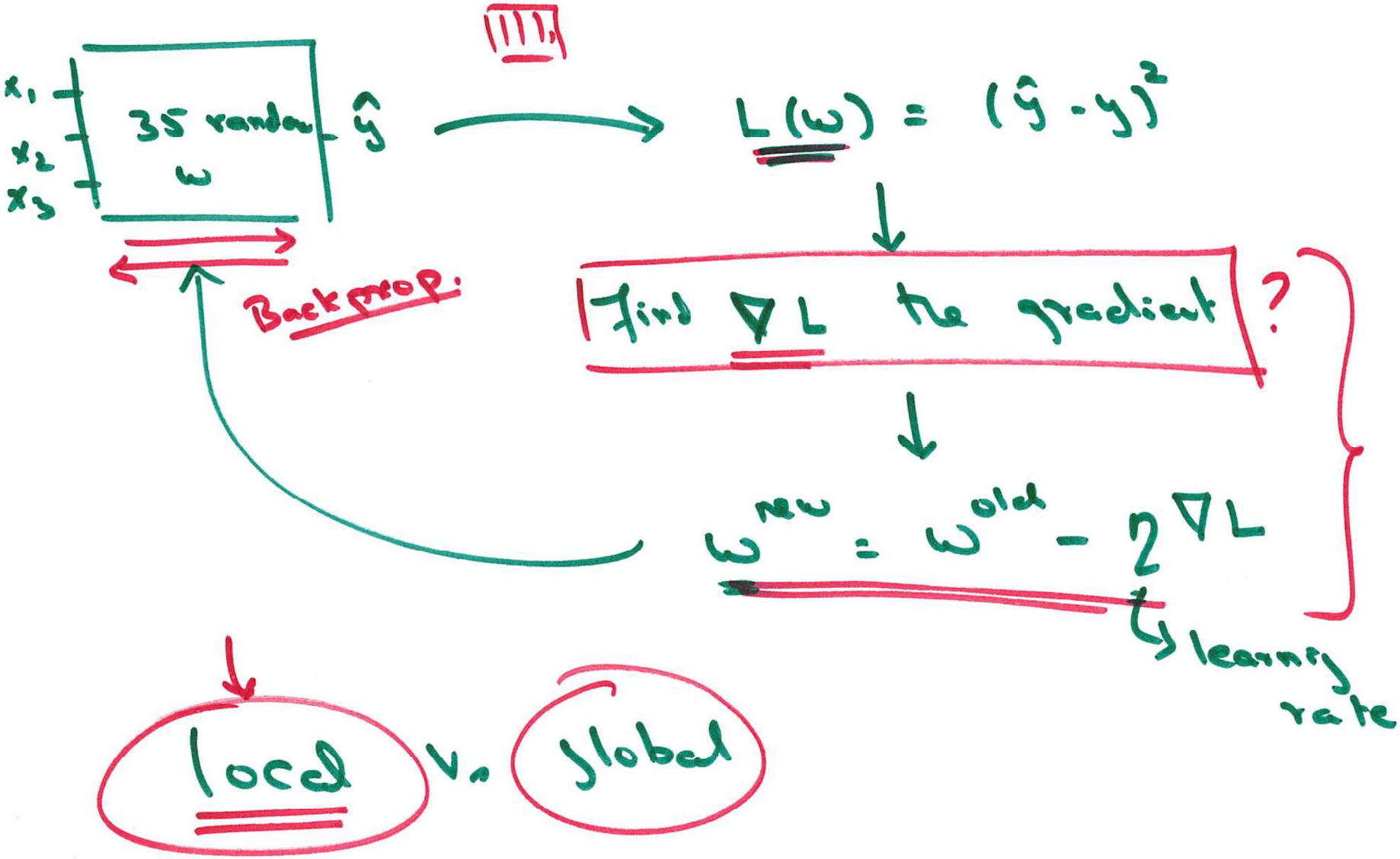

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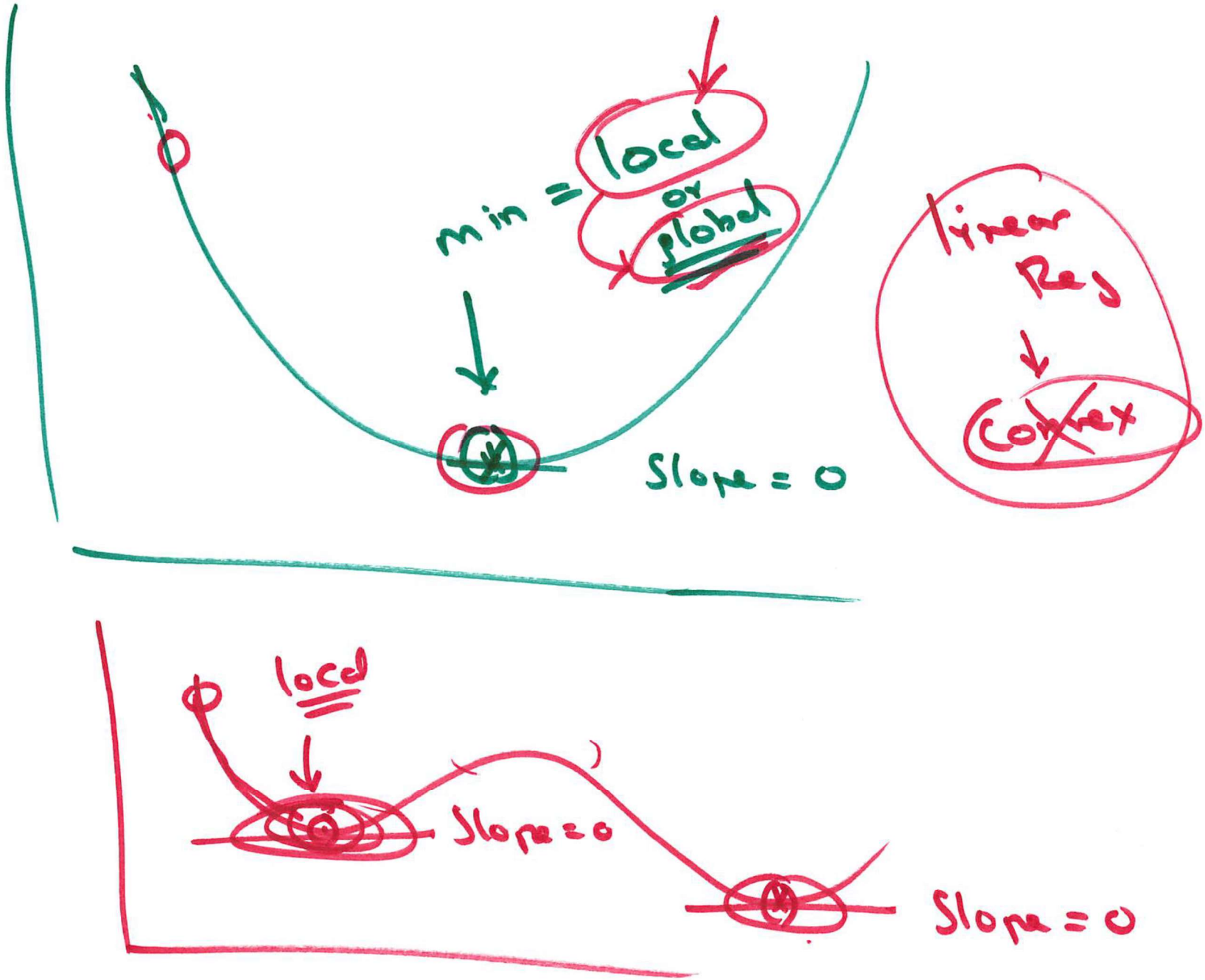

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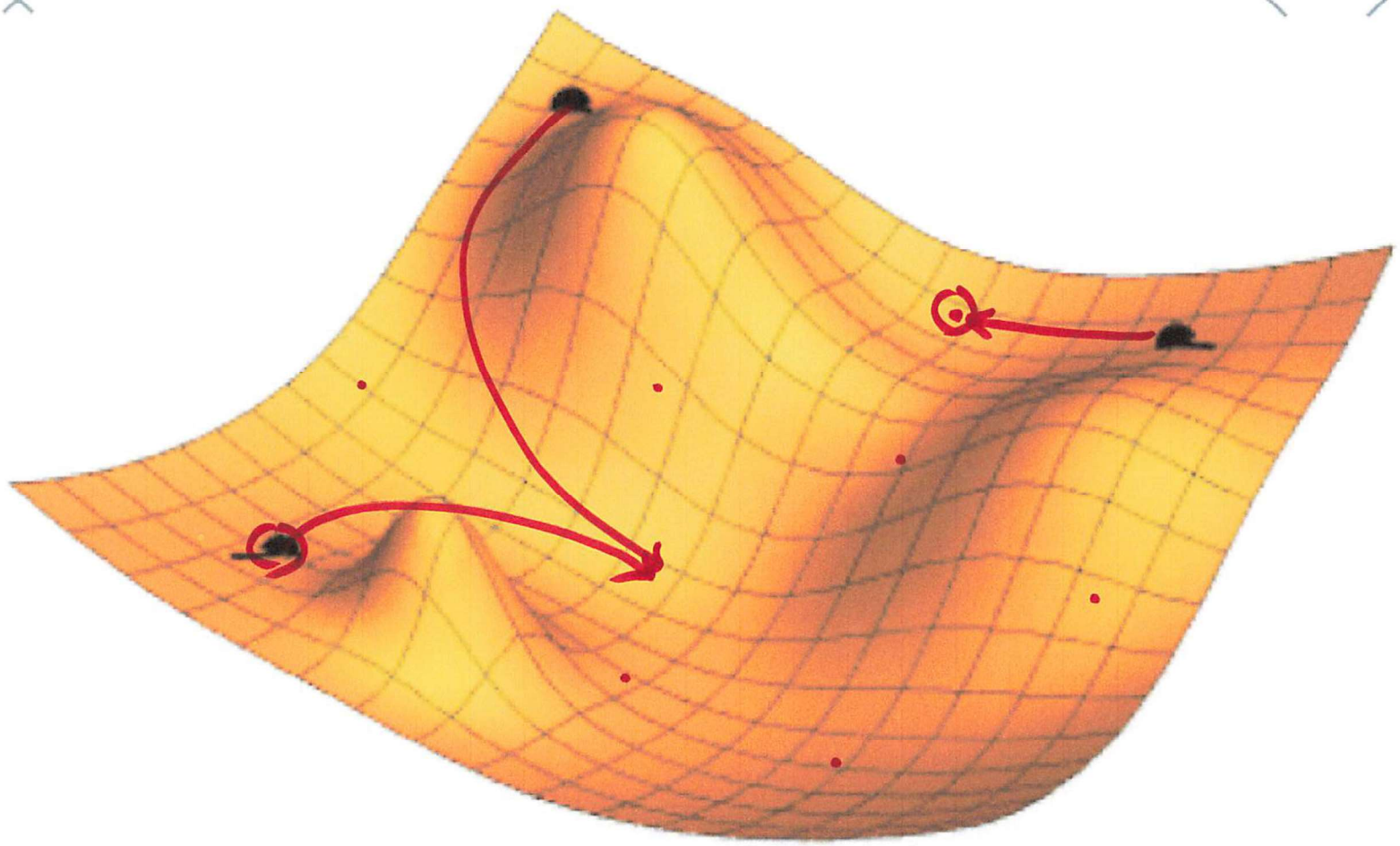

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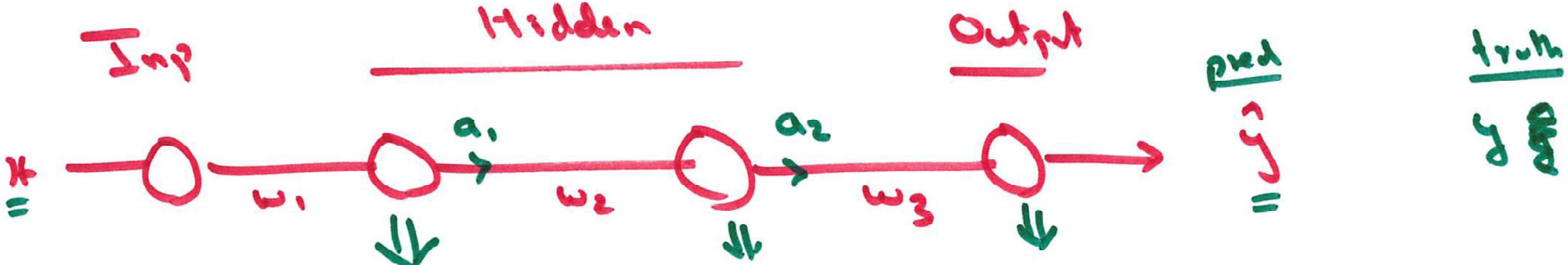
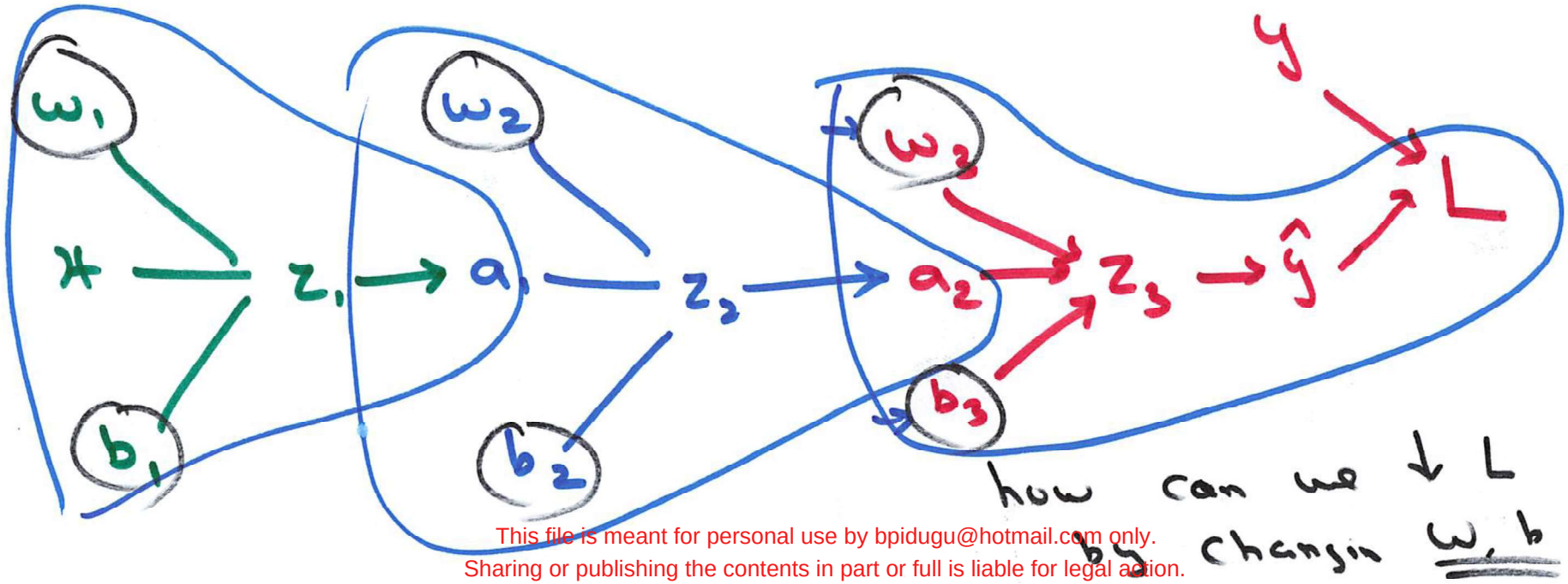


$$\begin{cases} z_1 = x w_1 + b_1 \\ a_1 = \sigma(z_1) \end{cases} \qquad z_2 = a_1 w_2 + b_2 \quad a_2 = \sigma(z_2) \qquad z_3 = a_2 w_3 + b_3 \quad \hat{y} = \sigma(z_3)$$

$$L(w) = \Sigma (\hat{y} - y)^2$$

∇L ?



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Slope of L with respect to ω_3 $= \dfrac{\partial L}{\partial \omega_3}$

$$\frac{\partial L}{\partial \omega_3} = \frac{\partial L}{\partial \hat{y}} \cdot \frac{\partial \hat{y}}{\partial z_3} \cdot \frac{\partial z_3}{\partial \omega_3}$$

$\dfrac{\partial L}{\partial \hat{y}} \rightarrow 2(\hat{y} - y)$

$\dfrac{\partial \hat{y}}{\partial z_3} \rightarrow \sigma'(z_3)$

$\dfrac{\partial z_3}{\partial \omega_3} \rightarrow a_2$

$$\frac{\partial a_2}{\partial \omega_2}$$

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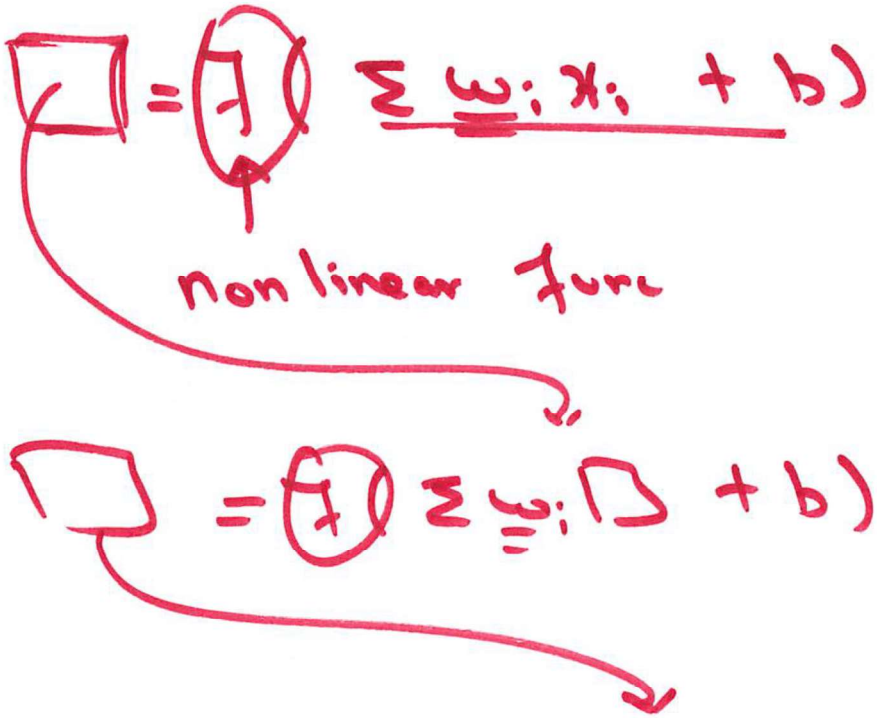

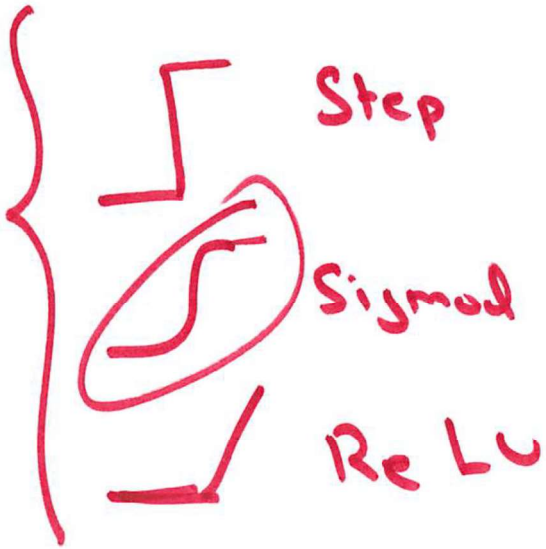

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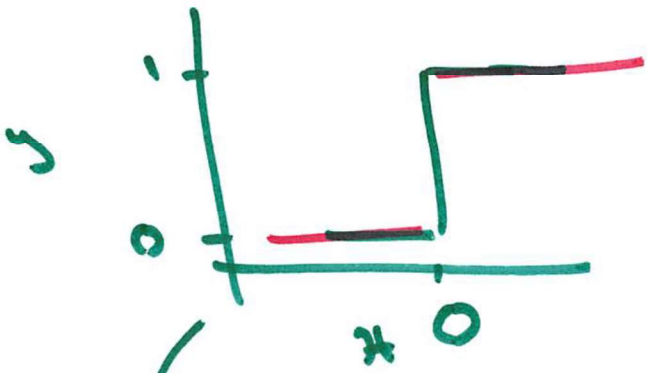
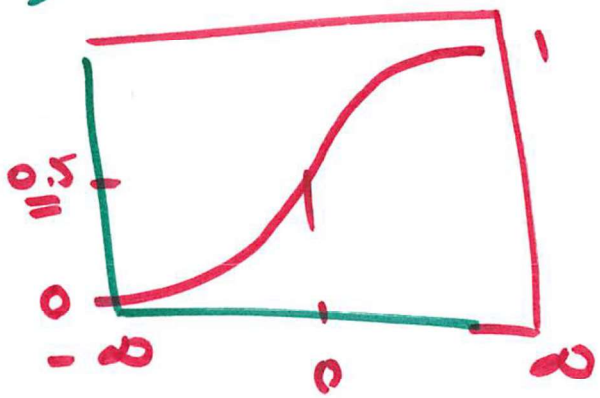


$$y = \begin{cases} 1 & \text{if } x \geq 0 \\ 0 & \text{if } x < 0 \end{cases}$$

$\cancel{y = 0}$ $\quad y = f(x)$

$$w^n = w^0 - \eta\,(\text{slope of } L)$$

$\sigma'(x)$



Sigmoid $\rightarrow$ 0 to 1

$$y = \sigma(x) = \frac{1}{1+e^{-x}} = \frac{e^x}{e^x+1}$$

$\boxed{2\sigma(x) - 1} \rightarrow -1$ to 1

$$y = \tanh(x) = 2\sigma(2x) - 1 \rightarrow -1 \text{ to } 1$$

$$\hookrightarrow \frac{e^x - e^{-x}}{e^x + e^{-x}} = \frac{e^{2x} - 1}{e^{2x} + 1}$$

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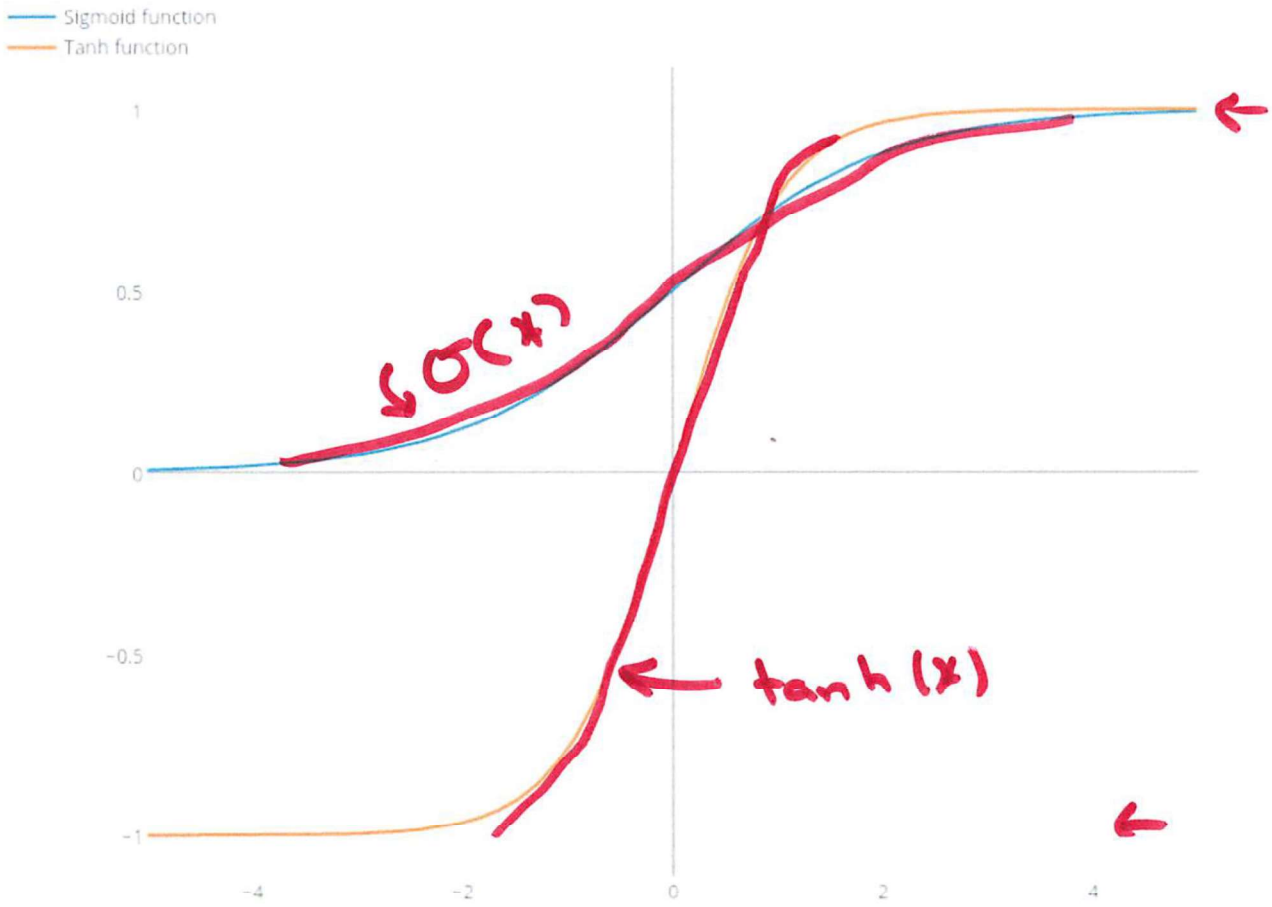
$$\tanh(x) = 2\sigma(2x) - 1$$



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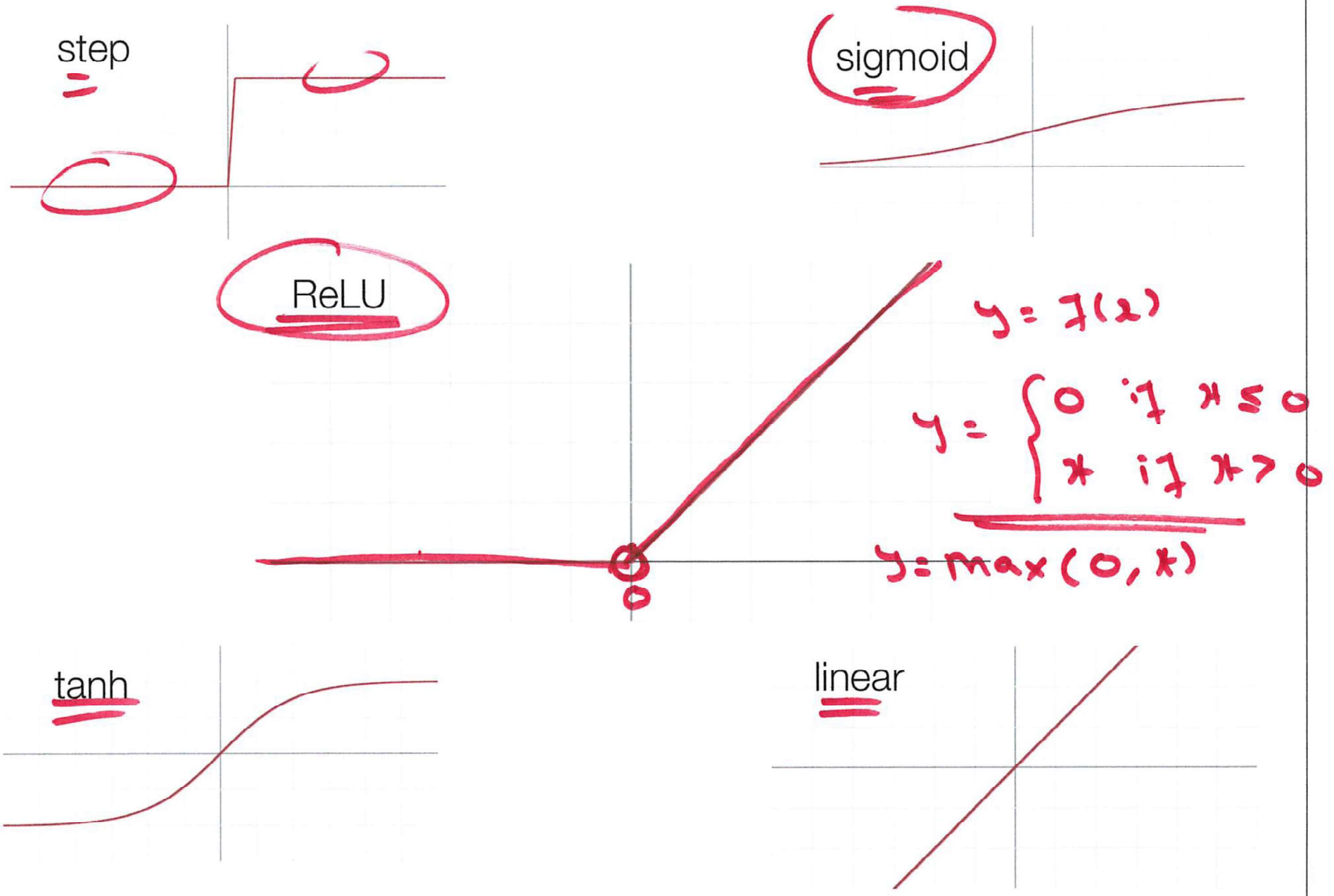
Activation Functions



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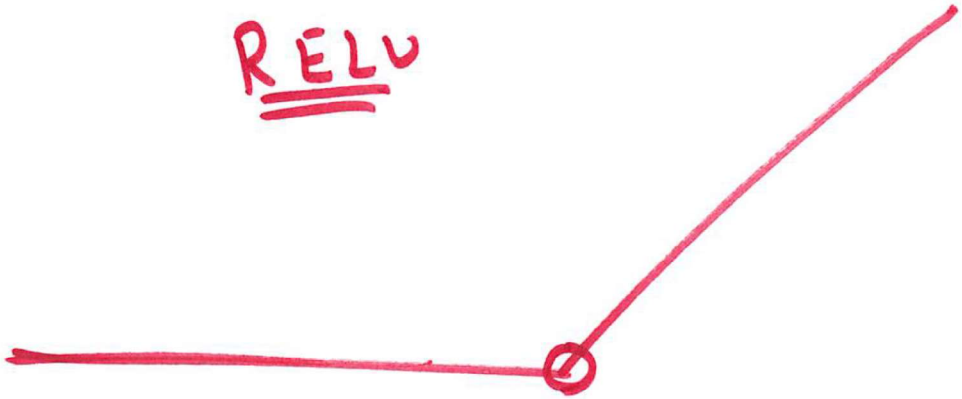
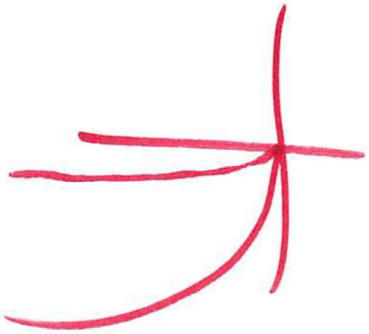
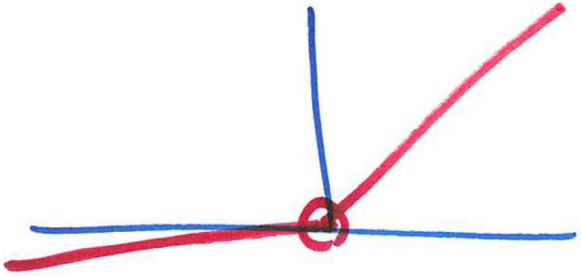
RELU



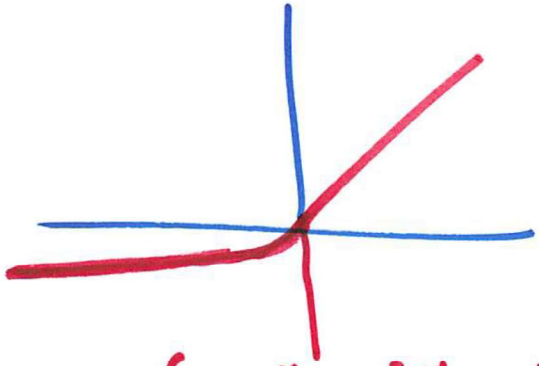


Leaky RELU



$$y = \begin{cases} x & \text{if } x \geq 0 \\ 0.001x & \text{if } x < 0 \end{cases}$$

ERELU



$$y = \begin{cases} x & \text{if } x \geq 0 \\ \alpha(e^x - 1) & \text{if } x < 0 \end{cases}$$

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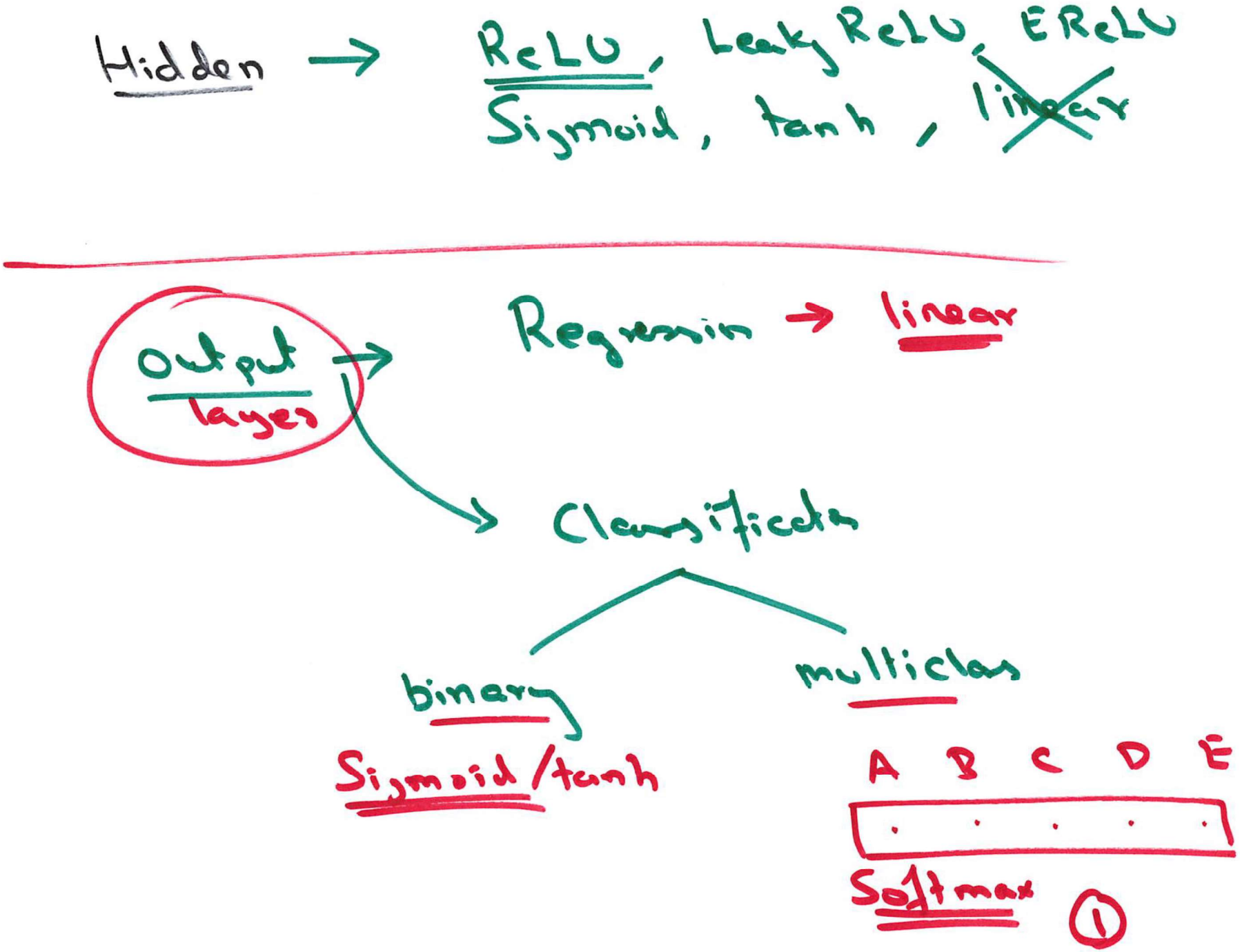

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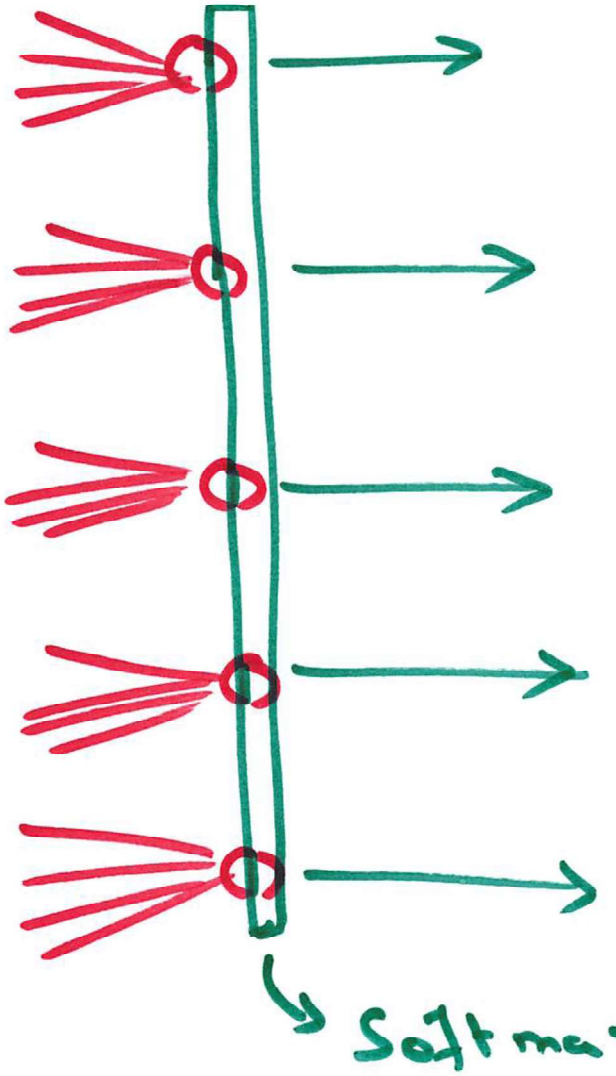
$f(\ldots) \rightarrow$



↳ Softmax activation

$z_1 = (\Sigma w x + b)$

$a_1 = f(z_1)$

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