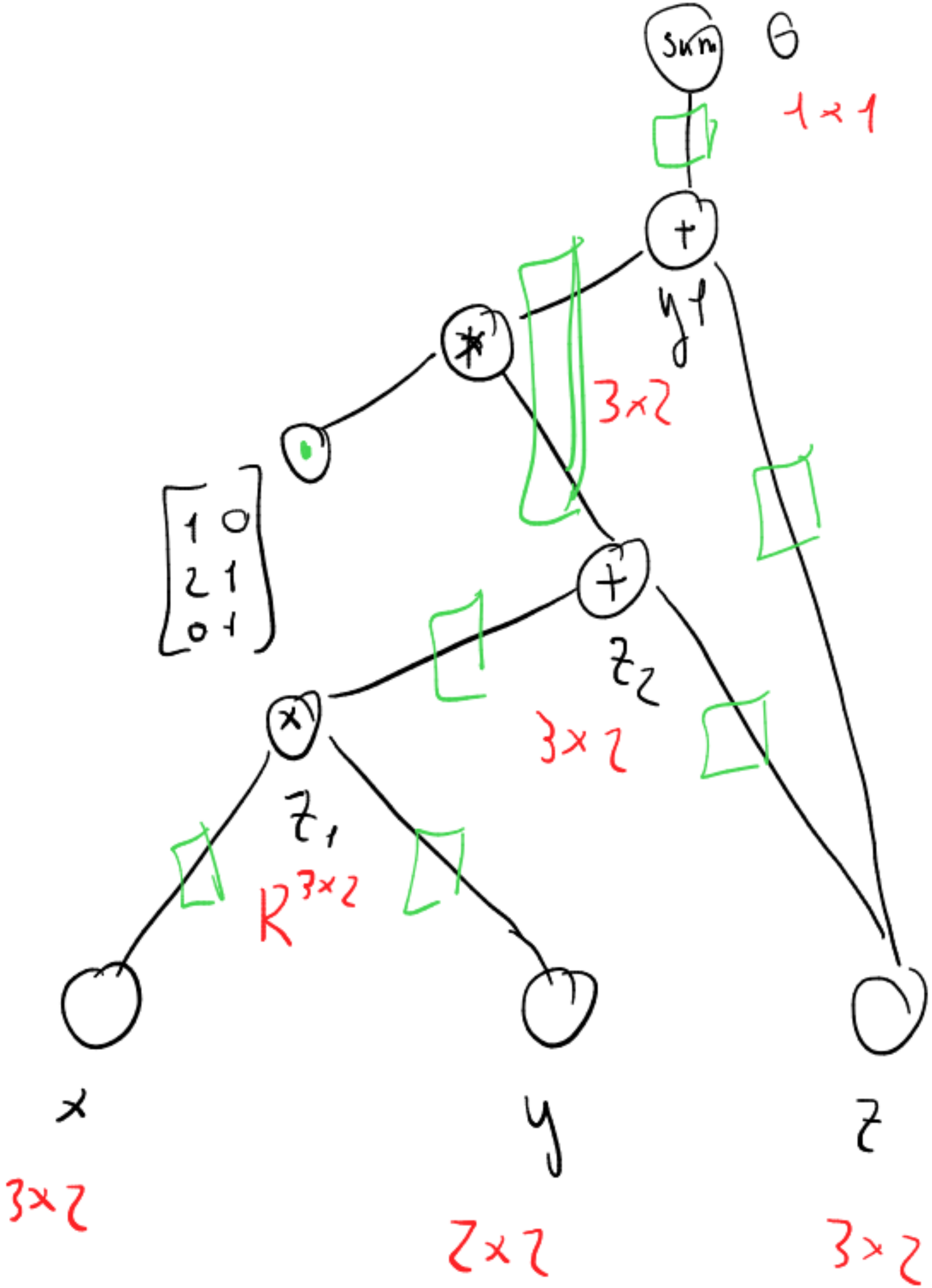
$$x = \begin{bmatrix} 1 & 1 \\ 1 & 1 \\ 1 & 1 \end{bmatrix} \in \mathbb{R}^{3 \times 2}$$

$$y = \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} * 0.5 = \begin{bmatrix} 0.5 & 0.5 \\ 0.5 & 0.5 \end{bmatrix} \in \mathbb{R}^{2 \times 2}$$

$$z = \begin{bmatrix} 0.25 & 0.25 \\ 0.25 & 0.25 \\ 0.25 & 0.25 \end{bmatrix} \in \mathbb{R}^{3 \times 2}$$



$$\frac{\partial o}{\partial y}$$

$$\frac{\partial o}{\partial z}$$

$$\frac{\partial o}{\partial x}$$

$$\frac{\partial o}{\partial y_1} = \frac{\partial}{\partial y_1} \sum_{i,j} y_1^{(i,j)} = \begin{bmatrix} 1 & 1 \\ 1 & 1 \\ 1 & 1 \end{bmatrix}$$

$$\frac{\partial y_1}{\partial z} = \frac{\partial}{\partial z} (\text{const}) + z = \quad \Rightarrow \frac{\partial y_1}{\partial z_{11}} = \begin{bmatrix} 1 & 0 \\ 0 & 0 \\ 0 & 0 \end{bmatrix}$$

$$\left.\begin{array}{l} y_1 \in \mathbb{R}^{3\times 2} \\ z \in \mathbb{R}^{3\times 2} \end{array}\right\} (3\times 2) \times (3 \times 2)$$

$\vdots$

$$y = \boxed{f_k}(z_k \cdot W_k + b_k)$$

σ

$$w^{(t)} \leftarrow w^{(t-1)} + \eta \nabla_{loss}$$

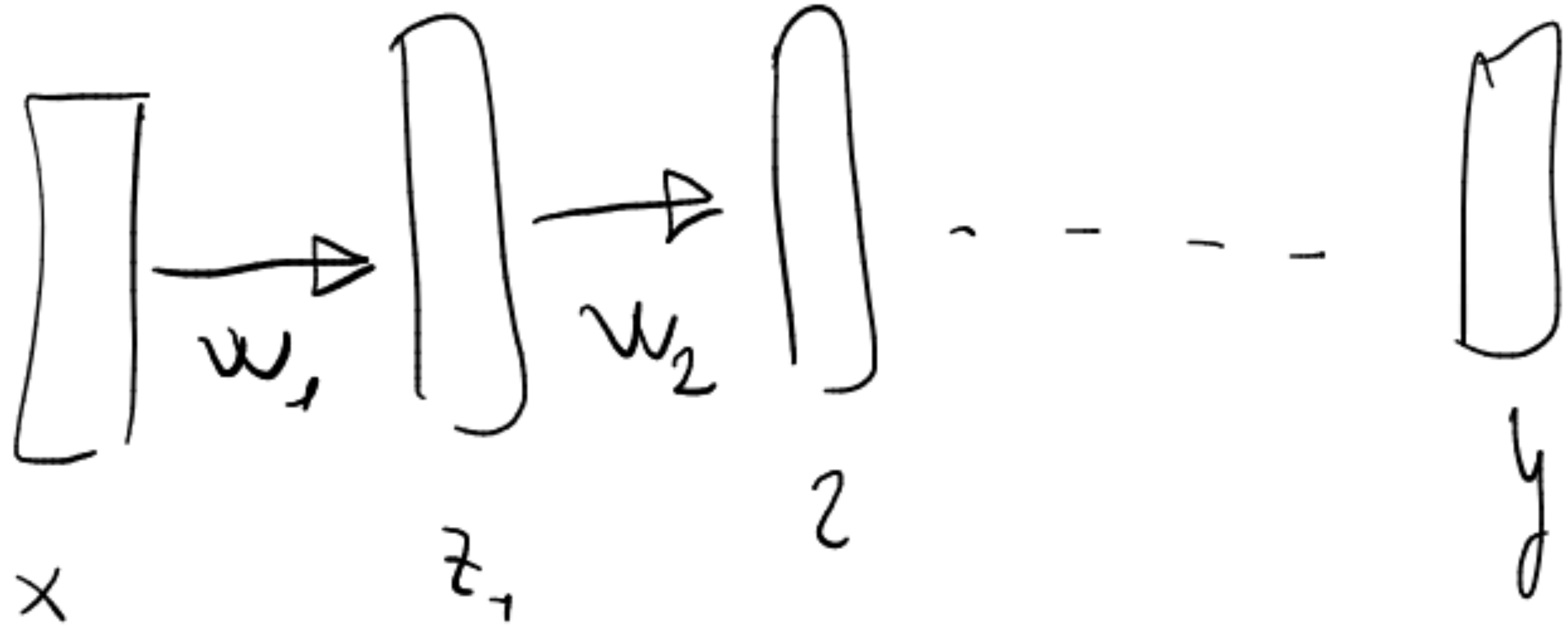
$$z_k = \boxed{f_{k-1}}(z_{k-1} W_{k-1} + b_{k-1})$$

σ

tanh

$$\vdots$$

$$z_1 = \boxed{f_0}(x \cdot W_0 + b_0)$$



$$\frac{\partial y}{\partial w_1} = \boxed{\frac{\partial y}{\partial z_4}} \cdot \frac{\partial z_4}{\partial w_1}$$

$$\frac{\partial}{\partial z_4} \sigma(z_4 \cdot w_5) = \underbrace{\frac{\partial \sigma(a)}{\partial a}}_{} \cdot \frac{\partial a}{\partial z_4}$$

$$\sigma'(z) \;\; \| $$

$$a = z_4 \cdot w_5$$

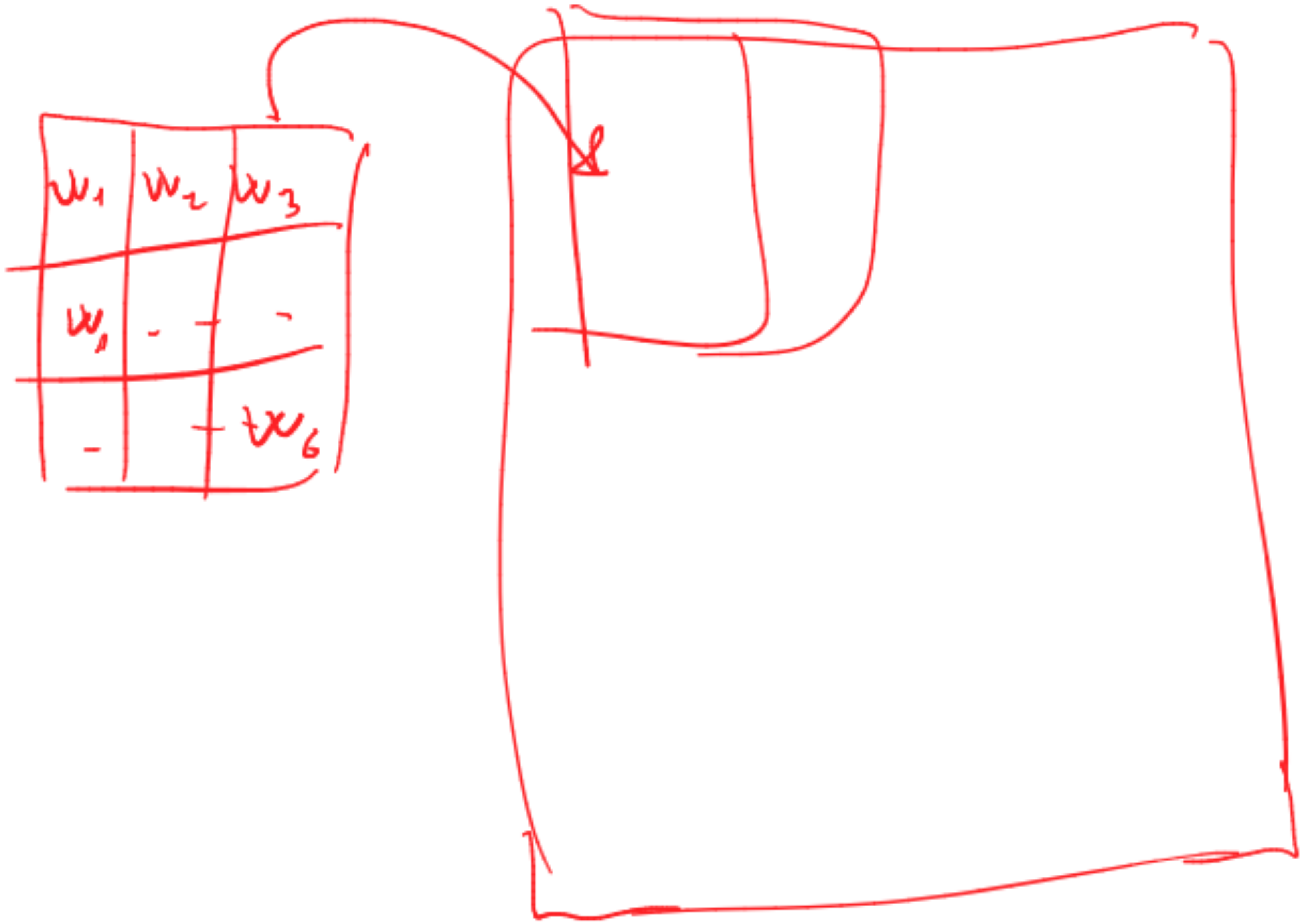
$$\mathrm{ReLU}(a) = \begin{cases} a & a \geq 0 \\ 0 & \text{o.w.} \end{cases}$$

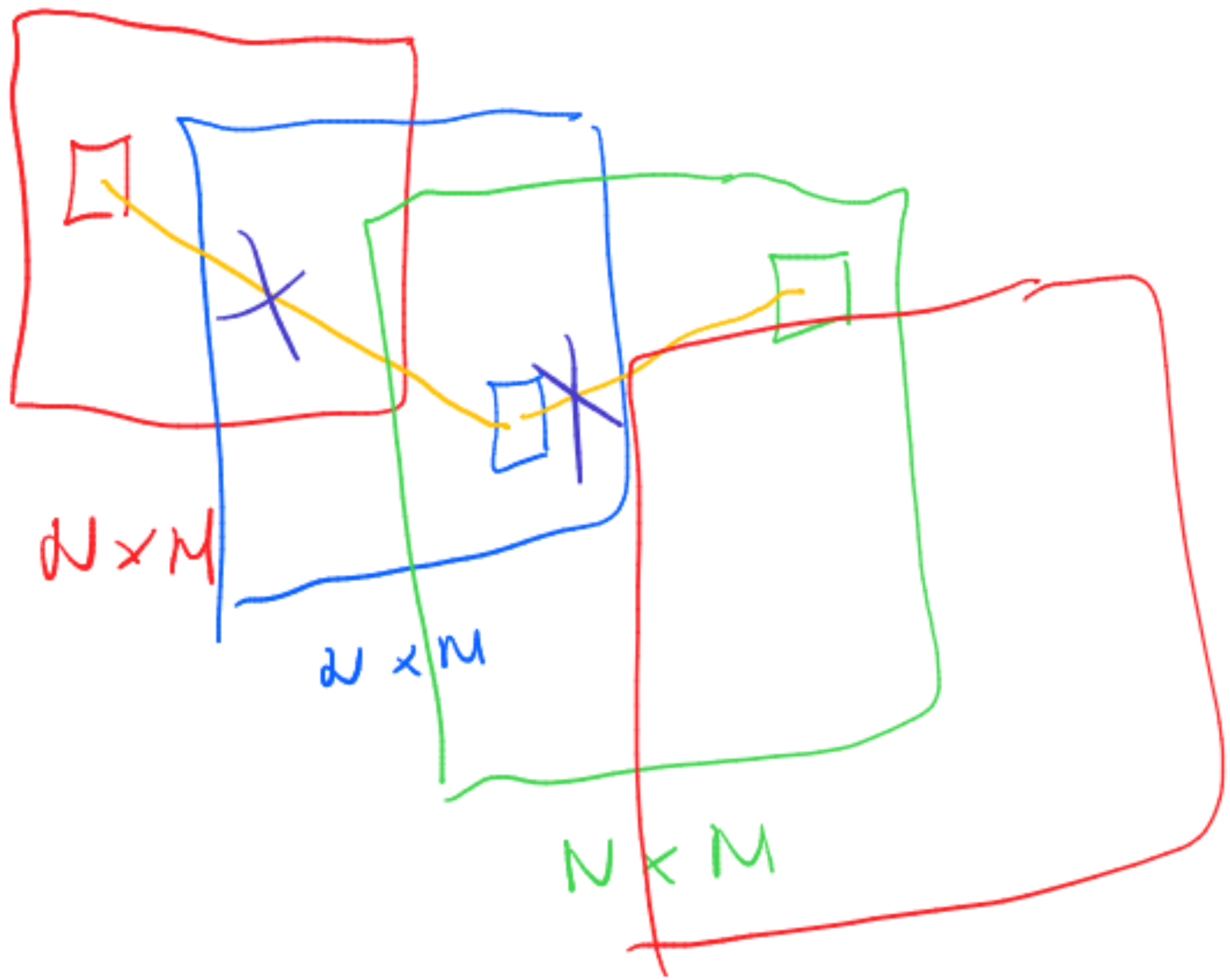
$$z = \boxed{f_0}(w_0 x + b_0) = wx + b$$

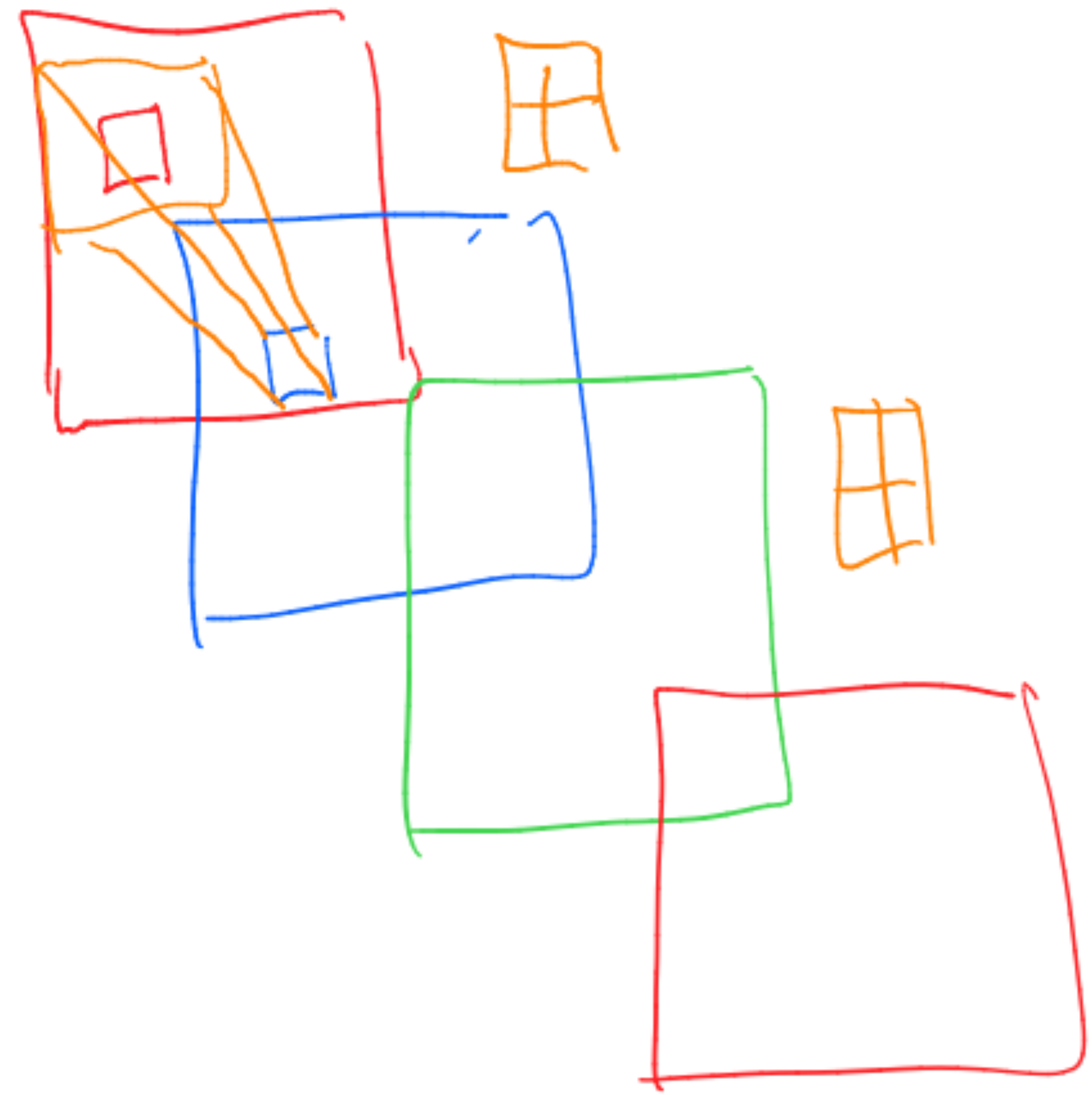
$$y = \boxed{f_1}(w_1 z + b_1)$$

$$y = w_1 \cdot (w_0 x + b_0) + b_1 = \underbrace{(w_1 w_0)}_{A} x + \underbrace{(w_1 b_0 + b_1)}_{c}$$

$$Ax + c$$


w_1
w_2
w_3
w_1
w_6


N×M
N×M
N×M



$$\tilde{y} = (x \cdot y + z) \cdot \begin{bmatrix} 1 & 0 \\ 2 & 1 \\ 0 & 1 \end{bmatrix} + z$$

$$\frac{\partial \tilde{y}}{\partial z} = \begin{bmatrix} 1 & 0 \\ 2 & 1 \\ 0 & 1 \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 1 & 1 \\ 1 & 1 \end{bmatrix}$$