198:334 Digital Imaging and Multimedia
Fall 2016

Assignment 2
Due Date – online Sunday October 16, 2016 at 5pm.

- You need to create a report where you put all your results (use MS word or other word processors). Make sure to put all the images you created (whenever the assignment says "print" or "plot" something, it means to include it in the report), and the codes you written in that report.

- Submit the electronic copy through Sakai. In the electronic copy, besides submitting the report file, also submit all the codes you wrote.

- *Late submission policy:* 10% of the grade for each day late.

Install the current version of ImageJ on your computer and make yourself familiar with the built in functions (open, convert, edit, and save images, etc.)

[Q1 - 15pts]

a) Develop an ImageJ plugin that uses the Java methods Math.random() or Random.nextInt(int n) to create an image with random pixel values that are uniformly distributed in the range [0,255]. Analyze the image's histogram to determine how the pixel values truly follow a uniform distribution.
b) Repeat the above question with a Gaussian distribution with mean =150 and standard deviation = 50 (use Random.nextGaussian() with appropriate scaling). Print the images and histograms for both cases.

[Q2 - 10pts]

Write an ImageJ plugin that count the number of pixels of a given color. Use this plugin to count the number of pixels with pure red (255,0,0), pure green (0,255,0), pure blue (0,0,255), white (255,255,255), and black (0,0,0) in an input image. Test your code

on your selfie photo and report the result. Test your code on the image shapes.png and report the result.

[Q3 - 25pts]
Take a selfie with your cell-phone camera of your face and download it to your computer.

a) Use ImageJ to plot the R,G,B component histograms, as well as the luminance histogram.
b) Comment about the image defects that you can notice from these histograms, including problems with contrast, exposure, dynamic range, and compression effect.
c) Convert the original image to gray-scale image by applying the transformation (R+G+B)/3, then apply a gamma function to your image, with gamma = ¼, ½, 2, 4; in each case visualize and print the resulting image (you can use the gamma correction code in Program 4.4).
d) Since in any visualization or printing of the resulting images, the display and the printer perform their own gamma transformation, which of the images you think gives the most faithful visualization of what stored in the file (prior to the display/print transformation).

[Q4 - 25 pts]
In this question you are going to use the gray-scale version of your selfie photo that you generated in the question Q2:
a) Add a Gaussian noise with mean 0 and standard deviations 5,15,25 to the image. This can be done by adding a random number generated (as in Q1) from a proper Gaussian distribution to each pixel. Visualize and print the resulting 3 images and the original image. Visualize and print the histograms of each of these 4 images. Comment on the effect of adding noise on the histogram of each of these images.
b) Apply a Gaussian Filter to each of the 3 noisy images you generated in part A. Visualize and print the resulting images and their histograms. Repeat this process with different size Gaussian filters: 3x3, 5x5 and 7x7. In each case write down the filter coefficients that you used and include the resulting images.

[Q5 – 25pts]

a) Implement the histogram specification using a piece-wise linear reference distribution function, as described in Sec.4.6.3 in the book *Digital Image Processing*. Define a new object class with all necessary instance variables to represent the distribution function and implement the required functions $P_L(i)$(Eqn.(4.23)) and $P_L^{-1}(b)$(Eqn.(4.24)) as methods of this class.

b) Test your code on the gray-scale version of your selfie photo that generated in Q2, and the following piecewise linear reference distribution: L=((0, 0.1),(50,0.15),(110,0.3),(170,0.7),(220,0.95),(255,1)). Print the histograms of original image and output image.

[Q6] This is a continuation of Q6 in Assignment 1. Please enter the data points you obtained in the following shared spreadsheet.

https://docs.google.com/spreadsheets/d/1u5guf4j8CMtum21mhq0fqYeA5pNW3wC4cXtm10muCP4/edit?usp=sharing

You are not allowed to enter new data points at this time, only the ones that you already included in your assignment 1 report should be entered here.