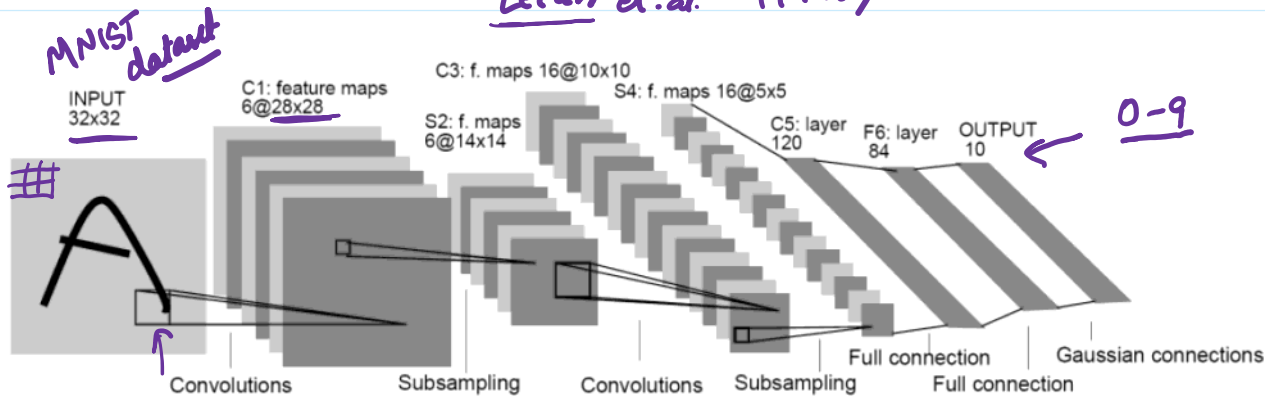


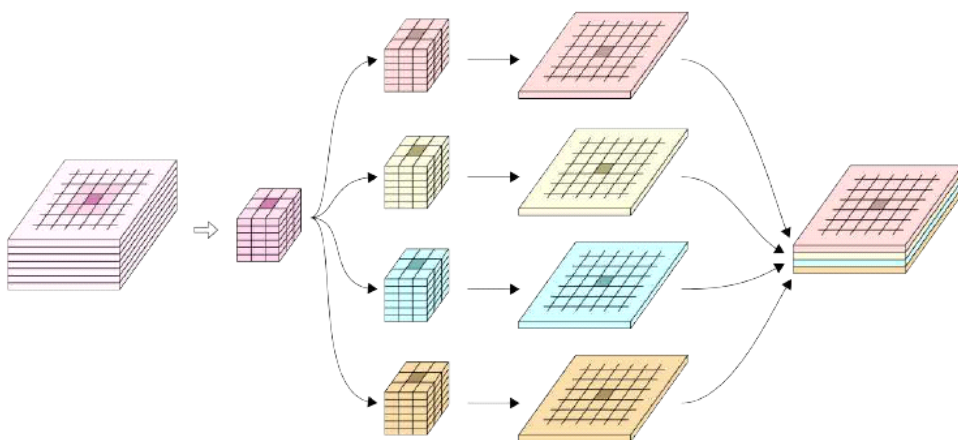
Convolutional Neural Networks:-

Lecun et.al. (1998)



Digit recognition

LeNet-5



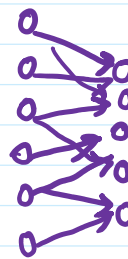
2D Convolution

CNN:-

⇒ Instead of connecting all the units in a layer to all the units in a preceding layer,

CNN organize each layer into feature maps.

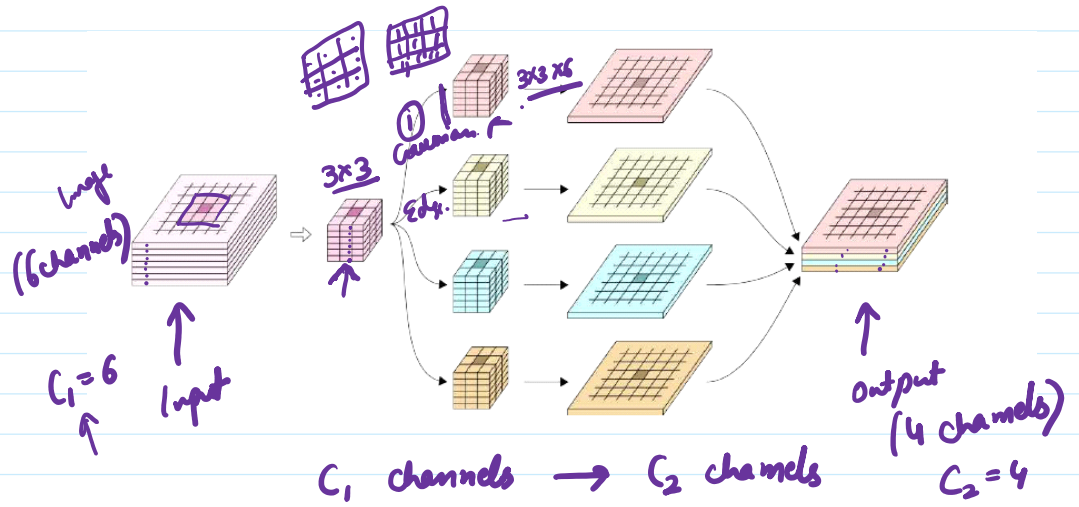
(parallel planes) channels.



MN.

(coloured)
(RGB)
ppp

3 channel image

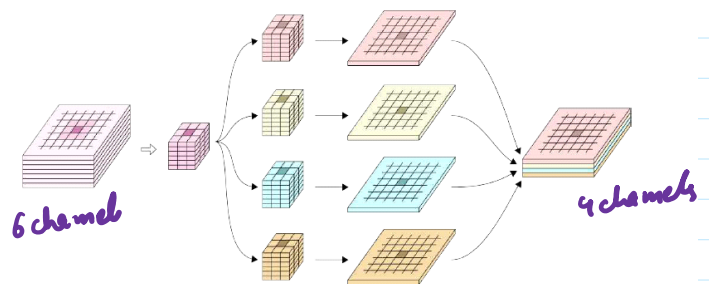


⇒ Each 2D conv. kernel takes as input all the C_1 channels in the preceding layer, (small window), produces the value (after non-linear activation)

⇒ No. of $\underbrace{\text{kernel}}_S$ weights for each of the output channel $\underbrace{C_2}$

⇒ # of learnable parameters in each convolution layer.

$$S^2 \times C_1 \times C_2$$



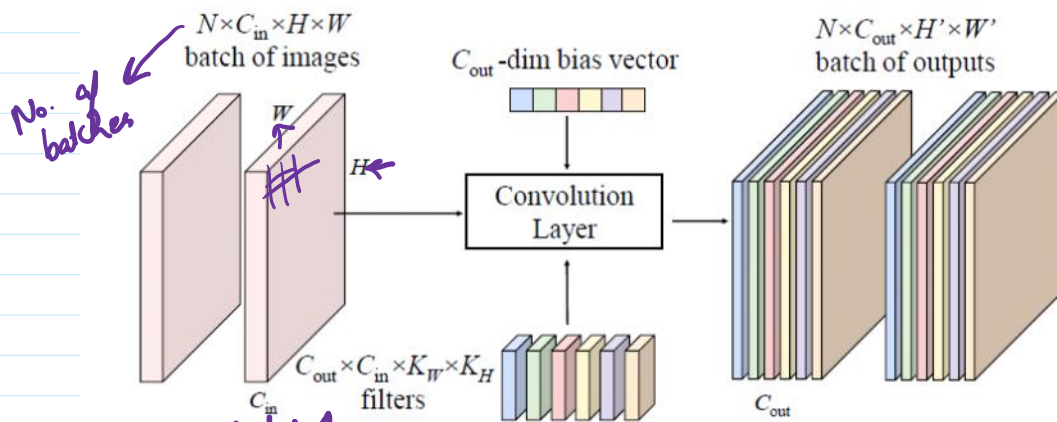
In this figure,

$C_1 = 6$ input channels

$C_2 = 4$ output channels

$S = 3$ convolution window

Learnable weights are $3 \times 3 \times 6 \times 4$.



batch 1
2D convolution with multiple batches.

\Rightarrow In a mini-batch gradient descent a whole batch of training images or features is passed in a convolution layer.

C_{in} \rightarrow input channels.

C_{out} \rightarrow output channels.

$K_W \times K_H$
kernel size.

For each of the output channel, kernel weights.

$K_H \times K_W \times C_{in}$ # of kernel weights.

of learnable parameters $K_W \times K_H \times C_{in} \times C_{out}$.