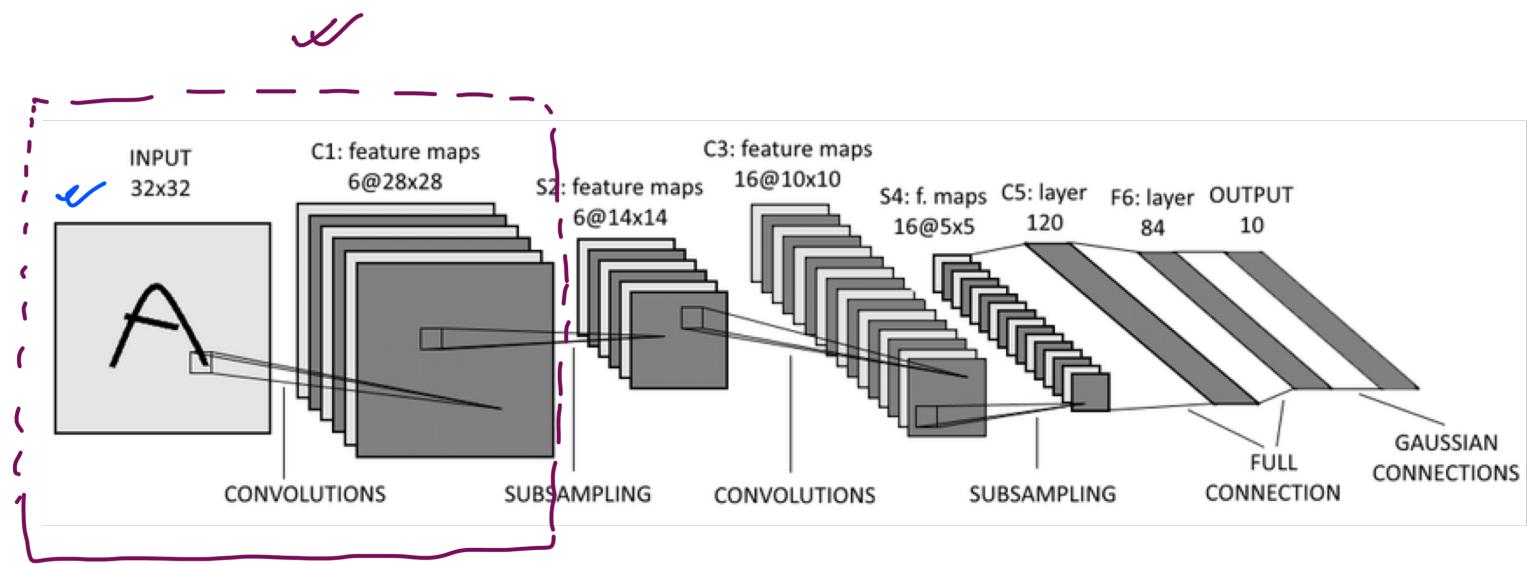
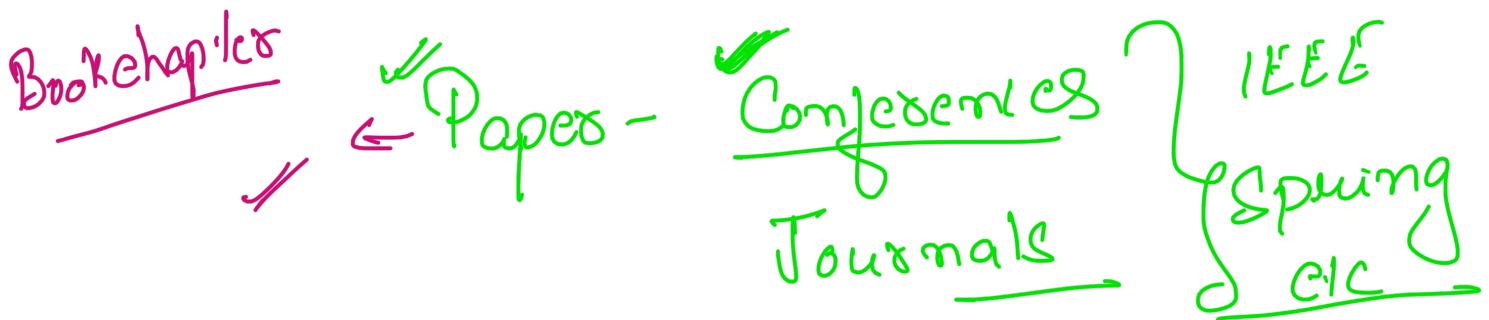


CNN-3

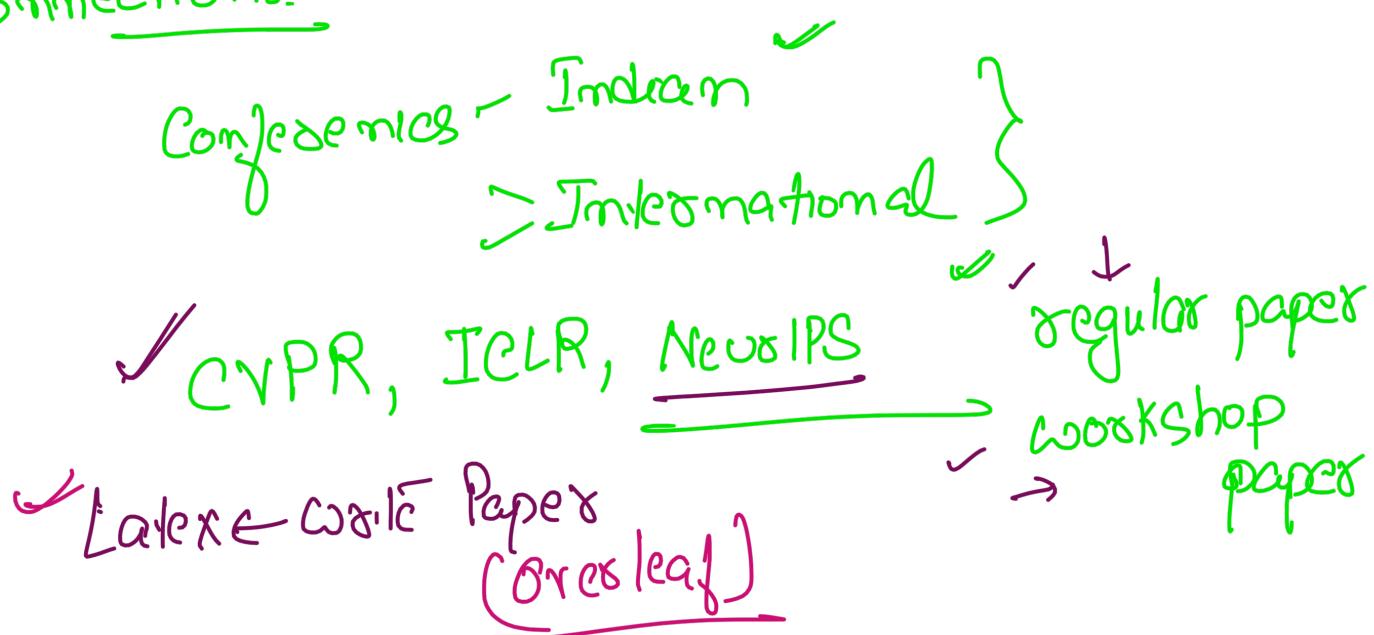


LeNet-5 (Classification)

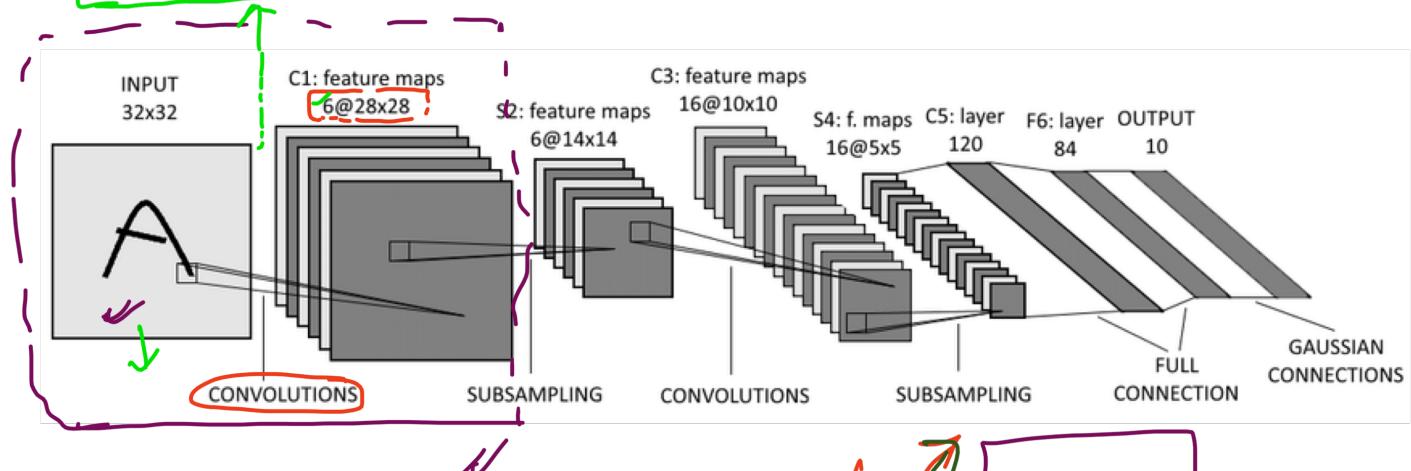
MNIST
→ Handwritten 10 classes [0, 9]



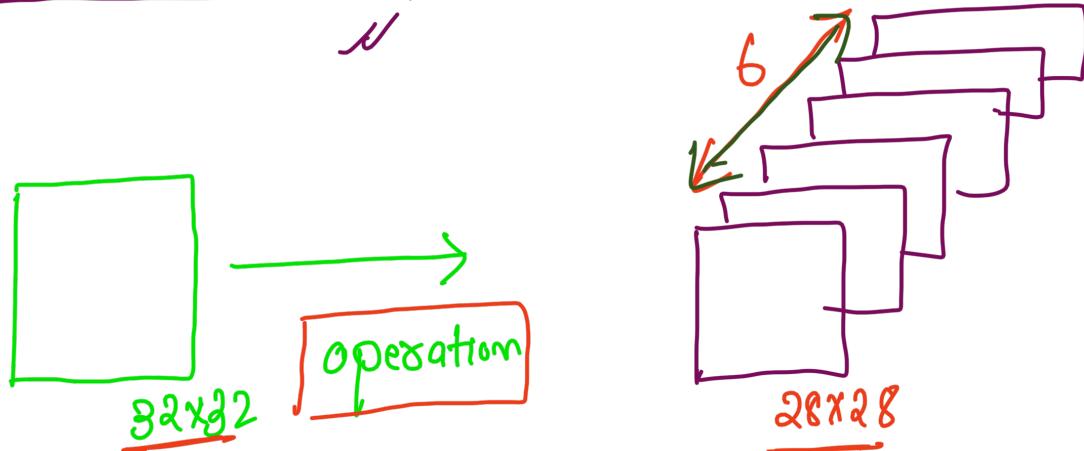
Connections:



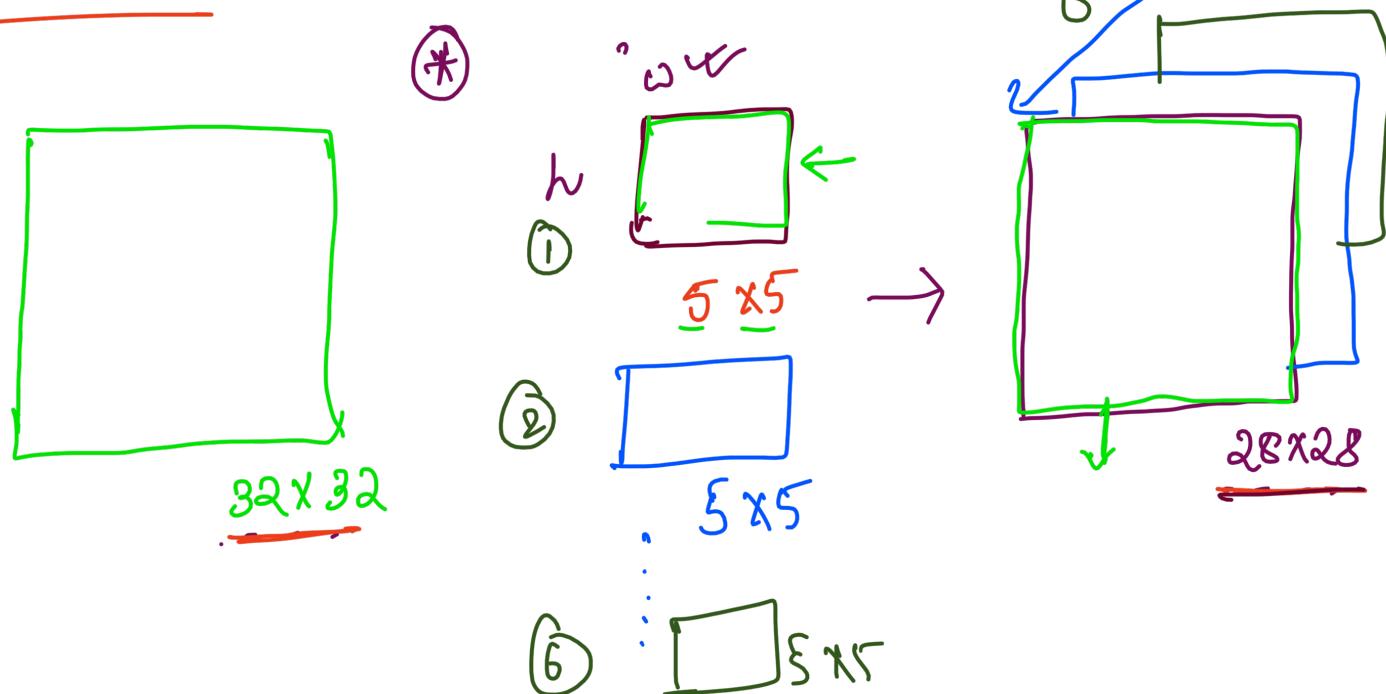
6 Conv Op



:P:



Understand



If we need an output of 28×28 then what will be the size of the kernel keeping $P=0.8$ slide-1?

$$P: \underline{1} \times 32 \times 32 \leftarrow \frac{\underline{m-\omega+2\varphi}}{S} + 1 = O_\omega - \textcircled{1}$$

$$m = 32 \quad \omega = ?$$

$$P=0 \quad S=1$$

$$O_\omega = 28$$

$$\textcircled{1} \rightarrow 28 = \frac{32 - \omega + 2(0)}{1} + 1$$

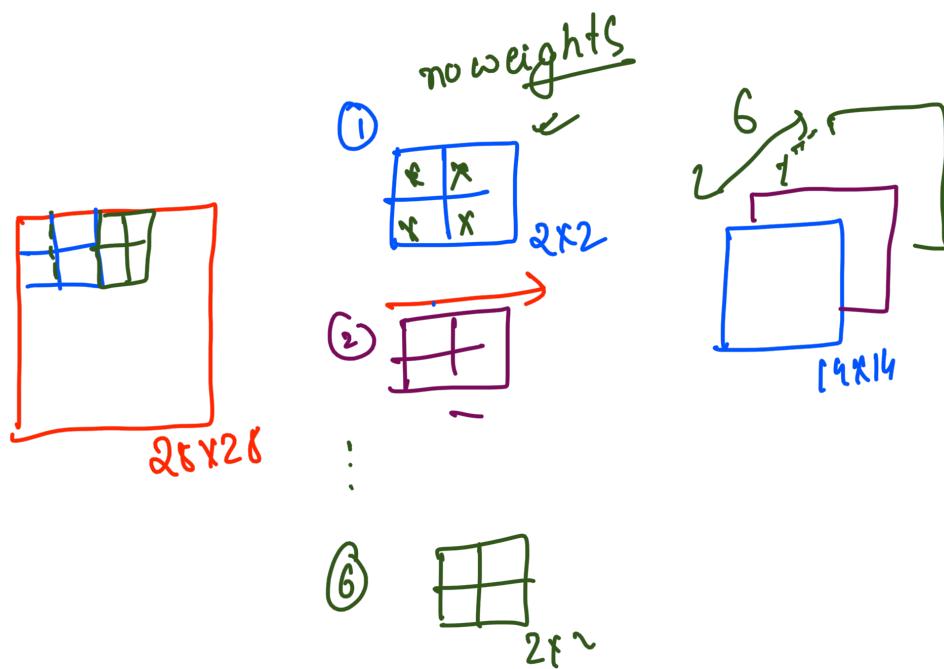
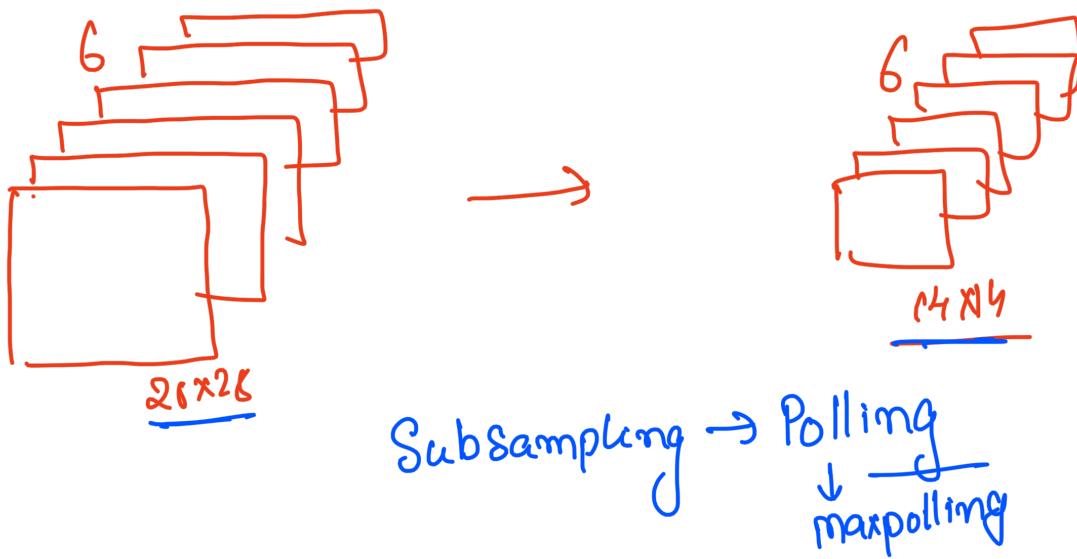
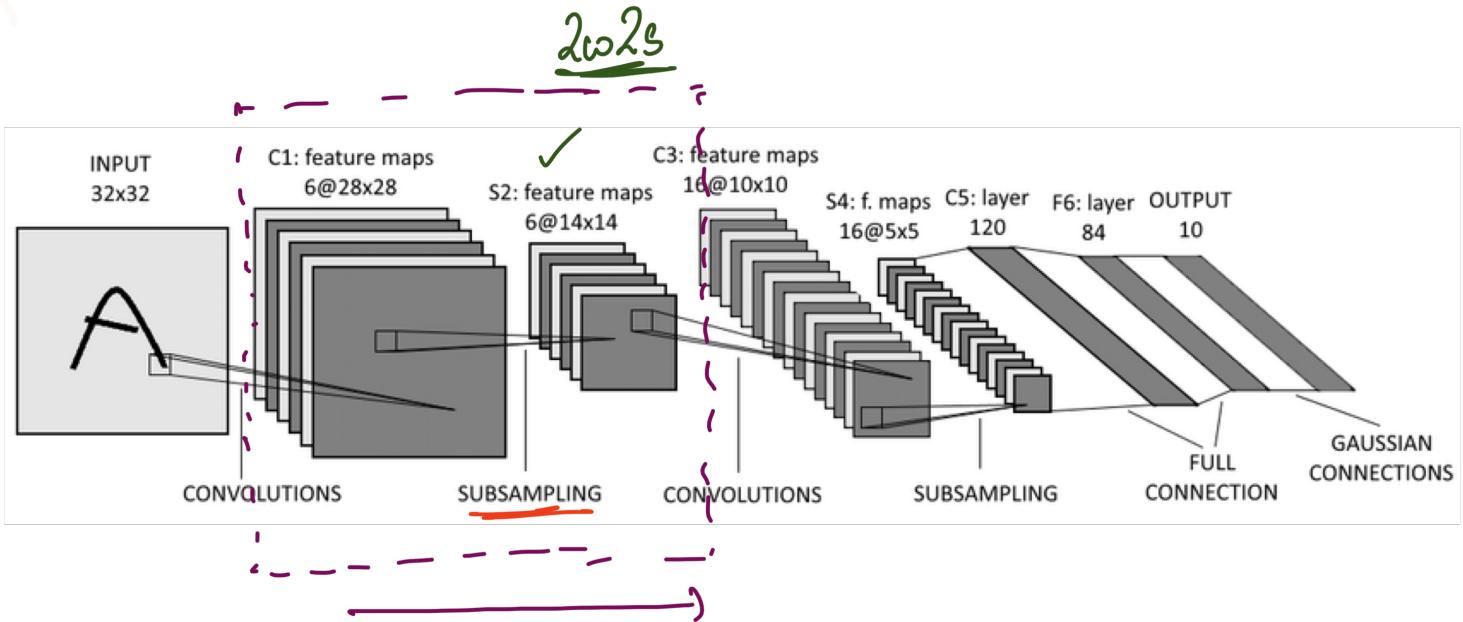
$$\omega = 5$$

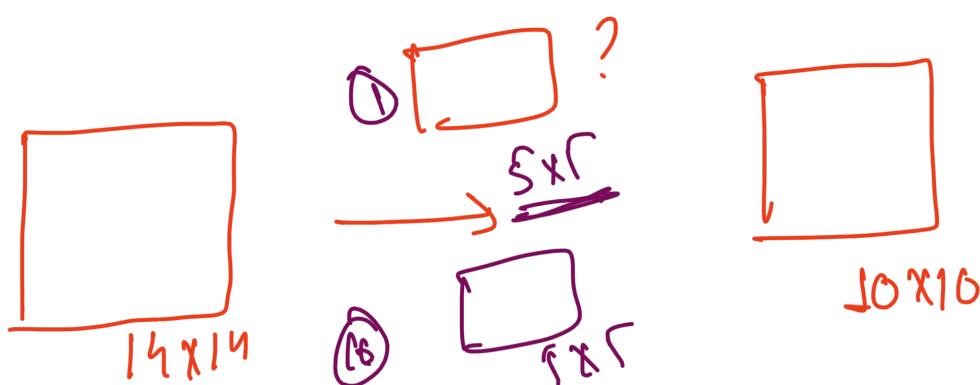
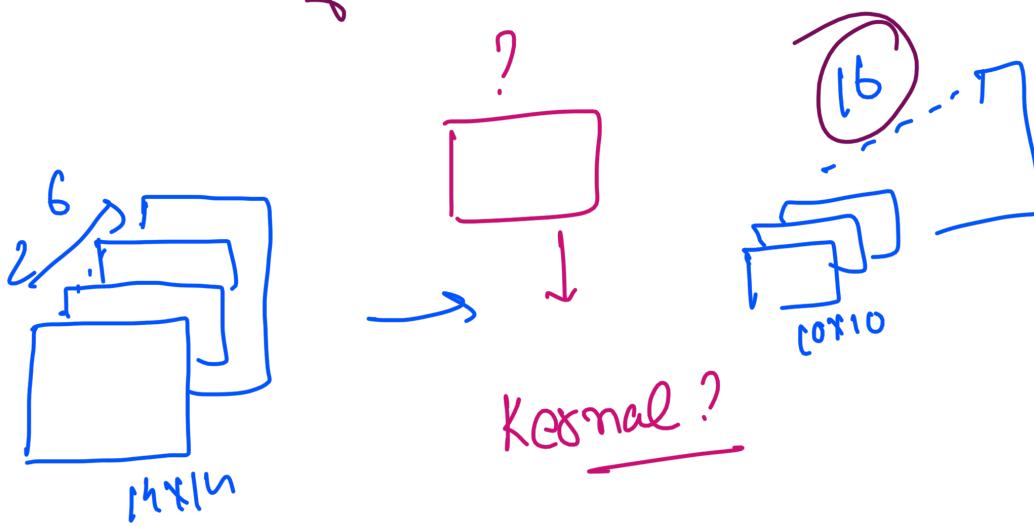
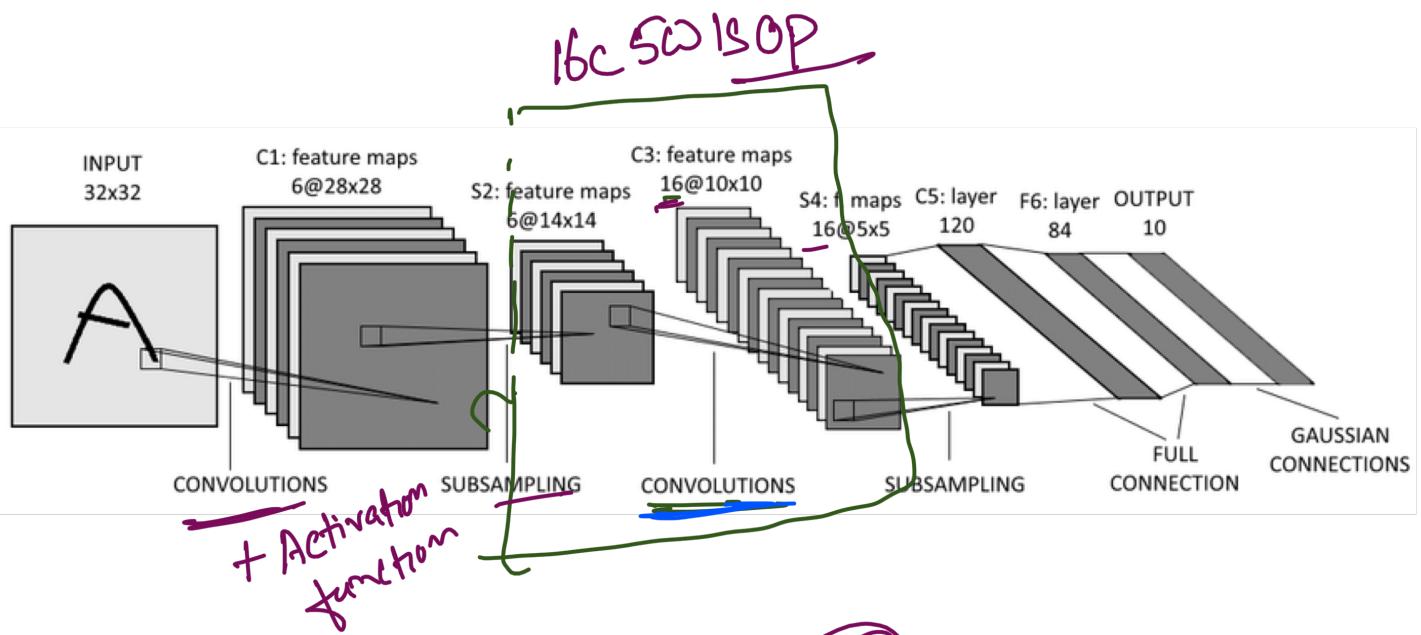
$$\Rightarrow 27 = 32 - \omega + 0$$

Similarly

$$\Rightarrow \underline{\omega} = 32 - 27$$

$$= \underline{5}$$





Stride = 1

$P=0$

Kernel
size = ?

$$O = \frac{m - w + 2p}{s} + 1$$

$$\begin{aligned} P &= 0 \\ m &= 14 \\ w &= 10 \end{aligned}$$

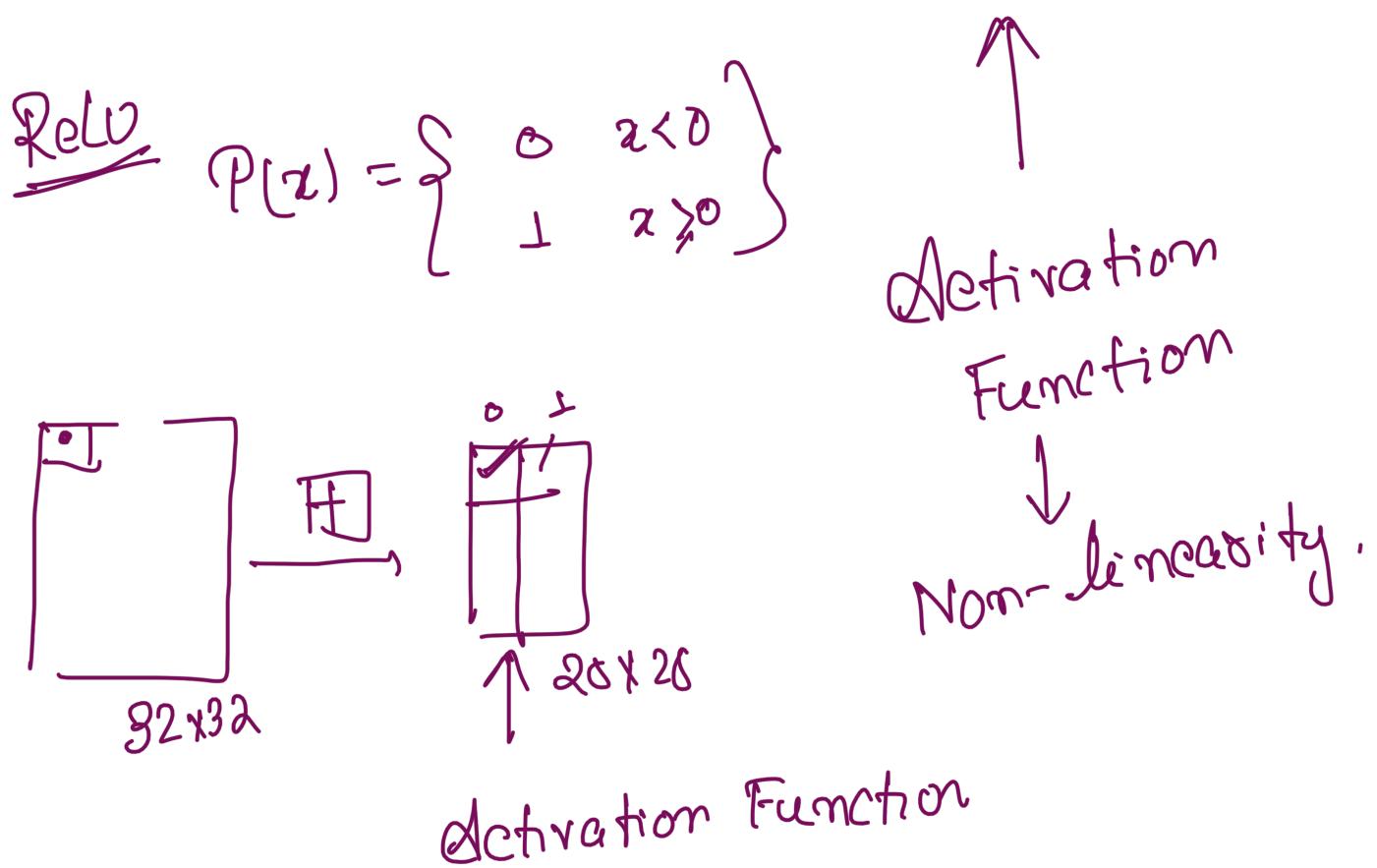
$$10 = \frac{14 - 10 + 2 \times 0}{1} + 1$$

$$s = 1$$

$$\begin{aligned} \text{if } w &= 14 - 9 \\ &= 5 \end{aligned}$$

$$O = 10$$

ACTIVATION FUNCTION	PLOT	EQUATION	DERIVATIVE	RANGE
Linear		$f(x) = x$	$f'(x) = 1$	$(-\infty, \infty)$
Binary Step		$f(x) = \begin{cases} 0 & \text{if } x < 0 \\ 1 & \text{if } x \geq 0 \end{cases}$	$f'(x) = \begin{cases} 0 & \text{if } x \neq 0 \\ \text{undefined} & \text{if } x = 0 \end{cases}$	$\{0, 1\}$
Sigmoid		$f(x) = \sigma(x) = \frac{1}{1 + e^{-x}}$	$f'(x) = f(x)(1 - f(x))$	$(0, 1)$
Hyperbolic Tangent(tanh)		$f(x) = \tanh(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}}$	$f'(x) = 1 - f(x)^2$	$(-1, 1)$
Rectified Linear Unit(ReLU)		$f(x) = \begin{cases} 0 & \text{if } x < 0 \\ x & \text{if } x \geq 0 \end{cases}$	$f'(x) = \begin{cases} 0 & \text{if } x < 0 \\ 1 & \text{if } x > 0 \\ \text{undefined} & \text{if } x = 0 \end{cases}$	$[0, \infty)$
Softplus		$f(x) = \ln(1 + e^x)$	$f'(x) = \frac{1}{1 + e^{-x}}$	$(0, 1)$
Leaky ReLU		$f(x) = \begin{cases} 0.01x & \text{if } x < 0 \\ x & \text{if } x \geq 0 \end{cases}$	$f'(x) = \begin{cases} 0.01 & \text{if } x < 0 \\ 1 & \text{if } x \geq 0 \end{cases}$	$(-1, 1)$
Exponential Linear Unit(ELU)		$f(x) = \begin{cases} \alpha(e^x - 1) & \text{if } x \leq 0 \\ x & \text{if } x > 0 \end{cases}$	$f'(x) = \begin{cases} \alpha e^x & \text{if } x < 0 \\ 1 & \text{if } x > 0 \\ 1 & \text{if } x = 0 \text{ and } \alpha = 1 \end{cases}$	$[0, \infty)$



$\sum \Phi$ ← Perception

$P = \underline{\phi(\Sigma)}$ $\phi \leftarrow$ Activation Function