CNN

Stands for
Convolutional Neural Network (ConvNN)

CNN

- Convolutional neural network (CNN) is a regularized type of <u>feed-forward</u> neural network that learns feature engineering by itself via filters (or kernel) optimization.
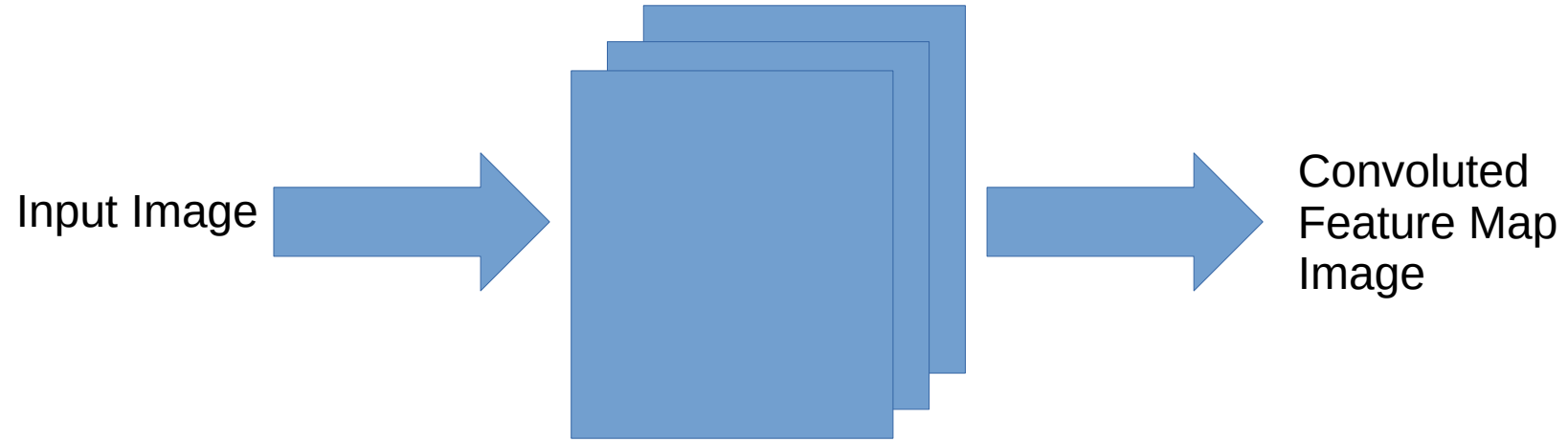
CNN applications examples:

- image and video recognition
- image classification,
- medical image analysis,
- natural language processing

Architecture
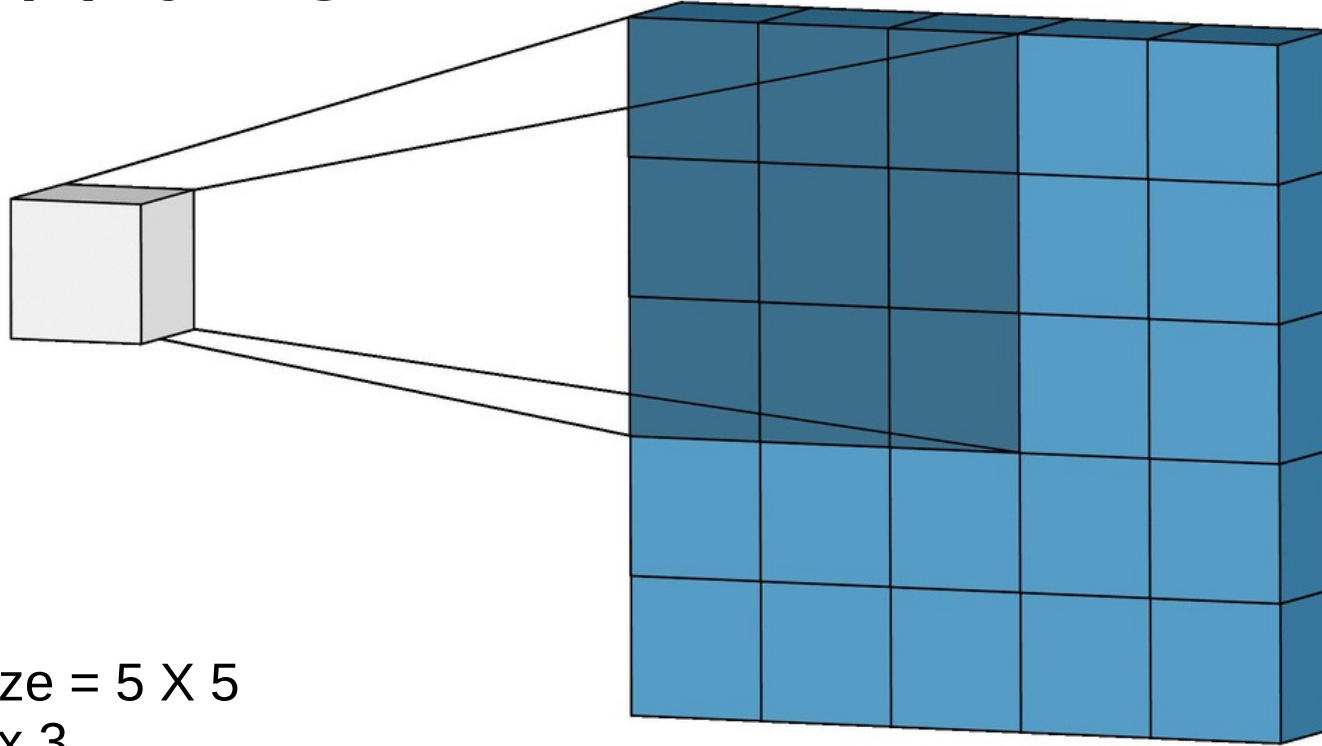
Convolution Neural Network (CNN)

Image Source: Medium.com

Convolutional Layer

Input Image
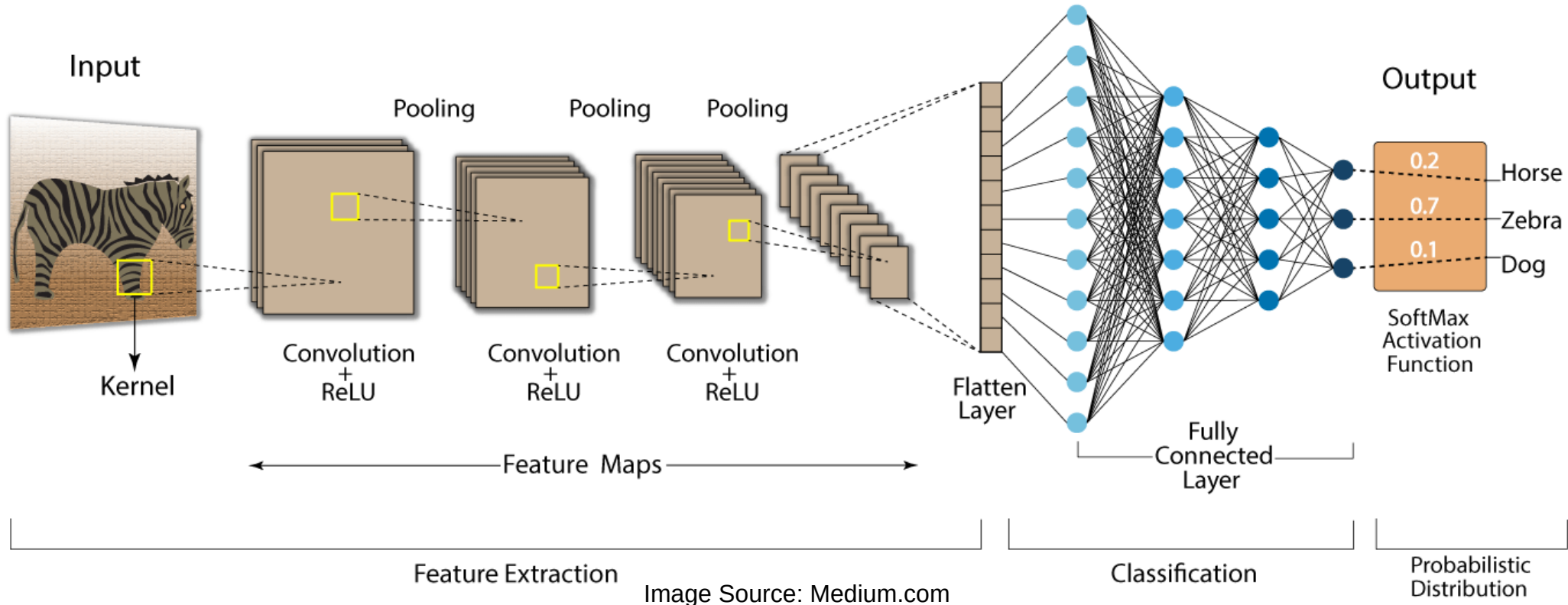
Convoluted
Feature Map
Image

Applying filters Convolutional layer cont..

Input Image Size = 5 X 5
Filter Size = 3 x 3
Stride = 1
Padding = 0
Feature map size(output) = 3 x 3

Applying filters Convolutional layer cont..

0	0	0	0	0	0	0
0	60	113	56	139	85	0
0	73	121	54	84	128	0
0	131	99	70	129	127	0
0	80	57	115	69	134	0
0	104	126	123	95	130	0
0	0	0	0	0	0	0

Kernel

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

114				

Image Source: vitalflux.com

Input Image Size = 5 X 5
Filter Size = 3 x 3
Stride = 1
Padding = 1
Feature map size(output) = 5 x 5

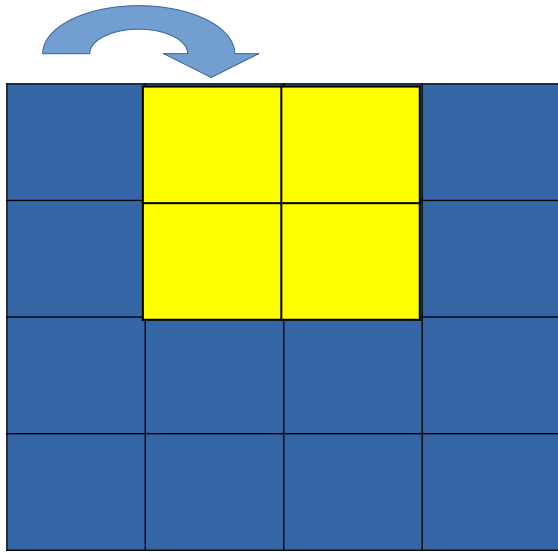# Feature map size Convolutional layer cont..

Depends on:

- Input Image Size D_I

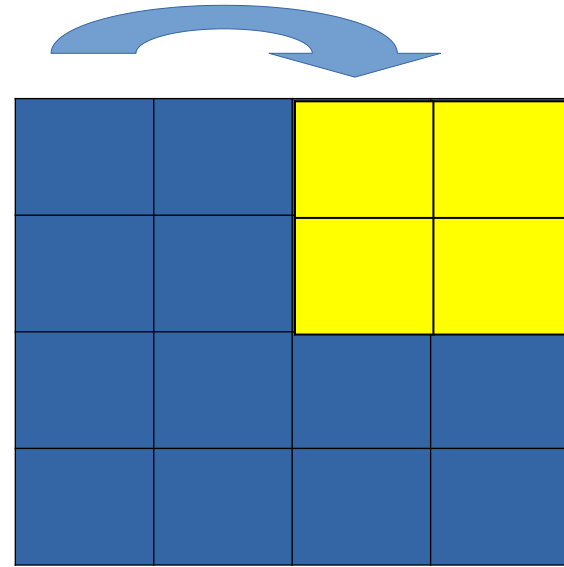- Filter Size D_F

- Stride S

- Padding P

Stride Convolutional layer cont..

- **Stride:** It denotes how many steps we are moving the filter at each step. [default is 1]
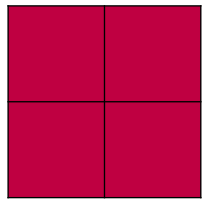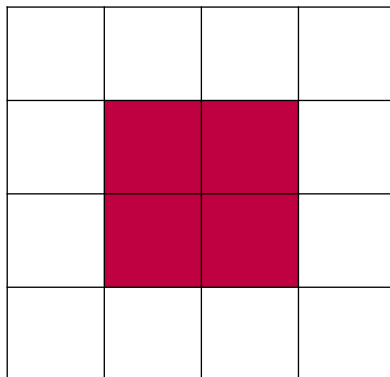

Stride = 1

Stride = 2
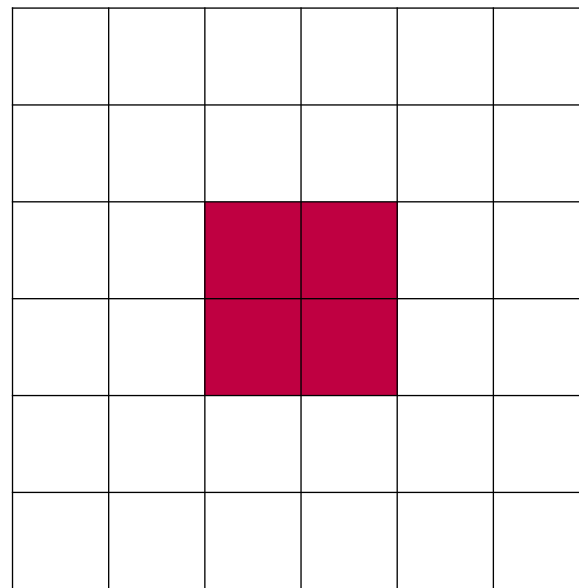
Padding Convolutional layer cont..

- Padding is a process of adding (row or column) to the input at each side

Padding = 0

Padding = 1

Padding = 2

Calculate the feature map size

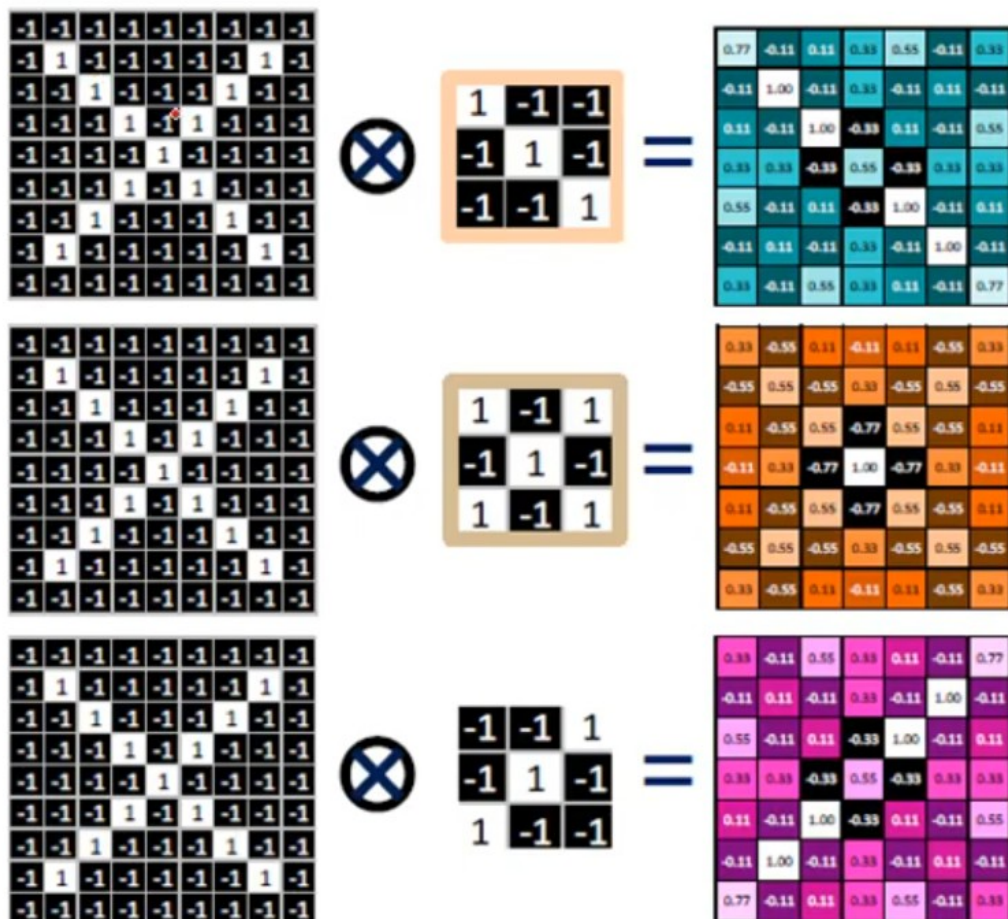$$feature\, map = \frac{D_I - D_f + 2P}{S} + 1$$

Convolutional Layer – Filters – Output Feature Map

- Output Feature Map of One complete convolution:
  - Filters: 3
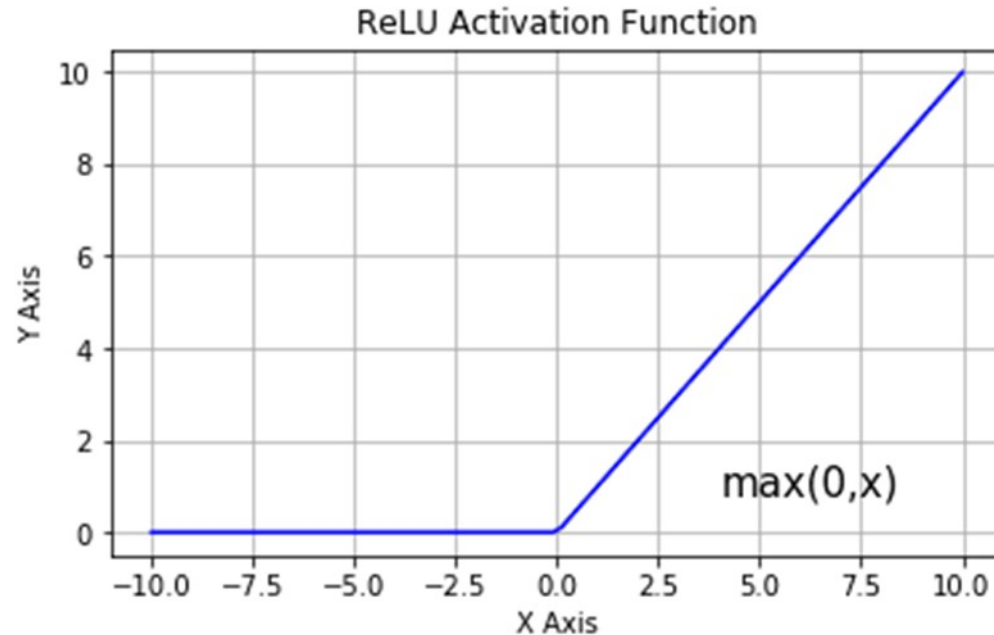 - Filter Size: 3 X 3
  - Stride: 1

- Conclusion:
  - Input Image:
    9 X 9
  - Output of Convolution:
    7 X 7 X 3

ReLU layer

- Applying max(0, x) on the previous feature map layers
- This one does not change size unlike the previous one

ReLU Activation Function

Relu Layer

Pooling layer

- Its purpose is to gradually shrink the representation's spatial size to reduce the number of parameters and computations in the network.

- The pooling layer treats each feature map separately.

Pooling layer methods (types)

Max Pooling

- **Max pooling**
- **Average Pooling**

Convolution Output

1	2	2	1
4	9	1	0
1	5	2	3
4	6	1	2

Source: Springer.com

9	2
6	3

Average Pooling

4	1
4	2

Resources

- Convolutional neural network [wikipedia]

- Feed-forward neural network [wikipedia]

- Basics of CNN in Deep Learning

- Intuitively Understanding Convolutions for Deep Learning

- Convolutional Neural Network CNN- الشبكات الـ عصبية الملتفة by dr. Ahmed Yousry [youtube]

- What is ReLU and Sigmoid activation function?