# Convolutional Neural Networks

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- Sometimes the local information are inportant, for example: images, speech etc.
- A further problem is that simple DNNs are not translation invariant

# Convolution

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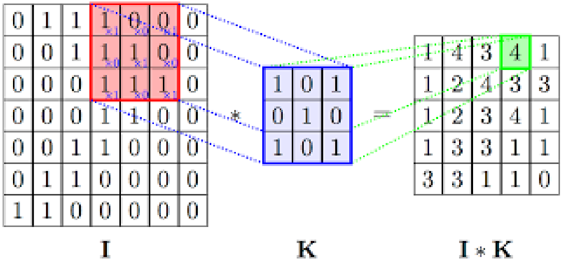

# Convolutional Neuron

- Each convolutional neuron (CN) processes data only for its small receptive field
- These CNs are convolved with the input, with the same weights (kernel)
- Each neuron has multiple output activation value
- CNs try to learn to recognize small local features and they are translation invariant as the are evaluated in every positions
- Two important parameters:
  **kernelsize** determines the size of its receptive field
  **stride** controls how the filter convolves around the input volume.

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- If we keep applying conv layers, the size of the volume will continue to decrease.
- To avoid this padding "pads" the input volume with some valuse around the border. (zero padding: padd with zeros)

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## Pooling layer

Pooling layer is also referred to as a downsampling layer. It basically takes a filter (normally of size 2 x 2) and a stride of some length. Pooling then applies it to the input volume and outputs some number (avg, max) in every subregion.

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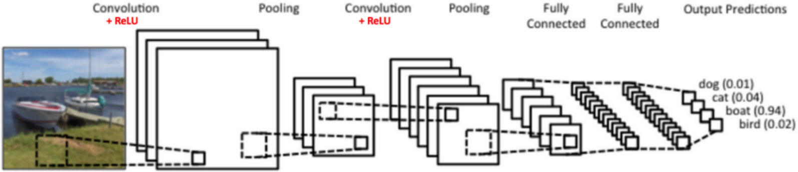
During training the optimizer needs to propagate the gradient trough this layer! To aid this, if max pooling is aplied the position of the max needs to be stored, as the gradient will propagate in its direction.

# CNNs

A traditional CNN structure consists of convolutional layers folowed by pooling layers, and at the end some fully connected layers:



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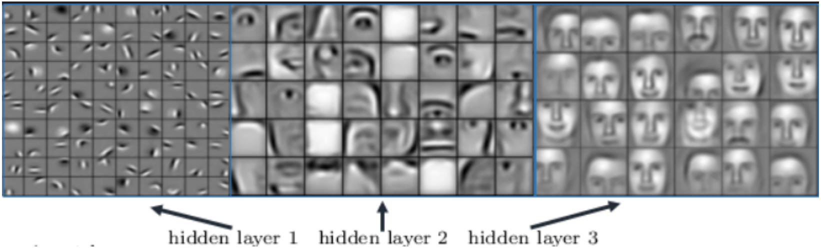
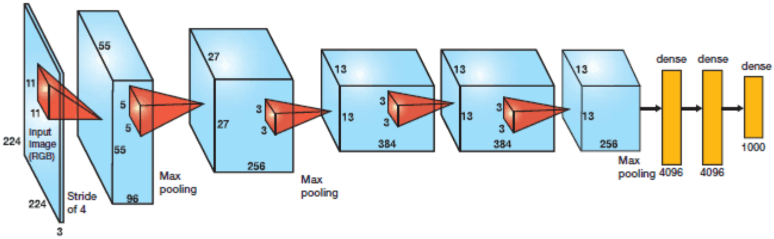
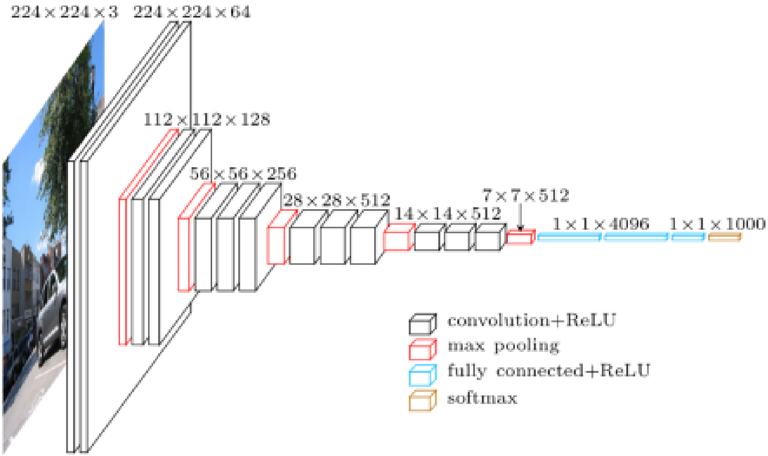


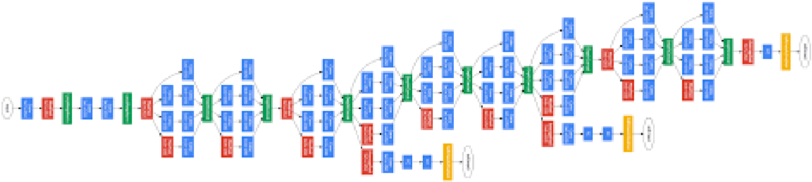
# Famous CNNs: AlexNet



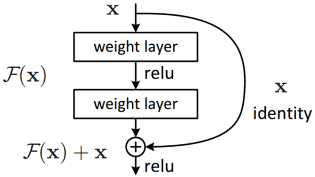
# Famous CNNs: VGG



# Famous CNNs: GoogLeNet



# Famous CNNs: ResNet




A residual block

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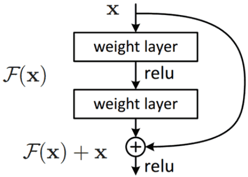


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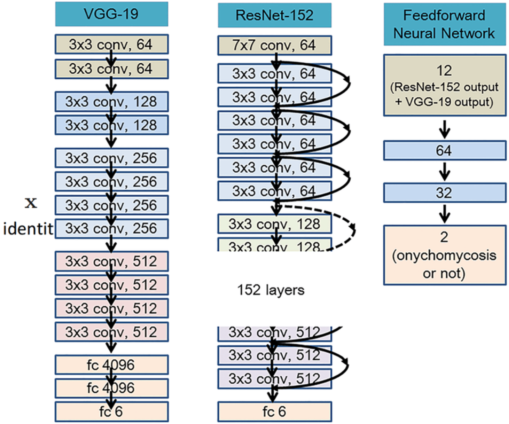

# Practice

Python tutorial: project_demo_en_colab.ipynb