Today's Agenda

1) CNN Visualization
2) Feature Output Calculation
3) Parameter Calculation

Input = $28 \times 28 \times 1$

$K = 5 \times 5$ $S = 1$

$K^n = 6$

3×3 → $26 \times 26 \times 6$

5×5 → $24 \times 24 \times 6$

5×5 → $2(3 \times 3)$

→ $2 \times 9 = 18$

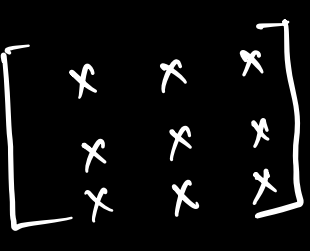
25

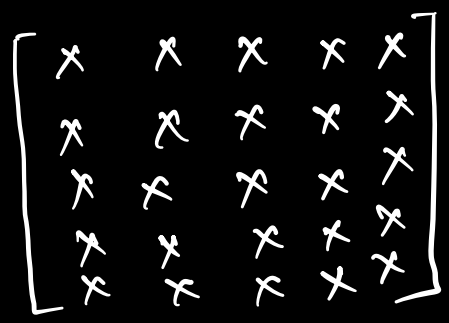
ANN → Trainable Params

3×3 is faster as compared to 5×5

Nvidia

$2(3 \times 3) = 5 \times 5$





More more no of Kernels, you do not require big size kernel.

3×3

$= (3 \times 1)\ (1 \times 3)$

Bigger Size kernels always increase the parameters.

Feature Map Calculation

n_1 = image size
p = padding
s = stride
k = Kernel size

$$n_{out} = \left[\frac{n_{in} + 2p - k}{s}\right] + 1$$

Case 1

Input Image :- $28 \times 28 \times 1$, padding = 0, $s = 1$

Kernel Size = 3×3

No of Kernels = 6

$$n_{out} = \frac{28 + 2 \cdot 0 - 3}{1} + 1$$

$$= 28 - 3 + 1$$

$$= 29 - 3$$

$$n_{out} = 26$$

Output :- $26 \times 26 \times 6$

Case 2

Input :: $28 \times 28 \times 1$, $p = 0$, $s = 1$, $k = 5 \times 5$, $k^n = 6$

$$n^{out} = 28 + 2 \cdot 0 - 5 + 1$$

$$n^{out} = 28 - 5 + 1$$

$$n_{out} = 29 - 5$$

$$n_{out} = 24$$

Case 1 Extension

Input = $26 \times 26 \times 6$, $p = 0$, $s = 1$, $k = 3 \times 3$, $k^n = 12$

$$n_{out} = 26 + 2 \cdot 0 - 3 + 1$$

$$= 26 - 3 + 1$$

$$= 27 - 3$$

$$n_{out} = 24$$

Right Now,

$$5 \times 5 = 2\,(3 \times 3)$$

Final Case :

Input :: $28 \times 28 \times 1$, $s = 1$, $p = 0$, $k = 7 \times 7$, $k^n = 6$

$$n_{out} = 28 + 2 \cdot 0 - 7 + 1$$

$$= 28 - 7 + 1$$

$$= 29 - 7$$

$$n_{out} = 22$$

Case 1 Extension 2

Input = 24×24, $p = 0$, $s = 1$, $K = 3 \times 3$

$K^n =$

$$n_{out} = 24 + 2 \cdot 0 - 3 + 1$$

$$= 25 - 3$$

$$n_{out} = 22$$

$7 \times 7 \Rightarrow 3\ (3 \times 3)$

$7 \times 7 \Rightarrow 3 \times 3$

3×3

3×3

$5 \times 5 = 2\,(3 \times 3)$

$7 \times 7 = 3\,(3 \times 3)$

$9 \times 9 = 4\,(3 \times 3)$

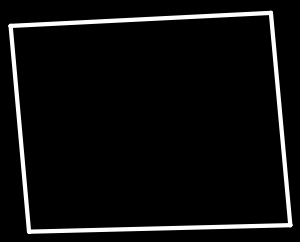
$11 \times 11 = 5\,(3 \times 3)$

$13 \times 13 = 6\,(3 \times 3)$

$15 \times 15 = 7\,(3 \times 3)$

$17 \times 17 = 8\,(3 \times 3)$

Lose 2 pixel at top
2 pixel at bottom



Input feature map Size :- $256 \times 256 \times 512$

$K = 7 \times 7$, $S = 2$, $p = 1$ $\quad n = 128$

$$n_{out} = \frac{256 + 2 \cdot 1 - 7}{2} + 1$$

$$= \frac{258 - 7}{2} + 1$$

$$= \frac{251}{2} + 1$$

$$= 125.5 + 1$$

$$= 126.5 \approx 126$$

$$n_{out} = \frac{126 \times 126 \times 128}{28 \times 28 \times 1}$$

$24 \times 24 \times 6$ → Max Pooling

$h/w \;,\; w/2 \;,\; c$

Parameter Calculation

$f \times w \times c$

Formula:- $p = ((m \times n \times d) + 1) \times K$

m = width of the filter
n = height of the filter
d = No of filters in the previous layer
K = no of filters in current layer.

ANN

=

(current layer neurons × previous layer neuron) +

bias of
each neuro
for current
layer