Math 354 Mathematical Modeling
Preliminary Matlab Coding Exercises
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Part I

1. Work through the matlab tutorial.
2. Plot your favorite function using matlab.
3. Write a function handle f for a quadratic polynomial. Plot the polynomial. What's the difference between a function and a function handle?
4. What is the difference between a row vector and a column vector? Can you change one to the other and vice versa? How so?
5. Write down an example of a matrix. How is the sizing of the matrix determined? Write down a 2×3 matrix A.
6. If I want to square all the elements in the matrix A you just created above, how would I do so?
7. What's the difference between the $.*$ and $*$ operator when multiplying two vectors? Are they the same? i.e. does $x.*y = x*y$ for any two vectors? Why or why not?

Part II

1. Write a "for" loop that outputs each number from 1 to 10.
2. Write a "for" loop that sums the numbers from 1 to N, where N is input chosen by the user.
3. Write a "for" loop that takes a product of the numbers from 1 to N, where N is input chosen by the user.
4. Repeat 1, 2, and 3 using a "while" loop.
5. Sum all of the numbers from 1 to 100 in two different ways. Using your code. And then by adding two appropriately chosen vectors and then summing the entries.
6. Type "help randi" at the matlab prompt. Can you think of a way to create the coin flip probability experiment with 2 coins using this function? How's about the 4 coin flip experiment? Write out pseudo-code for this experiment.
7. Write a script that uses the randi function and calculate the probabilities for the coin flip problem with 2 coins, 4 coins, and N coins. Here, N is input by the user.
8. Write a script that prompts the user to enter an integer and you output whether the number is a prime or not.
9. Write a script that outputs the first 100 primes.

Part III

1. Plot the paraboloid $z = x^2 +' y^2$ in 3 dimensions in the domain $[-5, 5] \times [-5, 5]$. Use the help function to find out what 'meshgrid' and 'surf' mean. This will be useful.

2. Plot your favorite surface in 3 dimensions.

3. load the cameraman image in matlab by typing the obvious 'f = imread(cameraman.tif)' into the console. If your computer does not have the image, you can download it from my webpage. You can view this by typing: 'image(f); colormap(gray(256))'

4. Note, the cameraman image is a grayscale image. Describe what this is exactly?

5. Load in the 'cameraman.tif' image and call it f. It is clearly a grayscale image of size 256×256. Downsampling is the methodology of reducing the resolution and hence, the size of an image. Create a set of 3 images obtained from the original cameraman image called f_1, f_2, and f_3 by downsampling where they are of sizes 128×128, 64×64, and 32×32 respectively. Note, the downsampling operator is called decimation since you are essentially tossing out image information when creating a smaller image.

6. By what factor are you downsampling when you go from a 256×256 image to a 128×128 one? i.e. what factor of less pixels do you have after the downsampling?

7. Create a 2×2 subplot and view all four images clearly labeling each plot and the factor of downsampling.

Part IV

1. What is a color image? Load the factory.jpg image into the console from my webpage. You can view this by typing 'image(f)'.

2. Make the cameraman image a color image, i.e. 3 channel image by embedding it into a $256 \times 256 \times 3$ array using the command 'repmat' and view it by typing 'image(f)'. Note, once it is a color image, you do not need to specify the colormap as you did when it was a grayscale one.

3. Load the 'fish.png' image from my webpage and call it f. It is an RGB color image with 3 channels. It is a stunning image with vibrant colors. In particular, the abstract fish is a nice blue color. Shuffle the channels so that you can make the fish into a beautiful pastel purple color and the surrounding non-fish circles into varying shades of green.

4. Write code that outputs all the different combinations of the shuffled channels of the fish image. You can use a loop and the 'pause' command so that each combination is shown after the user presses a key. What is the most visually stunning combination?

5. Histogram equalize the 'pout.tif' image (note: this is an actual Math 354 student after the midterm exam). You can do this by remapping the lowest intensity range to 0 and the highest intensity range to 255 linearly. This will automatically adjust the contrast for values in between the low and high. To start, you will need to find a linear function $f(x) = \alpha x + \beta$ such that f(low) = 0 and f(high) = 255 where 'low' is the lowest intensity in the image and 'high' is the highest. Solve for α and β then apply f to the entire image to equalize the histogram.

6. Histogram equalize the 'factory.jpg' image as well by doing so channel by channel.

7. Find a low light photo selfie of you or of you and some friends and histogram equalize it. Best ones will be shown in class.