**Assignment 3:**

**Submission Instructions:** Please submit a .zip file named <your name>.zip containing 1) report named report.pdf including your answers to all required questions with images and/or plots showing your results, and 2) the python notebook provided, with the cells run and the relevant source code. If you include other source code files for a given exercise, please indicate it in the report.

**Problem 1. Separable Convolution**

Separable Convolution refers to breaking down the convolution kernel into lower dimension kernels. Show that convolution with a 2D Gaussian kernel is a spatially separable convolution, i.e. there are two 1D kernels if applied to the image row-wise and column-wise in sequence, it is equivalent to convolving that image with the 2D Gaussian kernel. Is Sobel kernel spatially separable? Why separable convolutions are preferred?

**Problem 2. Hybrid Images**

In this problem you will create hybrid images as described in [1]. You may find the tools in

**numpy.fft.\*; scipy.signal.convolve2d** useful.

Take two images, A and B, that you’ll want to have blend from one to the other. Try to make the objects in the two images occupy more or less the same region. Construct a hybrid image from A (to be seen close-up) and B (to be seen far away) as follows:

out = blur(B) + (A-blur(A))

Where blur is a function that low-pass filters the image. You should write your own blur function. You can use a Gaussian filter or try other blur filters, such as the box filter. Which one works best? Try different sigmas for the Gaussian. How does the amount of blurring affect your perception of the results?

In your report, please specify the type of kernel you used and its parameters. Also, attach your final result.

**Problem 3. De-hybridizing**

Examine the image einsteinandwho.jpg included with the assignment folder. Using the method of your choice, remove the individual represented in the low spatial frequency range to create two images: one of Einstein, and one of the other person. Please intensity scale the images using the provided function ***intensityscale*** to make them easier to see. Include both images in the report. You may want to try different methods to achieve the best two images. For fun: can you guess who is in the low spatial frequency image?

**References**

[1] Aude Oliva, Antonio Torralba, and Philippe G Schyns. Hybrid images. *ACM Transactions*

*on Graphics (TOG)*, 2006.