

Agenda

- 1) CNN Foundations
- 2) Network Building
- 3) LeNet

Hidden (ANN) \rightarrow Dense, Fully Connected, Linear
 CNN (avoid) $1/2$ max

Backpropagation

$$\frac{-1}{+1}$$

Bias

Induces the network with different activation

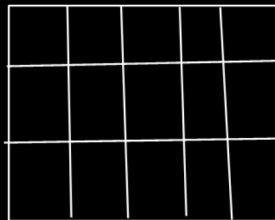
$$y = wx + \beta$$

Receptive Fields

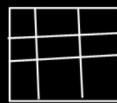
Local

Global

5x5



3x3



7x7

$f_{3 \times 3}$

5x5



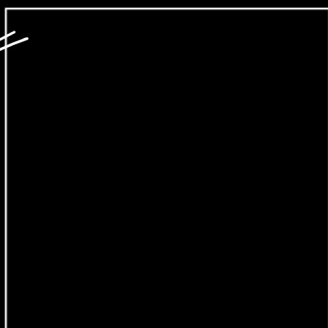
5x5

$f_{3 \times 3}$

3x3

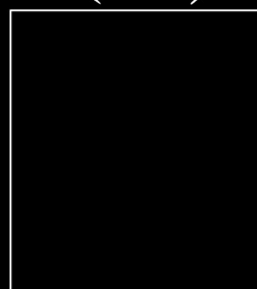
L_5

f_L

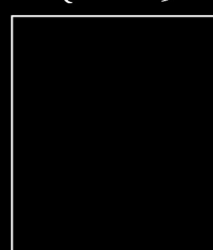


$f_1(40 \times 40)$

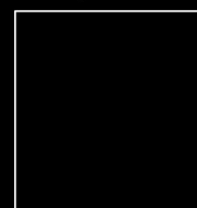
$f_2(38 \times 38)$



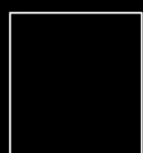
$f_3(36 \times 36)$



L_2



L_1



Receptive Field $f_2^{3 \times 3} = (5 \times 5)$

Local Receptive Field

$$\frac{f_3}{f_1} = 38 \times 38$$

$$f_1 = 40 \times 40$$

global

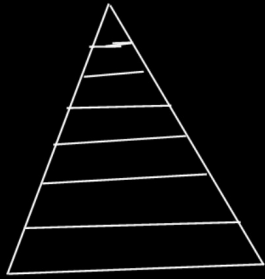
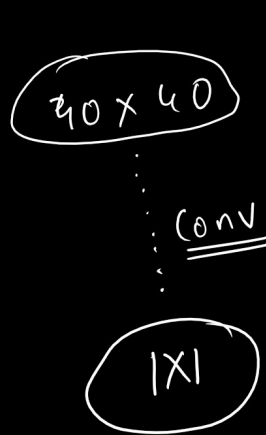


Image Size = $w \times h$
 \downarrow conv
 (1×1)

$$\frac{f_1}{f_1} = \frac{3 \times 3}{5 \times 5}$$



$$h \times w \times \underline{\text{channels}} \quad 1 \times 1$$

$$\{20 \times 20 \times 3\} - (3 \times 3) \times 32 \rightarrow 3 \times 3$$

$$O = \{18 \times 18 \times 32\} - (3 \times 3) \times 64 \rightarrow 5 \times 5$$

$$= \{16 \times 16 \times 64\} - (3 \times 3) \times 128 \rightarrow \underline{7 \times 7}$$

$$\underline{9 \times 9} \xrightarrow{\text{con}} \xrightarrow{f_1} (5 \times 5) \xrightarrow{f_1} 3 \times 3$$

Why 5×5

or 2 times (3×3) ?

$$9 \times 9 \rightarrow 5 \times 5$$

(5×5)

$$n = \frac{n_1 + 2p - k}{s} + 1$$

Receptive Field
output shape & dimension

1) ~~28~~ $28 \times 28 \times 3$

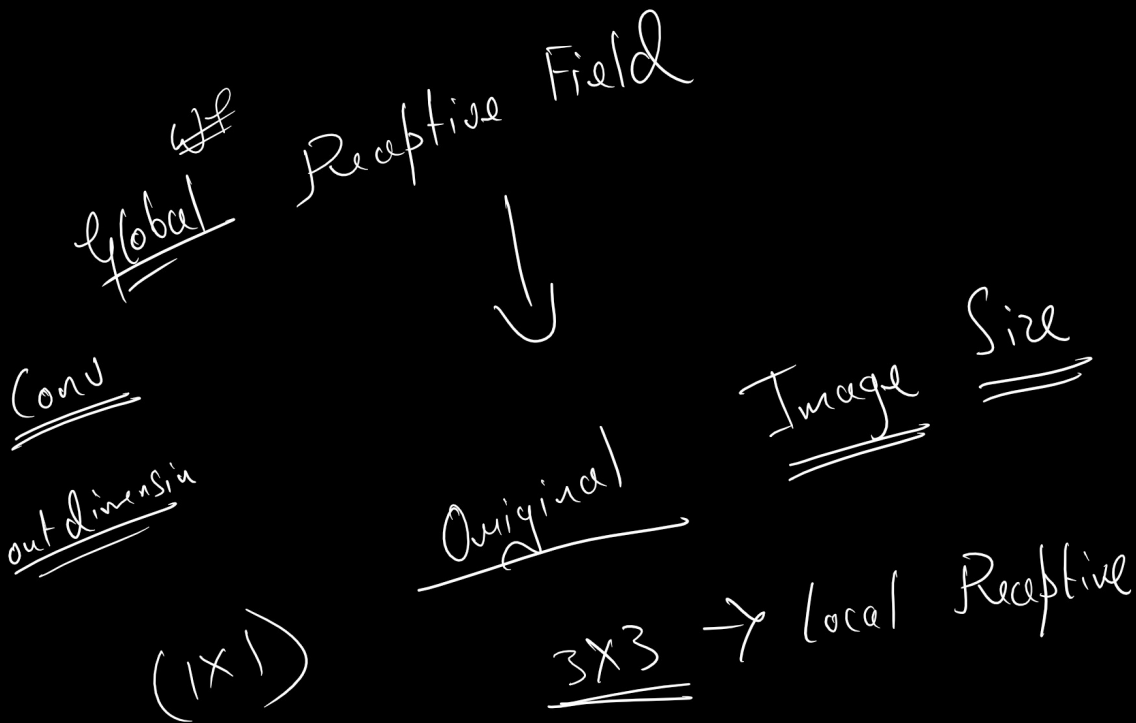
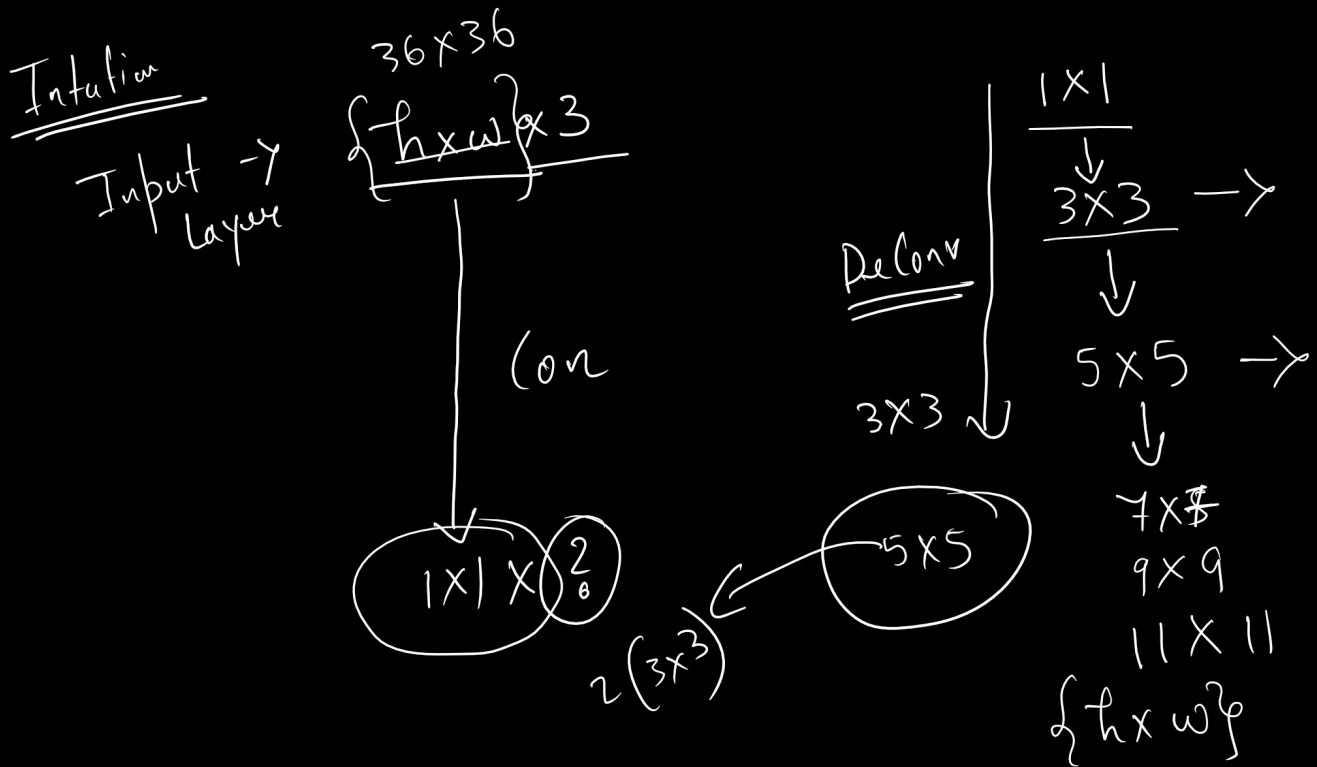
1×1

Layman

How much the
kernel has seen?

It decides the 1×1
output dimen
in a CNN network

28×28



Input Sample

$40 \times 40 \times 3$

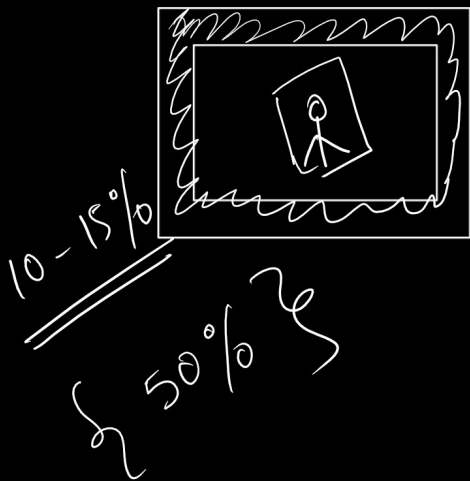
Reduction
Con

1×1

Addition
Decon

1×1

$h \times w$



In CV
Assumption

$$\underline{\underline{20 \times 20}} \quad 28 \times 28 \leftarrow$$

$$RF = \frac{1 \times 1}{3 \times 3}$$

$$L_1 \rightarrow 8, (3 \times 3)$$

$$L_2 \rightarrow 8, (3 \times 3)$$

$$\underline{\underline{RF = 5 \times 5}}$$

Flatten

Then we decide layer

$$\rightarrow 10 \times 10$$

$$L_1 \rightarrow (3 \times 3) \quad 8$$

$$L_2 \rightarrow (3 \times 3) \quad 46$$

$$L_3 \rightarrow (3 \times 3) \quad 32$$

$$RF = 3 \times 3$$

$$RF = 5 \times 5$$

$$RF = \underline{7 \times 7}$$

$$\underline{\underline{30\%}}$$

Flatten:-

$$\{ 5 \times 5 \}$$

$$\{ 50 \times 50 \}$$

$$\{ 25 \times 25 \}$$

W
6x6

$C_1 \rightarrow 3 \times 3$

$\rightarrow 4 \times 4$

$\rightarrow 2 \times 2$

$C_2 \rightarrow 3 \times 3$

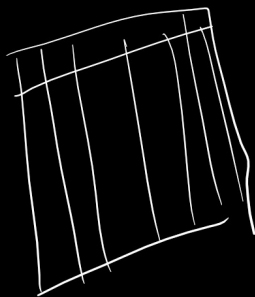
$\rightarrow 2 \times 2$

C_3

6x6 ✓

30x30

1x1



|||||

h x w

In 6/w or starting
1.5 x 3

Kernel Size
Size

Even
Symmetry
kernel

odd
No

$$= 32^0 + \left((3 \times 3) + \text{Bins} \right)$$

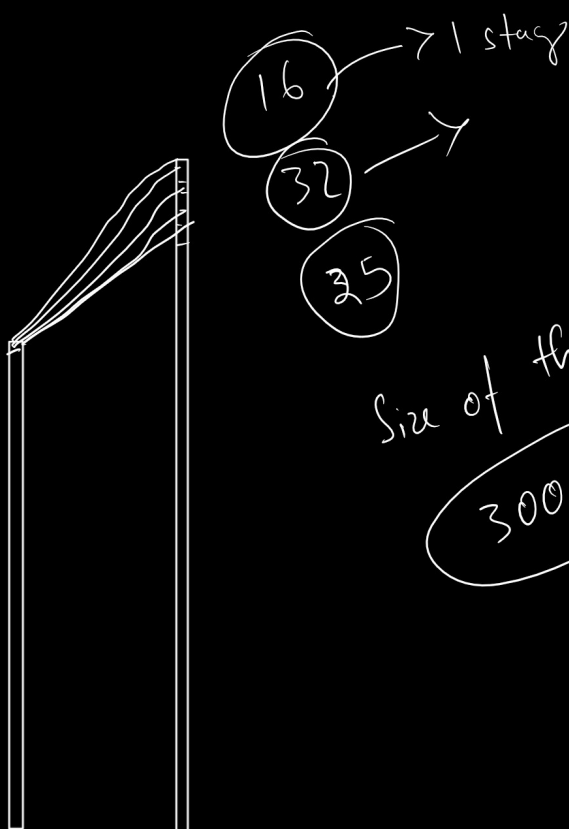
$$= 32 \times (a+1)$$

$$= 320$$

$$32 \times 32 \times \underline{\underline{16}} \times$$

$$(3 \times 3) \times \cancel{32} \times$$

$$= \underline{\underline{32 \text{ Filters Added}}} \quad \underline{\underline{16}} + \underline{\underline{16}}$$



Size of the
30000

$$\begin{array}{r} \underline{\underline{64}} \\ 128 \\ \hline 512 \end{array}$$