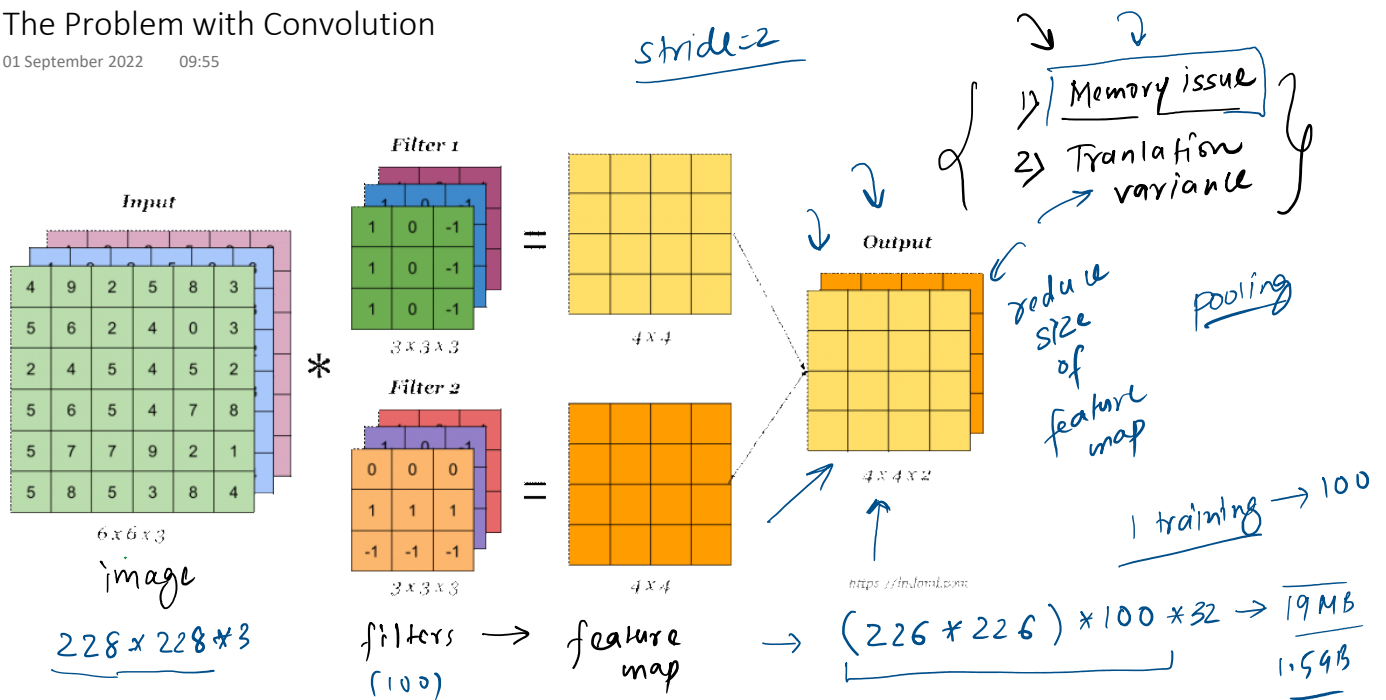
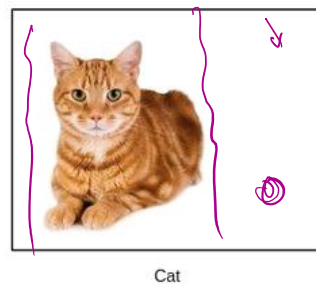
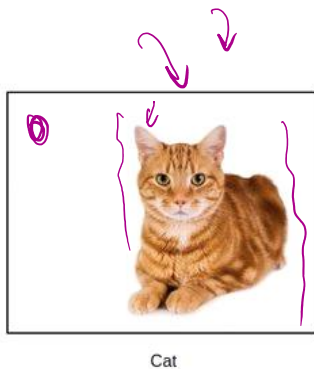


# The Problem with Convolution

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Translation Variance



features

{ location dependent }

location

{ down sample your feature map }

pooling

# Pooling

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

\*

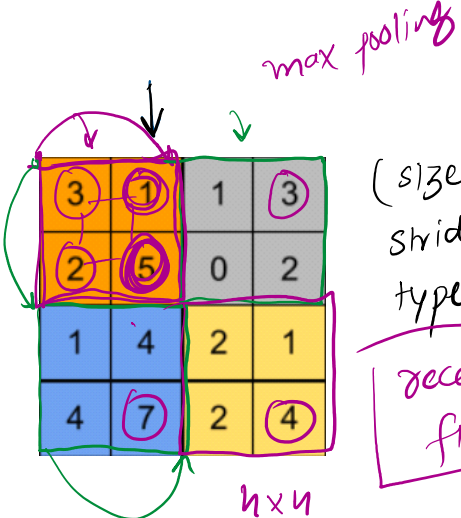
$$\begin{pmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{pmatrix}$$

=

$$\begin{pmatrix} - & - & - & - \\ - & & & \\ & & & \\ & & & \end{pmatrix}$$

Maxpooling  
Minpooling  
avg pooling  
L2 pooling  
Global pooling

feature map (non-linear)



(size)  $\rightarrow (2, 2)$   
stride  $\rightarrow (2)$   
type  $\rightarrow$  Max

receptive field

$$\begin{pmatrix} 5 & 3 \\ 7 & 4 \end{pmatrix}$$

feature map

2x2

low level details eliminate

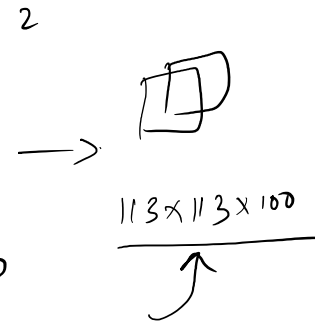
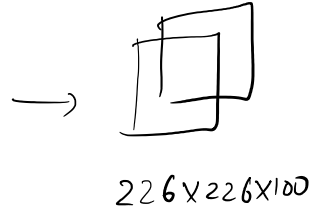
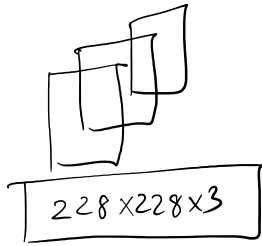
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# Advantages of Pooling

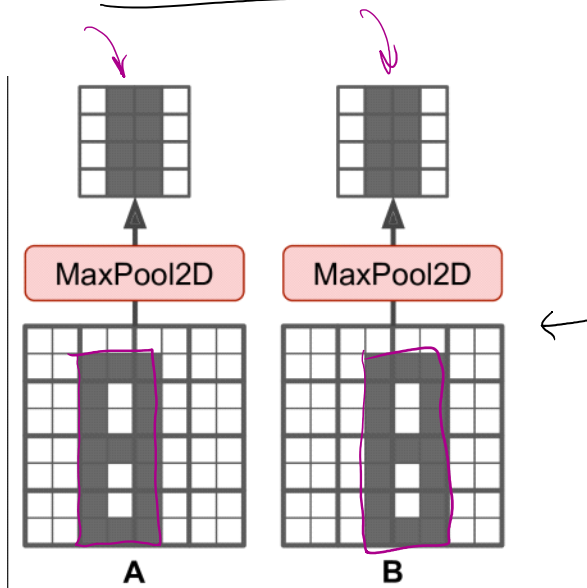
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1) reduced size

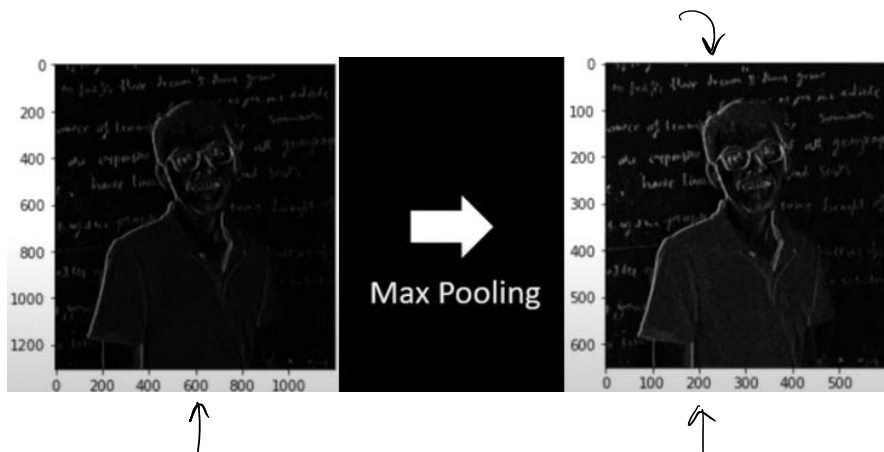


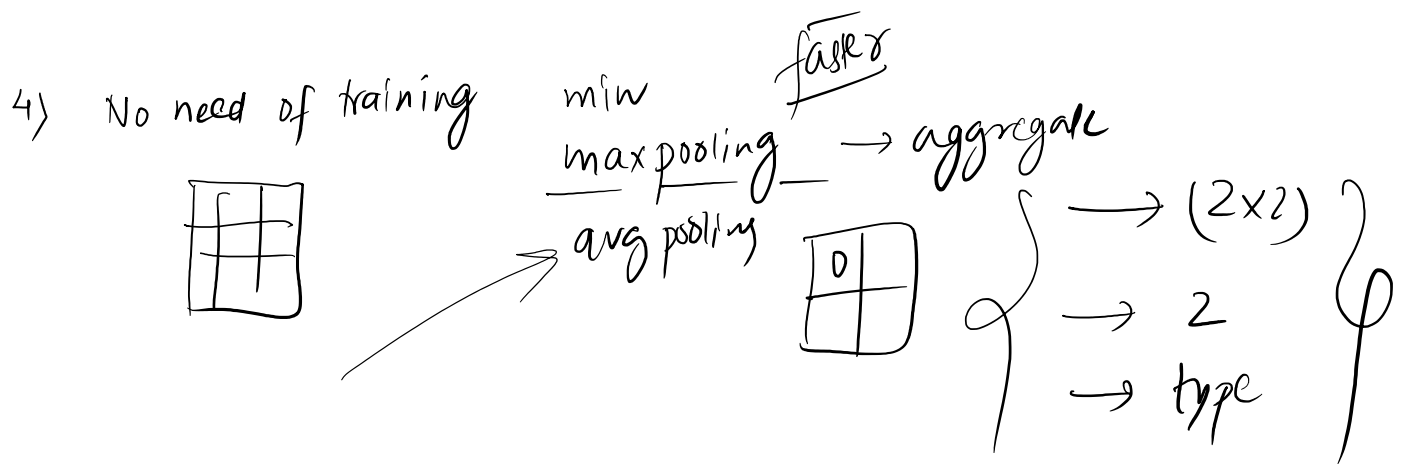
(2,2) → 2

2) Translation invariance



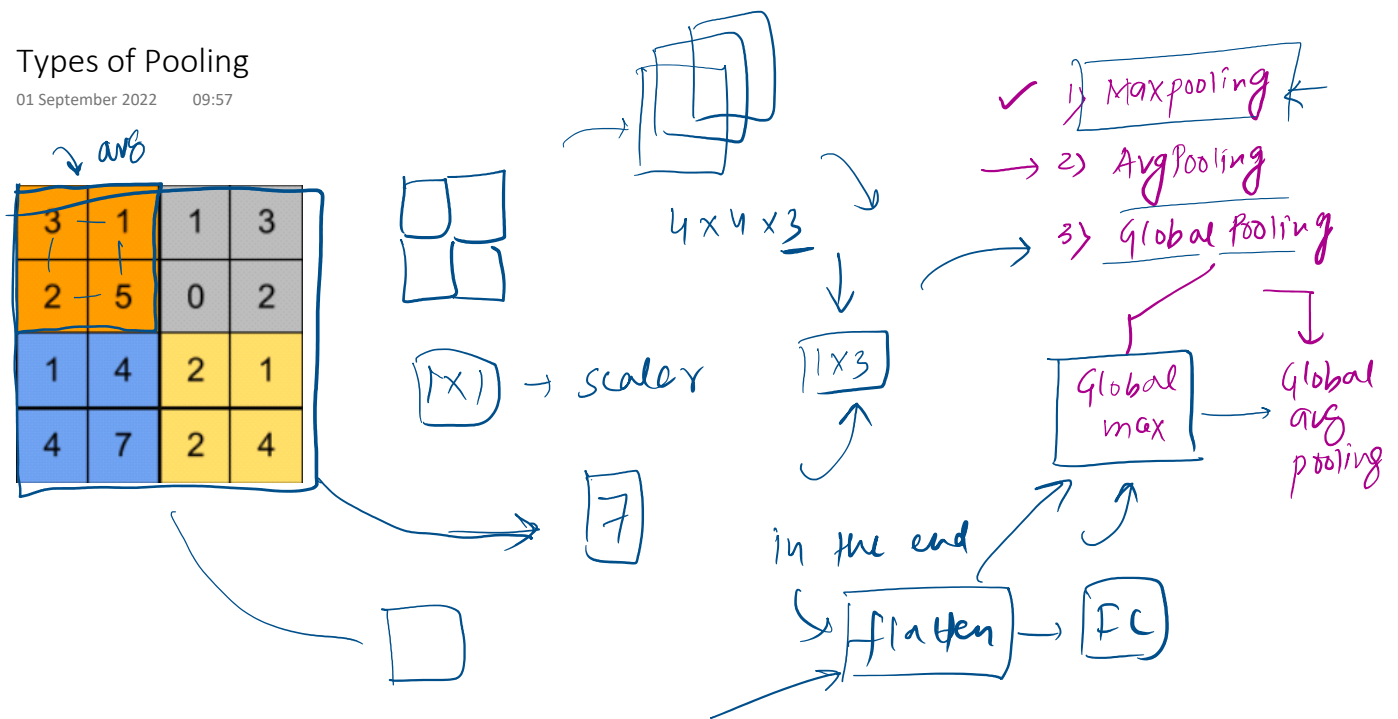
3) Enhanced features  
(only in case of Max pooling)





# Types of Pooling

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## Disadvantages of Pooling

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