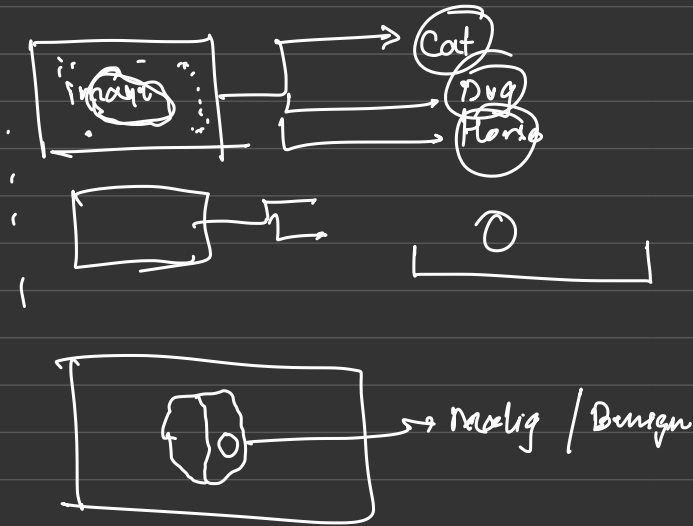


# Convolutional neural network

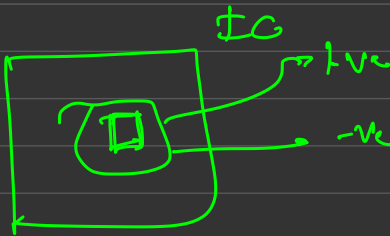
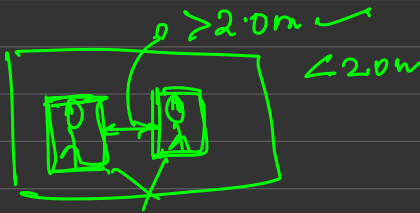
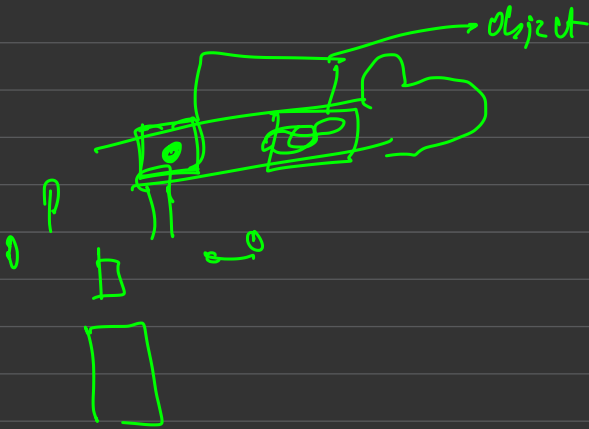
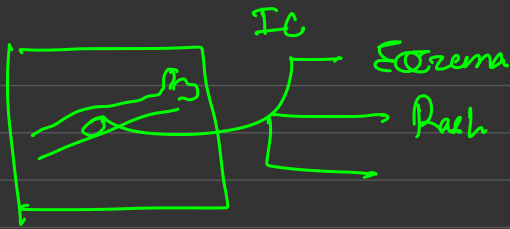
extract information from images

Image Classification



Object detection & localization



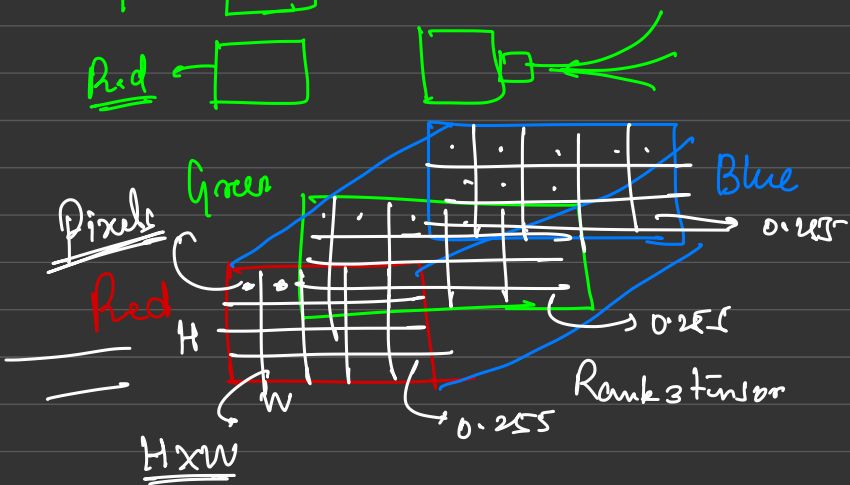


Siamese Network (Facial Rec system)



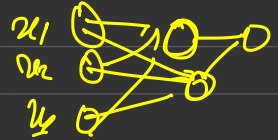
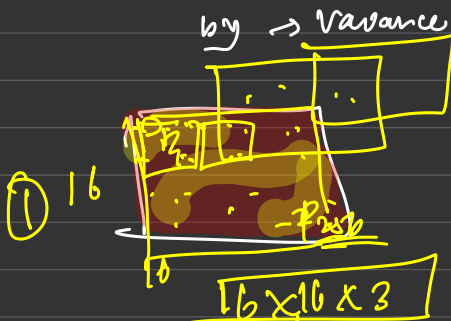
Blue  
Green  
Red

$R+G+B$



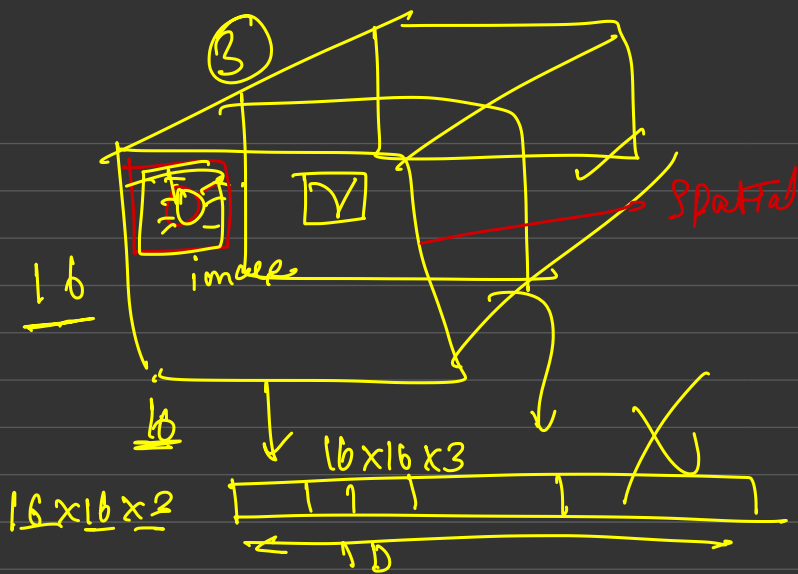
What is information in an image

Variance in pixel values across all the 3 color channels is what we mean

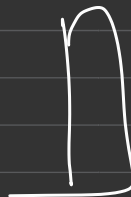
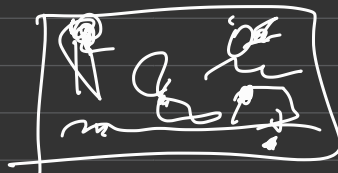
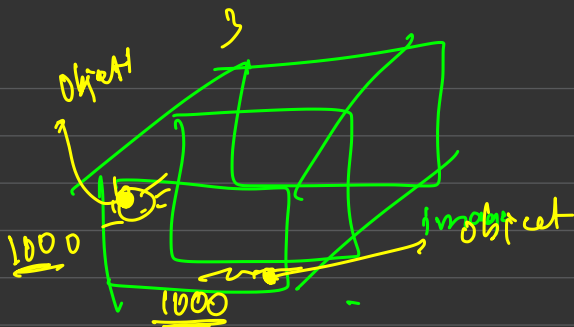


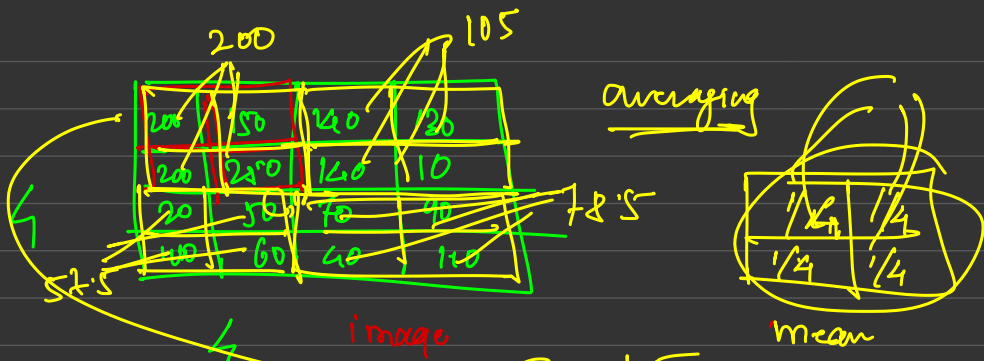
extracting information from images  
extracting features / modifying pixel values

$$\text{Image} \sim \begin{pmatrix} R & & \\ p_1 & \dots & p_{256} \\ G & & \\ p_1 & \dots & p_{256} \\ B & & \\ p_1 & \dots & p_{256} \end{pmatrix}$$



Convolution





Calculation

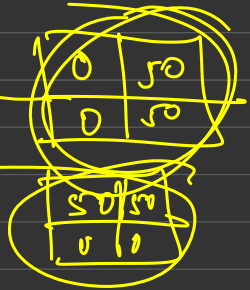
$$200 \times \frac{1}{4} + 50 \times \frac{1}{4} + 200 \times \frac{1}{4} + 250 \times \frac{1}{4}$$

$$= 50 + 37.5 + 50 + 62.5$$

$$= 100 + 38 + 62$$

200

Blurry



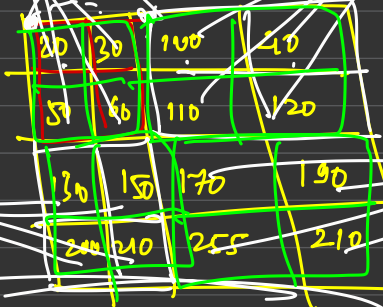
manual process of extracting features

Convolutional Neural network

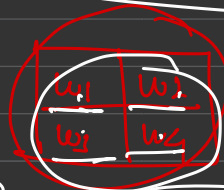


$$\text{tanh}(20 \times w_1 + 30 \times w_2 + 50 \times w_3 + 60 \times w_4 + b)$$

stride = 2



$$\text{tanh}(100 \times w_1 + 40 \times w_2 + 110 \times w_3 + 120 \times w_4 + b)$$



$$\text{tanh}(170 \times w_1 + 190 \times w_2 + 255 \times w_3 + 210 \times w_4 + b)$$

$$\text{tanh}(130 \times w_1 + 150 \times w_2 + 200 \times w_3 + 210 \times w_4 + b)$$

Nonlinearity

$$(20 \times w_1 + 30 \times w_2 + 50 \times w_3 + 60 \times w_4 + b)$$

ReLU/Tanh

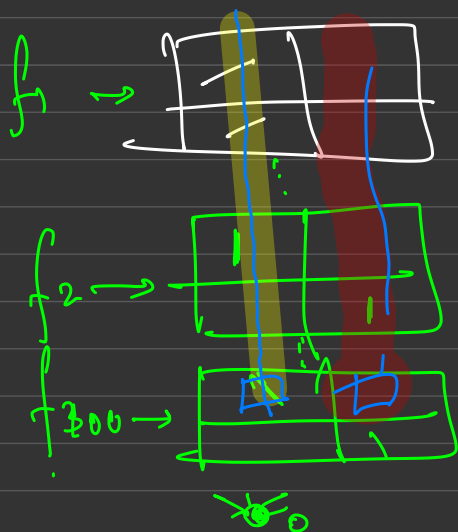
Capture a feature non-linearly



250	-150
60	-100

using this filter  
I have identified one particular pattern across the image

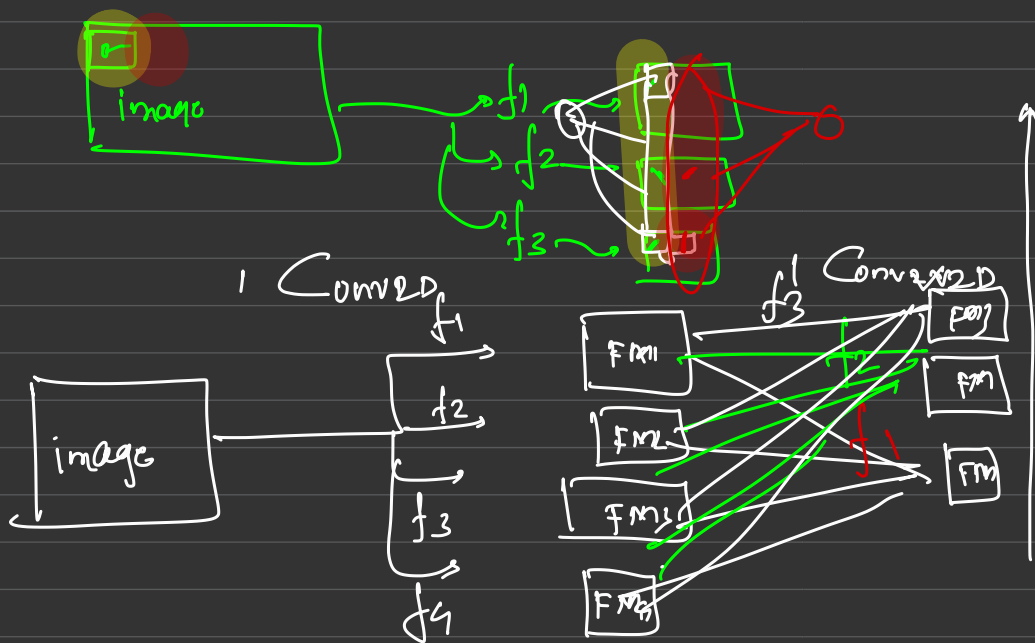
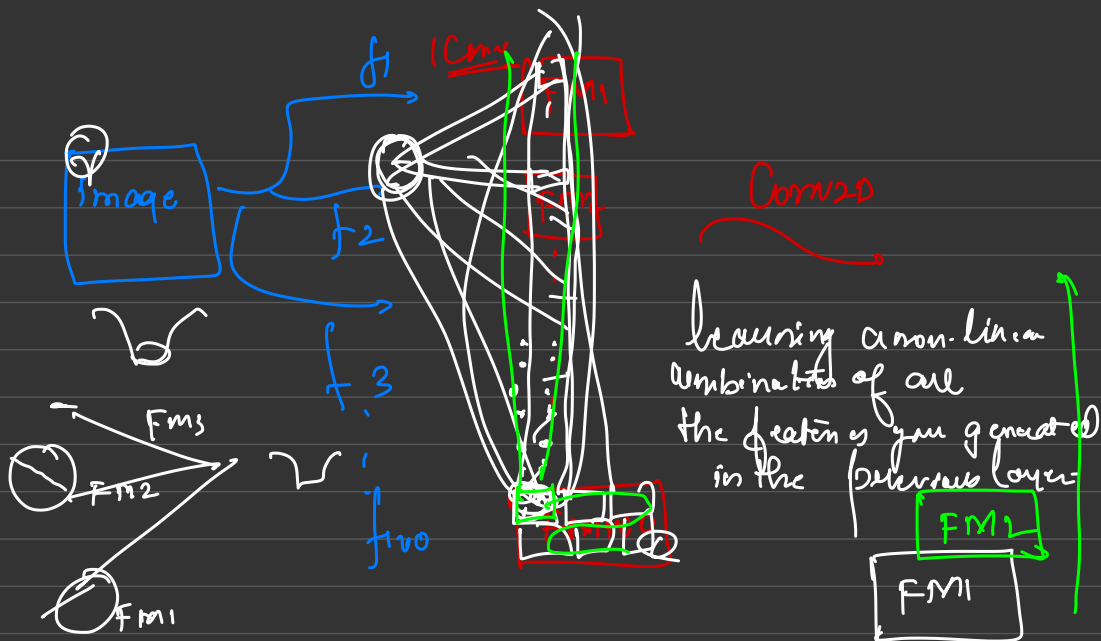
Feature map:

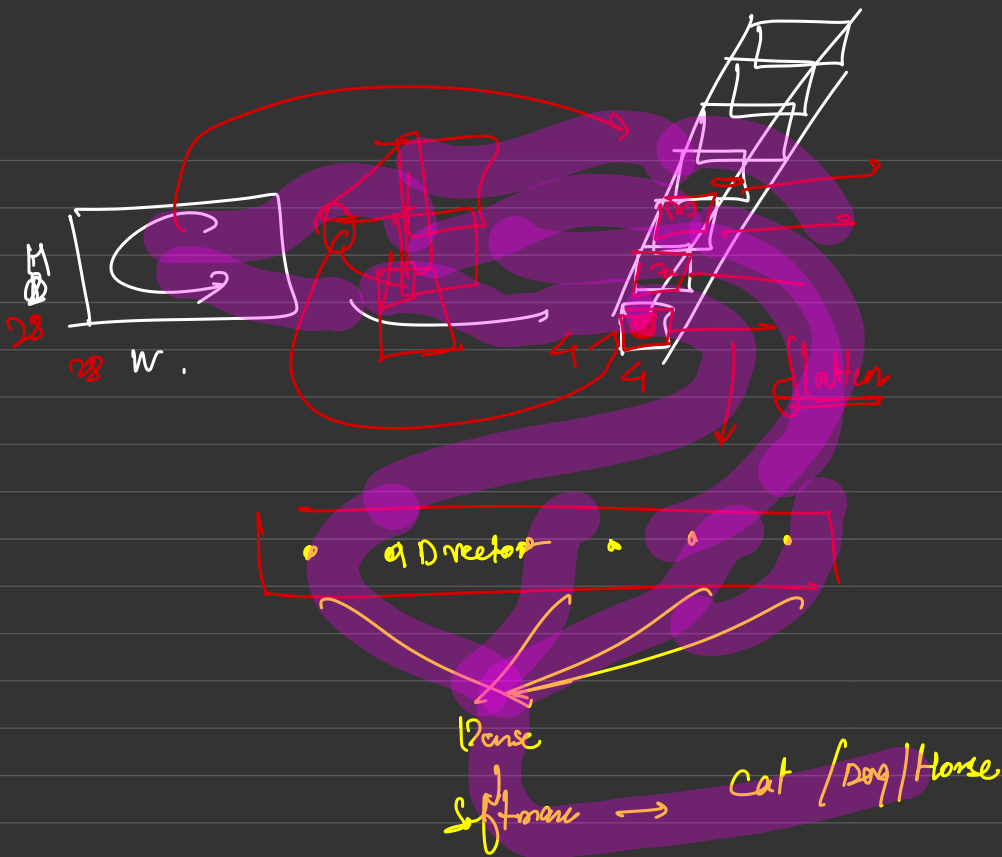


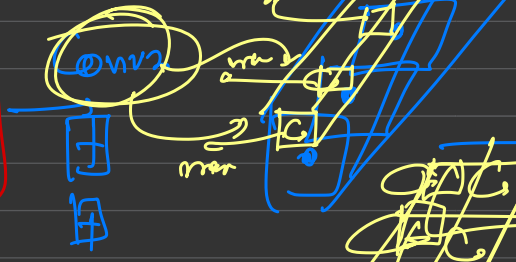
w5	w6
w7	w8



feature maps are  
basically the deconstructed  
version of given object at  
that location









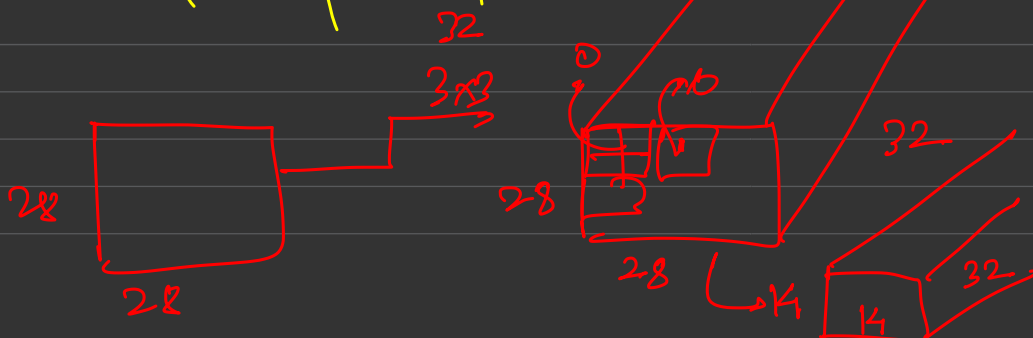
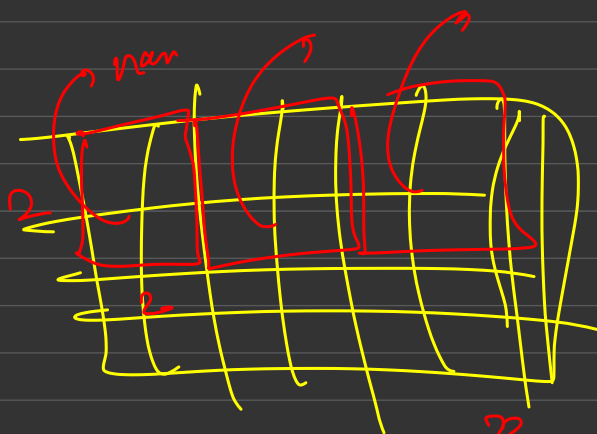
~~Dance~~  
Dance →



you will always have a image sent to a  
Conv layer / model as a 4D tensor

$(n\text{-samples}, H, W, \text{color-channels})$

$(28, 28) \rightarrow \text{Submap } (1, 28, 28, 1)$



4

20	10	60	70
40	50	80	90
100	101	150	170
120	170	160	200

50 90 200 190 4

2

50	90
190	200