Instructions:

You can see the code for doing some basic MATLAB operations with images in the Implementation Notes section.

Each student is required to submit an individual report of the project.

Problem 2: (40 points, 2 pages max)

In this exercise, you will learn histogram equalization and apply it to correct the histogram of an image

Histogram equalization is done by applying a transformation on the original image that performs an integration on its probability density function. Please read through the histogram lecture slides(or the complete Stanford CS232 slides). You may also want to visit Digitial Image Processing, Gonzalez, Chapter 3(Histogram Equalization section)

P2.1: Take a random gray scale image from your own collection, read and display it in MATLAB and display its histogram. If you don't have a gray scale image, you can convert a color image to gray scale using MATLAB's rgb2gray function(See Implementation Notes).

Repeating the same procedure, pick 5 photos from your own collection, display their histograms and find one image with a problematic/skewed histogram. Describe what is wrong with its histogram.

We'll call the selected image with bad histogram as MyBadHist.

P2.2: Write code for contrast-stretching, and apply it to MyBadHist image.

P2.3: Assume that our MyBadHist image $f(x, y)$ only takes values from 1 to L, where L = 256. For l =1 to 256, calculate the probabilities

$$P_l = \frac{n_l}{n}$$

where n_l is the total number of pixels where $f(x, y) = l$

P2.4: Use the probabilities P_l to come up with a transformation $g = T(f)$ such that $g(x, y)$ has an equalized histogram. Plot the histogram of $g(x, y)$ and verify that the image renders more detail and contrast on display.

Find the minimum intensity value in the equalized image. Is it correct? Why or why not?

P2.5: Read the `'BayArea.jpg'` image given on course web page and display its

histogram. Apply both contrast-stretching and histogram equalization to this image.

Implementation Notes

MATLAB has an extensive help available online. If some MATLAB command is missing here, or for more details on any of these commands, you can use MATLAB's help at www.mathworks.com

```
f=imread('MyImageFileIn.tif');% Read an image file

imwrite(f,'MyImageFileOut.tif');% Write an image file

imagesc(f);colormap(gray);colorbar;% Display an image
imshow(f);% Display an image

hist(f(:),[0:255]);% Display histogram of the read image

grayimg=rgb2gray(colorimg);% Convert a color image to gray
scale

Filt=[0,1,0;1,0,1;0,1,0];
g=imfilter(f,Filt);% Filter an image f to produce g

F=fft2(f);
F=fftshift(F);
imagesc(abs(F))% Find 2D FFT F(u,v) of an image f(x,y)
 % Sometimes the dynamic range of FFT is too large, so you may
see one or two impulses only while actually there is more.  To
see such a FFT, use imagesc(log(abs(F))) to squeeze the dynamic
range.

fr=ifft2(ifftshift(F));
imagesc(abs(fr))% Find Inverse 2D FFT fr(x,y) of a 2D FFT
F(u,v)

surf(X,Y,Z)% Plot a surface Z = f(X,Y)

imhist(f) or hist(f(:))% Plot histogram of image f
```

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