Written Assignment 1

1. Run GaussianBlurImage and SeparableGaussianBlurImage with sigma = 2, 4, 8 on "Seattle.jpg". How many seconds does it take to run each function? How long do you think it would take to run each with sigma = 32?

The time that run GaussianBlurImage and SeparableGaussianBlurImage will be different on different machines, but just make sure the calculation time on SeparableGaussianBlurImage will grow linearly and it will grow quadratically on GaussianBlurImage.

2. Which of the following filters are separable, i.e. can be computed from a combination of 1D horizontal and vertical filters? Why?

(a)   (b)   (c)   (d)
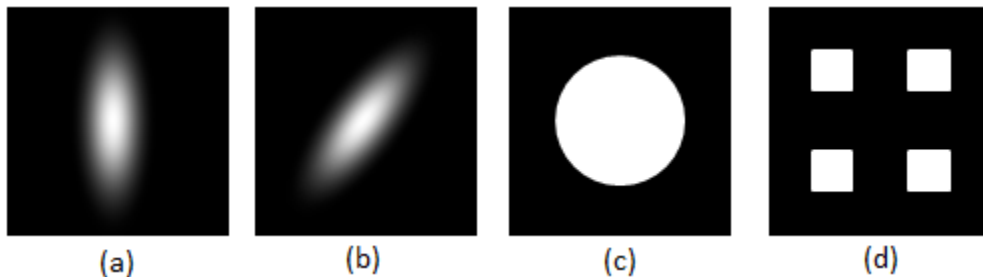
A filter is separable if it has rank 1, which means the rows of matrix are all linearly dependent of each other and could all be described as multiples of one identical row vector. Hence (a) and (d) are possible to form separable filters but (b) and (c) are not.

2. What is the best amount of blur to apply when downsampling Moire.gif by 8x (pressing "Half Size" 3 times)? Does downsampling "Seattle.jpg" require the same amount of blur?

There's no strict answer about the amount of blur applies to each image, but here is an example that makes sense:
Moire.gif: blur with sigma around 4
Seattle.jpg: blur with sigma round 1

Downsampling "Seattle.jpg" does not require the same amount of blur.

3. What is the best bilateral input values (sigmaS and sigmaI) for removing the jpg artifacts in "Seattle.jpg" without blurring the image's details?

Again, there's no strict answer in this question, but usually we'll apply small sigmaS and relatively larger sigmaI here to remove the jpg edge artifacts and keep details.

4. Can you find an edge in "TightRope.png" that is visible to the human eye, but does not have a strong response from the Sobel edge detector?

There are a few places meet this requirement, for example, the upper edge of the rising leg and part of the left rock wall.

5. If you rotate the image 20 times by 2 degrees, does it produce the same result as rotating the image by 40 degrees? If not, why?

The major difference is caused by the bilinear interpolation applied in each rotation step, the more times you apply rotation, the more blurry image you'll get.

6. If you apply blur before applying FindPeaksImage you can remove many noisy edges. What is the best amount of blur to apply to Gogh.png to find the "cleanest" edges? Does using BilateralImage to blur the image before applying FindPeaksImage produce better edges? In addition to answering these questions, please turn in your best peak edge image called "GoghEdge.png".

Generally Gaussian blur will work better in this case because it will only leave major edges while bilateral filtering will keep more seemly non-important edges. However, it is possible to tweak the parameters in bilateral filtering to make it just like Gaussian filtering. In this case, bilateral filtering could possibly perform better.