

# Lecture - 3

22/01/2025

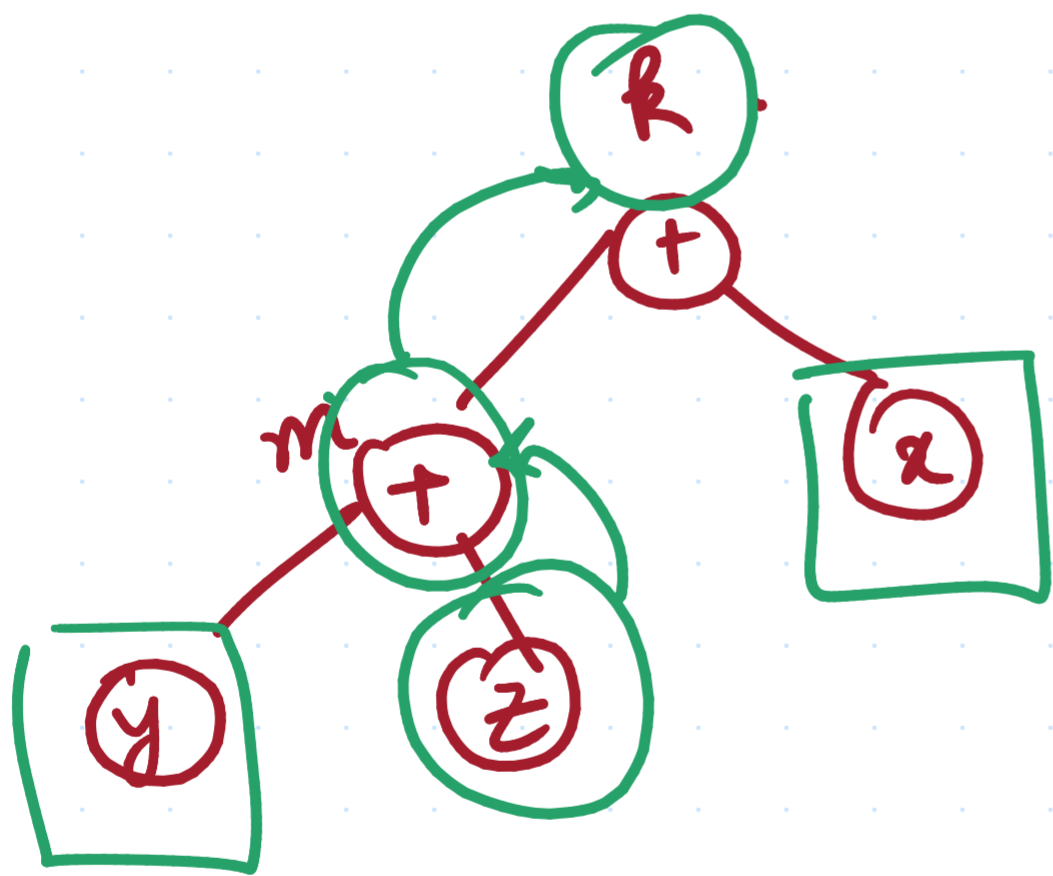
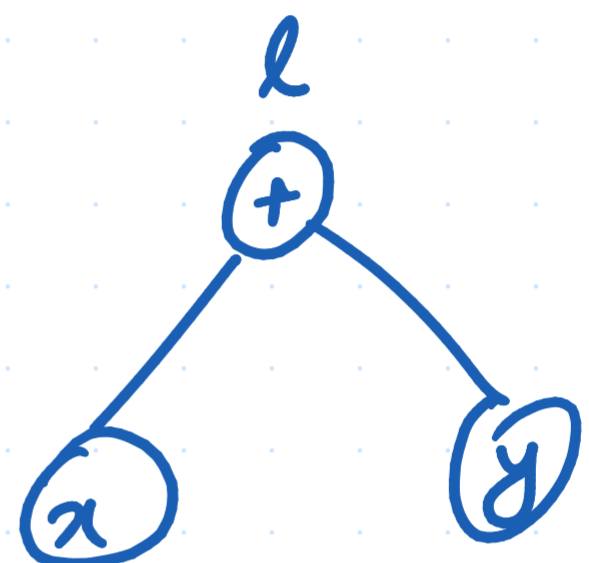
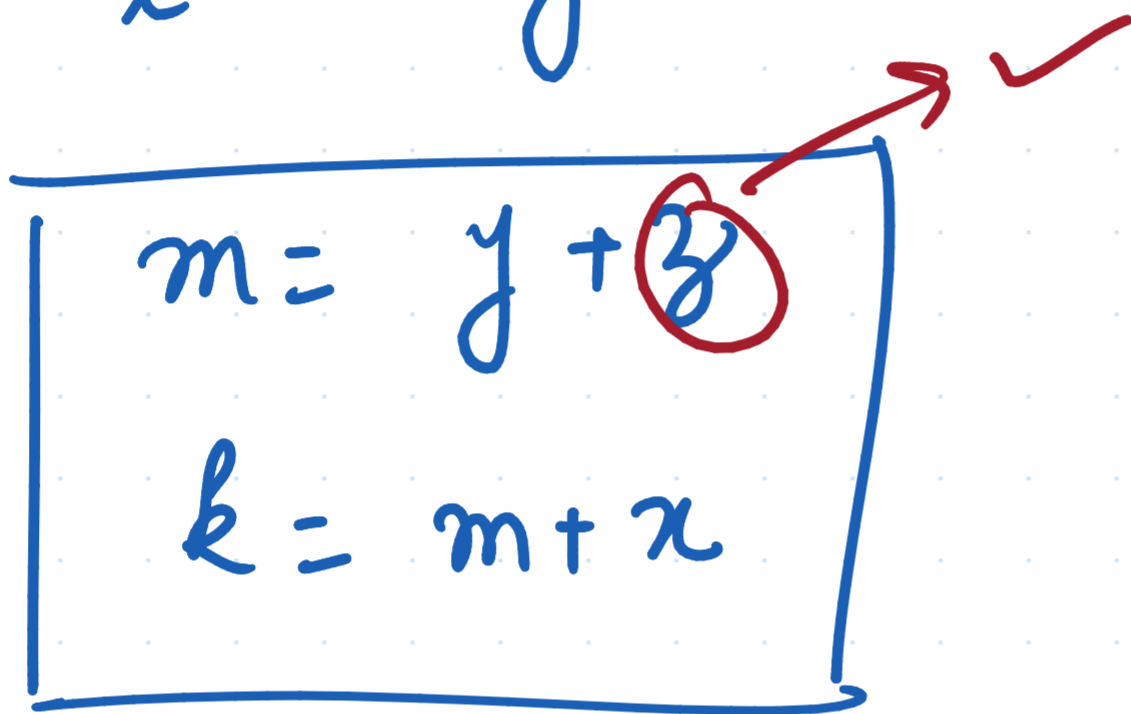
## Jupyter Notebook stuffs: -

$x = \text{var}$

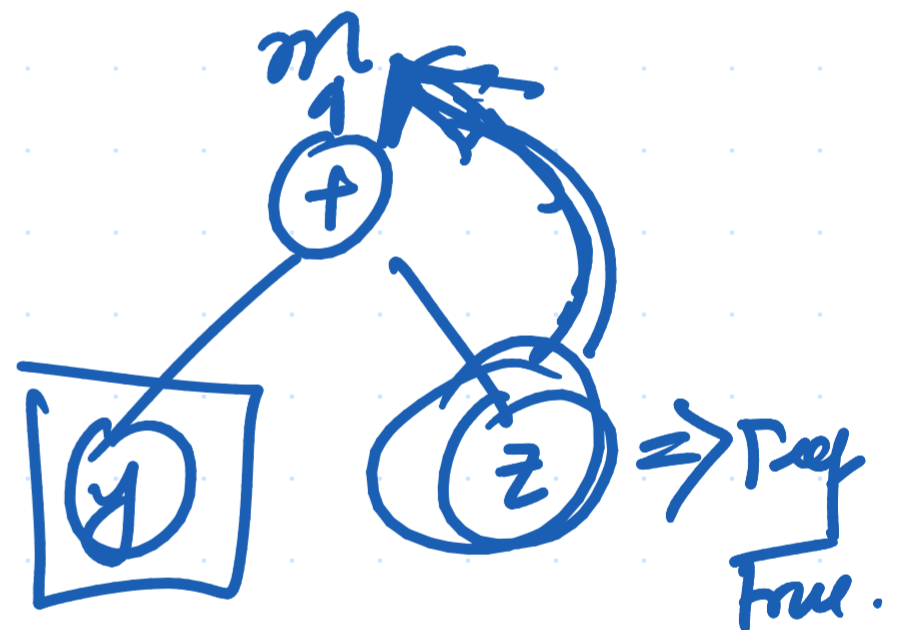
$y = \text{var}$

$z = \text{var} \rightarrow \text{requires\_grad} = \text{true}$

$l = x + y$



DAG.



$$x = \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix} = x_i$$

$$a = \overline{x} + 2$$

$$b = a^2$$

$$c = b + 3$$

$$y = c \cdot \text{mean}()$$

$$\left\{ \frac{\partial y}{\partial x_i} = \frac{\partial y}{\partial c_i} \cdot \frac{\partial c_i}{\partial b_i} \cdot \frac{\partial b_i}{\partial a_i} \cdot \frac{\partial a_i}{\partial x_i} \right\}$$

$$\begin{matrix} \downarrow & & \downarrow & & \downarrow & & \downarrow \\ \frac{1}{3} & \times & 1 & \times & 2 & \times & 1 \end{matrix}$$

$$\frac{\partial}{\partial x_i} \frac{x_i}{n} = \frac{1}{n}$$

$$\frac{\partial y}{\partial x_0} = \frac{1}{3} \times 1 \times 2 \times 4 \times 1 = \frac{8}{3}$$

$$\frac{\partial y}{\partial x_1} = \frac{1}{3} \times 10 = \frac{10}{3}$$

$$\frac{\partial y}{\partial x_2} = \frac{1}{3} \times 12 = 4$$

$$\underline{\underline{\left[ \frac{8}{3}, \frac{10}{3}, 4 \right]}}$$

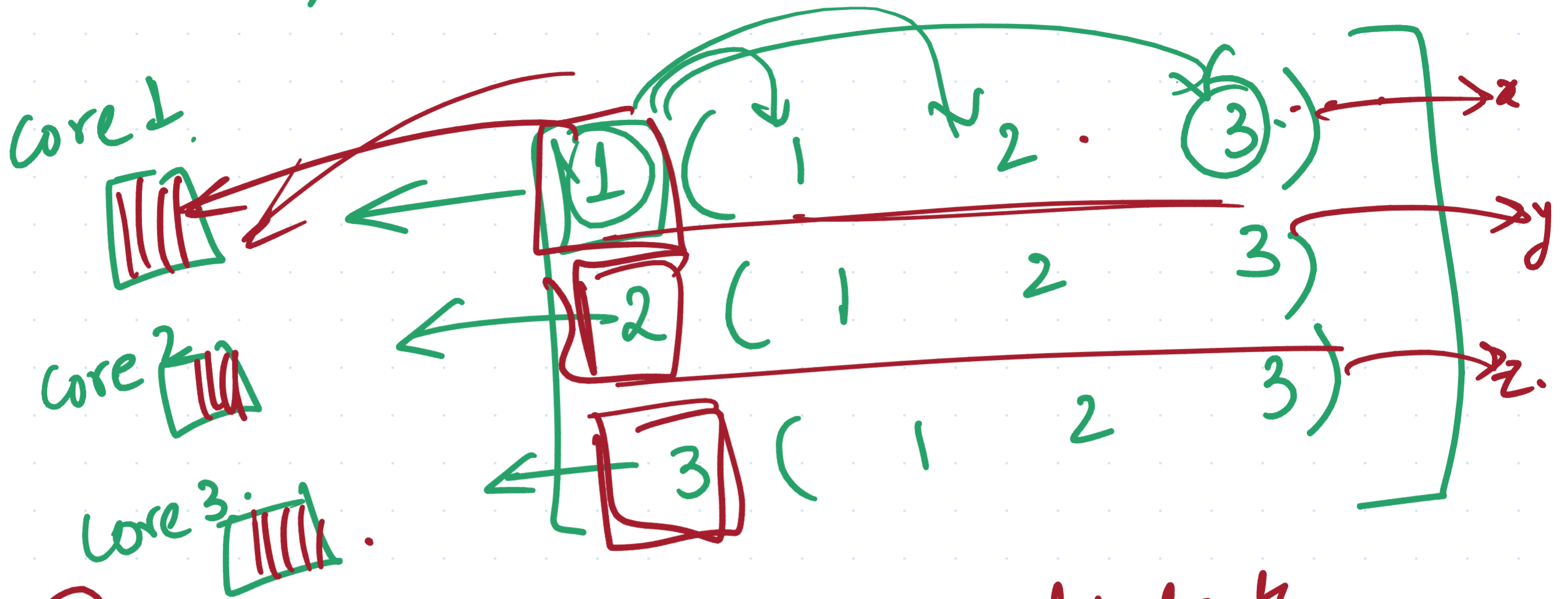
$$v = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$$

$$v^T = (1 \ 2 \ 3)$$

$$\frac{3 \times 1}{1 \times 3} = 3 \times 3$$

$$v \cdot v^T = \text{outer product.}$$

$$\begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} (1 \ 2 \ 3) = \begin{pmatrix} 1 \cdot 1 & 1 \cdot 2 & 1 \cdot 3 \\ 2 \cdot 1 & 2 \cdot 2 & 2 \cdot 3 \\ 3 \cdot 1 & 3 \cdot 2 & 3 \cdot 3 \end{pmatrix}$$



$x, y, z \rightarrow$  independently.

GPU  $\gg$  CPU

10,000.

8



$$y = \begin{pmatrix} 1 \\ -7 \\ 6 \\ -5 \\ 3 \\ 10 \end{pmatrix}$$

ReLU

$$\begin{pmatrix} 1 \\ 0 \\ 6 \\ 0 \\ 3 \\ 10 \end{pmatrix}$$

$$f(x) = \begin{cases} x & \text{when } x \geq 0 \\ 0 & \text{when } x < 0. \end{cases}$$

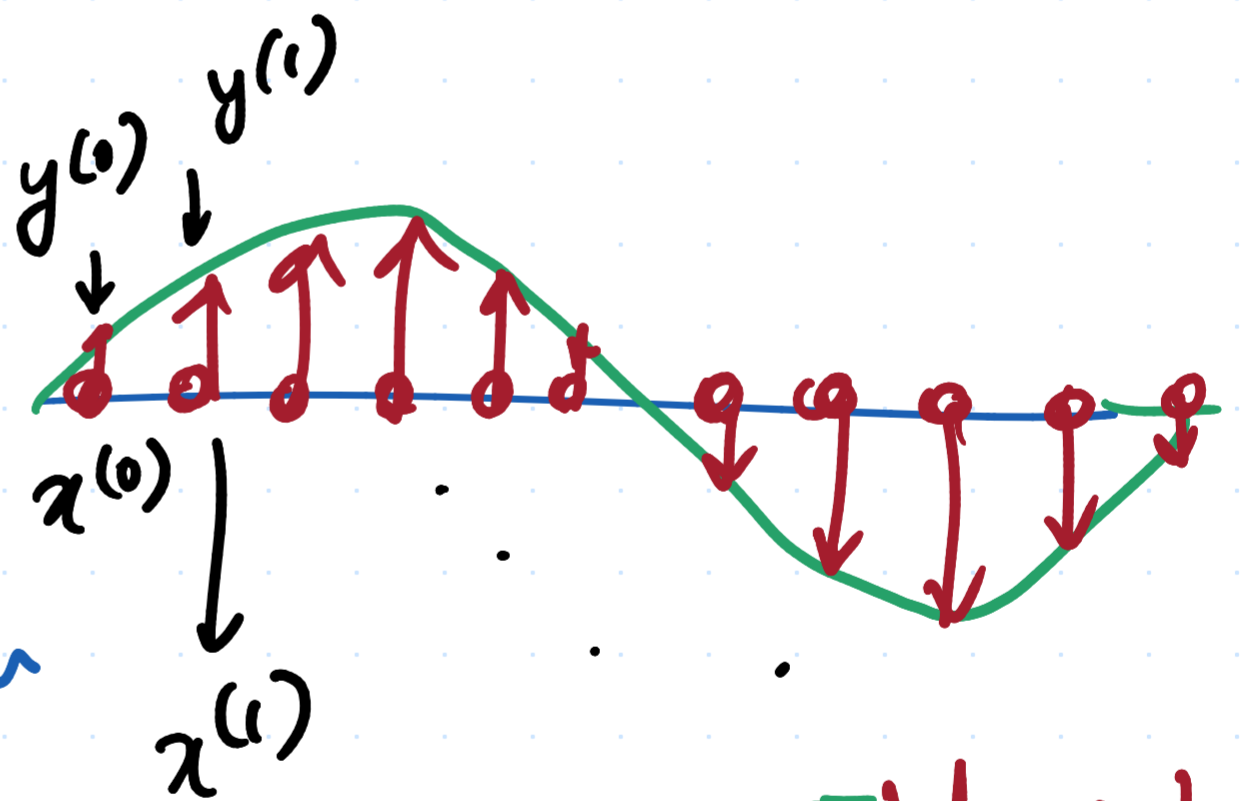
Sigmoid =

$$f(x) = \frac{1}{1 + e^{-x}} \rightarrow$$

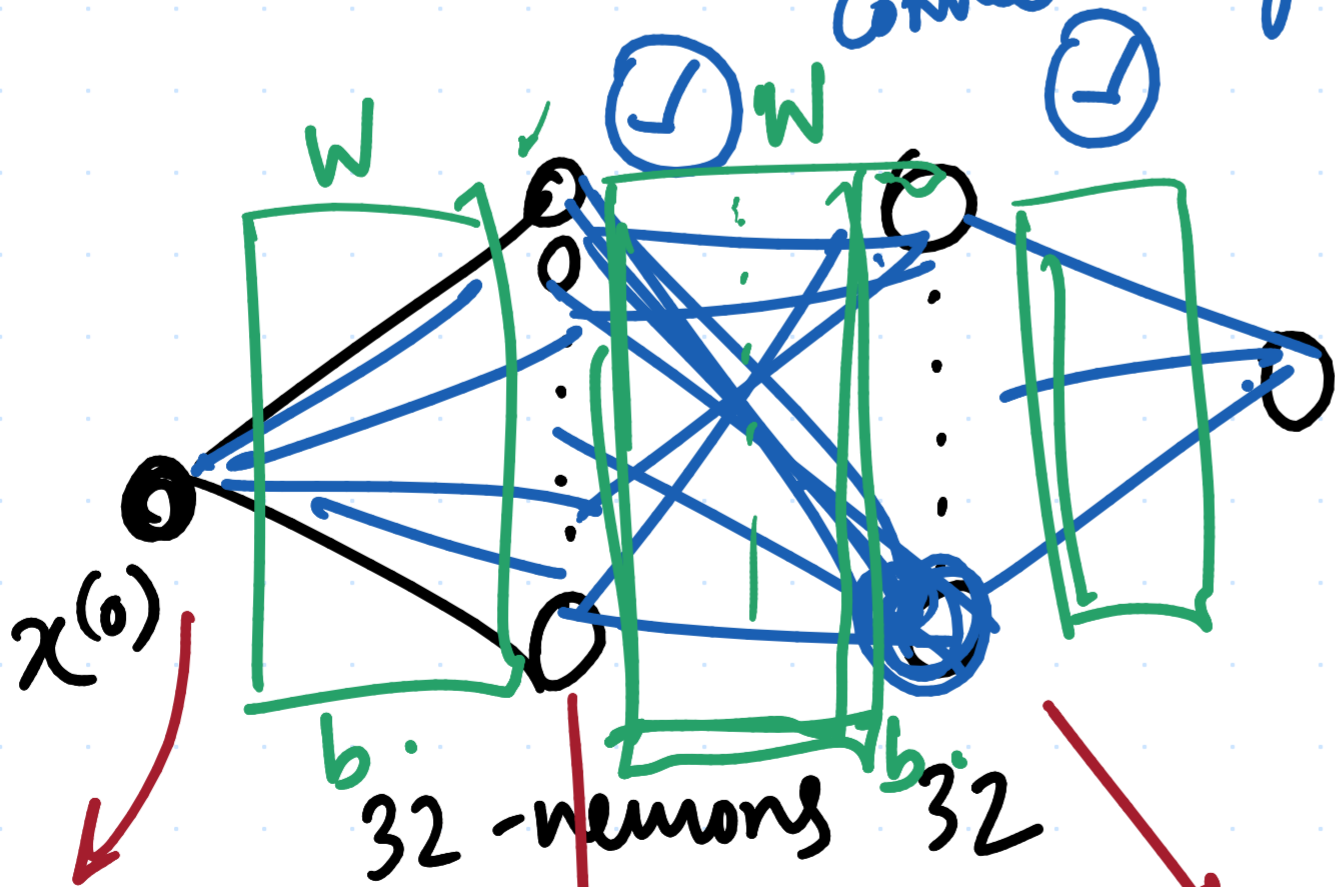
$$f'(x) = f(x)(1 - f(x)).$$

(~~inp~~, 32)  
(32, 32)  
(32, 1)

Dense / Fully Connected layer



$$= Wx + b.$$

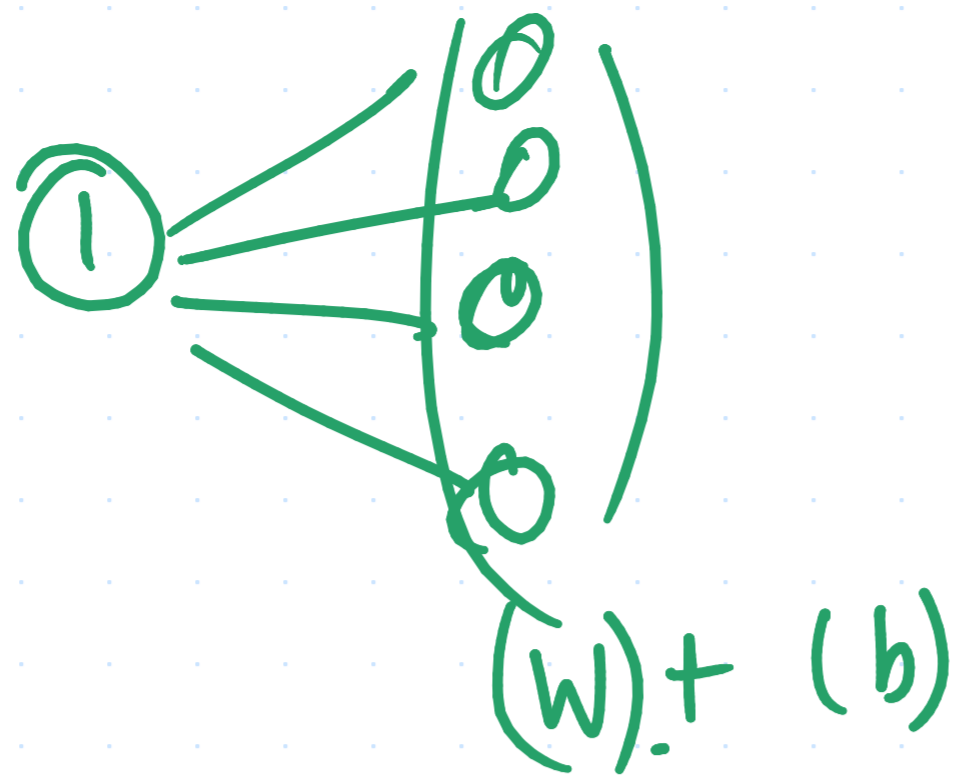


output - (32).  
(32, 1).  
(w, b).

weight, b,

Weight, bias.

weight, bias.



$$W = 2D$$