**CS 378H Honors Machine Vision**
**Spring 2017**

**Assignment 0**
**Out: Tues Jan 17**
**Due: Friday Jan 27 (11:59 PM)**

The goal of this warm-up problem set is to become familiar with basic Matlab commands, practice manipulating vectors and matrices, and try out basic image display and plotting functions. If you are unsure what a function does, at the command line, type '`help`' and then the command name.

## I. Using Matlab [75 points]

1. Read over the provided Matlab introduction code and its comments. Open an interactive session in Matlab and test the commands by typing them at the prompt. (Skip this step if you are already familiar with Matlab.)

2. Describe (in words where appropriate) the result of each of the following Matlab commands. Use the `help` command as needed, but try to determine the output without entering the commands into Matlab. Do **not** submit a screenshot of the result of typing these commands.

```
a. >>  x = randperm(12345);

b. >>  a = [1:2:30; 3:2:31];
   >>  b = a(2,:);

c. >>  f = randn(25,1);
   >>  g = f(find(f > 0));

d. >>  x = zeros(1,500)+0.5;
   >>  y = 0.5.*ones(1,length(x));
   >>  z = x + y;

e. >> a = [1:100];
   >> b = a([end:-1:1]);
```

3. Suppose you are given a 100 x 100 matrix `A` representing a grayscale image. Write a few lines of code to do each of the following. Try to avoid using loops.

    a. Plot all the intensities in `A`, sorted in increasing value. (Note, in this case we don't care about the 2D structure of A, we only want to sort all the intensities in one list.)

    b. Display a histogram of `A`'s intensities with 16 bins.

    c. Create and display a new color image the same size as `A`, but with 3 channels to represent R G and B values. Set the values to be bright red (i.e., R = 255) wherever the intensity in `A` is greater than a threshold `t`, and black everywhere else.

    d. Create a new image X that consists of the bottom left quadrant of `A`.

e. Generate a new image, which is the same as A, but with A's mean intensity value subtracted from each pixel.

f. Use rand to write a function that returns the roll of a six-sided die.

g. Let y be the vector: `y = [1 2 3 4 5 6]'`. Use the reshape command to form a new matrix z that looks like this:

$$z = \begin{bmatrix} 1 & 3 & 5 \\ 2 & 4 & 6 \end{bmatrix}.$$

h. Use the `max` and `find` functions to set x to the maximum value that occurs in A, and set `r` to the row it occurs in and c to the column it occurs in.

i. Let v be the vector: `v = [1 8 8 2 1 3 9 8]`. Set a new variable x to be the number of 8's in the vector v.

## II. Short programming example [25 points]

Write functions to do each of the following to an input grayscale image, and then write a script that loads an image, applies each transformation to the original image, and displays the results in a figure using the Matlab `subplot` function. Label each subplot with `title`.

Apply the script to an image(s) of your choosing, and show us the results.

a) map a grayscale image to its "negative image", in which the lightest values appear dark and vice versa.

b) map the image to its "mirror image", i.e., flipping it left to right.

c) swap the red and green color channels of the input color image

d) average the input image with its mirror image (use typecasting!)

e) add or subtract a random value between [0,255] to every pixel in a grayscale image, then clip the resulting image to have a minimum value of 0 and a maximum value of 255.

**Matlab tips**: Do the necessary typecasting (`uint8` and `double`) when working with or displaying the images. Some useful functions: `title, subplot, imshow, mean, imread, rgb2gray` (converts a color image to grayscale). Again, try to avoid using loops.

## Submission instructions:

What to submit:

- Your responses and code snippets for Part I.
- Documented code for Part II, and a screenshot of the results with your image(s)

How to submit: **electronically** on Canvas:

- Compress all the files (code, writeup with images) into a zip file
- Log into Canvas
- Click "Assignments" on the left, and select the appropriate assignment.
- Upload the zip file.