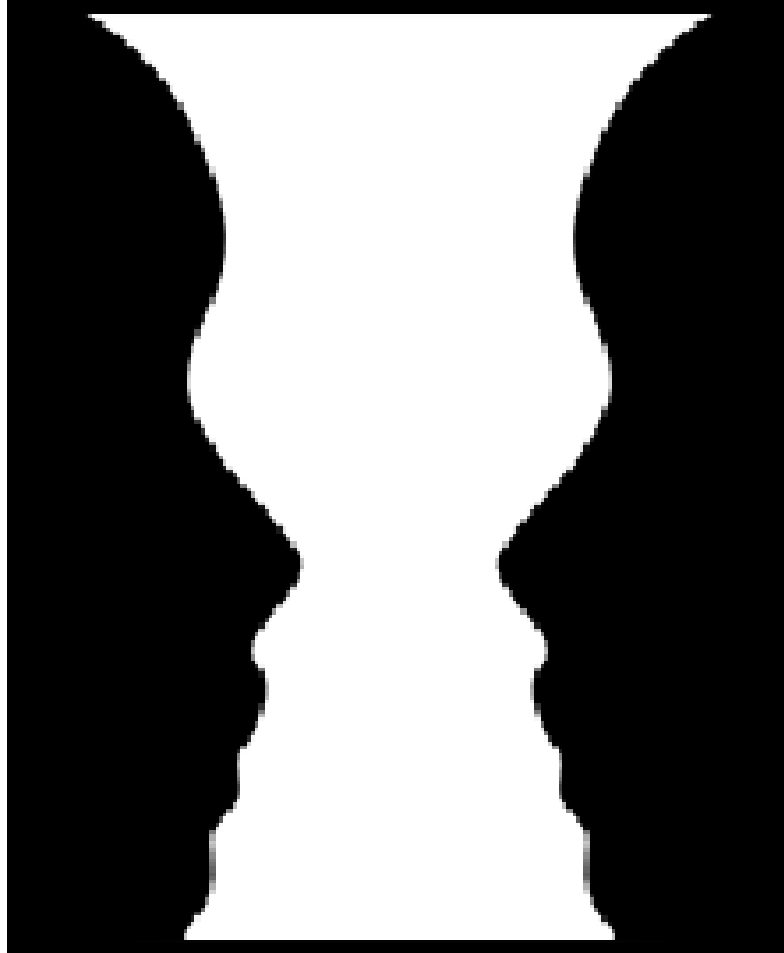# Convolutional Neural Networks

BY UMANG KEJRIWAL

Convolutional Neural Networks

➢ **Image Processing** is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image.

➢ **Computer Vision** is a field of computer science that works on enabling computers to see, identify and process images in the same way that human vision does, and then provide appropriate output. It is like imparting human intelligence and instincts to a computer. In reality though, it is a difficult task to enable computers to recognize images of different objects.

Convolutional Neural Networks
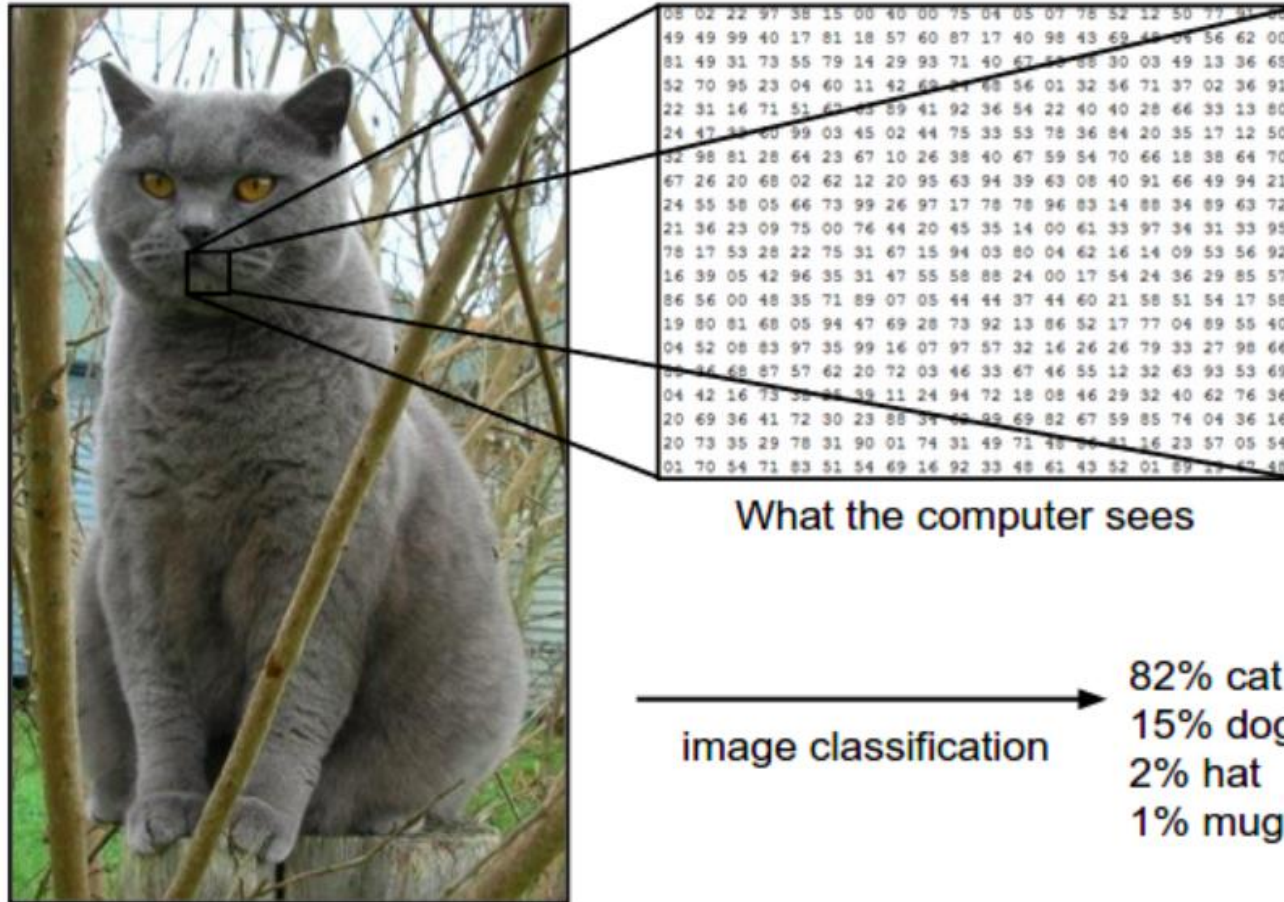
Convolutional Neural Networks

Convolutional Neural Networks

But, the question arise, how will be learning in this stage?
Let's understand the learning first about kids!

So, what about the Computer? CNN? Learning... (by image features)
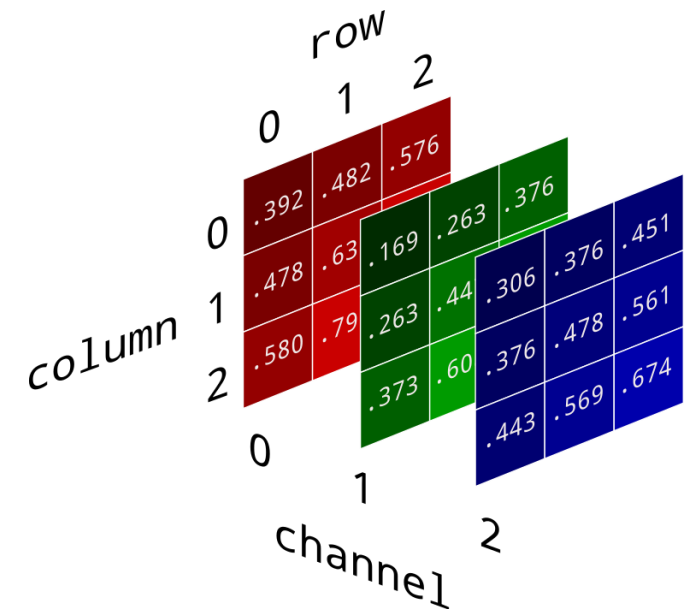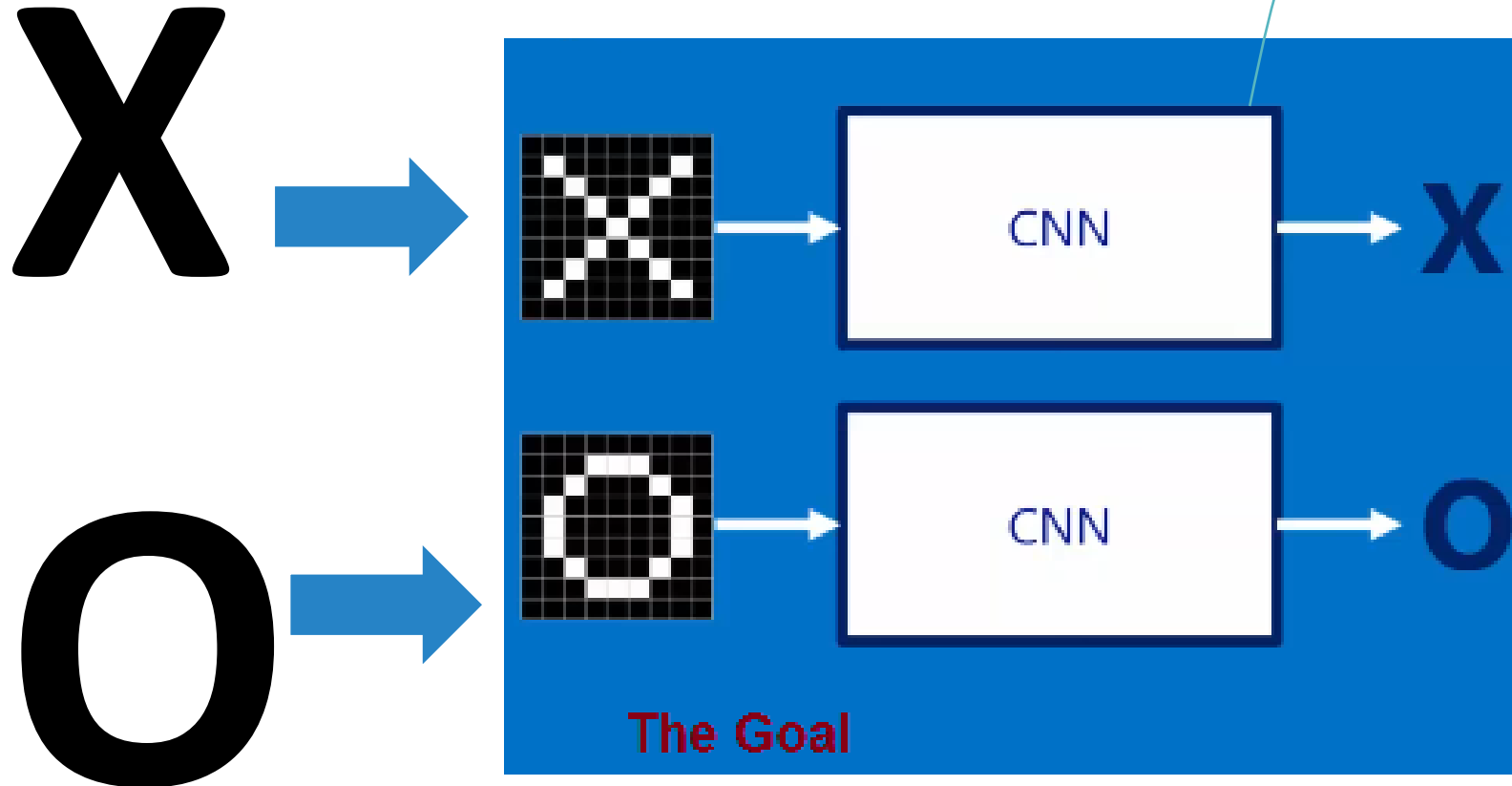

What the computer sees

image classification → 82% cat
15% dog
2% hat
1% mug

Gray scale image or RGB image

So, What about the Computer? CNN? Learning…

Here CNN work as like black box, so what is inside the black box!
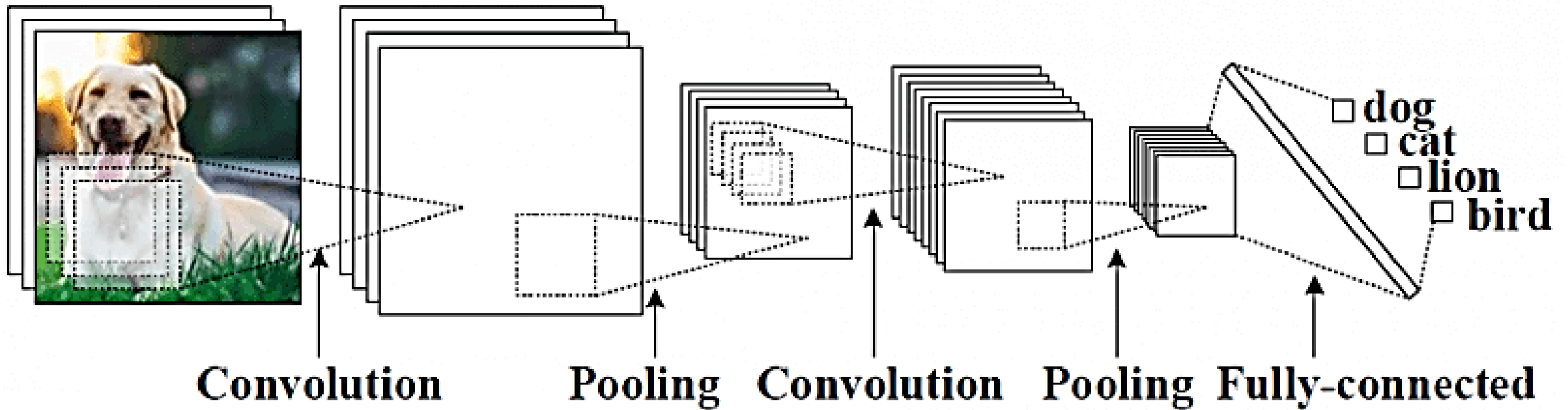
Steps in CNN

STEP 1: Convolution

↓

STEP 2: Max Pooling

↓

STEP 3: Flattening

↓

STEP 4: Full Connection

Convolution   Pooling   Convolution   Pooling   Fully-connected

□ dog
□ cat
□ lion
□ bird

1. Convolutional (of Smiling Face)

Input Image

Feature Detector

1. Convolutional (of Smiling Face)

Input Image

Feature Detector

Feature Map

1. Convolutional (of Smiling Face)

We create many feature maps to obtain our first convolution layer

Feature Maps

Input Image

Convolutional Layer

1. Convolutional (of Smiling Face)

We create many feature maps to obtain our first convolution layer

Feature Maps

Input Image

Convolutional Layer

$\phi(x) = \max(x, 0)$

$\sum_{i=1}^{m} w_i x_i$
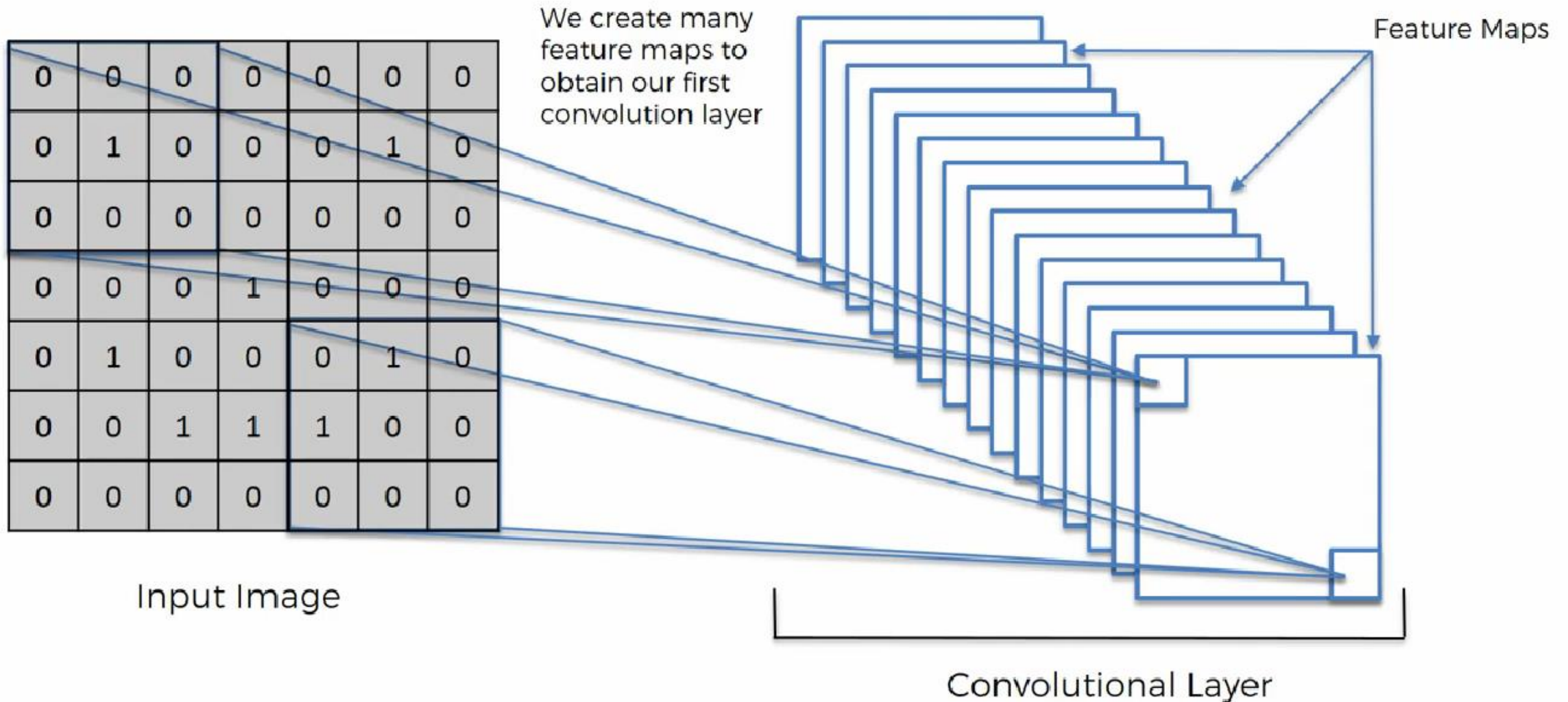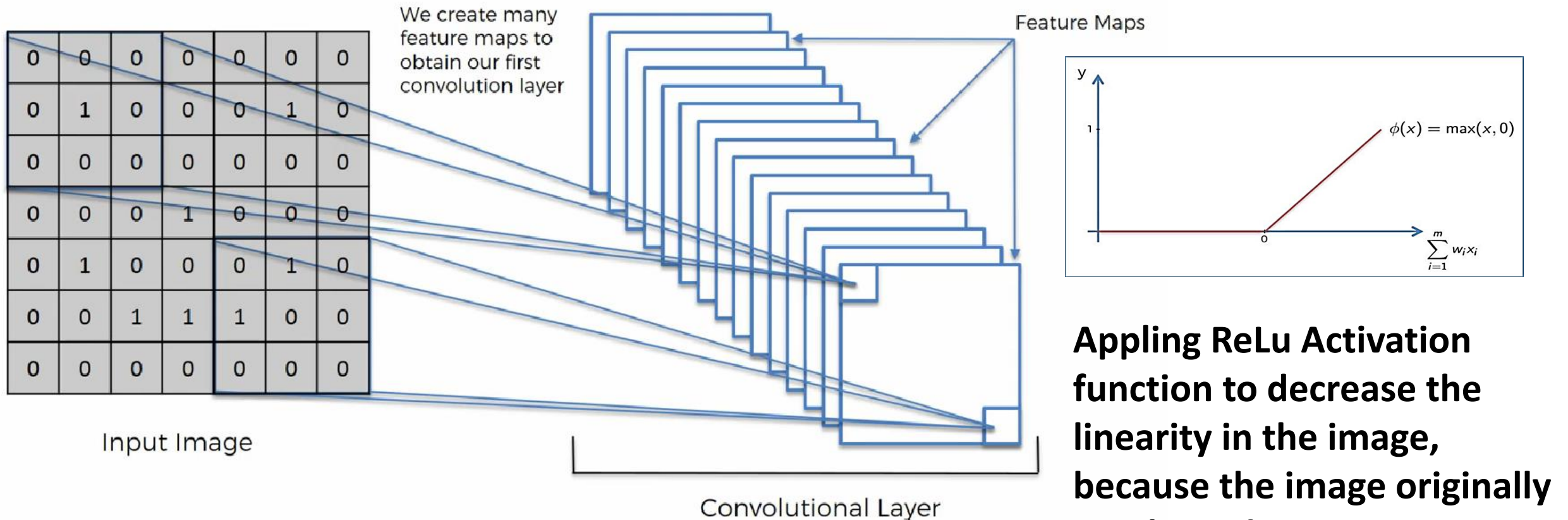
Appling ReLu Activation function to decrease the linearity in the image, because the image originally non linear!

1. Convolutional (of Smiling Face)

Different kind of filters / kernels in image processing!

http://setosa.io/ev/image-kernels/

2. Pooling

A **pooling** layer is another building block of a **CNN**. Its function is to progressively reduce the spatial size of the representation to reduce the amount of parameters and computation in the network. **Pooling** layer operates on each feature map independently. The most common approach used in **pooling** is max **pooling**.

0	1	0	0	0
0	1	1	1	0
1	0	1	2	1
1	4	2	1	0
0	0	1	2	1

Max Pooling →

Feature Map

Pooled Feature Map

Max / Avg. Pooling

Average pooling   Max pooling

Pooling…

$\phi(x) = \max(x, 0)$

$\sum_{i=1}^{m} w_i x_i$

Input Image

We create many feature maps to obtain our first convolution layer

Feature Maps

Convolutional Layer
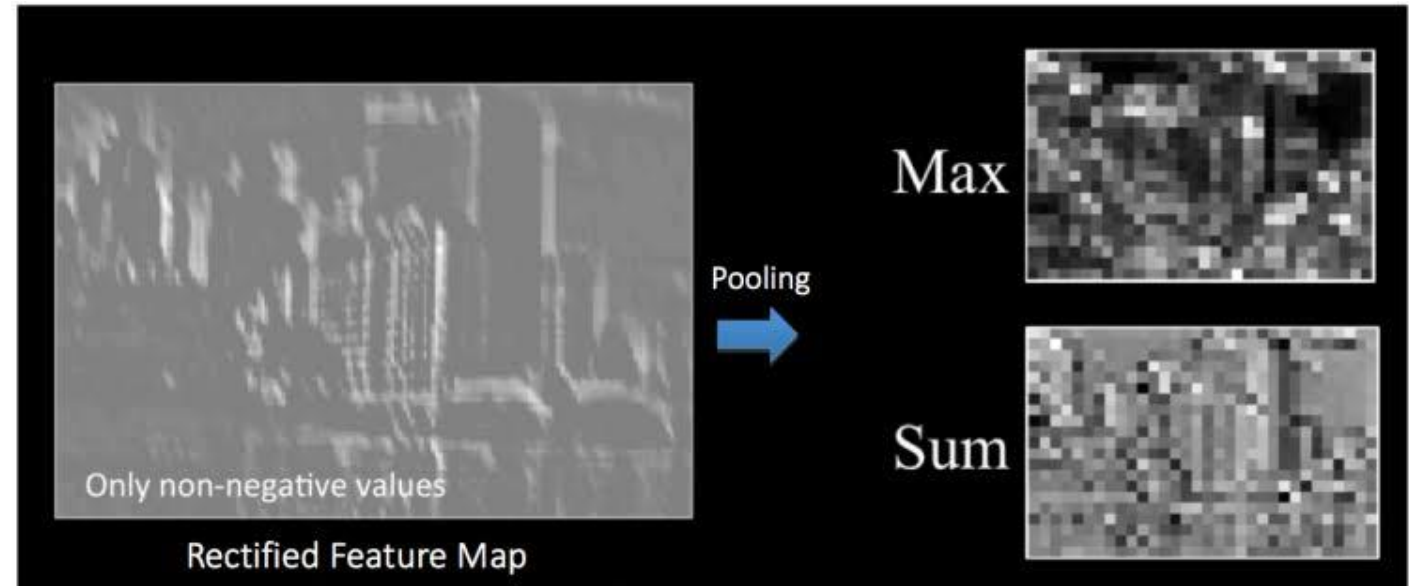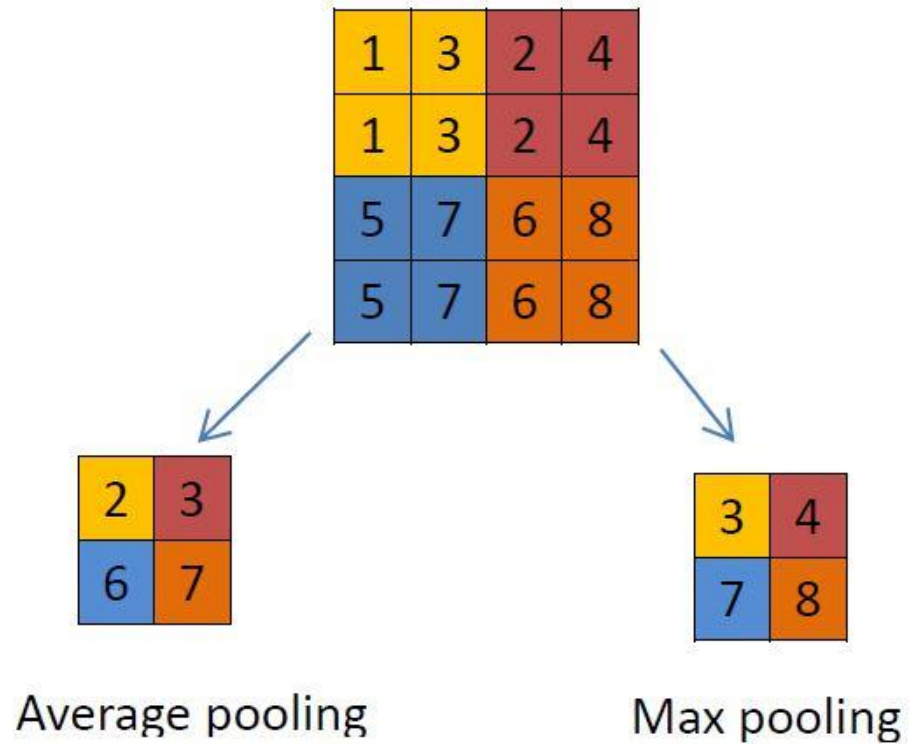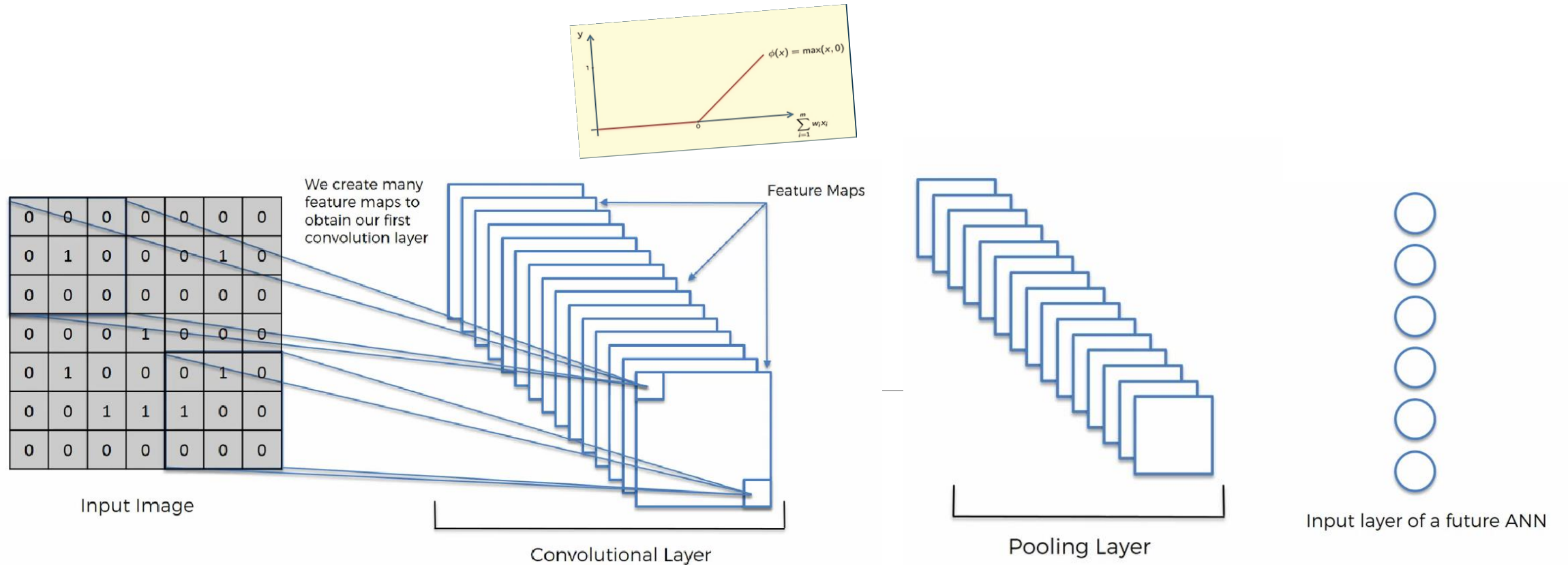
Pooling Layer
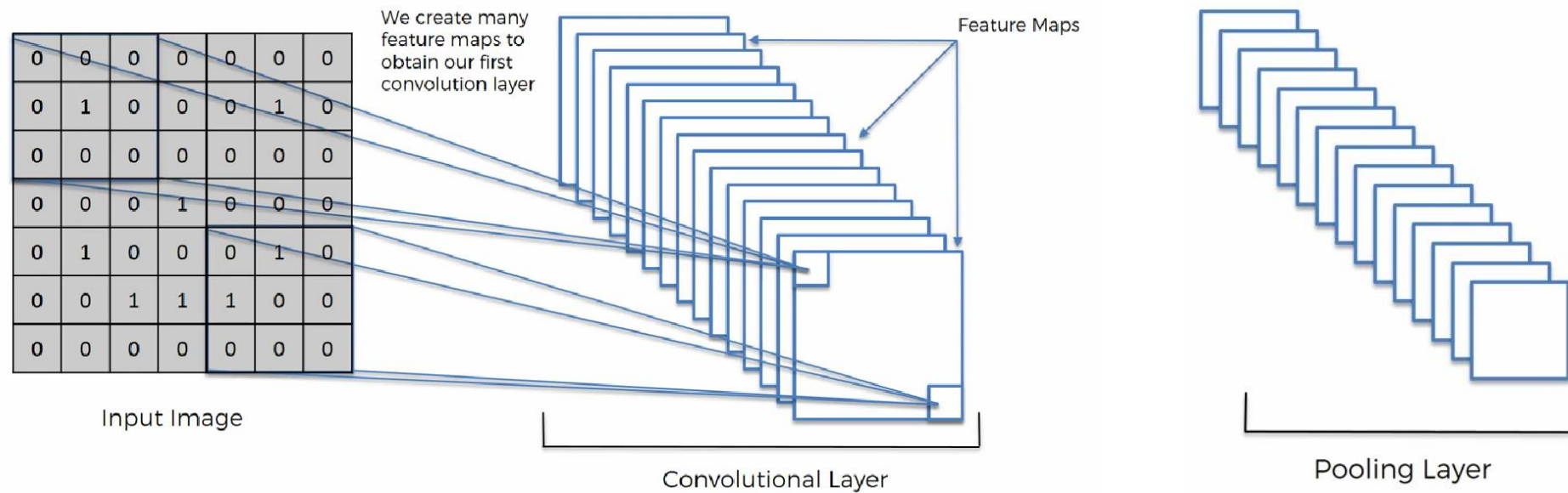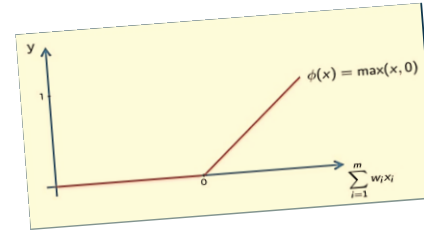
3. Flattening

Flattening is converting the data into a 1-dimensional array for inputting it to the next layer. We **flatten** the output of the convolutional layers to create a single long feature vector. And it is connected to the final classification model, which is called a fully-connected layer
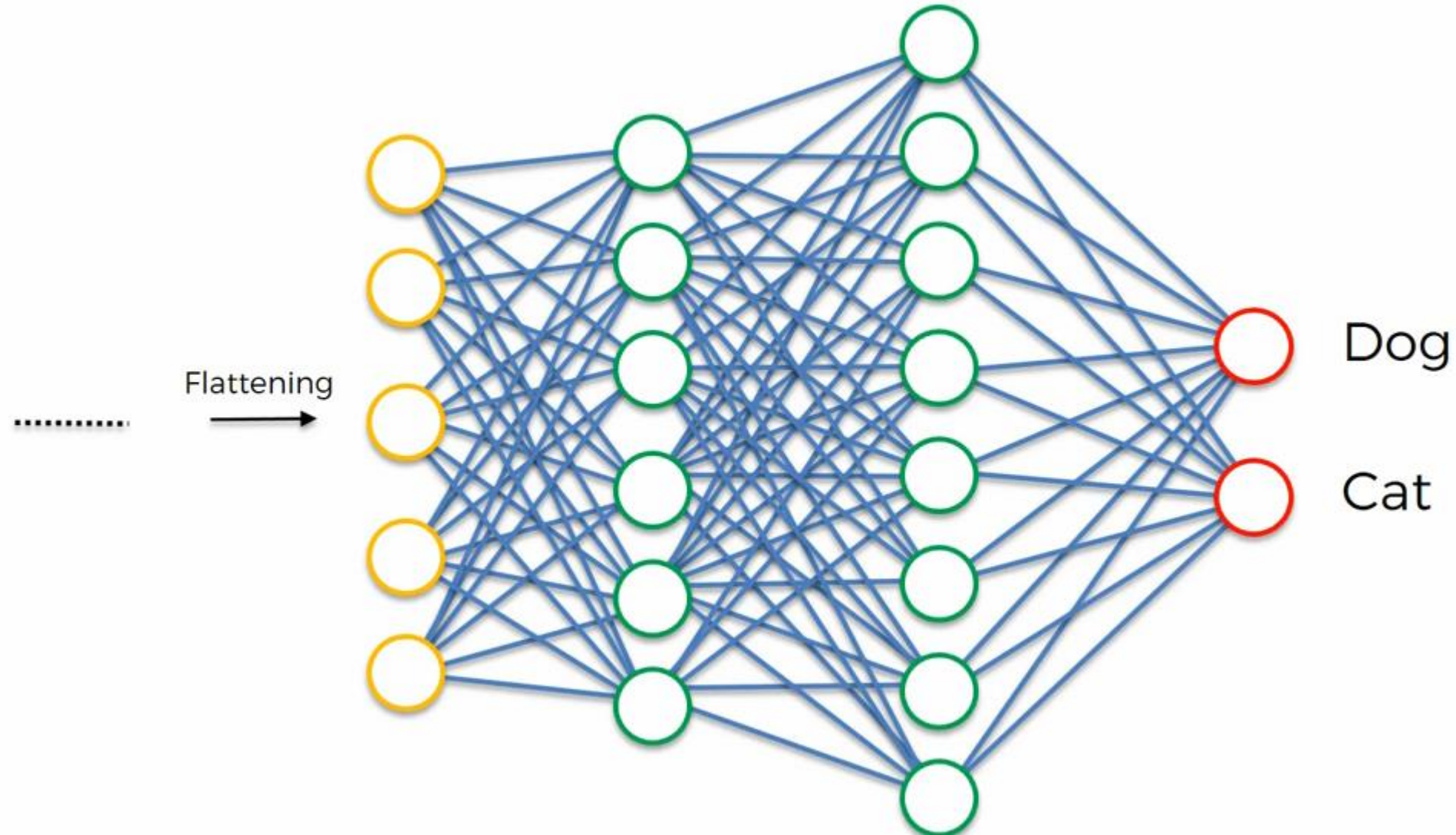

Pooled Feature Map

Flattening ...

$\phi(x) = \max(x, 0)$

$\sum_{i=1}^{m} w_i x_i$

We create many feature maps to obtain our first convolution layer

Feature Maps

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

Input Image

Convolutional Layer

Pooling Layer

Input layer of a future ANN

4. Fulling Connection

Complete CNN in one View