IMPORTANT: In your report, you have to show the input images and all processed images. Add captions to your figures to make them self-explanatory.

Recommended resources:

- On-line manual on basic MATLAB:
  http://www.mathworks.com/help/matlab/index.html
- Image Processing Toolbox manual:
  http://www.mathworks.com/help/images/index.html

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Question 1 (10 Marks)

An8-bit image has a histogram given by $H(D)=1704sin(\pi D/255)$. Find a point operation that will flatten the image. You can assume continuous variables.

Question 2 (10 Marks)

Find a point operation (in tabular form) that will equalize a 3-bit image with the following histogram:

r_k	n_k
0	1028
1	3544
2	5023
3	3201
4	1867
5	734
6	604
7	383

Plot the both the original and the equalized histograms.

Question 3 (10 Marks)

Given a 3-bit image with the following histogram,

r_k	n_k
0	0
1	0
2	4096
3	4096
4	4096
5	4096
6	0
7	0

find a point operation (in tabular form) that will match it to the following histogram:

r_k	n_k
0	0
1	1365
2	2731
3	4096
4	4096
5	2731
6	1365
7	0

Plot the three histograms and comment on the output.

Question 4 (50 Marks)

a. Write a MATLAB function called `equalize` that implements the histogram equalization algorithm that was described in class. The function header should have the form:

```
function im2 = equalize(im)
```

where `im` is a `uint8` grayscale image and `im2` is the `uint8` output image. You can use any built-in MATLAB functions in your code except for `histeq`, which also does histogram equalization. A mark of zero (0) will be given if you use `histeq`.

b. Download images "`livingroom.tif`" and "`woman_darkhair.tif`" from the course webpage and process them with both `equalize` and `histeq` functions. Include a printout of the images before and after equalization with both functions in your report. Also include a plot of the histogram before and after equalization with both functions. Comment on the outputs.

Question 5 (20 Marks)

Download image "`lena_gray_512.tif`" from the course webpage. Corrupt the image by adding salt & pepper noise with densities 5%, 10%, and 20%. Process the three corrupted images with 3×3 and 5×5:

    i.   Median filter.

    ii.   Smoothing average filter.

Comment on the results.