Neural Networks

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Objectives

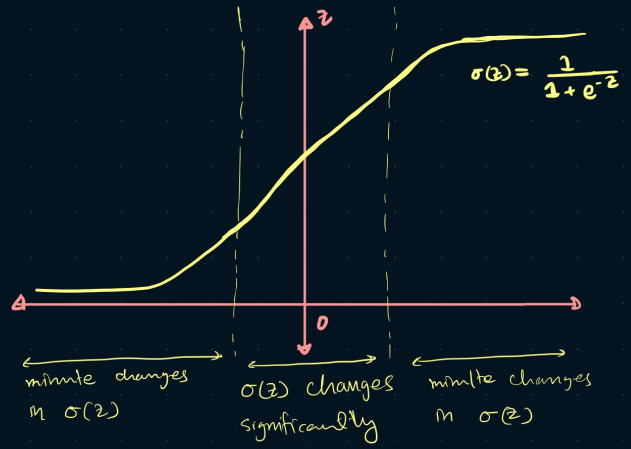
1. What are Neural Networks?
2. How we train them? (Back Propagation)
3. What is Convolution
4. How to write a Convolutional Neural Network to classify images

Neurons

- Perceptrons
  - Activation is step-function
  - Not differentiable

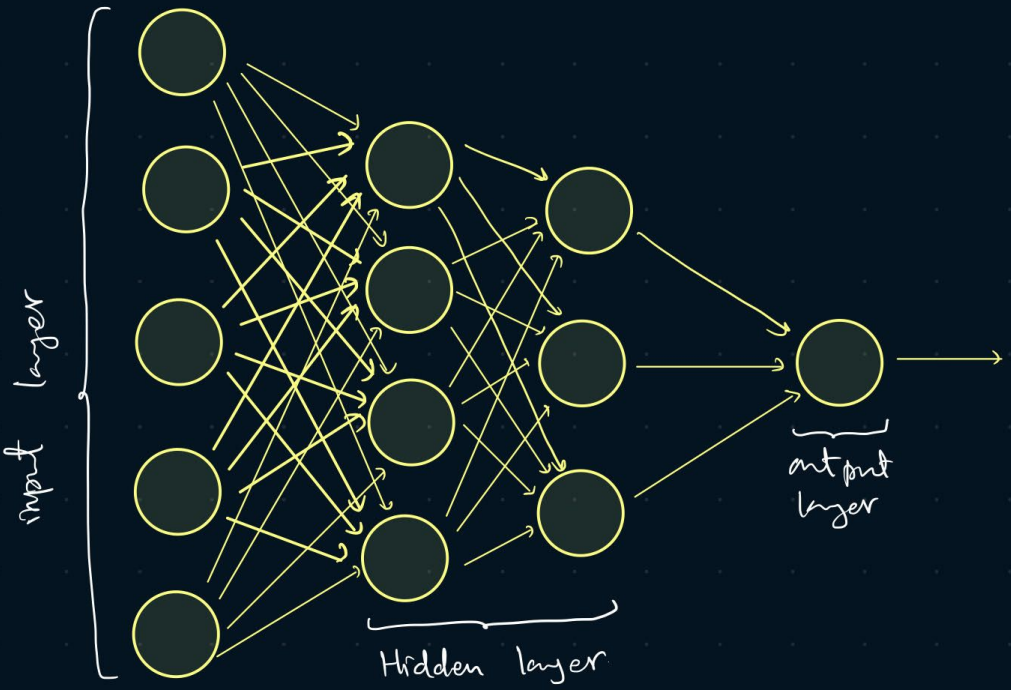
- Sigmoid Neurons
  - Activation is sigmoid function
  - Differentiable

- Output of Sigmoid Neurons
  - $\sigma(w.x + b)$
    - $\sigma(z) = 1 / 1 + \exp(-z)$



The Network - Feed Forward

- Connections are Weights
- Each neurons have a Bias.



Learning Algorithm

- Cost Functions
  - Quadratic Cost Function

$$C = \frac{1}{2n} \sum_x \| y(x) - a^L(x) \|^2$$

L: no. of layer

y(x): True output

$a^L(x)$: output / Activation of a layer

  - Cross Entropy Cost Function

$$C = -\frac{1}{n} \sum_x [y (\ln a) + (1-y) \ln (1-a)]$$

  - Log likelihood Cost Function

$$C = \ln a^L_y$$

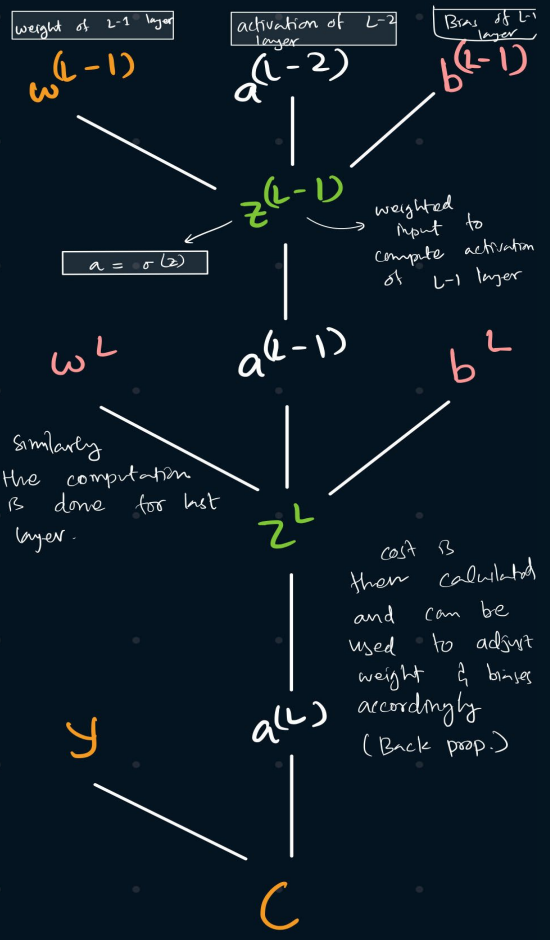
Learning Algorithm - Back Propagation

- The idea is to Minimize the Cost Function - Negative Gradient of Cost
- We feed backwards how the cost function changes with weights and biases

$$a^l = \sigma(w^l a^{l-1} + b^l)$$

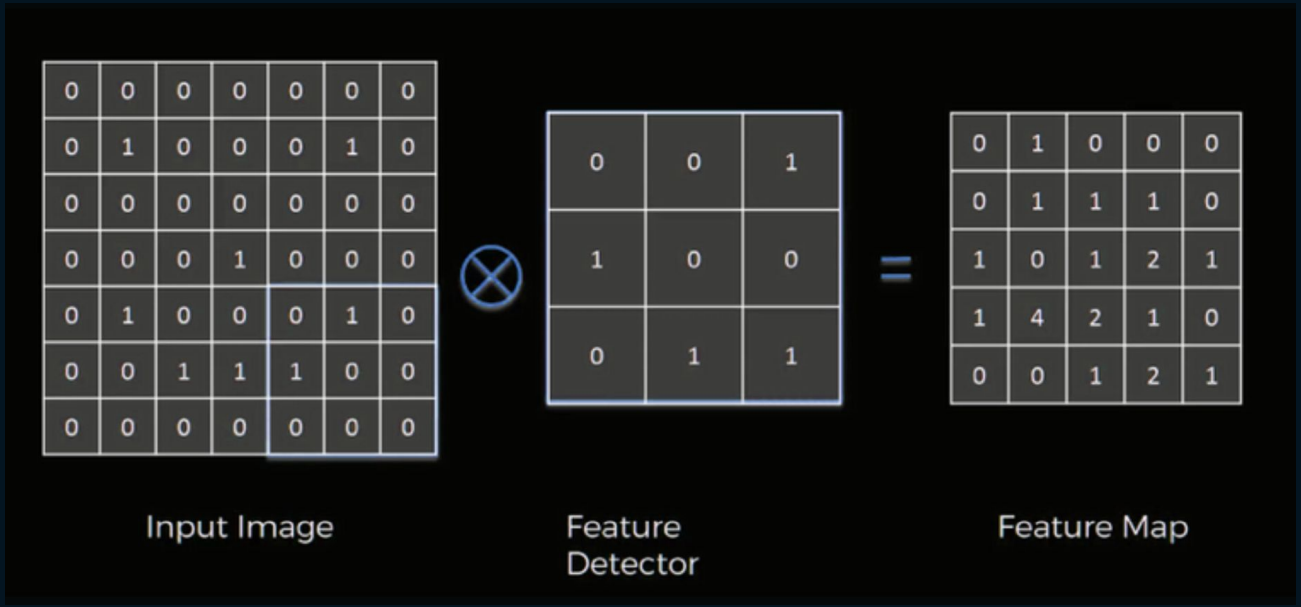
$$a^l = \sigma(z^l) \quad \begin{cases} z^l \equiv w^l a^{l-1} + b^l \end{cases}$$

z^l → weighted input to layer l.



Convolutional Neural Networks

- Convolution Operation -



Effects of Convolution

Sharpen

0	0	0	0	0
0	0	-1	0	0
0	-1	5	-1	0
0	0	-1	0	0
0	0	0	0	0

Blur

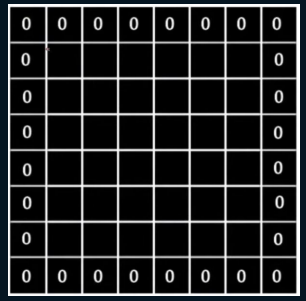
0	0	0	0	0
0	1	1	1	0
0	1	1	1	0
0	1	1	1	0
0	0	0	0	0

Edge Detection

	0	1	0	
	1	-4	1	
	0	1	0	

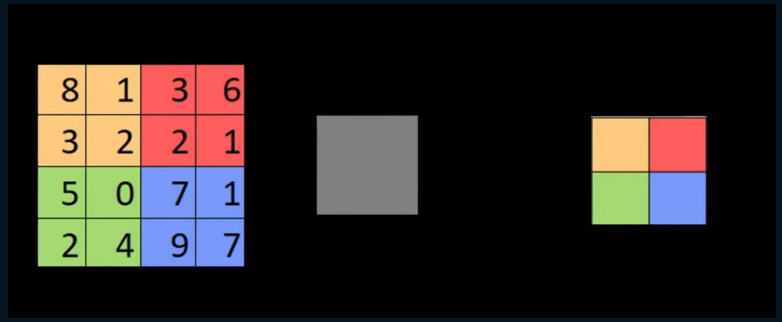
Padding, Stride and Max Pooling

- Padding :



- Stride : How much you move the filter

- Max-Pooling :



To The Code