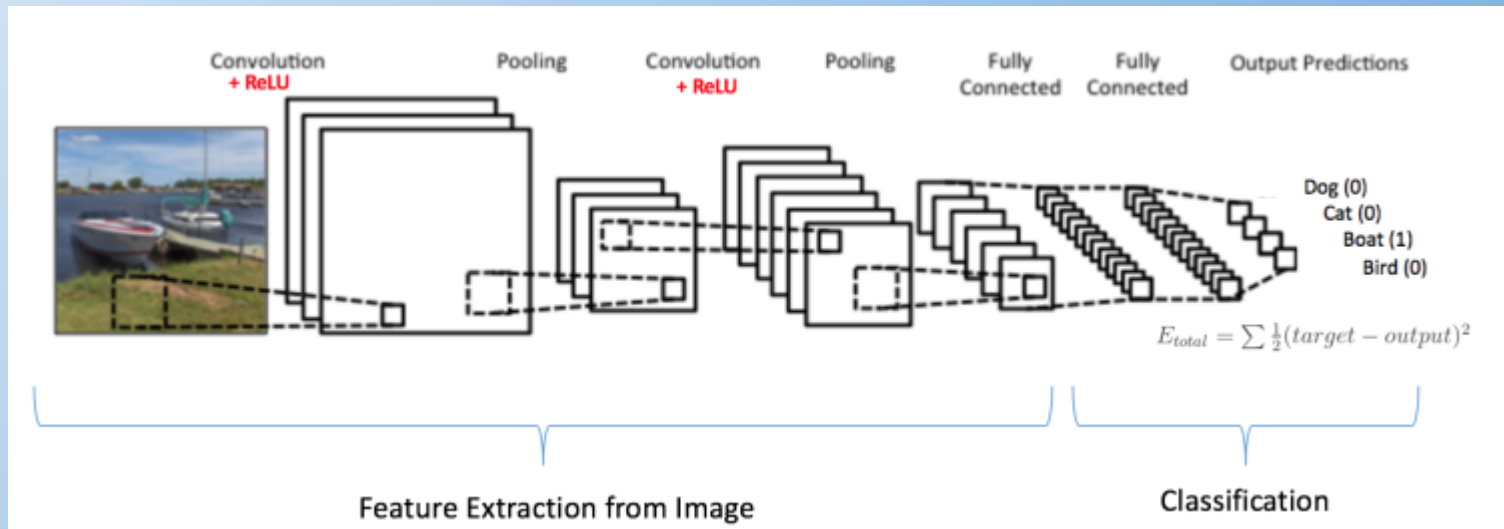# CNN concept

- Convolutional Neural Networks are a category of Neural Networks that have proven very effective in areas such as image recognition and classification. CNNs have been successful in identifying faces, objects and traffic signs apart from powering vision in robots and self driving cars.

-

Source: https://www.apsl.net/blog/2017/11/20/use-convolutional-neural-network-image-classification/

CNN concept

2D Convolution:
- Apply a filter on the image moving at a certain **stride** to build a feature map
- Use several filters (**depth**)

Filter

1	0	1
0	1	0
1	0	1

Image

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

Image

Convolved Feature

Feature Map having depth of 3 (since 3 filters have been used)

Feature Map

Convolution Operation

CNN concept

What are "features"?

Input Image   First Layer   Second Layer   Third Layer

| Raw data | Low-level features | Mid-level features | High-level features |

Sources: https://www.learnopencv.com/image-classification-using-convolutional-neural-networks-in-keras/
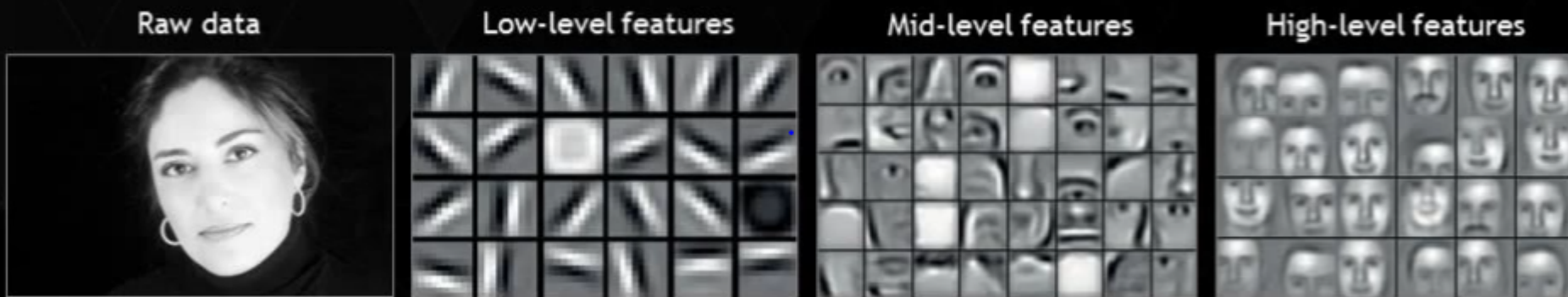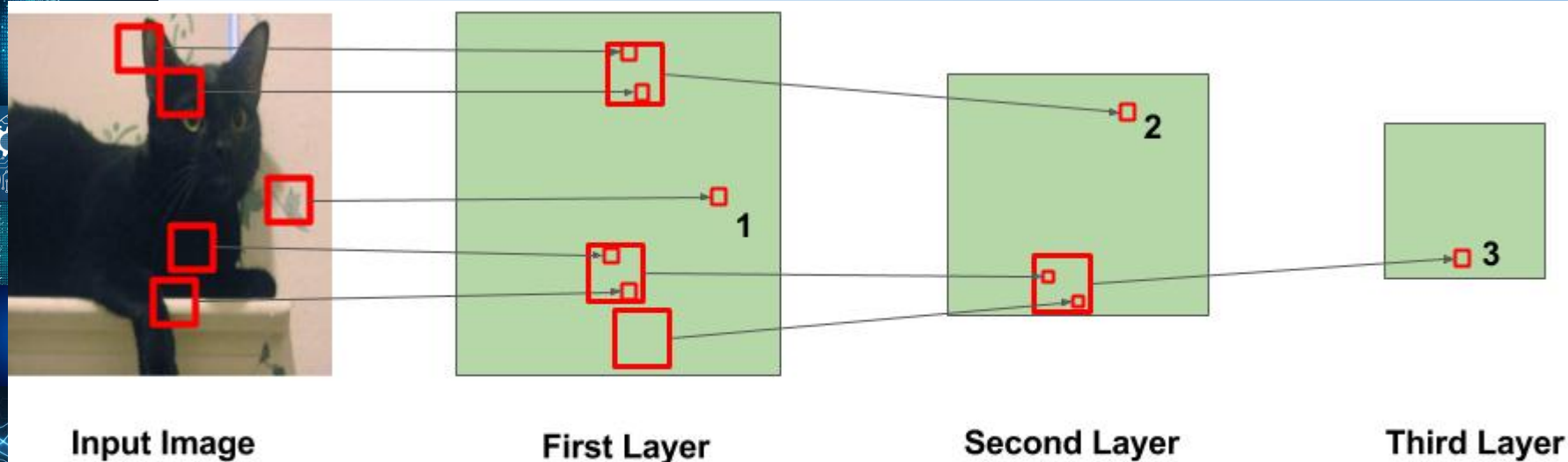
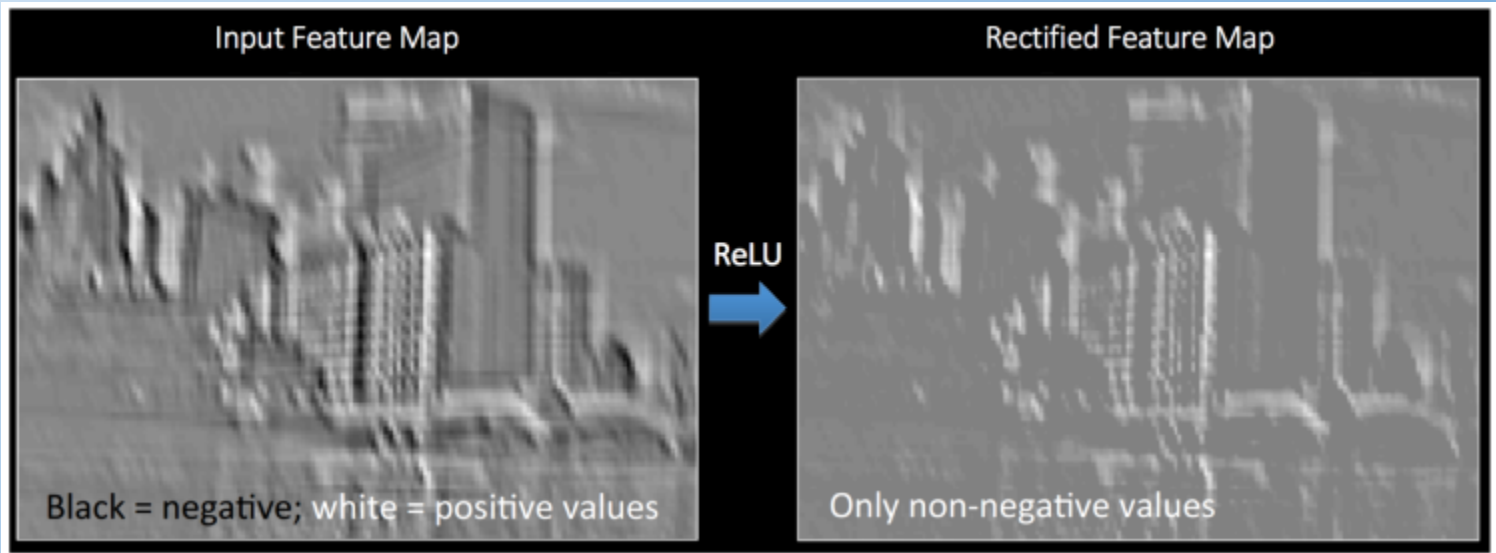# CNN concept

2D Convolution:
- Apply a Rectified Linear Unit (ReLU)

Source: https://www.apsl.net/blog/2017/11/20/use-convolutional-neural-network-image-classification/
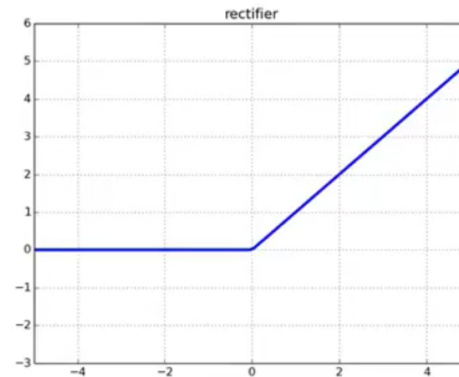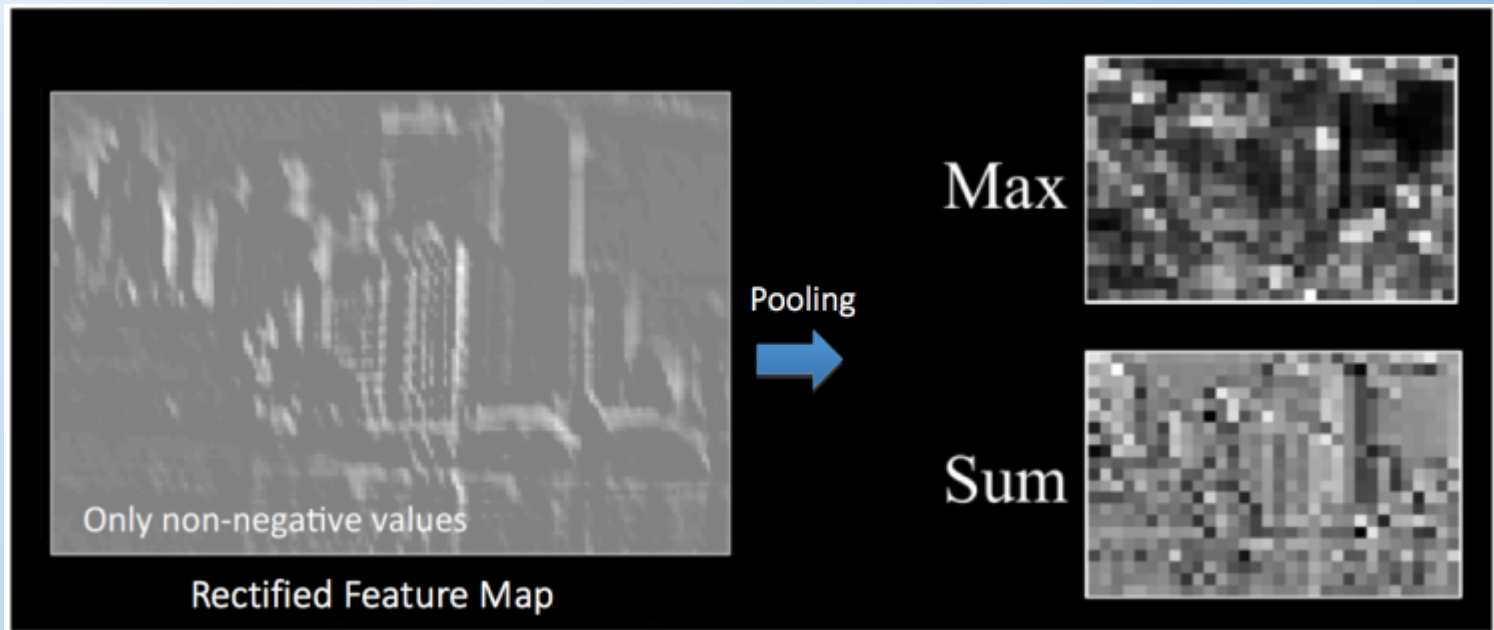
CNN concept

2D Convolution:

- Applying pooling to rectified feature maps
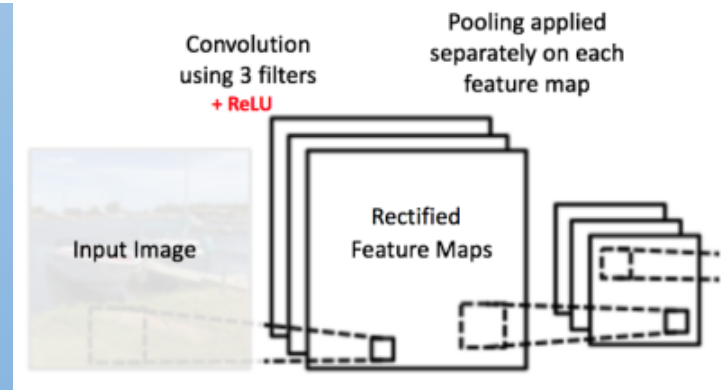
CNN concept

2D Convolution:

- Applying convolution + ReLU + pooling several times
- Pass output to a traditional Multi Layer Perceptron
- SoftMax output layer provides probabilities per classes

Convolution + ReLU   Pooling   Convolution + ReLU   Pooling   Fully Connected   Fully Connected   Output Predictions

Dog (0)
Cat (0)
Boat (1)
Bird (0)

$$E_{total} = \sum \frac{1}{2}(target - output)^2$$

Feature Extraction from Image   Classification