ANN:- 3 layers
i/p layer hidden layer output layer

CNN:- Convolutional N.N.

ANN:-

IL   HL₁   HL₂   OL

CNN:-   CONV.   → ANN

Image 28 x 28

Convolution padding = 1, kernel = 3x3, stride = 1 + ReIU

32 x 28 x 28

Max pooling Kernel = 2x2, Stride = 2

32 x 14 x 14

Convolution padding = 1, kernel = 3x3, stride = 1 + ReIU

64 x 14 x 14

Max pooling Kernel = 2x2, Stride = 2

64 x 7 x 7

3136 x 128   Flatten

128 x 10

0 1 ... 9

$s = 1$
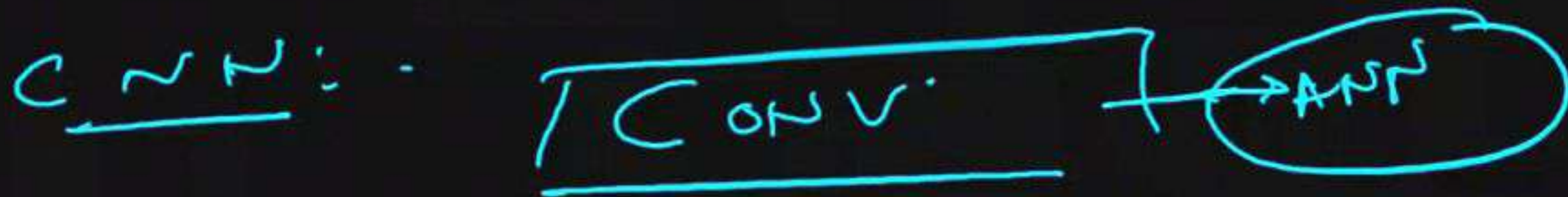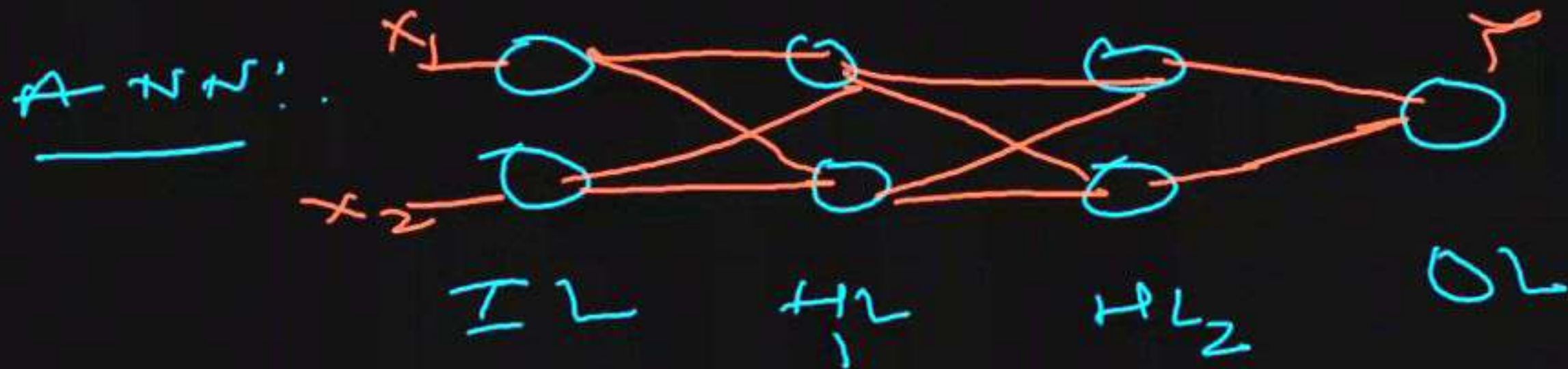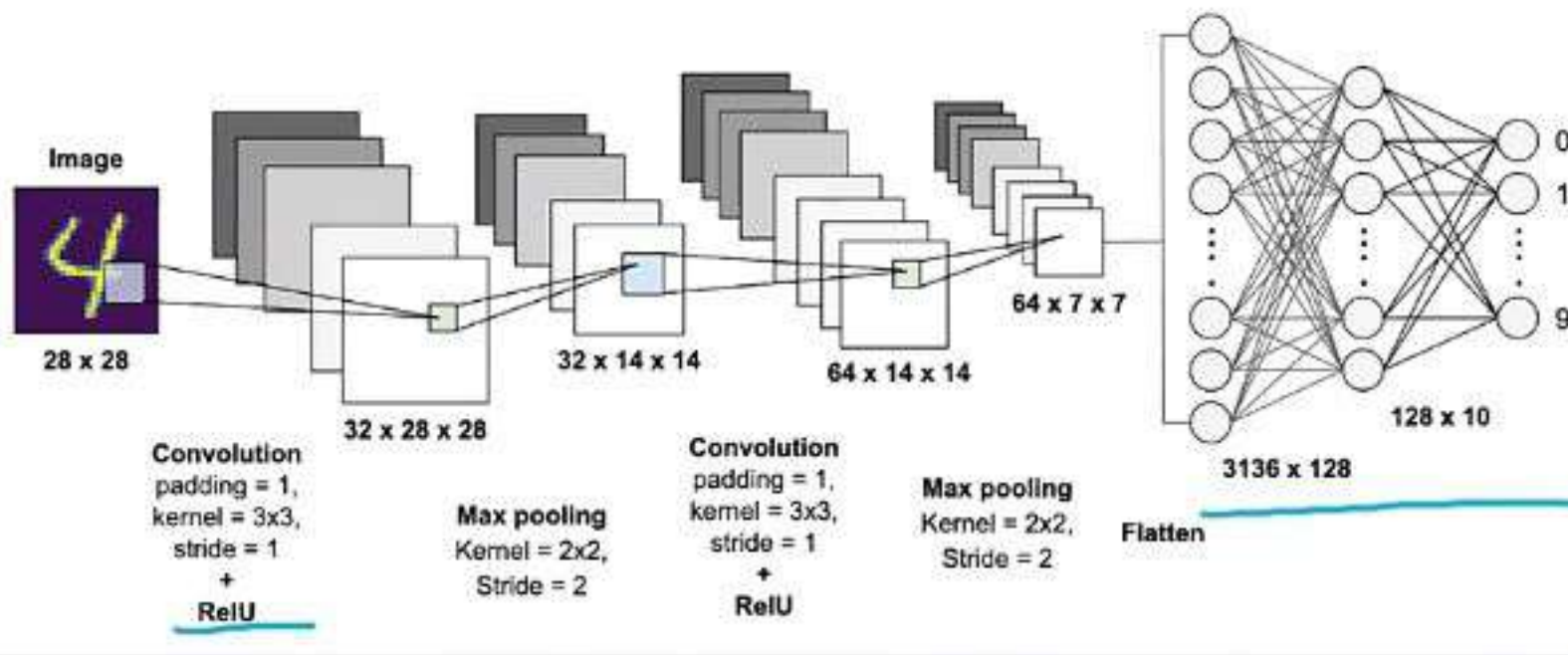
Stride

1 2 3 4 5
2 10 3 4 5
3 255 2 4 5
4 1 2 3 5
5 1 2 3 4

① Kernel / filters / feature Detectors

② Stride

③ Padding

④ Pooling

⑤ flatten

Kernel := 3x3 = $\begin{bmatrix} 1 & 1 & 1 \\ 2 & 1 & 2 \\ 3 & 1 & 3 \end{bmatrix}$

$1 \times 1 + 2 \times 1 + 3 \times 1$
$+ 2 \times 2 + 1 \times 1 + 3 \times 2$
$+ 3 \times 3 + 1 \times 1 + 2 \times 3$

feature / convolutional map

3 3

① $n \ast n$

$m \ast m$

$s = 1$

Size of feature map

$= n - m + 1$

$= 5 - 3 + 1 = 3$

$= 3 - 3 + 1 = 1$

② $n \ast n = 5 \ast 5$

$m \ast m = 3 \ast 3$

$s = 2 \ast 2 = 2 \ast 2$

$$\begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 2 & 2 & 2 & 2 & 2 \\ 3 & 3 & 3 & 3 & 3 \\ 4 & 4 & 4 & 4 & 4 \\ 5 & 5 & 5 & 5 & 5 \end{bmatrix}$$

$2 \ast 2$
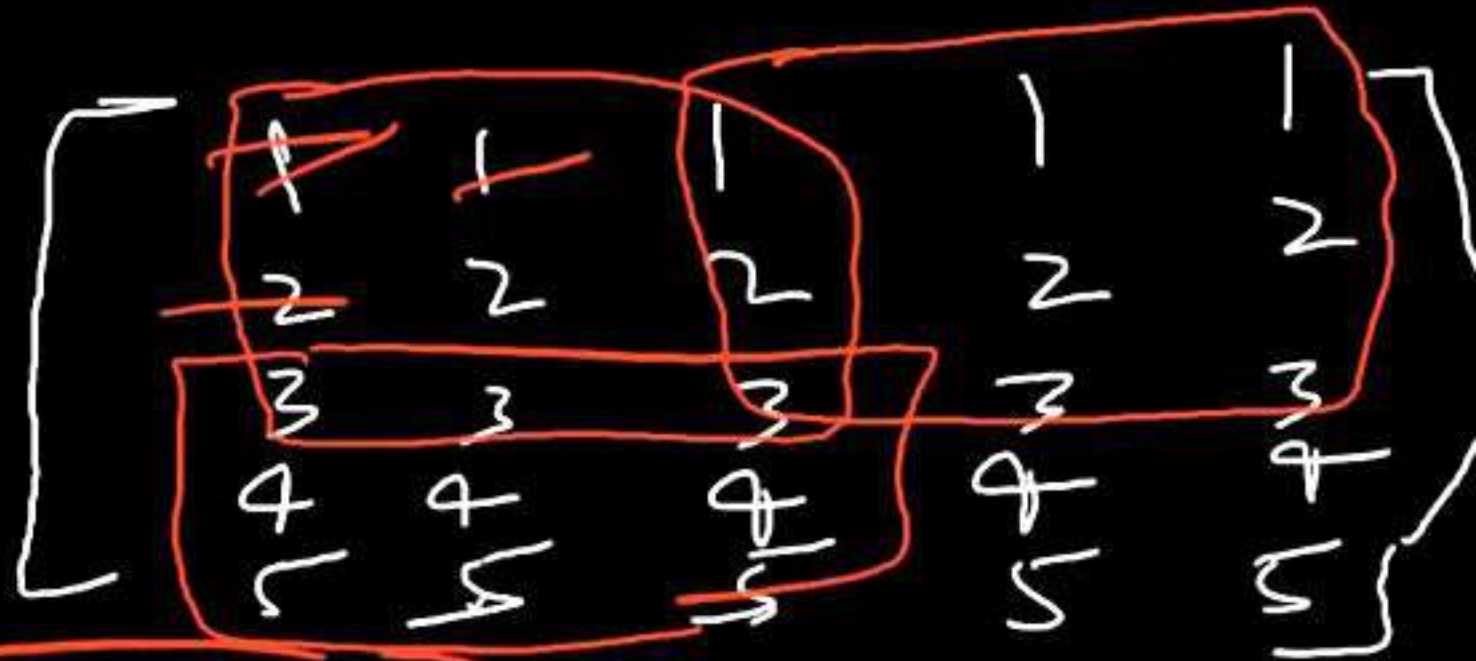
$\dfrac{s=5}{2}\left[\dfrac{n-m}{s}\right] + 1 = ②$

Padding :- $s=1$, $K=3\times3$

To fix border effect

Problem :-
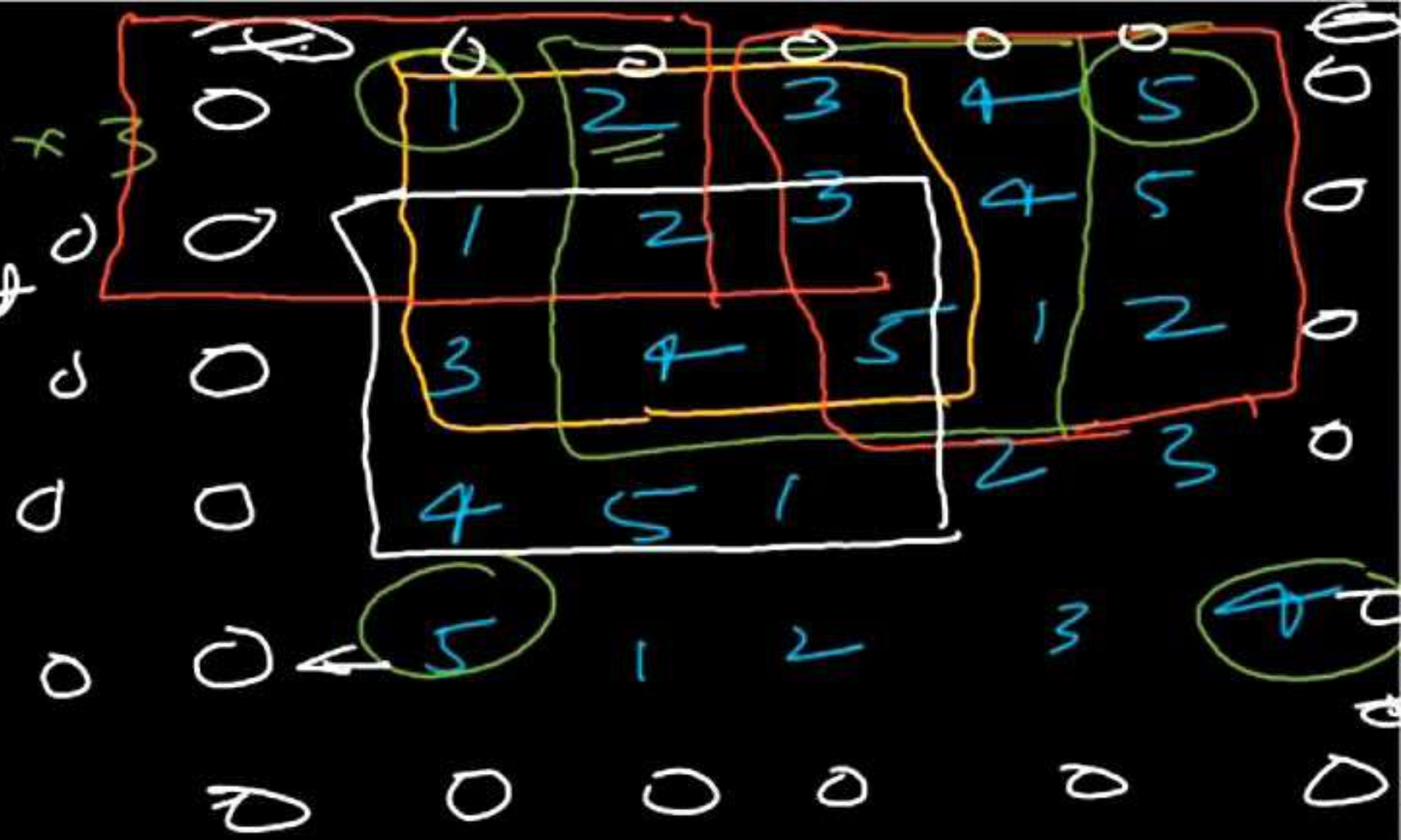
$n*n = 5\times5$

$m*m = 3\times3$

$s*s = 1\times1$

$P = 1$

Size of feature map?

$$= \left[\frac{n-m+2P}{s}\right] + 1 = \frac{5-3+2}{1} + 1 = \boxed{5*5}$$

0	0	0	0	0	0	0
0	0	1	2	3	4	5	0
0	0	1	2	3	4	5	0
0	0	3	4	5	1	2	0
0	0	4	5	1	2	3	0
0	0	5	1	2	3	4	0
0	0	0	0	0	0

Pooling :- 2×2, 3×3 → Max, Avg, Sum

$S - 2 \times 2$

1	2	3	4	5
2	3	4	5	1
3	4	5	1	2
4	5	1	2	3
5	1	2	3	4

5×5

3×3

⟹ [

2×2

img $= n \neq n$
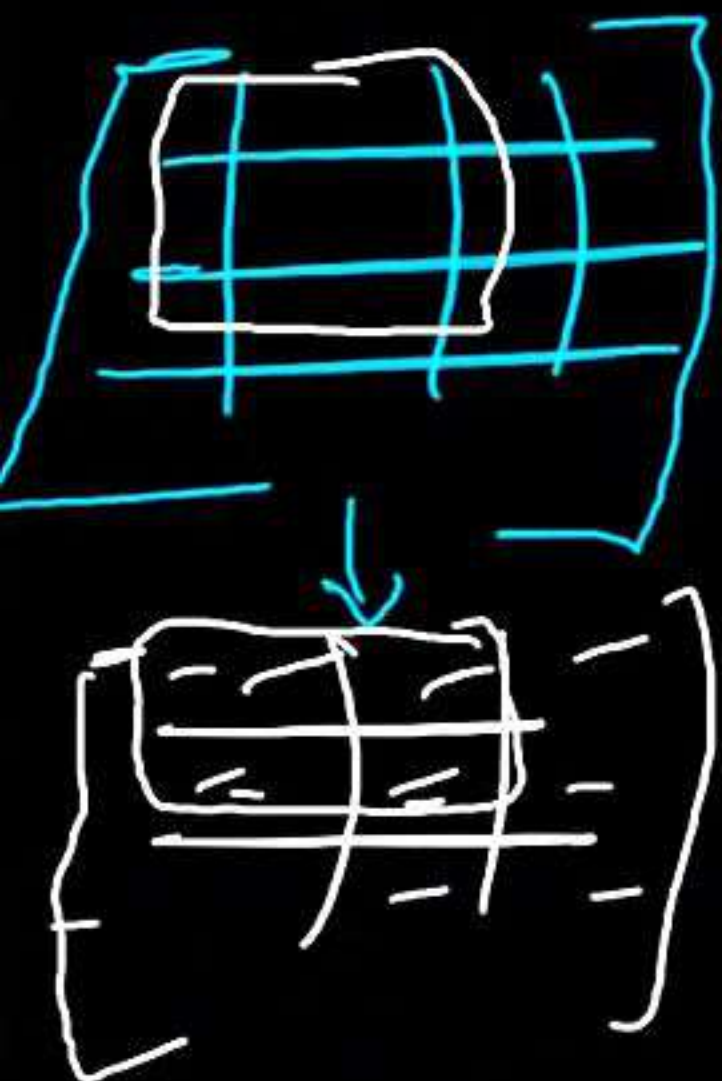
Conv. Op^n
$\quad \hookrightarrow$ Kernel $m \times m$
$\quad \hookrightarrow$ Padding
$\quad \hookrightarrow$ Stride
$\quad \downarrow$
feature Map
$\quad \downarrow$
Pooling

$K = 32 \times \boxed{3 \times 3}$
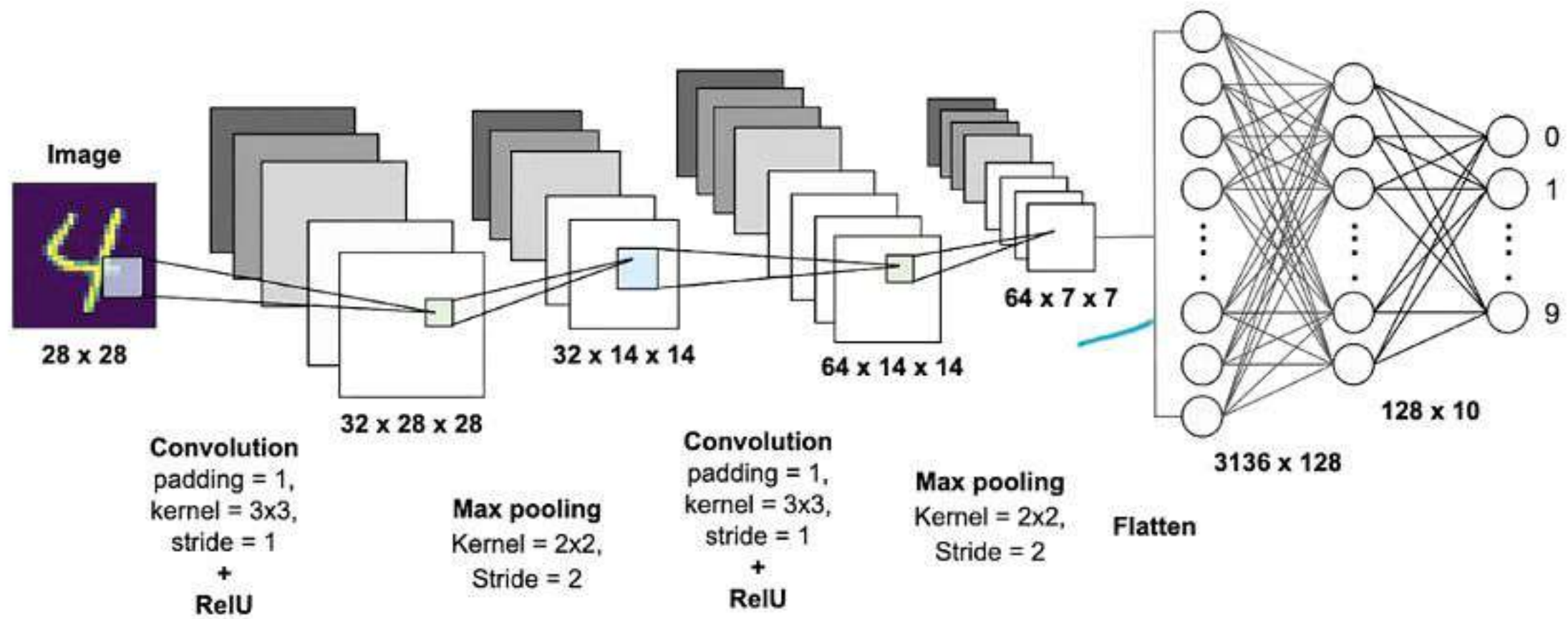
Image 28 x 28

Convolution
padding = 1,
kernel = 3x3,
stride = 1
+
RelU

32 x 28 x 28

Max pooling
Kernel = 2x2,
Stride = 2

32 x 14 x 14

Convolution
padding = 1,
kernel = 3x3,
stride = 1
+
RelU

64 x 14 x 14

Max pooling
Kernel = 2x2,
Stride = 2

64 x 7 x 7

Flatten

3136 x 128

128 x 10

0
1
9

$$14 - 3 + 2 \neq$$
$$[1 + 2 + 1$$
$$= 14$$

$$\boxed{C + P} \rightarrow$$
$$\boxed{C + P}$$

$$28 * 28$$
$$\downarrow \qquad h* = 32$$
$$\qquad k = 3$$
$$C \oplus$$
$$\frac{h - m + 2p}{s} + 1$$

$$n * n$$
$$m * m$$
$$s * s \implies$$
$$p$$

$$\frac{h - m + 2p}{s} + 1$$

$$\frac{28 - 3 + 2}{1} + 1$$

$$\boxed{28}$$

$chg \leftarrow cp - 64 \times \overset{7}{\cancel{64}} \times \overset{7}{\cancel{49}} = [\quad]$
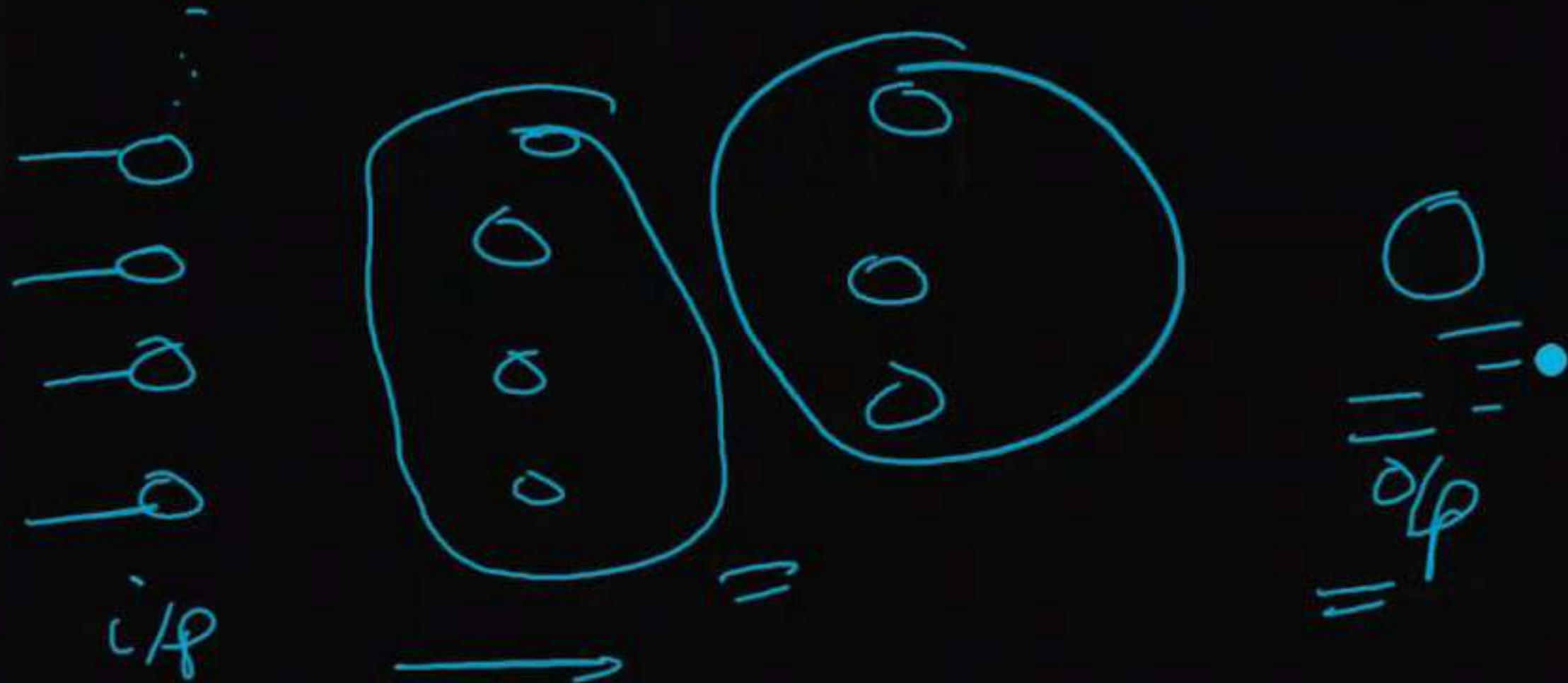
$64 \times 49 = 3136$

final feature map :-

$\dfrac{\qquad}{64} \rightarrow 49 \qquad\qquad 64 \times 49 = 3136$

1×1

$\dfrac{3D -}{\qquad}$

float

[[[ ],
  [ ],
  [ ],
  [ ]]