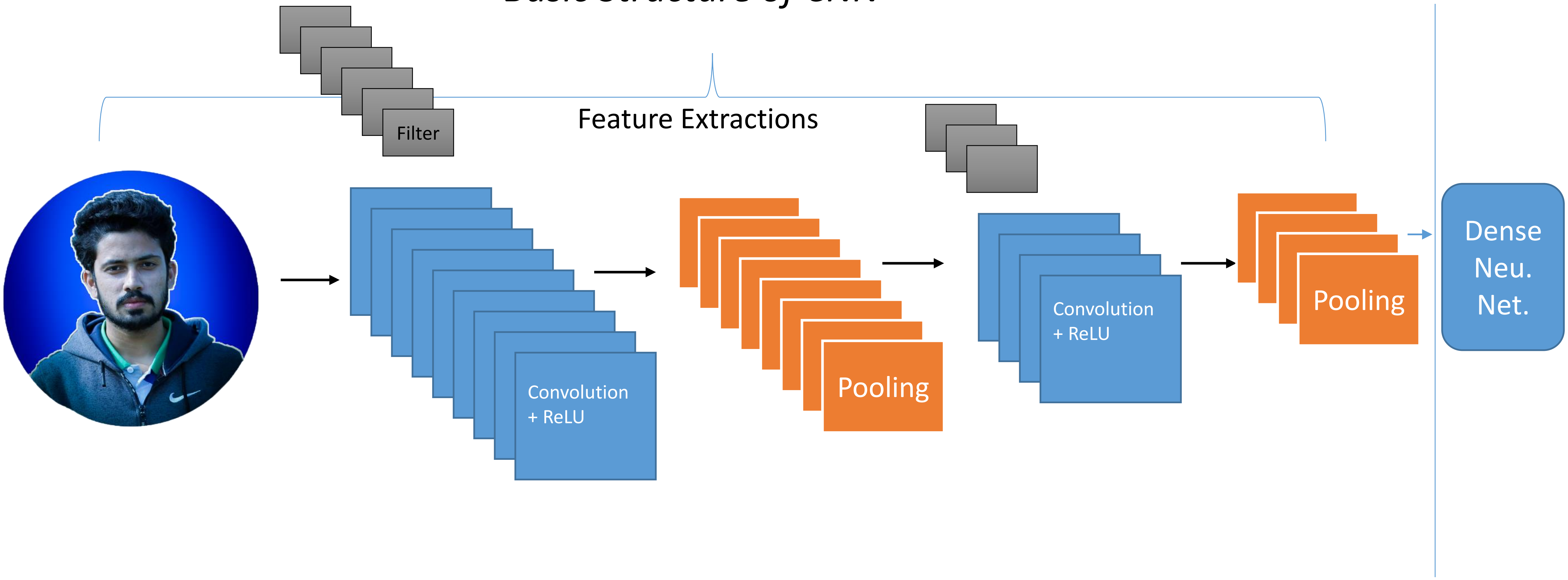
Convolutional Neural Network (CNN)

Basic Structure of CNN



Convolutional Neural Network (CNN)

- Images recognition
- Images classifications
- Objects detections
- Decoding facial recognition
- Understanding climate
- Driverless cars
- Human genome mapping
- Predicting earthquakes
- Natural disasters

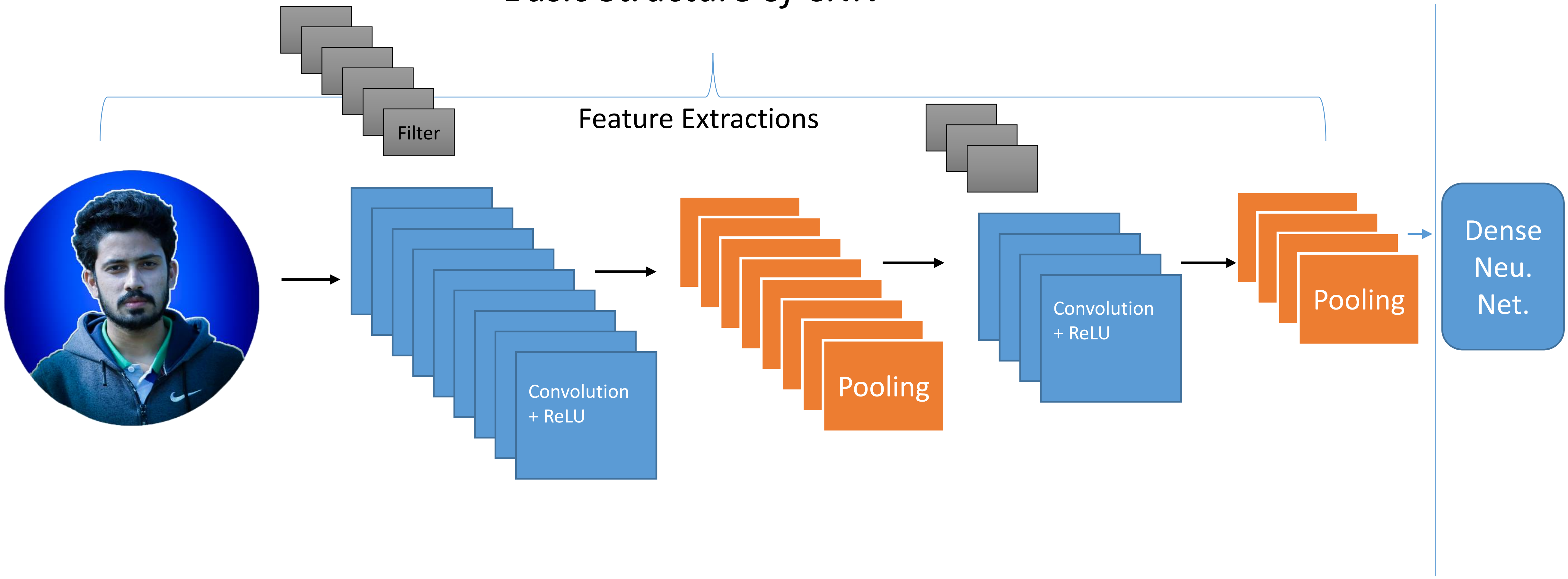
Convolutional Neural Network (CNN)

How many layers does CNN have?

There are **three types** of layers in a convolutional neural network: **Convolutional layer**, **Pooling layer**, and **Fully connected layer**. Each of these **layers has** different parameters that can be optimized and performs a different task on the input data.

Convolutional Neural Network (CNN)

Basic Structure of CNN



Images: Grayscale

302* 320 Grayscale image

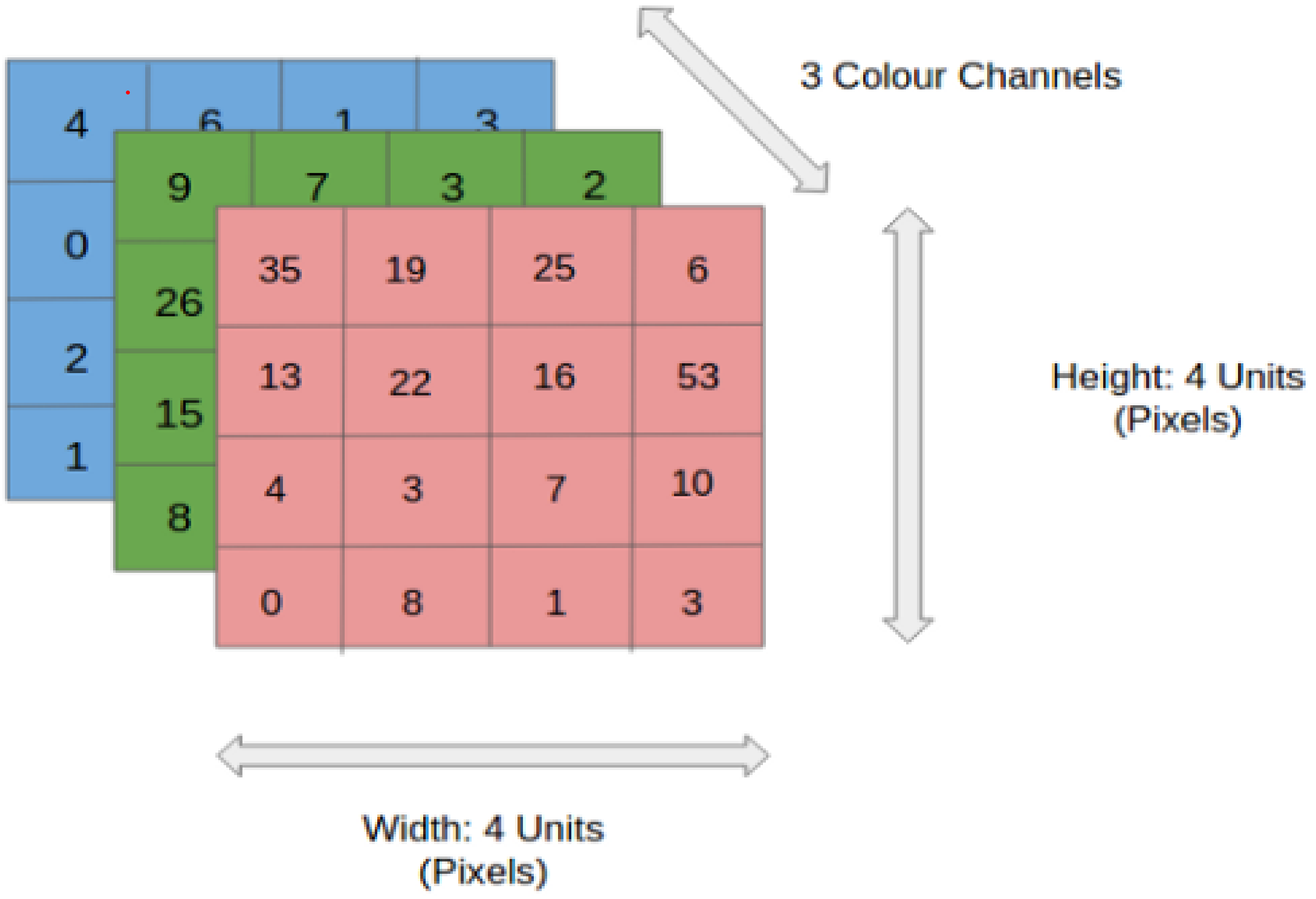
Channel: 1
Type: Less Complex

Images: RGB

Channel: 3
Type: Complex

3840* 2160 RGB image

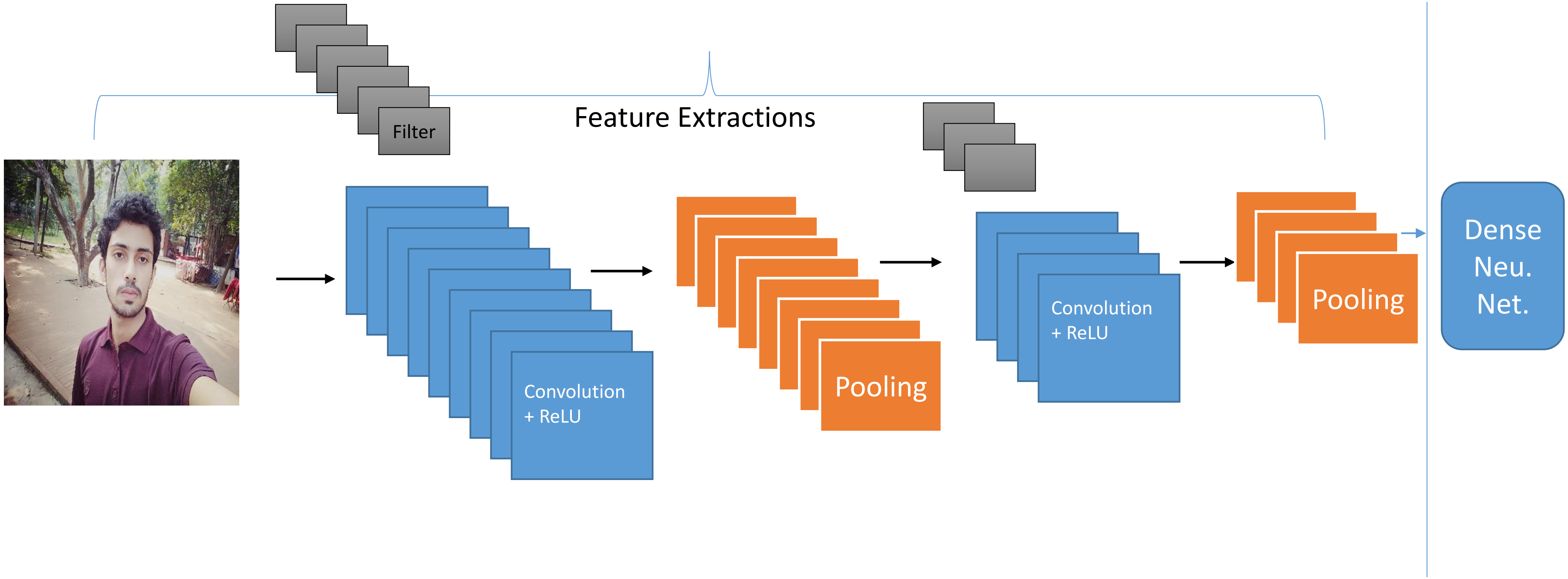
Convolutional Neural Network (CNN)



4*4*3 RGB image

Convolutional Neural Network (CNN)

Basic Structure of CNN



Convolutional Neural Network (CNN)

Convolution Layer — The Kernel

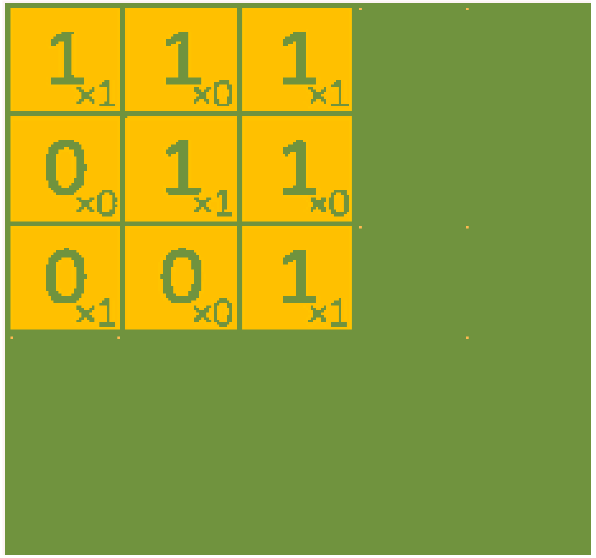
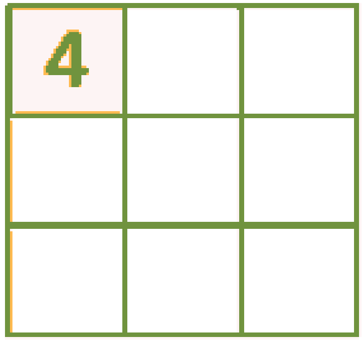


Image 5*5



Feature Map 3*3

Convolved Feature

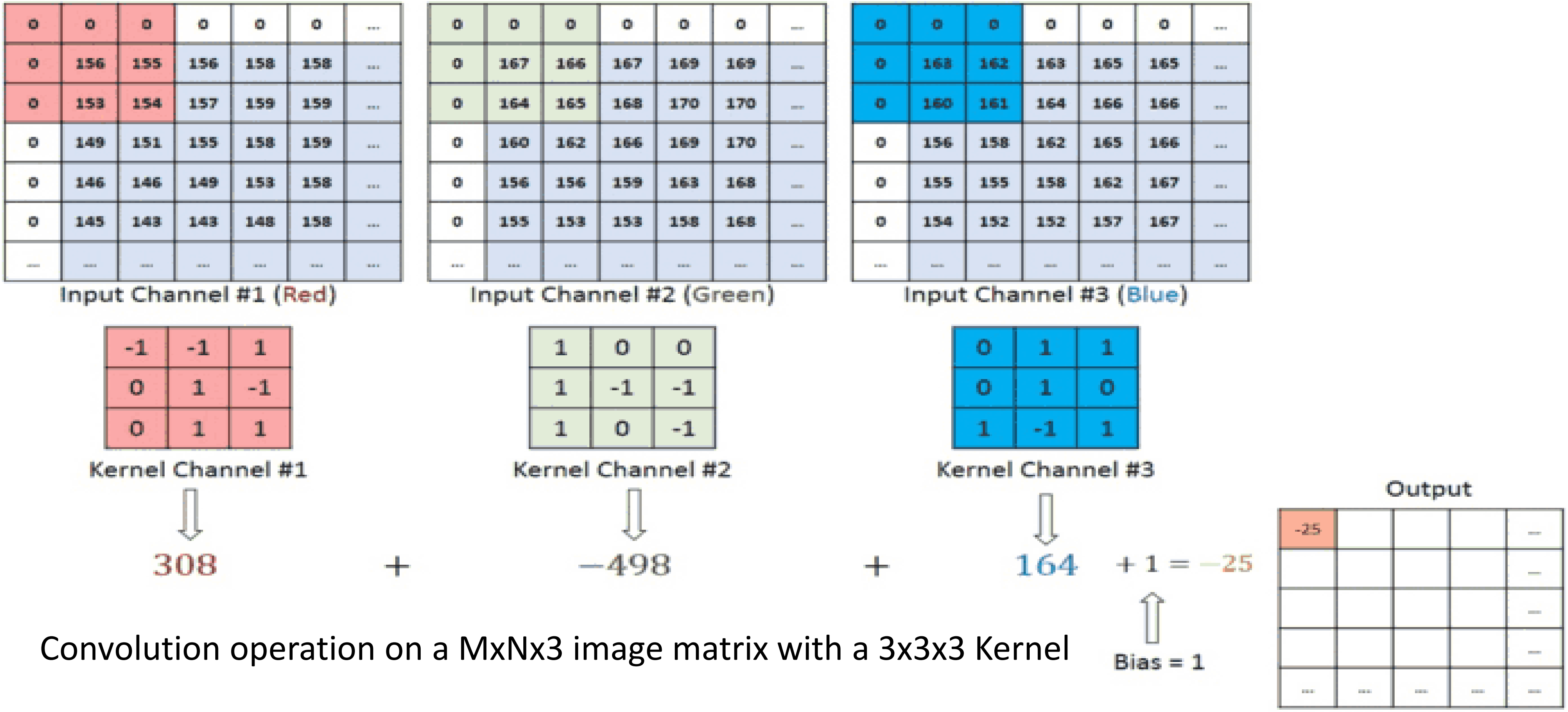
$$\begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix} \rightarrow \text{Filter 1}$$

Multiplication: 1*1 + 1*0 + 1*1 + 0*0 + 1*1 + 1*0 + 0*1 + 0*0 + 1*1 = 4

Map size = (N – F + 1) * (N – F + 1)
= (5 – 3 + 1) * (5 – 3 + 1)
= 3*3 Matrix

Convolutional Neural Network (CNN)

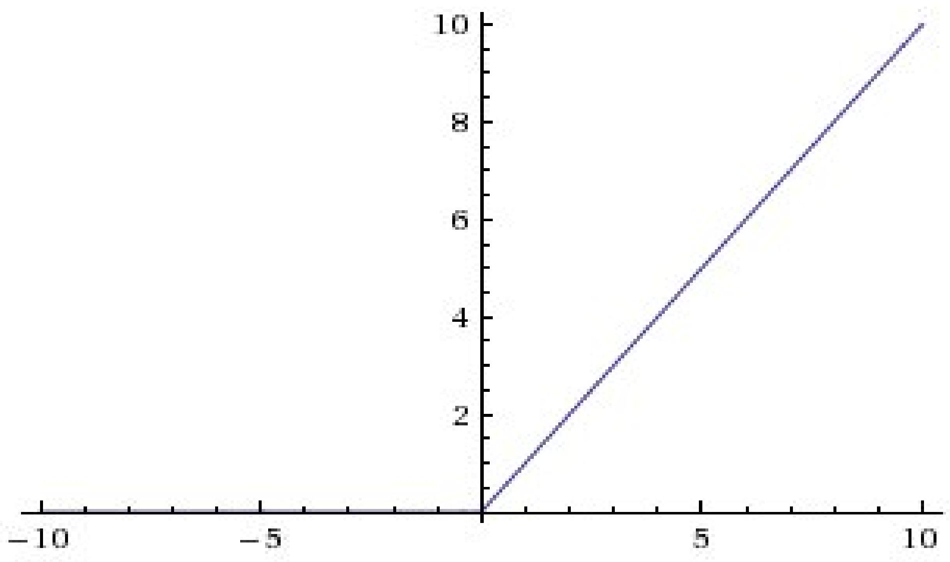
Convolution Layer — The Kernel



Convolution operation on a MxNx3 image matrix with a 3x3x3 Kernel

Convolutional Neural Network (CNN)

Activation function: **Rectified Linear Units (ReLU**)



Convolutional Neural Network (CNN)

Activation function: **Rectified Linear Units (ReLU)**

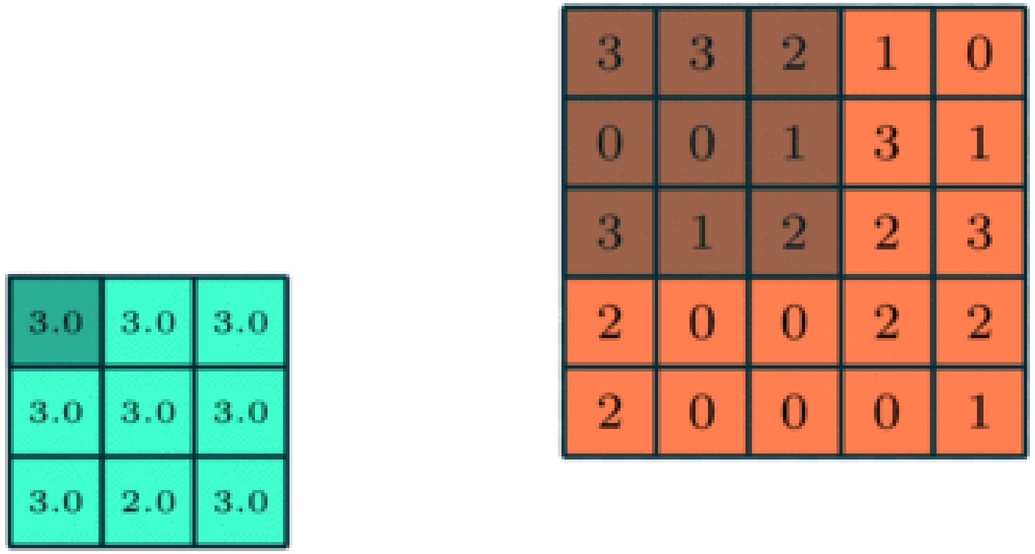
Filter 1 Feature Map

9	3	5	-8
-6	2	-3	1
1	3	4	1
3	-4	5	1

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

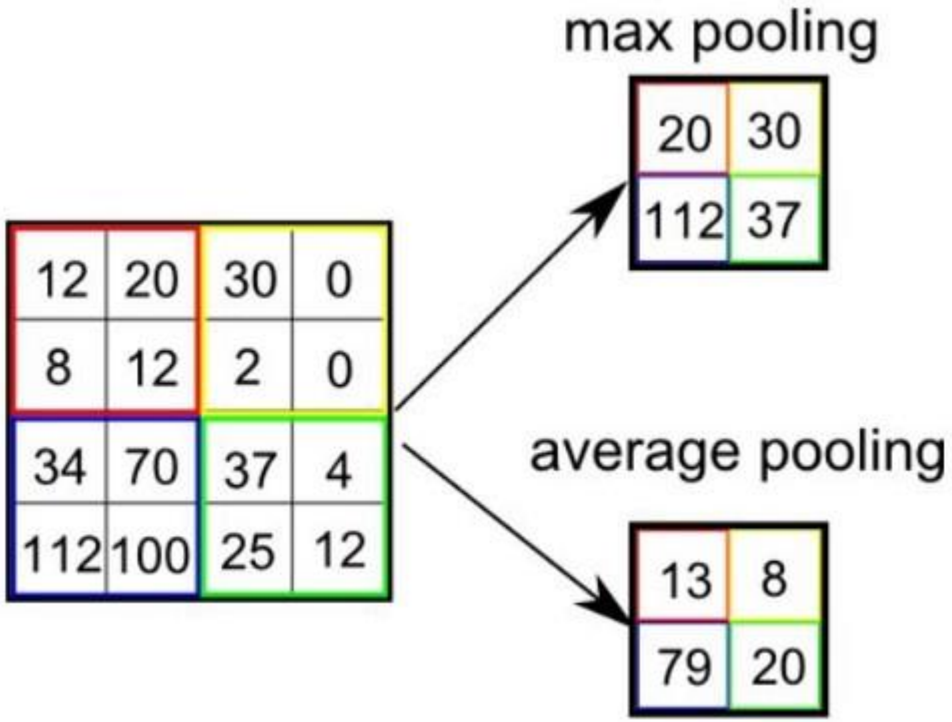
Convolutional Neural Network (CNN)

Pooling Layer



Convolutional Neural Network (CNN)

Pooling Layer



Convolutional Neural Network (CNN)

Padding

- What is padding in CNN?

Padding is a term relevant to convolutional neural networks as it refers to the amount of pixels added to an image when it is being processed by the kernel of a **CNN**. For example, if the **padding** in a **CNN** is set to zero, then every pixel value that is added will be of value zero.

Convolutional Neural Network (CNN)

Padding

- Why does CNN use padding?

Padding is simply a process of adding layers of zeros to our input images so as to avoid the problems mentioned above. This prevents shrinking as, if p = number of layers of zeros added to the border of the image, then our (n x n) image becomes (n + 2p) x (n + 2p) image after **padding**.

35	19	25	6
13	22	16	53
4	3	7	10
9	8	1	3

4 * 4

After Padding
P = 1

0	0	0	0	0	0
0	35	19	25	6	0
0	13	22	16	53	0
0	4	3	7	10	0
0	9	8	1	3	0
0	0	0	0	0	0

6 * 6

Input size = n + 2p – f + 1
= 4 + 2*1 – 3 + 1 = (4*4)

Convolutional Neural Network (CNN)

Padding

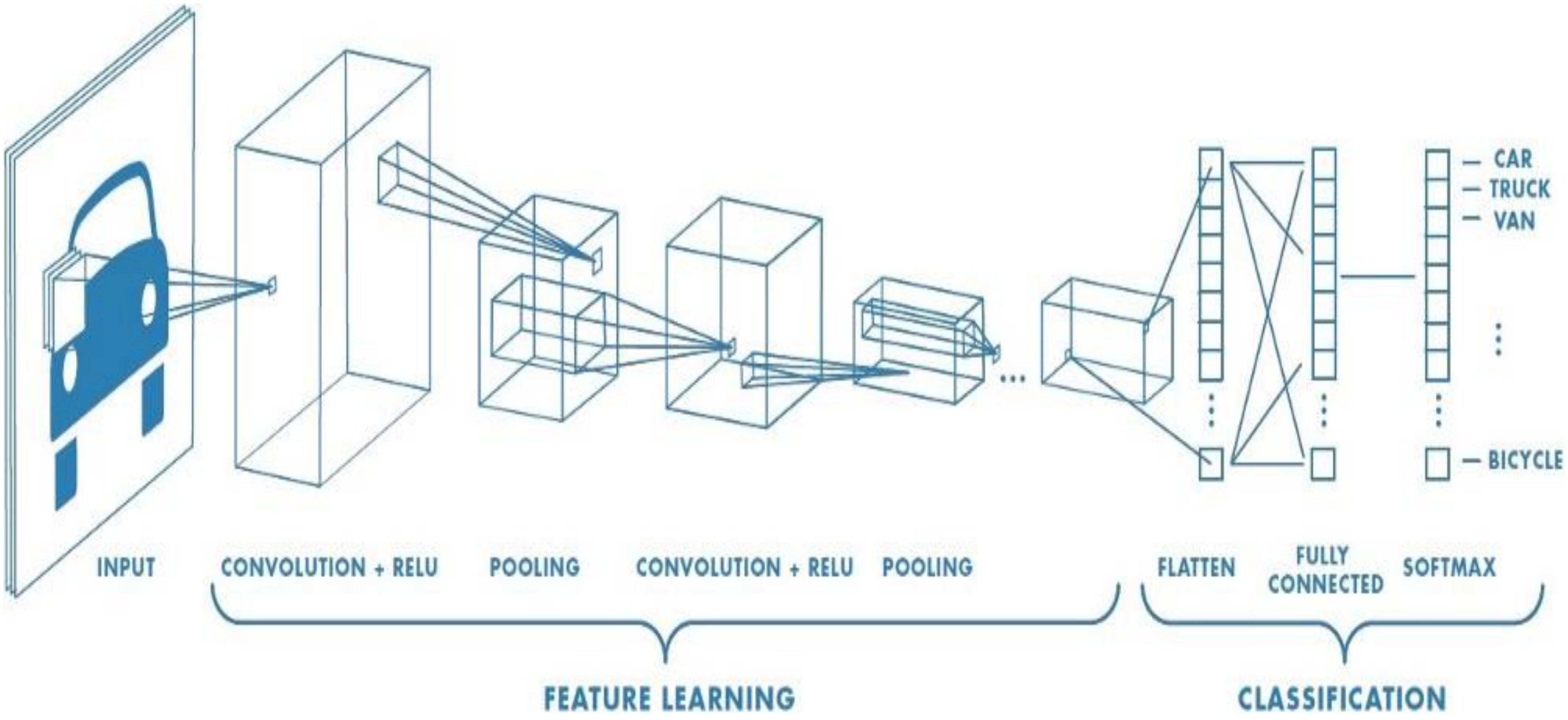
Types of Padding:

- **Valid Padding :** It implies no padding at all. The input image is left in its valid/unaltered shape. So, ***[(n x n) image] * [(f x f) filter] —> [(n – f + 1) x (n – f + 1) image]***

- **Same Padding :** In this case, we add 'p' padding layers such that the output image has the same dimensions as the input image.
  So, ***[(n + 2p) x (n + 2p) image] * [(f x f) filter] —> [(n x n) image]***

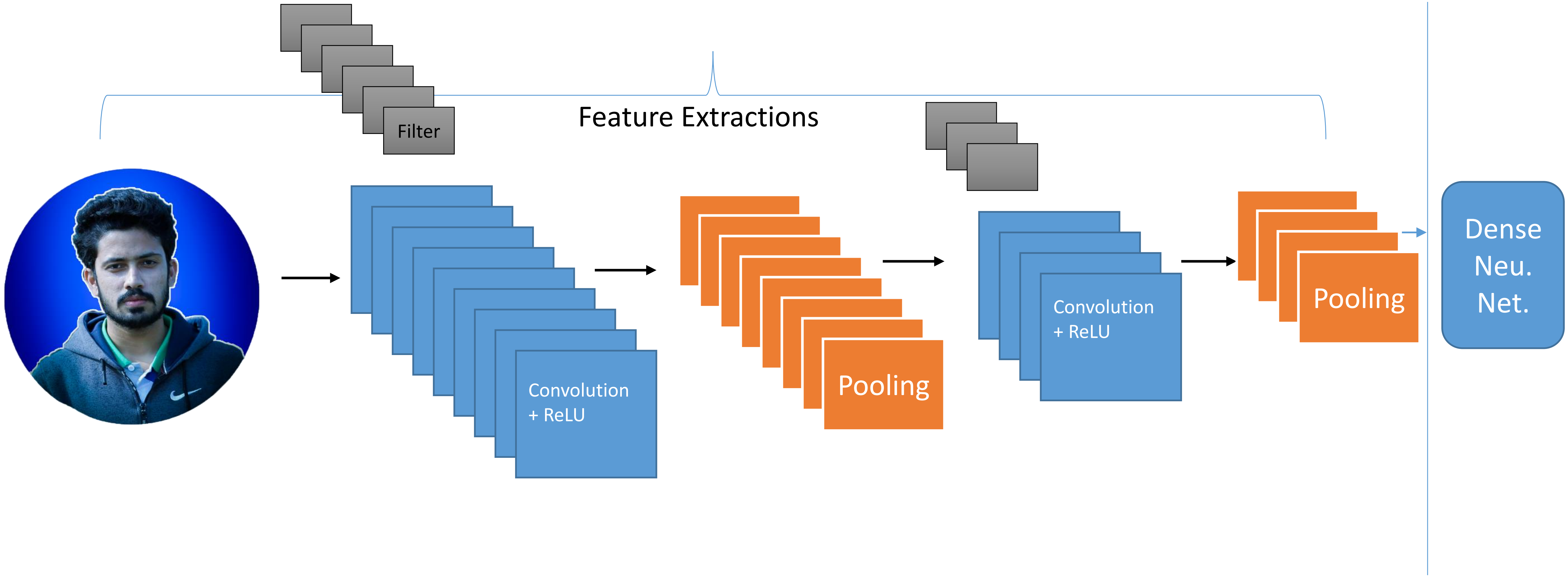
  Output size = n + 2p – f + 1

Convolutional Neural Network (CNN)



Convolutional Neural Network (CNN)

Basic Structure of CNN



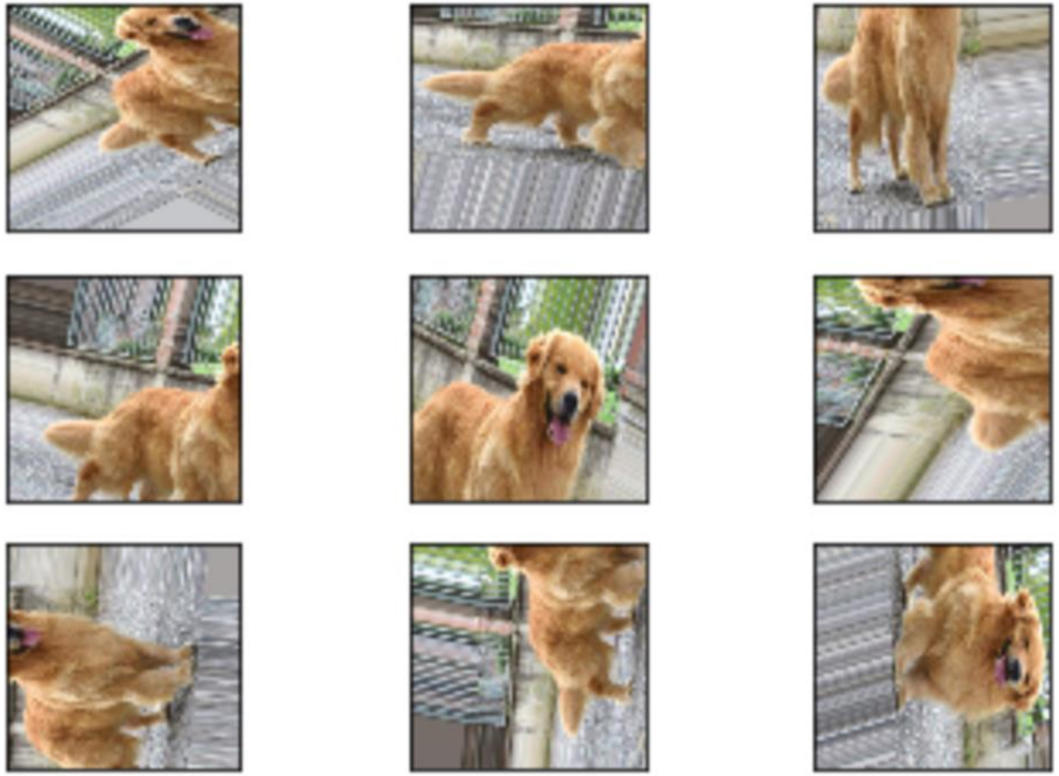
Data Augmentation in Deep Learning

How do I get more data, if I don't have "more data"?

Class - 19

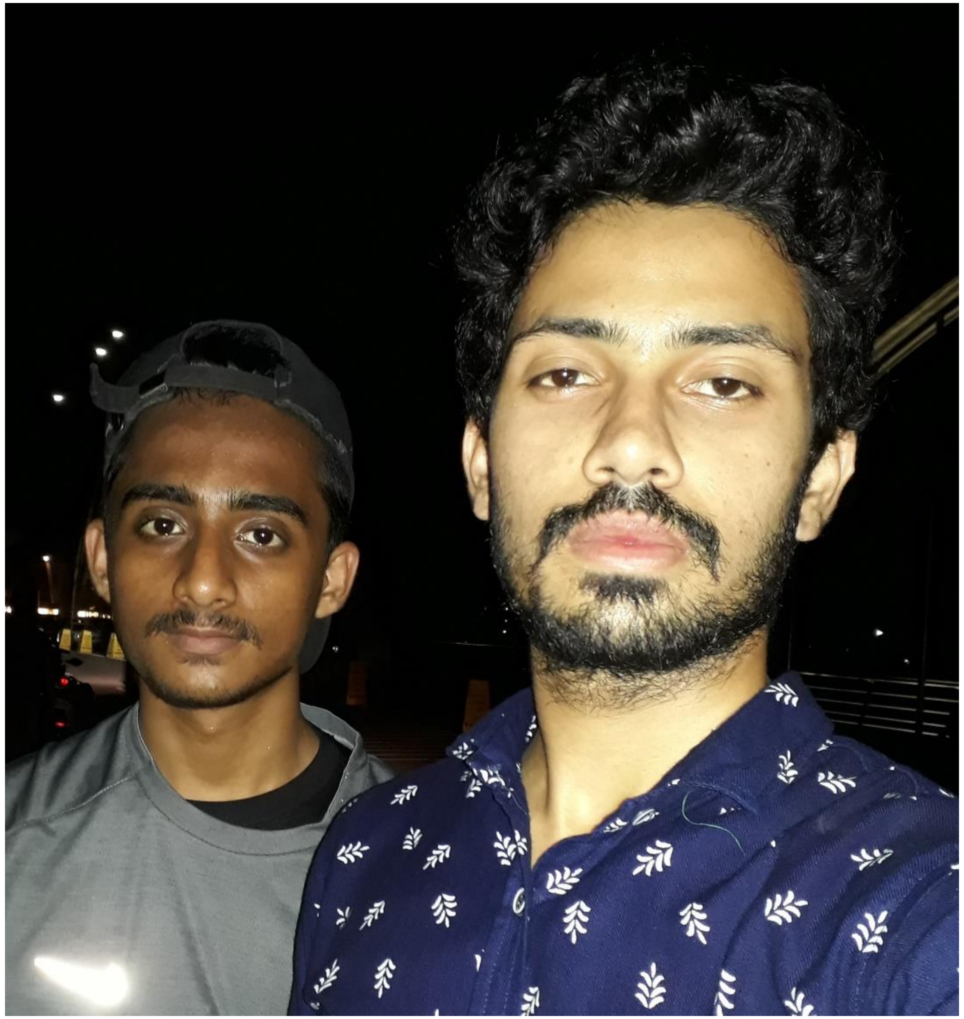
Data Augmentation in Deep Learning

What is Data Augmentation?



Convolutional Neural Network (CNN)

1. Zoom in/out



Data Augmentation in Deep Learning

2. Rotation

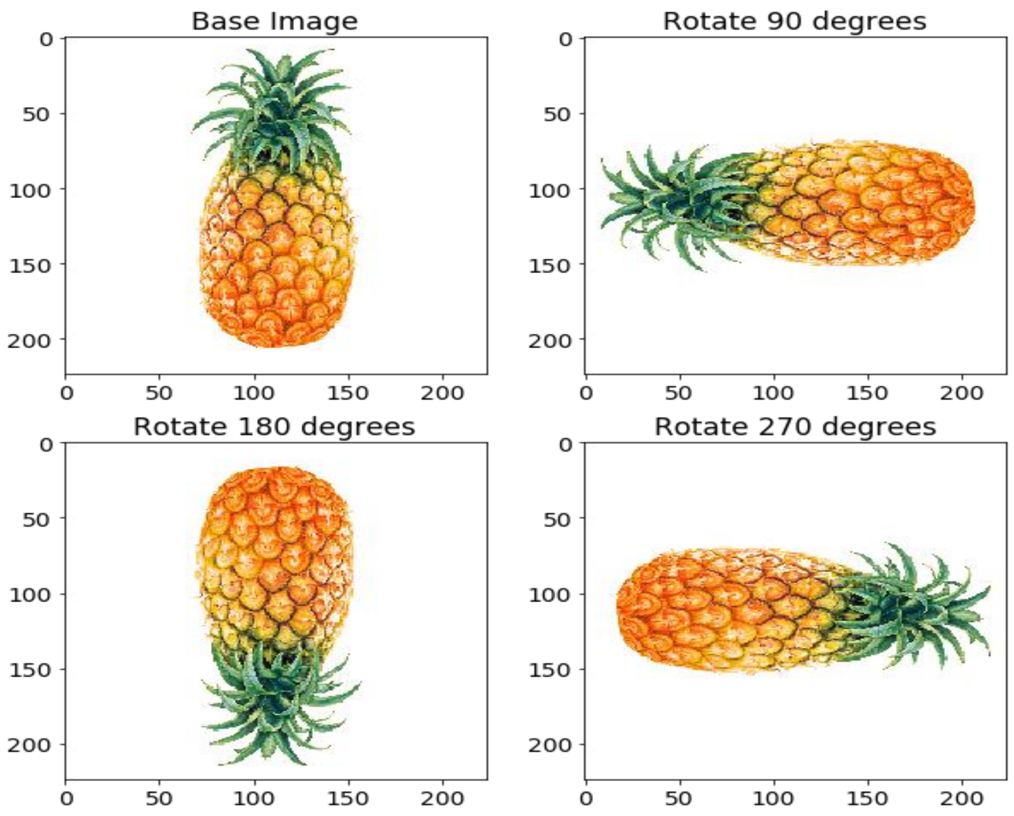


Image: medium.com

Data Augmentation in Deep Learning

3. Flipping

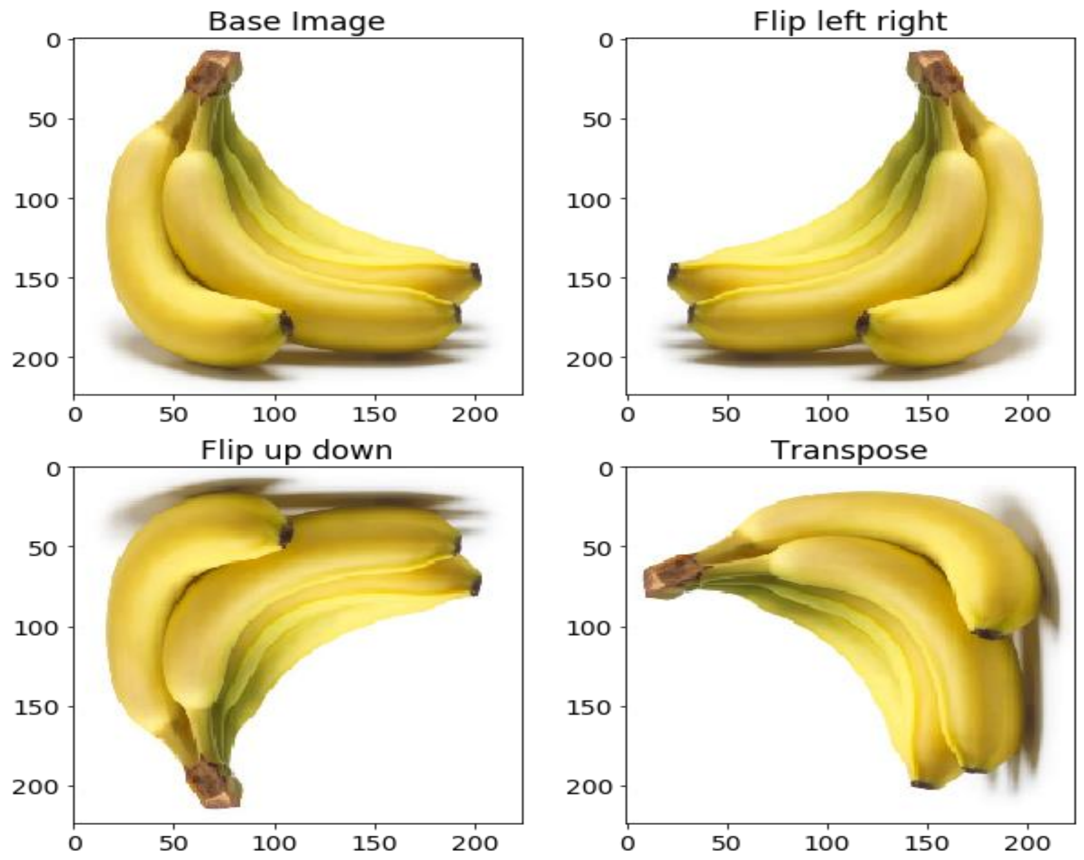


Image: medium.com

Data Augmentation in Deep Learning

4. Adding Noise

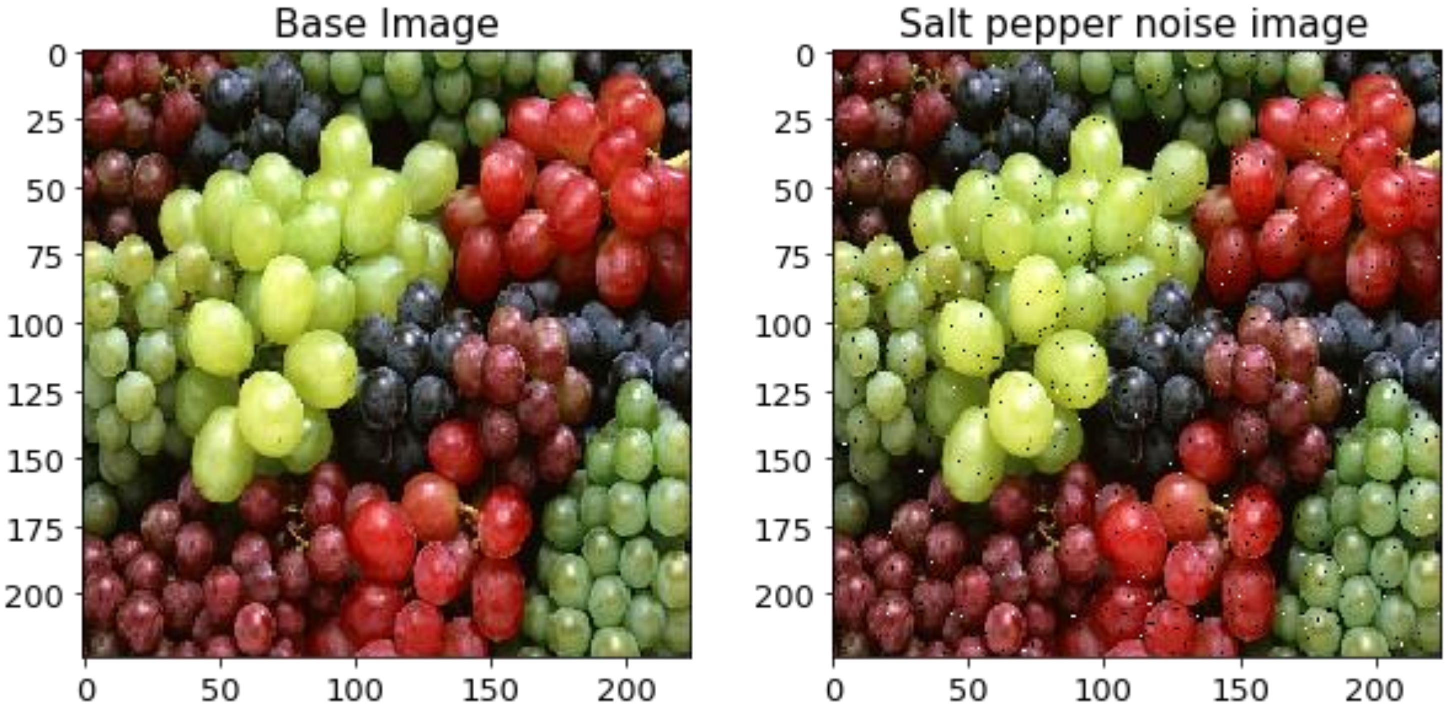


Image: medium.com

Data Augmentation in Deep Learning

5. Lighting Condition

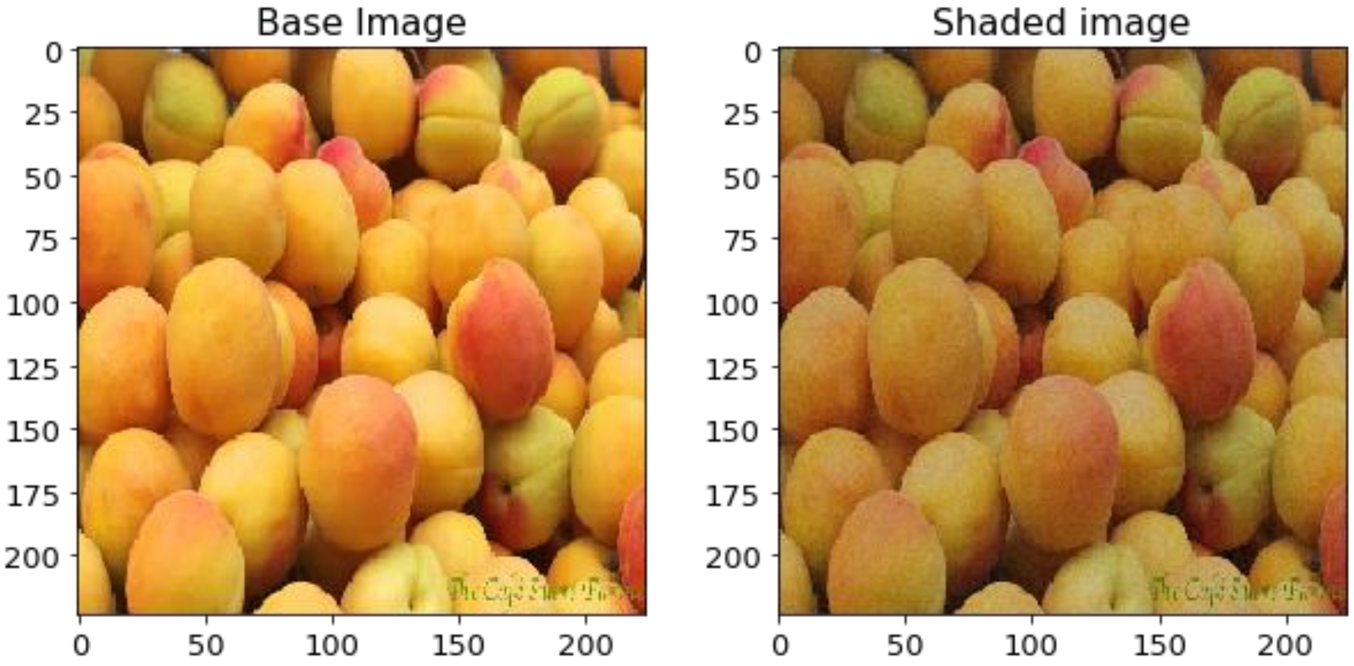
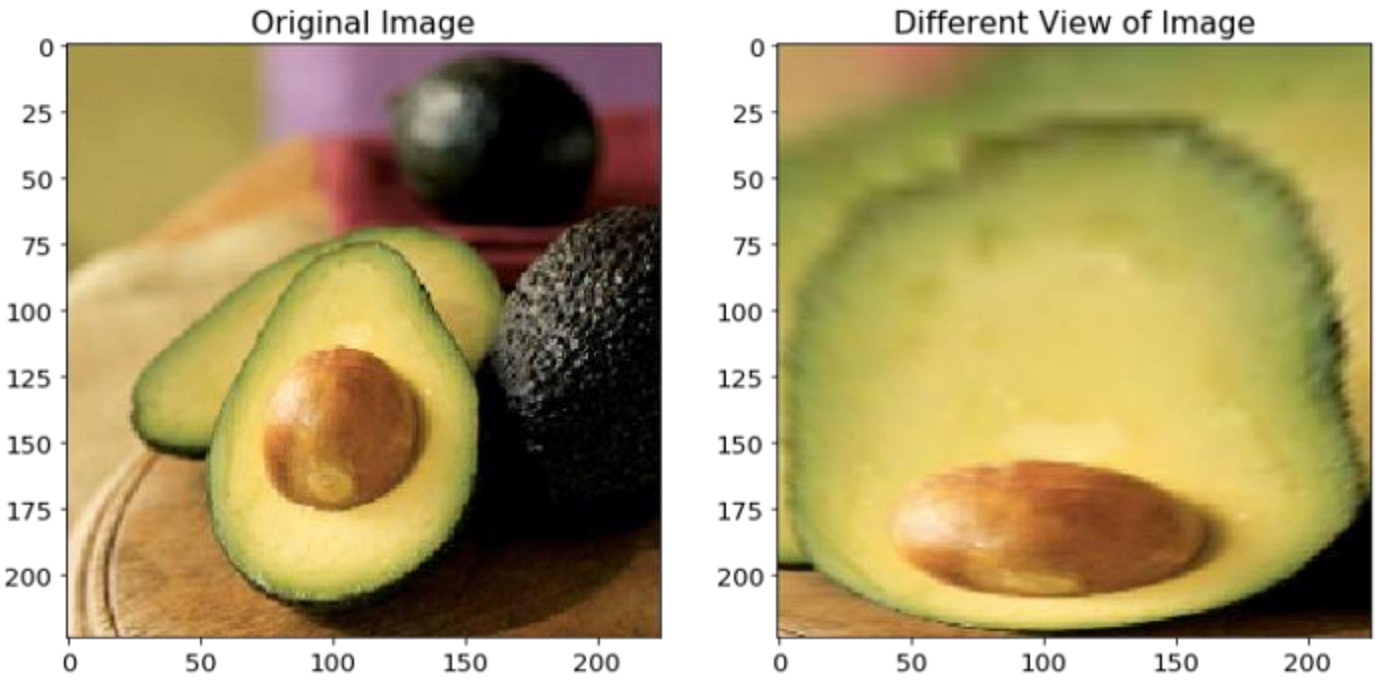


Image: medium.com

Data Augmentation in Deep Learning

6. Perspective transform



Watch: https://youtu.be/p8e7dGY-Oko

Image: medium.com


@jrsugianto