# 6.819/6.869 Problem Set 3

PSET SOLUTIONS

Mar, 2022

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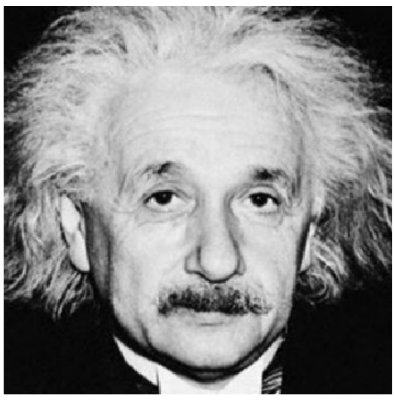
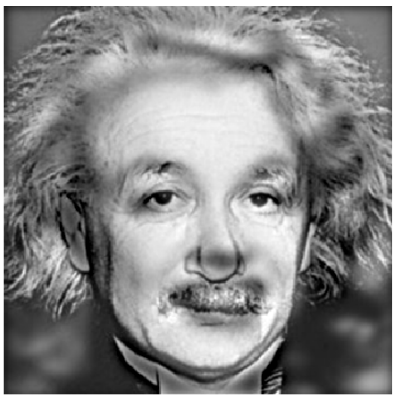
## Problem 1: Hybrid images



Einstein

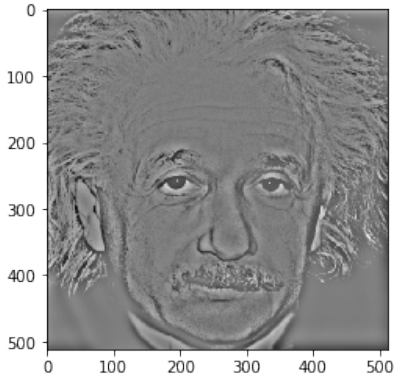
Monroe



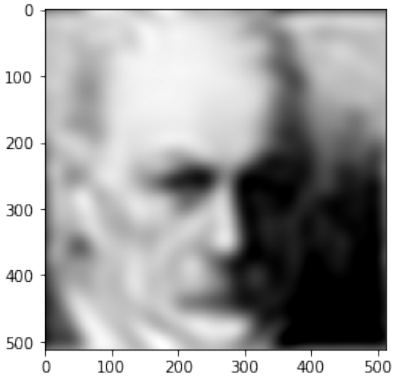
Hybrid

## Problem 2: De-hybridizing

The person hidden in the low spatial frequencies of the image is Sigmund Freud. The right figure shows a (rough) extracted version of Freud. The left figure shows the rest of the image, intensity-scaled. The code in `problem 2` computes the FFT of the original image, creates a Gaussian low-pass filter $G$, applies $G$ and $1 - G$ to the FFT'd image, and then computes the IFFT of the two results to get two images, respectively. The code also normalizes the intensity of the images to make them easier to see.




Just Einstein.

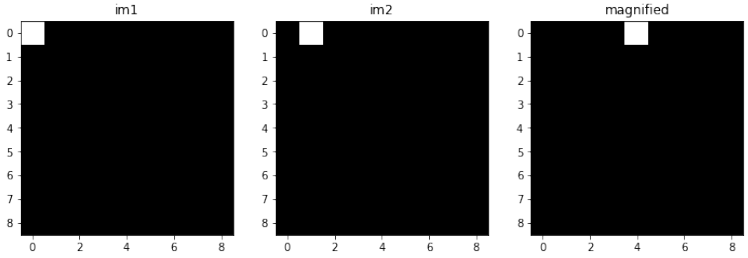



Extracted Freud.

Solution code can be found at `Problem 2`

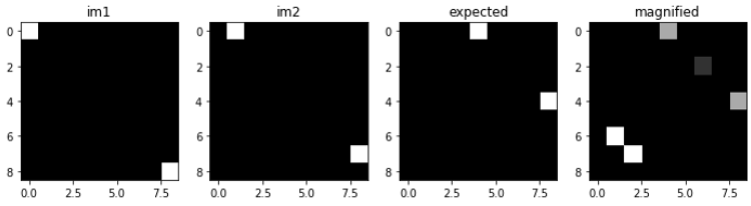
# Problem 3: Motion Magnification

(a) See appropriate lines in `magnifyChange`. Phase shift between images 1 and 2 is increased by the specified `magnification_factor`. After doing this and running `Problem 3.a`, the following plot is shown. The code successfully magnifies the horizontal offset between image 1 and image 2.



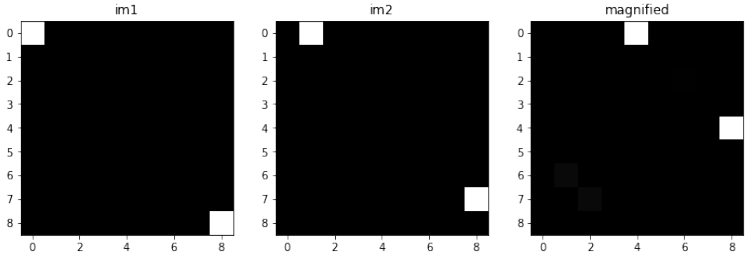

Magnifying the horizontal offset between image 1 and image 2

(b) ii)The magnified version does not look particularly great when naively magnifying the phase shift of the whole images when there is motion in two directions. In the magnified image we see the correct transformations in the top right but the wrong transformations in the bottom left. These squares in the bottom left of the magnified image came from vertically shifting up the square in the top left of image 2 and horizontally shifting right the square in the bottom right of image 2. Because of the periodicity of the Fourier domain, these two squares essentially wrapped around the edges of the image.




Problems arise when magnifying motion in two directions

(c) Motion in two directions is dealt by applying Gaussian filters to mask small windows of the image. Afterwards, the phase shift of each small window is dealt independently. After filling in the appropriate lines in `Problem 3.c` and running the code, the following plot is shown. Below is the sucessful magnification of the horizontal and vertical offsets between image 1 and image 2.

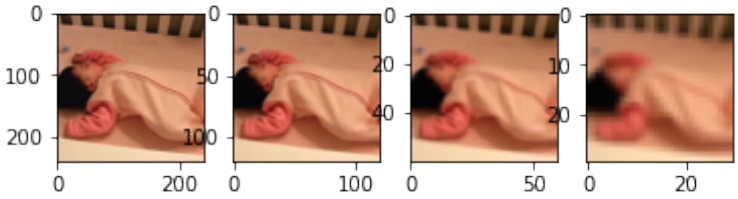



Using Gaussian filters to correctly magnifying motion in two directions

(d) Motion magnification is applied to a short video. See the completed code in `Problem 3.d`. See the video submission titled `bill_magnified.avi`.

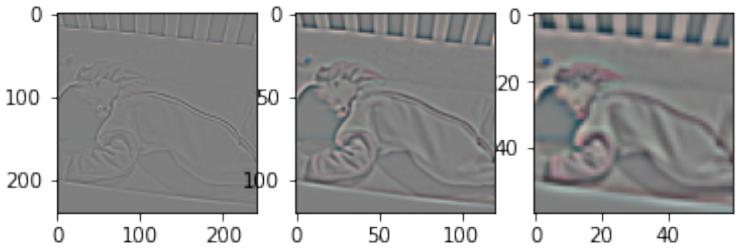
## (6.869 Only) Problem 4: Eulerian Motion Magnification

(a) The Gaussian pyramid consists of 4 levels:




Gaussian pyramid

(b) We have 3 levels for the Laplacian pyramid and the code for this problem in the notebook.




Laplacian pyramid