Homework #1
Due Tu. 9/15

Be sure to show all your work for credit. You must turn in your code as well as output files (**code attached at the end of the report**).

Please generate a report that contains the code and output in a single readable format using Latex.

0. Getting Started

   (a) Install Latex on your machine for writing your report. Windows users can download MiKTeX. Generate your report using the article class. Many tutorials exist like `http://www.latex-tutorial.com/tutorials/`.

   (b) Download the "standard" test images from the Gonzalez and Woods website. `http://www.imageprocessingplace.com/root_files_V3/image_databases.htm`

   (c) Download the sample images from the class website. `http://www.ee.unlv.edu/~b1morris/ecg782/hw/hw01`

1. Histogram Equalization

   (a) Write a function `hist_eq.m` that performs histogram equalization on an intensity image. The function should take as inputs an intensity image and the number of gray level value bins. Create a separate m-file for this function.

   (b) Perform histogram equalization on the jetplane image using 256, 128, and 64 bins. Compare the original image and the histogram equalized images by plotting the corresponding histograms and images side-by-side in a 2×2 subplot matrix.

   (c) Perform the equalization in 32×32 blocks. Display the output image. You will find `blockproc.m` useful.

2. Basic Morphology

   (a) Threshold the image `SJEarthquakesteampic.jpg` to detect faces. Be sure to describe how you obtained your threshold. You may find this is easier in another colorspace such as HSV.

   (b) Use morphological operations to clean the image. Count the number of players in the cleaned threshold image.

   (c) Create an output image that has a bounding box around each face. Use `regionprops.m`. In your report, create an output figure with three images in a row. (a) is the face threshold image, (b) morphologically cleaned image, and (c) the color image with bounding box around face areas.

(Extra) Repeat for `barcelona-team.jpg`. Explain the differences you found.

3. Filtering

   (a) Consider image `DSCN0479-001.JPG` as a perfect image. Add white Gaussian noise with variance 0.005. Smooth with a 3×3 and 7×7 box filter and a median filter. Compute the mean squared error (MSE)

$$MSE = \frac{1}{MN} \sum_m \sum_n (I_1(m,n) - I_2(m,n))^2$$

and the peak signal-to-noise ratio (PSNR)

$$PSNR = 20 \times \log_{10}(255/\sqrt{MSE})$$

for the noise reduced images. Compile results using a Latex Table. Which filter has the best results based on the error measures? How do the results compare visually?

(b) Repeat (a) with salt and pepper noise with noise density 0.05. Compile results using a Latex Table.

(c) Do the filtering again but this time on a real noisy image `DSCN0482-001.JPG` obtained at higher ISO. Compare the results visually only this time. Which filter works best for "real" noise? How much time does each type of filter require (use `tick.m` and `toc.m`)?