EE168 **Lab/Homework #3**
Introduction to Digital Image Processing Handout #9

In this assignment, we are going to stop using the automatic scaling feature of Matlab and start using our own code to select the range of brightness in the display. We will be using the Matlab call 'image' rather than 'imagesc', which does the automatic scaling.

For all the problems on this assignment, use the following steps to display the images on the screen. First, create an array containing your image with values ranging from 0 to 255.

Step 1. Create a colormap with 256 elements. First, create a vector using the 'linspace' command and store its transpose in a vector, which here we will call 'v':

```
v = linspace(0, 1, 256)';
```

Now load this as the colormap using:

```
colormap([v v v]);
```

Step 2. When you are ready to display an image in an array a, load it into an array and call the 'image' routine as

```
image(a');
```

Following this with the call axis('image') sets the axes properly for an image.

This code expects the input data array to be scaled from 0 to 255 to fill the full range of the display.

Problem 1 - Image stretching.

Download the file lab3prob1data from the class web area. The line length is 540 bytes.

i. Display the image using the steps shown above. Print the 'raw' image and comment on its brightness and contrast.

ii. Plot a histogram of the image. Although Matlab has a histogram function, write your own code to calculate the histogram. What are the mean and standard deviation of the image as recorded on the disk ?

iii. Derive a transformation that yields a mean of 128 and a standard deviation of 80 for the processed image. Stretch the image according to your transformation and print it. Make sure you account for pixels falling "off the ends" of the distribution. Submit the processed image, and also a plot of the new histogram.

Problem 2 - More stretching.

Reread the data from problem 1 for each part of this problem.

i. Stretch the image for mean brightness of 80, standard deviation 80. Print and submit electronically.

ii. Stretch the image for mean brightness of 80, standard deviation 120. Print and submit electronically.

iii. Stretch the image for mean brightness of 160, standard deviation 120. Print and submit electronically.

iv. Stretch the image for mean brightness of 160, standard deviation 80. Print and submit electronically.

v. Which of the above stretches, including the one from problem (1), is the most visually pleasing ?

Problem 3 - Equalization stretches.

Read in the data from problem 1 again. Calculate an approximate equalization stretch for the image. Note: due to the quantization of the image levels, you will not be able to achieve a perfectly flat histogram. In fact, it will have large 'holes' and 'spikes' in it. Submit the stretched image and its histogram.

Problem 4 – Nonlinear stretches

Read in the data file “lab3prob4data”. This image is also 540 by 173 bytes, and resembles the previous image.

i. Create a new image in which each pixel is raised to a power 1/2 (that is, take the square root). First scale the image to lie between 0 and 1, raise the pixel to the desired power, and scale back to 0-255. Display and submit the new image.

ii. Repeat (i) for a power 1/3, or a cube root.

iii. Repeat (i) again, with the power 0.2. Which of the three images is most pleasing to your eye, and why?