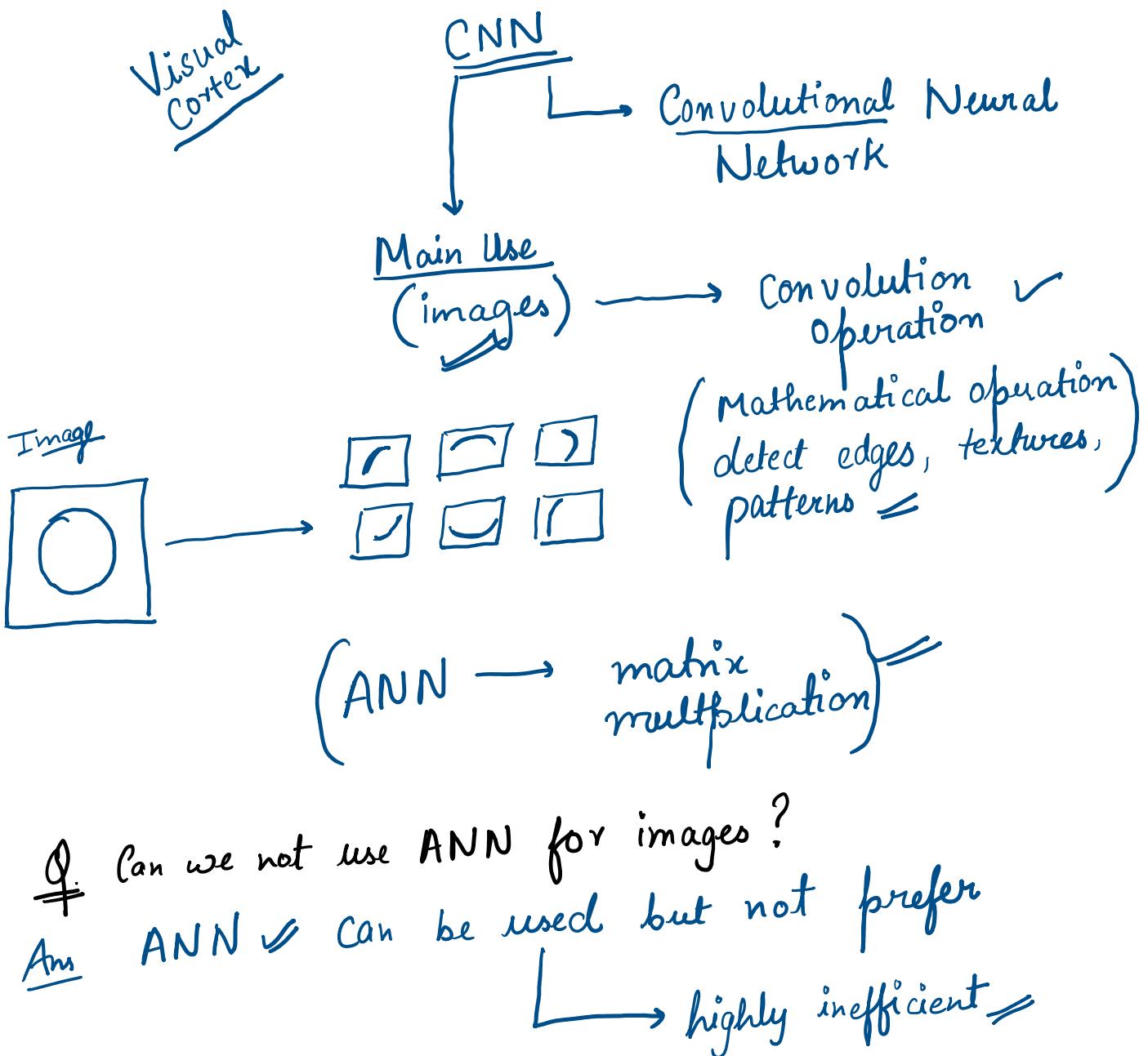
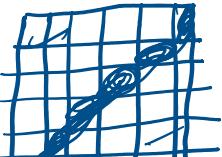


WHAT YOU WILL STUDY IN TODAY VIDEO ?

- ▶ What is CNN?
- ▶ ANN vs CNN
- ▶ Convolutional Layer



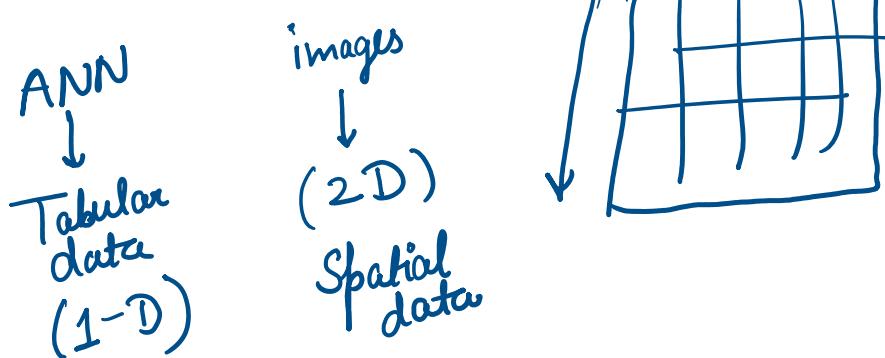
Example Image → 100×100 pixels
 Total pixels → 10,000 pixels ≡ 
ANN Input neurons = total pixels
 = 10,000 input neurons
 ① Too many input features =
 (unnecessary)
 . . . e.g. (10,000)

(unseen)
 ② Suppose you made the input layer (10,000)
 Hidden layer (512 neurons)

$$\begin{aligned} \text{Params} &= 10,000 \times 512 \quad \text{trainable} \\ &= 5.12 \text{ million parameters} \quad \begin{pmatrix} \text{Weight} \\ \text{&} \\ \text{bias} \end{pmatrix} \end{aligned}$$

\Rightarrow (Training very slow
 High computational power
 Overfitting ↑)

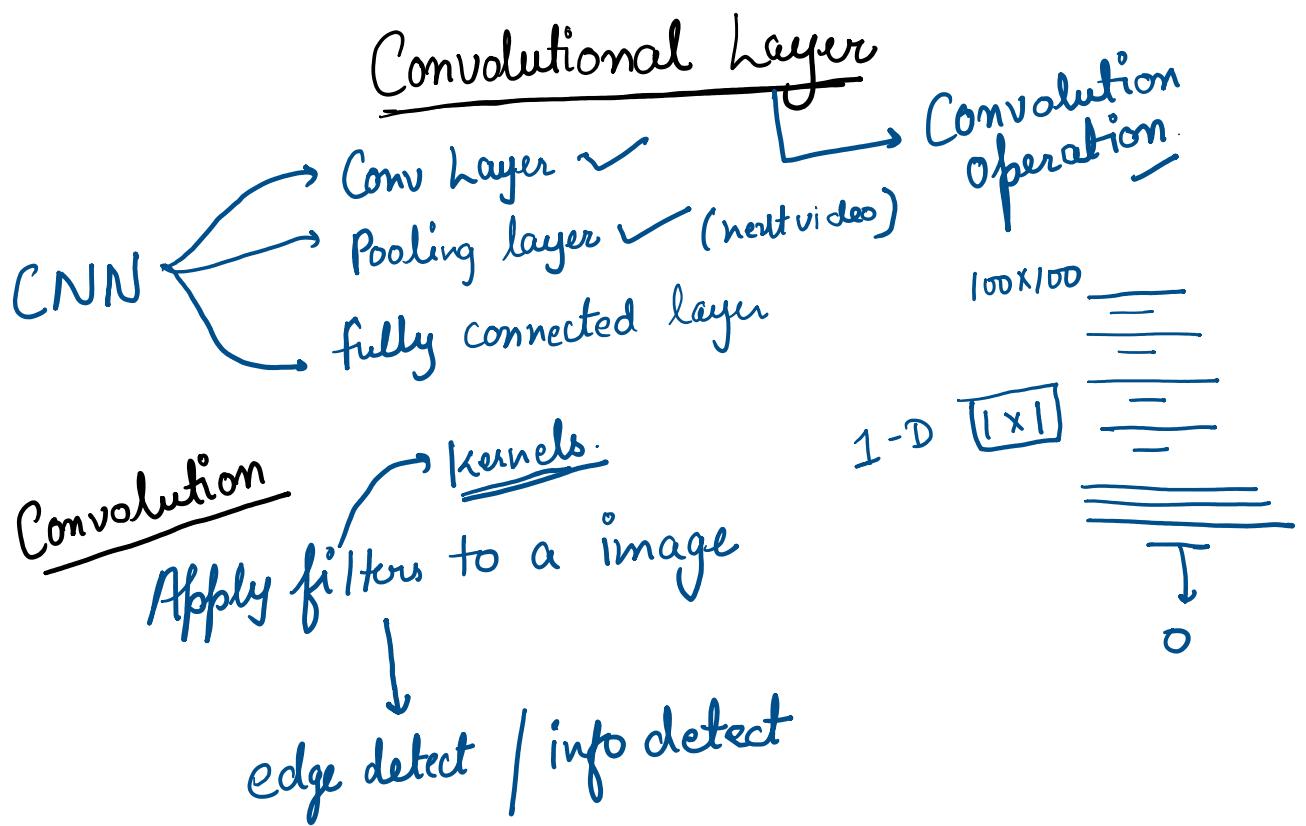
③ Loss of spatial information (Main reason)



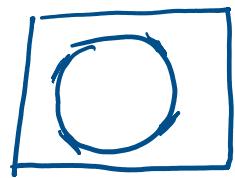
Note: ANN treat each pixel as separate input feature.

eg. \Rightarrow CNN \rightarrow line.
 \Rightarrow ANN \rightarrow dots.

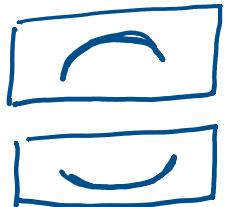
ANN can't understand
edges, pattern, etc in images //



e.g.



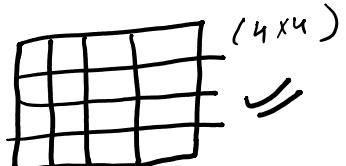
+ edge filter (kernel)
(common)



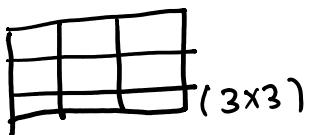
Convolution Operation

Components

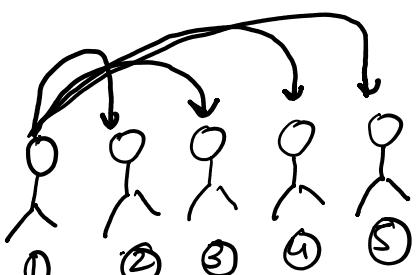
① Input image (4×4)



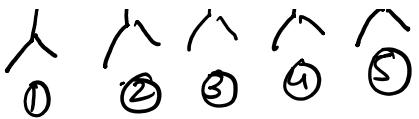
② Kernel / filter (3x3)



③ stride = ①
(jump / step)



Jump / Cut

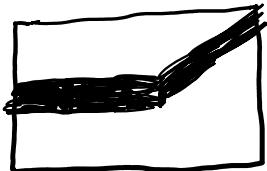


④ feature Map $\hat{=}$

Image + filter \longrightarrow feature map.

- (Black / white)
① Binary image
(0, 1)

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



Types of Images

- ② Grayscale image (greyish shade)
(0 - 255)

0 \rightarrow dark
255 \rightarrow whitest

$$\begin{bmatrix} 5 & 8 & 0 \\ 12 & 15 & 122 \\ 255 & 0 & 32 \end{bmatrix}$$

- ③ RGB image
(colored images)

$$\begin{array}{c} \text{RGB} \\ \swarrow \quad \searrow \\ 0-255 \quad 0-255 \end{array}$$

$$\begin{bmatrix} 255 & 0 & 0 \end{bmatrix}$$

- Pure red image

Mathematical

Image
(X)

$$\begin{bmatrix} 1 & 2 & 3 & 0 \\ 4 & 5 & 6 & 1 \\ 7 & 8 & 9 & 2 \\ 3 & 2 & 1 & 0 \end{bmatrix}$$

(4×4)

Kernel
(f)

Edge
detection
kernel

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

(3×3)

Put your Kernel over your image (top-left)

$$X = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \quad \begin{bmatrix} 1 & 0 & -1 \\ 0 & 0 & -1 \\ 0 & 0 & -1 \end{bmatrix}$$

⇒ Multiplication

$$\Rightarrow (1 \times 1) + (2 \times 0) + (3 \times -1) + (4 \times 1) + (5 \times 0) + \dots + (9 \times -1)$$

$$\Rightarrow -6.$$

(value for
feature map)

stride = 1. (jump right for 1 step)

$$X = \begin{bmatrix} 2 & 3 & 0 \\ 5 & 6 & 1 \\ 8 & 9 & 2 \end{bmatrix} \quad \begin{bmatrix} 1 & 0 & -1 \\ 0 & 0 & -1 \\ 0 & 0 & -1 \end{bmatrix} \Rightarrow \underline{\underline{12}}.$$

value for
feature map

