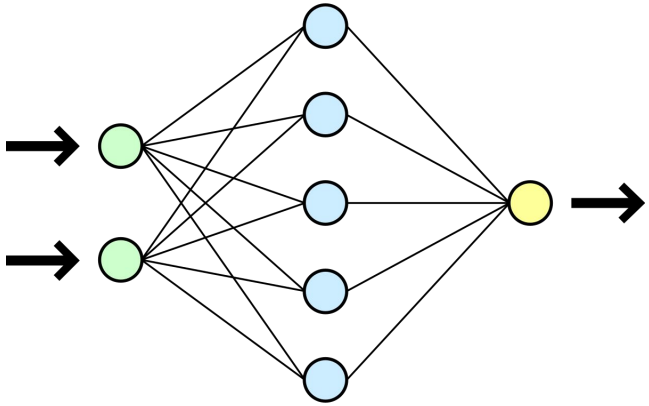

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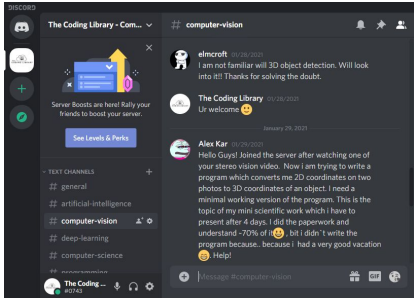
Neural Networks

Convolutional Neural Networks



Discord Link in Description

Recap of Artificial Neural Networks

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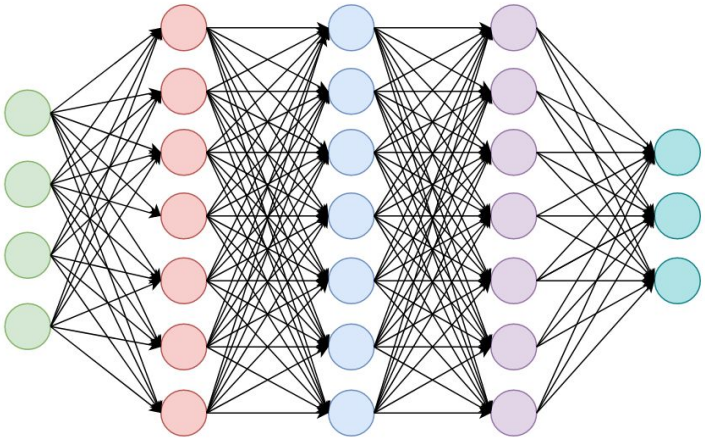
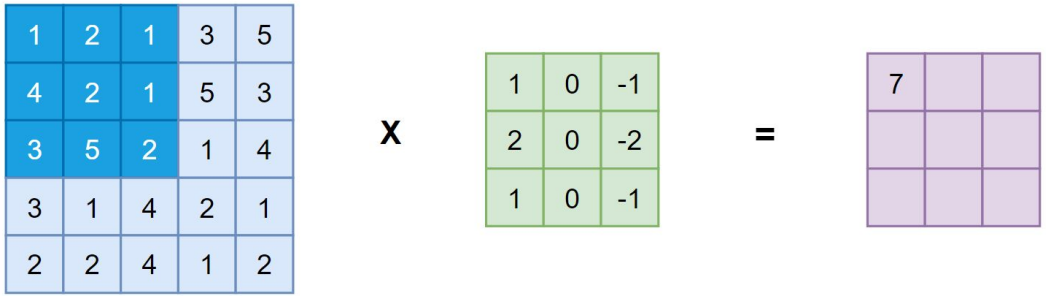
- Parameters in ANNs
- Classification / Regression
- Training process
- Elements in Neural Networks for optimization
- Created, trained and predicted with a ANN from scratch

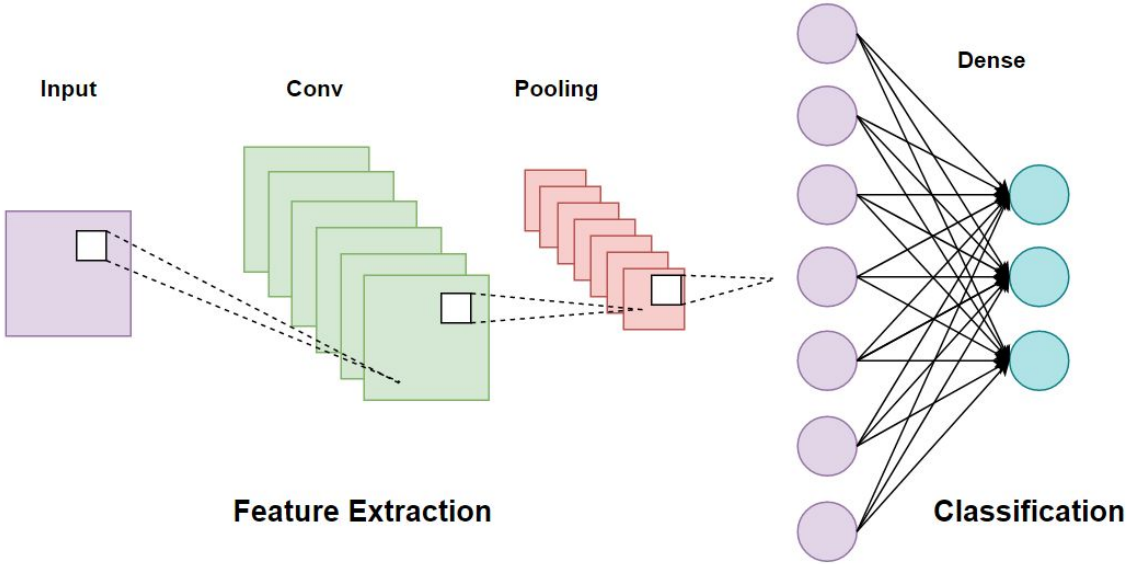


What is Convolution?

1. Overlay the filter on top of the image
2. Element-wise multiplication between values in the filter and the corresponding value in the image
3. Summing all products - Sum is the output value
4. Repeat for all locations - Column by column and row by row



Convolutional Neural Networks



Applications - Convolutional Neural Networks

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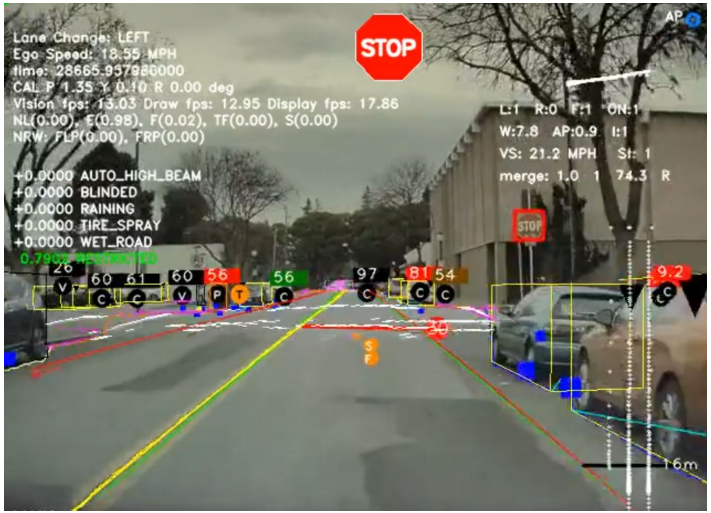
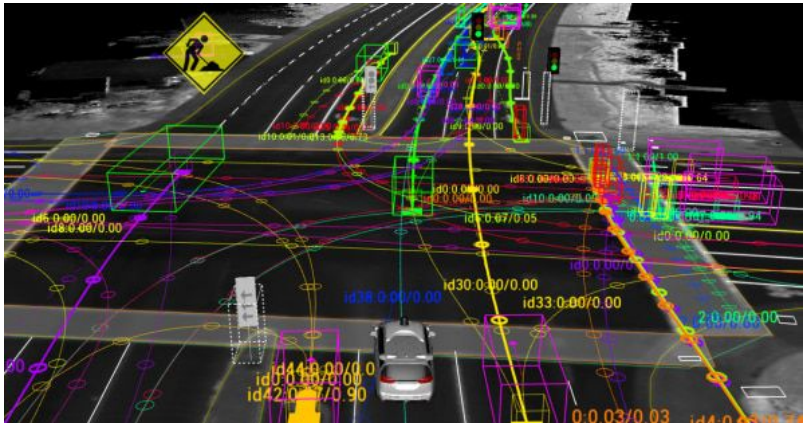
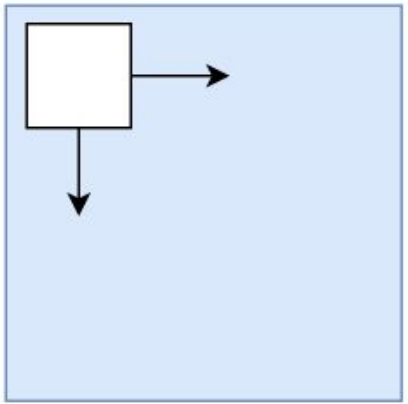
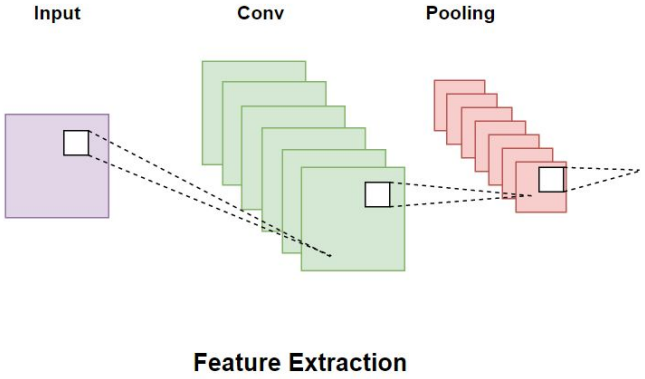




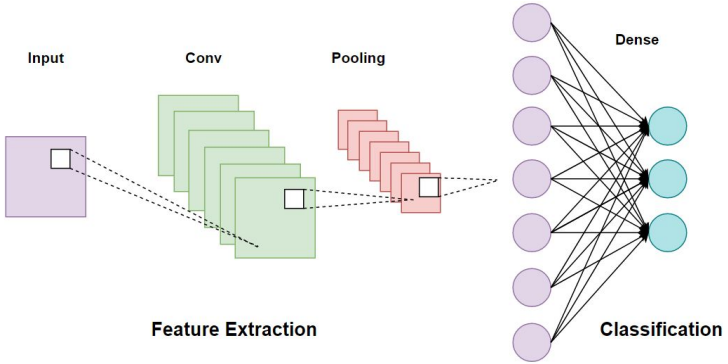
Layers and Filters in Convolutional Networks

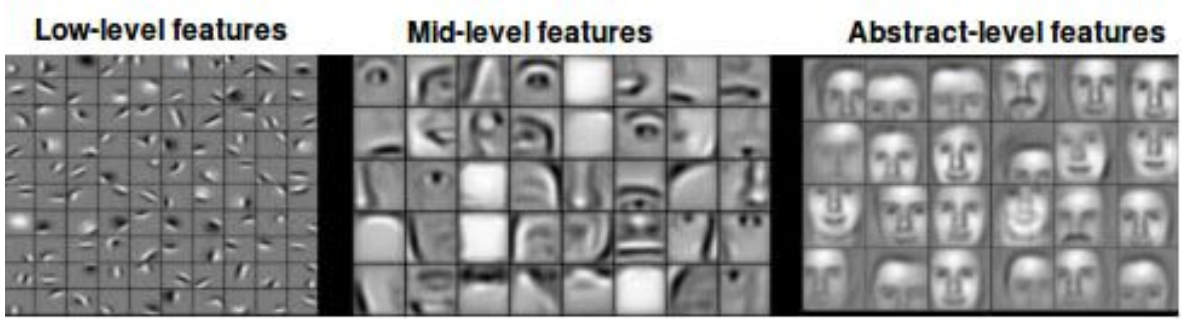




What does the CNN learn?

- Features layer by layer
- Different layers and parameters
- How to create a CNN?
  - How to specify parameters?
  - What layers to use?





Trainable Parameters in CNNs

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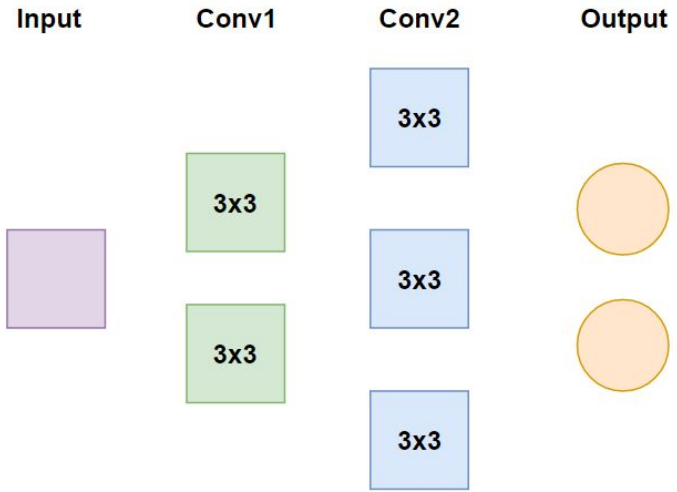
number of filters x (number of filters x size of filters) + biases



CNNs in Keras

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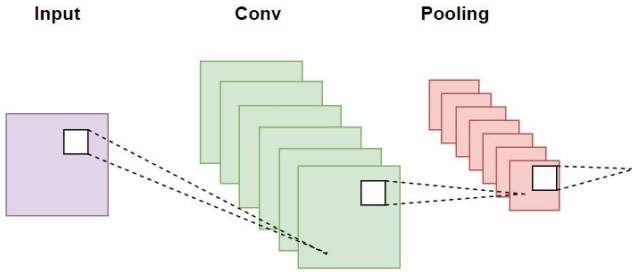
Conv2D class

```
tf.keras.layers.Conv2D(
    filters,
    kernel_size,
    strides=(1, 1),
    padding="valid",
    data_format=None,
    dilation_rate=(1, 1),
    groups=1,
    activation=None,
    use_bias=True,
    kernel_initializer="glorot_uniform",
    bias_initializer="zeros",
    kernel_regularizer=None,
    bias_regularizer=None,
    activity_regularizer=None,
    kernel_constraint=None,
    bias_constraint=None,
    **kwargs
)
```



Feature Extraction