Texture Features

We want to analyze the local frequencies (often referred to as texture) in a given image.

1. Compute the Gabor filtered image $G(\lambda, \theta, \sigma)$ for an image I given
   - the wavelength of the cosine factor λ,
   - the orientation θ,
   - and the standard deviation of the Gaussian kernel σ as

   $$g(x, y, \lambda, \theta, \sigma) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{x'^2+y'^2}{2\sigma^2}} \cos(\frac{x'}{\lambda}),$$

   where $x' = x\cos(\theta) + y\sin(\theta)$ and $y' = -x\sin(\theta) + y\cos(\theta)$. The pixels of $G(\lambda, \theta, \sigma)$ are then computed as the the convolution of the image with the kernel $g(x, y, \lambda, \theta, \sigma)$:

   $$G(x, y, \lambda, \theta, \sigma) = \sum_u \sum_v I(u, v) g(x - u, y - v, \lambda, \theta, \sigma)$$

2. Vary the parameters λ, θ, and σ and discuss the effects on the image.
3. Think of applications for the Gabor filter.