

$$S = Wx + b$$

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

Scores

$$\begin{pmatrix} -3 \\ -2 \\ -1 \end{pmatrix} = \begin{bmatrix} -4 & -2 \\ -3 & 1 \\ 4 & -5 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$$P(Y = \text{Reg}/2) = \begin{bmatrix} \frac{e^{s_1}}{D} \\ \frac{e^{s_1} + e^{s_2} + e^{s_3}}{D} \\ \frac{e^{s_2}}{D} \\ \frac{e^{s_3}}{D} \end{bmatrix}$$

$$\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \begin{matrix} y_{i1} \\ y_{i2} \\ y_{i3} \end{matrix}$$

R Y G

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$\{x_i, y_i\}_{i=1, \dots, 300} \quad \underline{(W, b)}$$

$$\max_{W, b} \log \left(P(y_i = \text{Red} | x_i)^{y_{i1}} \cdot P(y_i = \text{Y} | x_i)^{y_{i2}} \cdot P(y_i = \text{G} | x_i)^{y_{i3}} \right)$$

min
W, b

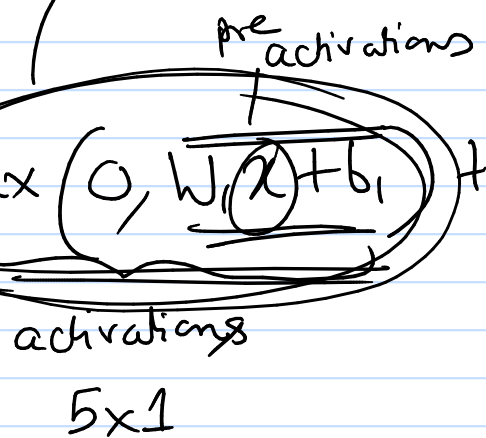
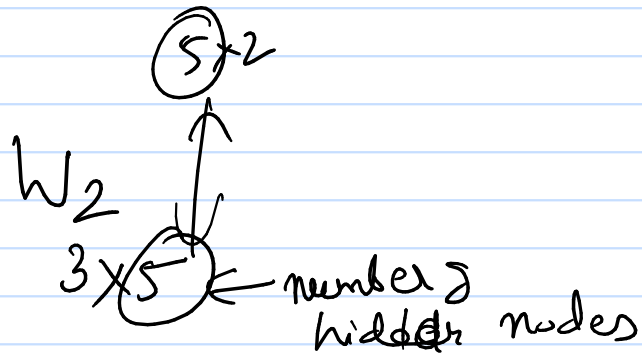
~~$-\log(\text{Prob})$~~

~~$-\sum_{i=1}^3 y_i \log p_i$~~

$\rightarrow \frac{e^{s_i}}{\sum_{j=1}^3 e^{s_j}}$

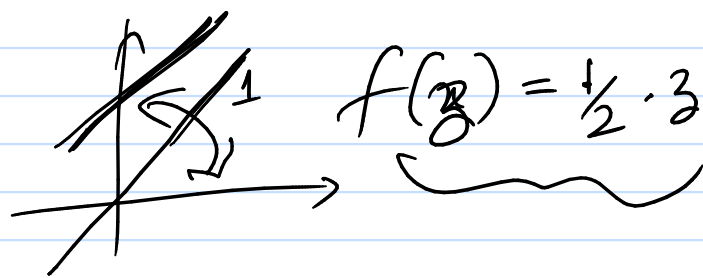
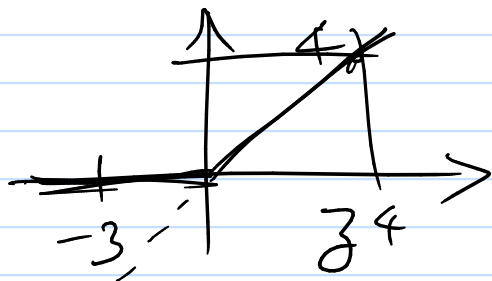
$$\text{LR: } f(x; \underset{3 \times 2}{W}, \underset{3 \times 1}{b}) = \underline{\underline{Wx + b}}$$

$$\text{FFN: } f(x; W_1, b_1, W_2, b_2) = W_2 \max(0, W_1 x + b_1) + b_2$$



$$\max(0, z)$$

ReLU



$$\underline{\underline{W_2}} \frac{1}{2} (W_1 x + b_1) + b_2$$

3×5 5 dim 3×1

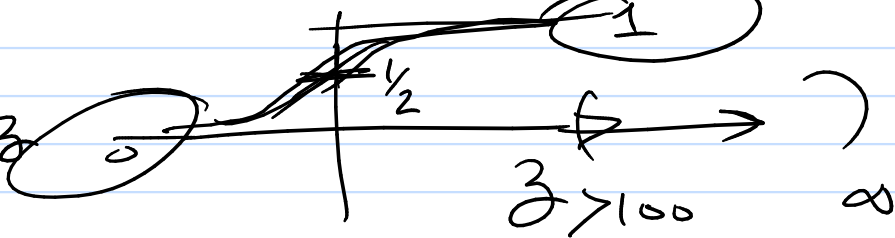
$$\frac{1}{2} W_2 \cdot W_1 x + \frac{1}{2} W_2 \cdot b_1 + b_2$$

W_3 b_3

Sigmoid

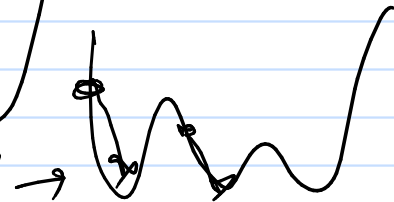
$$\sigma(z) = \frac{1}{1 + e^{-z}}$$

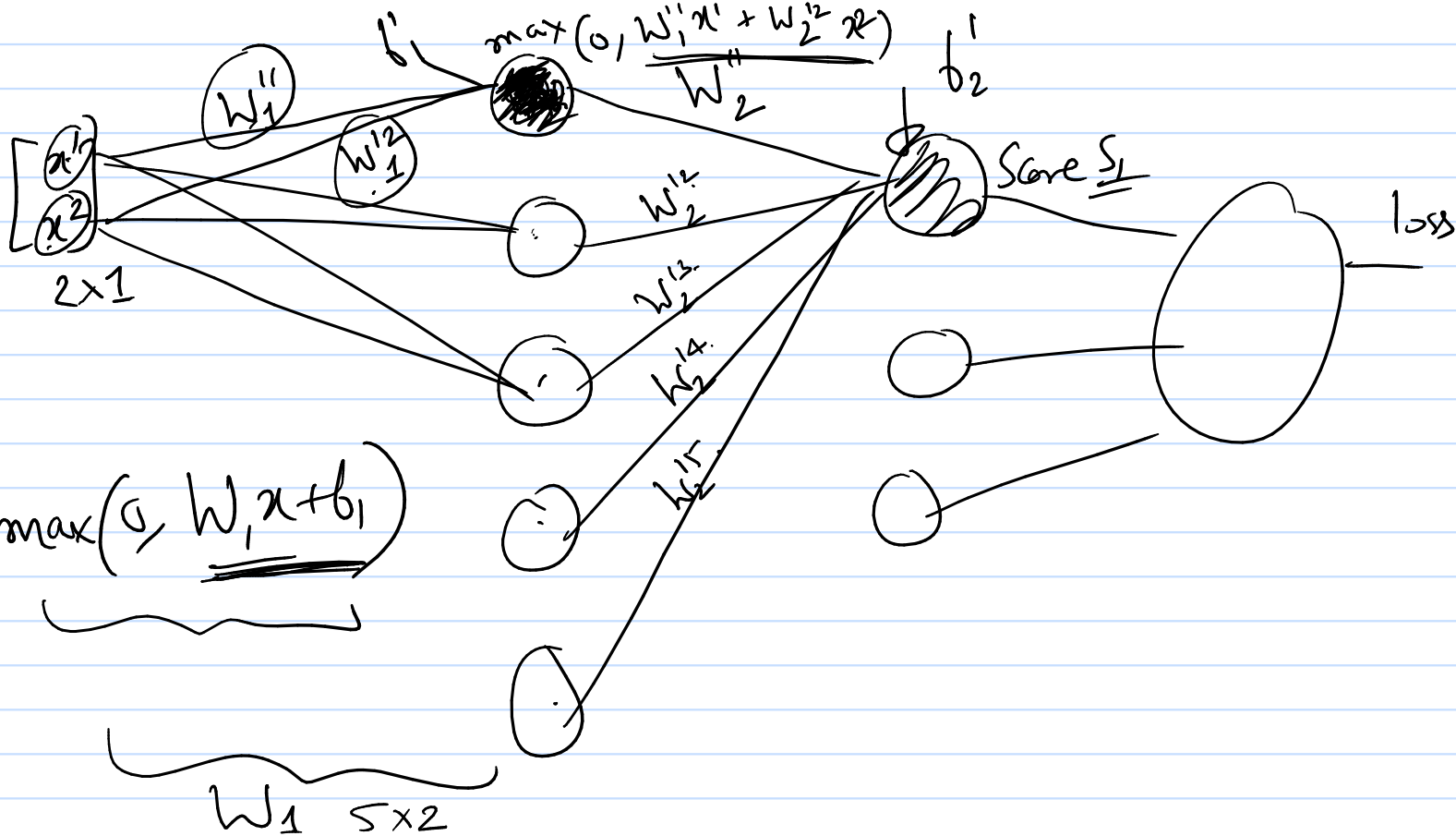
$$\frac{1}{1 + e^{-z}}$$



$$\text{loss}(w_1, w_2, b_1, b_2)$$

$$\begin{matrix} \uparrow & \uparrow & \uparrow \\ 2 \times 2 & 3 \times 5 & 5 \times 1 \end{matrix} \quad 3 \times 1 \rightarrow$$





$$\underline{\underline{h}}_{5 \times 1} = \max(0, \underline{W_1 x + b_1})$$

$$W_1 \quad 5 \times 2$$

$$\begin{bmatrix} 10 \\ \vdots \\ 2 \\ \vdots \\ 1 \\ \vdots \\ 1 \end{bmatrix}$$

5x2

+

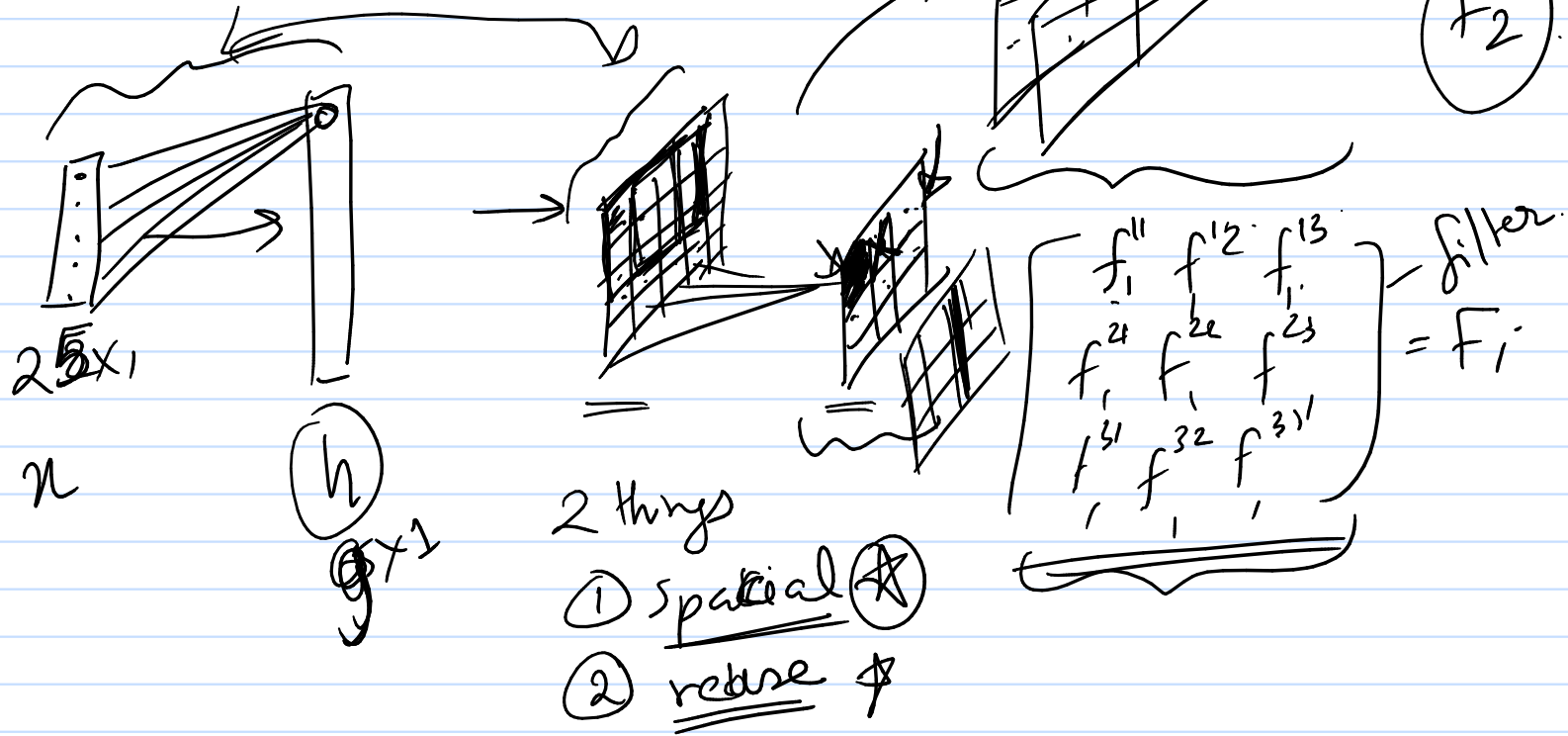
$$\begin{bmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{bmatrix}$$

$$W_2 = \begin{bmatrix} 1 & 1 & 2 & 3 & 1 \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots & \vdots & \vdots \end{bmatrix}$$

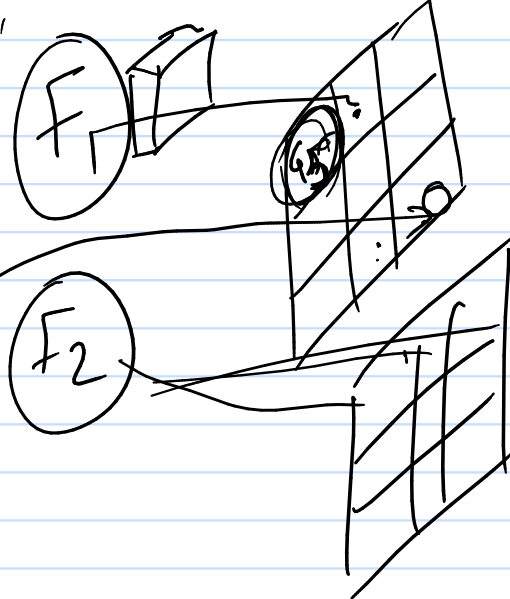
3x5

$$\max(0, \underbrace{10 + 2 + 1}) = 13$$

CNN Convolutional

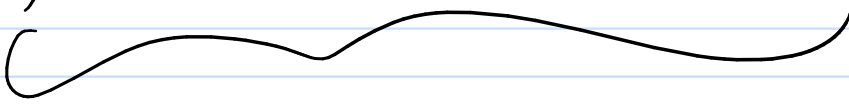


1	2	3			
4	5	6	0	0	0
7	8	9	0	0	-10
		0	0	0	

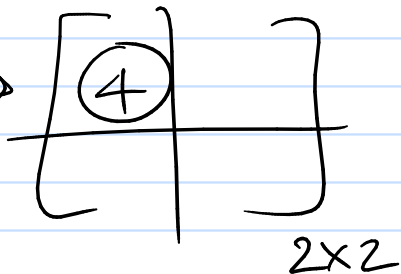
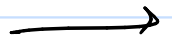
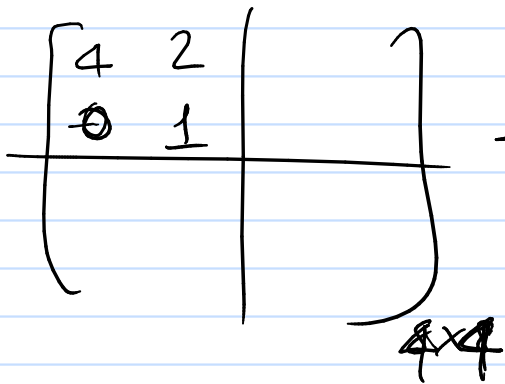
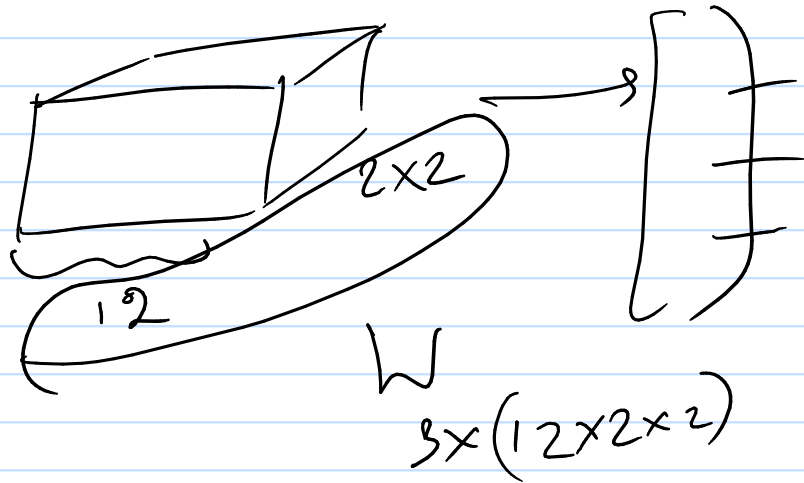
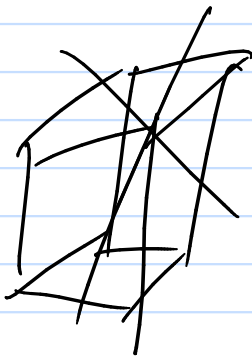
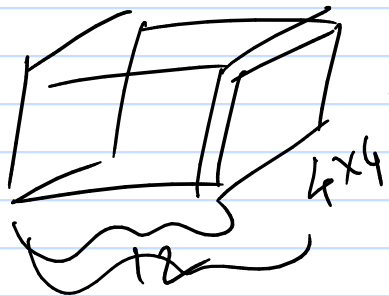


$$F = \begin{pmatrix} 1 & 1 & 1 \\ \vdots & \vdots & \vdots \\ \vdots & \vdots & \vdots \end{pmatrix}$$

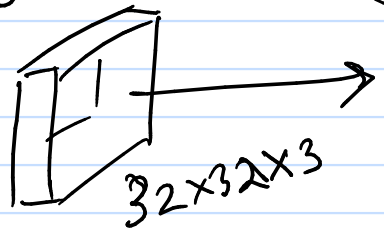
2



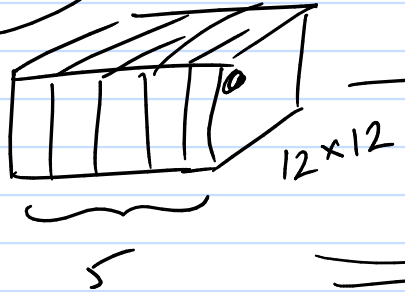
Pooling layer



eg CNN



5 filter



maxpool



linear layer

