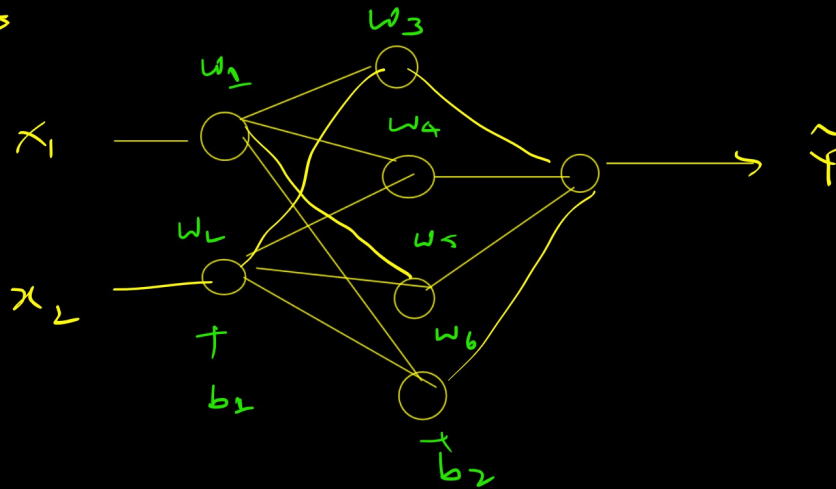


# Backpropagation in CNN

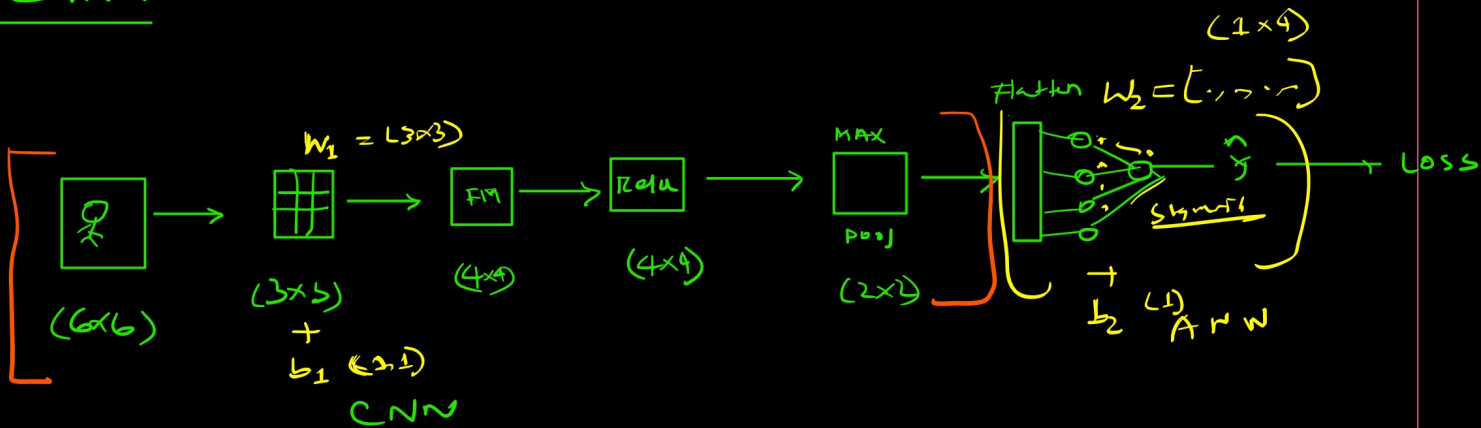
ANN  $\rightarrow$



$$W = w_1, w_2, w_3, w_4, w_5, w_6,$$

$$b = b_1, b_2,$$

# CNN :-



# Trainable all parameters:

$$w_1 = (3,3)$$

$$w_2 = (1,4)$$

$$b_1 = (1,1)$$

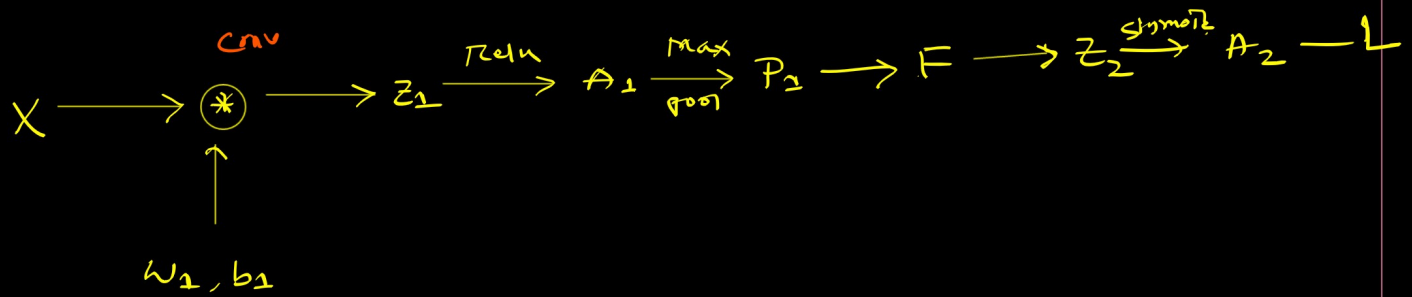
$$b_2 = (1,1)$$

Total:  
 $\Rightarrow$  15 trainable parameters

$$L = -y_i \log(y_i) - (1 - y_i) \log(1 - y_i)$$

$$A_2 = 9$$

## # Logical flow / Diagram:



$$z_1 = \text{conv}(x, w_1) + b_1$$

$$A_1 = \text{relu}(z_1)$$

$$P_1 = \text{maxpool}(A_1)$$

$$F = \text{flatten}(P_1)$$

$$z_2 = w_2 \cdot F + b_2$$

$$A_2 = \sigma(z_2)$$

## # Forward pass

### Gradient Descent

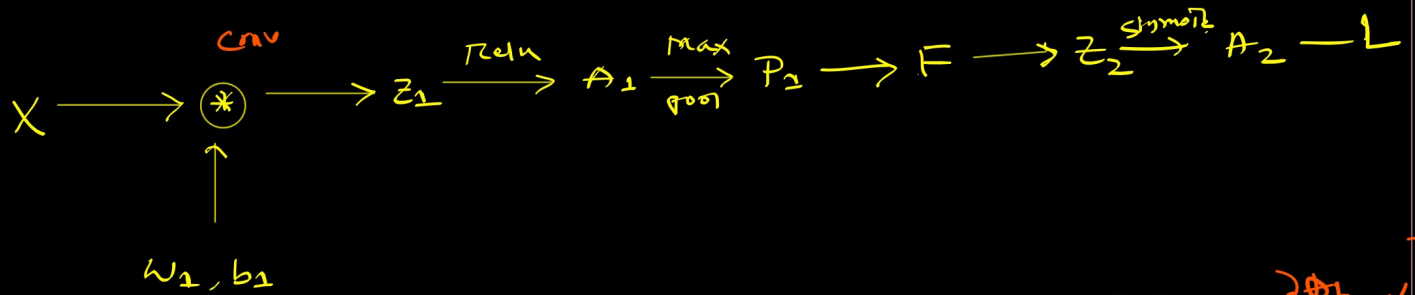
$$w_1 = w_1 - \eta \frac{\partial L}{\partial w_1}$$

$$b_1 = b_1 - \eta \frac{\partial L}{\partial b_1}$$

$$w_2 = w_2 - \eta \frac{\partial L}{\partial w_2}$$

$$b_2 = b_2 - \eta \frac{\partial L}{\partial b_2}$$

## Backward pass



$$\frac{\partial L}{\partial w_1} = \frac{\partial L}{\partial A_2} \times \frac{\partial A_2}{\partial z_2} \times \frac{\partial z_2}{\partial F} \times \frac{\partial F}{\partial P_1} \times \frac{\partial P_1}{\partial A_1} \times \frac{\partial A_1}{\partial z_1} \times \frac{\partial z_1}{\partial w_1}$$

$$\frac{\partial L}{\partial b_1} = \frac{\partial L}{\partial A_2} \times \frac{\partial A_2}{\partial z_2} \times \frac{\partial z_2}{\partial F} \times \frac{\partial F}{\partial P_1} \times \frac{\partial P_1}{\partial A_1} \times \frac{\partial A_1}{\partial z_1} \times \frac{\partial z_1}{\partial b_1}$$

$$\frac{\partial L}{\partial w_2} = \frac{\partial L}{\partial A_2} \times \frac{\partial A_2}{\partial z_2} \times \frac{\partial z_2}{\partial w_2}$$

$$\frac{\partial L}{\partial b_2} = \frac{\partial L}{\partial A_2} \times \frac{\partial A_2}{\partial z_2} \times \frac{\partial z_2}{\partial b_2}$$

$$Loss = 0$$

Transfer Learning

pretrain notes

ATP