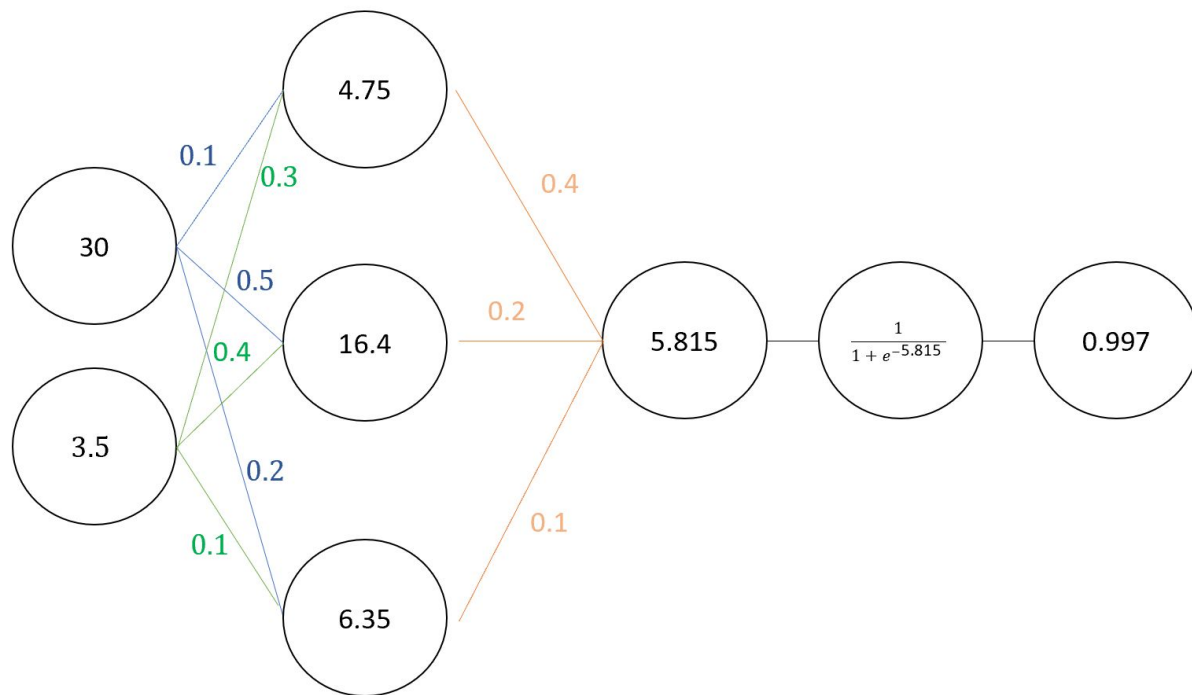
$$\frac{\partial L}{\partial \hat{y}} = \frac{1}{2} * 2(y - \hat{y}) * -1 = \hat{y} - y$$

$$\frac{\partial \hat{y}}{\partial z} = \sigma(z) * (1 - \sigma(z)) = \hat{y} * (1 - \hat{y})$$

$$\frac{\partial z}{\partial w_7} = \frac{\partial (h_1 w_7 + h_2 w_8 + h_3 w_9)}{\partial w_7} = h_1$$

$$\frac{\partial L}{\partial w_7} = \frac{\partial L}{\partial \hat{y}} * \frac{\partial \hat{y}}{\partial z} * \frac{\partial z}{\partial w_7} = (\hat{y} - y) * \hat{y} * (1 - \hat{y}) * h_1$$

<b>Hours of study</b>	<b>GPA</b>	<b>Exam result</b>
30	3.5	'pass'
12	2	'fail'
10	2.2	'fail'
34	4	'pass'





$$\frac{\partial L}{\partial \hat{y}} = \frac{1}{2} * 2(y - \hat{y}) * -1 = \hat{y} - y = 0.997 - 1 = -0.003$$

$$\frac{\partial \hat{y}}{\partial z} = \sigma(z) * (1 - \sigma(z)) = \hat{y} * (1 - \hat{y}) = 0.002991$$

$$\frac{\partial z}{\partial w_7} = \frac{\partial(h_1 w_7 + h_2 w_8 + h_3 w_9)}{\partial w_7} = h_1 = 4.75$$

$$\frac{\partial L}{\partial w_7} = \frac{\partial L}{\partial \hat{y}} * \frac{\partial \hat{y}}{\partial z} * \frac{\partial z}{\partial w_7} = (-0.003) * 0.002991 * 4.75 = -0.0000426$$

$$w_7' = w_7 - \frac{\partial L}{\partial w_7} = 0.4 - (-0.0000426) = 0.4000426$$