# Vision in Human and Machine - Tutorial 1
# Simple and Complex Cells

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## 1 Gabor Filters and Simple Cells

### 1.1 Gabor Filters

The two-dimensional Gabor functions can be used to model the response properties of simple cells in the V1 area of the visual cortex. Take a look at the Matlab function `get_gabor` in the file `get_gabor.m` and analyze the code to understand it.

### 1.2 Computation of Simple Cell Responses with Convolution

1. Use the function `get_gabor` to generate a set of Gabor filter matrices, and visualize them using `imagesc`. Note that the result of get_gabor is a three-dimensional matrix, where the last index is the index of the gabor filter. Try out the parameters of `get_gabor` and investigate the resulting 2D filter maps, based on your choices.

2. Read in one of the images from the COIL100 database `(/vol/lehre/VisionHumanMachine/Coil100/pgm128)` into a 128x128 double matrix with maximal values of 1.0.
   `(e.g. a=double(imread('[...]/pgm128/obj1__0.pgm')./256)` Apply the two-dimensional convolution of the Gabor filters onto the image using the `conv2` function. Investigate the resulting response maps after the convolution for different choices of the Gabor filter parameters. Try out images of different objects;

## 2 Generating Complex Cells

Create a 'bar' stimulus image by defining `bar=zeros(128,128);bar(48:80,48:72)=1.0`. Compare the response of Gabor filters on the bar stimulus, when you vary the phase of the filters.

Using the output of two Gabor filters, build a complex cell that optimally responds to the bar. Optimal means here that there is unique peak of activity at the center of the bar and few activation in the surround. The complex cell should be invariant in the sense that there is no oscillation over space visible anymore, and there do not exist any other local maxima of response, except for the center of the bar.