COSC 190: Class Exercise 1
Matrices, Images, and Matlab
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1. **Matrices:** A matrix is a rectangular array of numbers as defined in class.
   Given the matrix defined in matlab: `>> A = [1 2 3; 4 5 6]`,
   (a) What is the size of the matrix A? How many rows and columns? How can you use Matlab to determine the size?
   (b) Using matlab code, in one command, extract the first row of the matrix A and output it. Do the same for the third column.
   (c) In one command, square every entry in the matrix A and output it.
   (d) In one single Matlab command, add a third row to the matrix A with entries 7, 8, and 9.

2. **Color Image Viewing and Manipulation:** Load in the 'marbles.jpg' image into the Matlab workspace. You can find the image on my website: `www.fredpark.com/teaching`
   (hint: use the command `>> f = imread('marbles.jpg');`)
   (a) Use the command: `>> figure(1); image(f);` to view the image and add the title "Color Image" to it.
   (b) Using specific matlab notation, extract the red, green, and blue channels from the color image respectively.
   (hint: you can try using `>> R = f(:,:,1);` to extract the red channel. What does the ':' notation represent?)
   (c) Use the matlab subplot environment to plot both the image and the R, G, and B channels in the same figure. Use a Matlab script to do so. Make sure to title each of the channels in the subplots.
   (d) Now, manipulate the color image f by blacking out the red and green marbles so that only the blue marble is viewable. You can set the side of the image containing the red and green marbles to a pixel intensity of 50. Now view the image and you should only be able to see the blue marble.

3. **Explain in Your Words:** Explain in words what the key issue is with color constancy in images. i.e. what is the issue with the computers color sensing under differing illumination conditions? Is the human system better or worse?

4. **Retinex Revisited:** Using the transformation from the first day of class to linearly re-map the min and max values of f to 0 and 255 respectively.
   (a) (optional) For you advanced students, you can create a coefficient matrix A and write the problem of finding α and β from $y = \alpha x + \beta$ as a 2×2 system $A\vec{x} = \vec{b}$ where $\vec{x}$ contains α and β and you can figure out what $\vec{b}$ contains. You can solve for $\vec{x}$ by using the simple matlab command for Gaussian Elimination: `A\b`
   (b) Histogram viewing. Use the "hist" definition from class to view the histogram distribution of the image intensities for both the original image and the one you adjusted the contrast on. What do you notice?
   (c) Are the high intensity values sparsely distributed?
   (d) Can you think of a way to increase the contrast of the shirt? It seems a bit dark still in the contrast adjusted image? Hint, find a way to neglect certain high intensity values so you can boost the next set of intensities.