EE168 **Lab/Homework #2**
Introduction to Digital Image Processing Handout #5

Problem 1 - Image scaling.

i. Start matlab, and read in the byte image rodin.raw from the website. Determine the line length and display the image using *imagesc* and *axis* commands. Record the image size.
ii. Scale the image by factors of 2, 3, and 4, interspersing zero rows and columns between known data points. Comment on the appearance of the image as it is scaled up. *Note: The way your computer screen renders the image might make it appear as if the zero rows and columns are not evenly spread throughout the image. Use the zoom function in the figure window so that you may see the actual pixels at full resolution and confirm that the scaling is correct.*
iii. Create scaled images using a zero-order hold for the above zoom factors. Plot a couple of cuts through features in the zoomed images and describe the shape of the features as the image is zoomed.
iv. Now zoom each using a first-order hold, and compare to the results in part (iii). Redo the cuts along the same locations and compare the shape of the features.

Problem 2 - Rotations.

i. Re-open the rodin.raw image.
ii. Rotate the image by 45 degrees, 100 degrees, and 670 degrees, and display/submit. Write your own code for rotation rather than using the built-in matlab rotate commands.

Problem 3 - Subtracting to get image change.

i. Read in the byte files lab2prob3data1 and lab2prob3data2 from the class data directory. Determine the line length and display the images.
ii. Compare the two images and note any differences.
iii. Subtract the second image from the first and display the difference to highlight any changes in the image. What parts of the image are highlighted, and why ?

Problem 4 - Image inversion.

i. Open the image lab2prob4data from the class web site, and display.
ii. Calculate the negative (inverse) of the image and display/submit.
iii. Describe the visual appearance of the final result and speculate how this might be used in some practical application (science, movies, etc.)

Problem 5 – Image subsetting, translation, and addition

For your friend's surprise birthday party next week, you want to quickly create a fun banner for the Facebook event. You decide that you can use techniques from EE168 to subset (cut out) a picture of her face and replace all faces in another picture with hers!

i. Choose an image of a group of people from the internet or from your personal library. Load this image into matlab. You can use the function *imread* to read in a ".jpg", ".tif", or ".png" as a 3D matrix. For simplicity, convert the image to grayscale using the function *rgb2gray*.
ii. Subset (that is, cut out of the original image) a portion (ex. someone's face) and display it as its own image.
iii. Write a matlab function that takes in two grayscale images and a set of coordinates as inputs, and places the smaller one on top of the larger one at the given set of coordinates. You can either put this function in a new ".m" file or at the bottom of your homework script. For more information about matlab functions, see: https://www.mathworks.com/help/matlab/matlab_prog/local-functions-in-scripts.html
Note: in general, writing image processing operations (like scaling or image subsetting) from these labs as functions will be useful for your final project.
iv. Use the function you just wrote to insert the piece of the image you have cut in part (ii) back into the original image in at least three different locations. Display and submit. (Optional helpful extension: to make it easy to choose coordinates, explore using the ginput function).
v. Write a new function (or modify your old one) to again place a small image into a larger one at a given set of coordinates, but this time blend the subset image with the background image by adding the two pixel values together and dividing by two in the regions of overlap. Submit an example of this function in action.
Note: later in the quarter we will learn about "morphing", a more interesting way to blend two faces.

Problem 6. An unknown format.

You are participating in the Seti@Home experiment, where you use your personal computer to decode possible messages from extraterrestrial beings. You find on your computer one morning a strange file, which you copy to the class directory so that the 168 class can decode the message. Hence the class directory now contains an image entitled lab2prob6data in an unknown format. It contains a special header at the beginning of the image and a special trailer at the end of the image. It may or may not contain header information on each line. Your mission is to find the image that is being sent to Earth, to see who is trying to contact Earth. Decode and submit the image in a pixel/line raster format with the extraneous data removed.