

COEN 45, MATLAB Programming  
Winter Quarter, 2011

Lab assignment #1  
Random numbers  
Jan. 11, 12, 13, 2011.

This assignment will give practice in using some of MATLAB's built-in commands. You will first use them in the Command Window and then when you have gotten satisfactory results, you will create a script that does all parts of the assignment. (The first line of any script should be `clear; close all`.) Where you are asked to explain some result, you can either enter your explanation as comment lines in your script or you can hand write it on your printout. Hand write your name on all printouts and submit them to the lab instructor.

In these assignments, I have hinted at built-in MATLAB commands that can be used. It's your job to consult the help text for these commands to learn what they do and how you use them.

1. Is your student ID a prime number? This exercise will give you an idea of how we use MATLAB's built-in functions and how we use the "help" facility to learn how they work.
  - (a) Store your student ID number in a variable called `id`. Notice what happens if you enter leading zeros.
  - (b) What is MATLAB's response when you try to raise your student ID to the 99<sup>th</sup> power? How about when you try to raise it to the negative 99<sup>th</sup> power? Explain each result.
  - (c) Find out whether your student ID is a prime number.<sup>1</sup> Can you tell just by looking at it? Hint: `isprime`. Hint: in MATLAB, true/false results are shown as 0 or 1.
  - (d) Find the prime factors of your student ID (hint: `factor`). Store the result in a new variable called `idfact`.
  - (e) If your ID is not prime, `idfact` will be a *vector* (a list of numbers). How many prime factors does your student ID have? Hint: `length`.
  - (f) Verify that if you multiply all the prime factors together, you get back your student ID (hint: `prod`).
2. An exercise with pseudo-random numbers.
  - (a) Initialize the pseudo-random number generator using your student id. Type `rand('twister',id)` which initializes the random number generator. Don't omit the quote marks.

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<sup>1</sup>A number that is evenly divisible only by 1 and itself, such as 2, 3, 5, 7, 11, 13

- (b) Generate an  $100 \times 1$  column vector filled with randomly selected integers from 1 to 10. If you have the R2008 or R2009 version of MATLAB you can use `r=randi(10,100,1)`. If you have R2007 you must use the expression on p. 73 of your text, `r=round(9*rand(n,1)+1)`.
  - (c) Generate a histogram showing the distribution of numbers that you got. Type `hist(r)`. A plot will appear. Generate a new set of numbers and a new histogram. Do this several times.
  - (d) When you have completed this, label your plot it with something like `title('Histogram by John Smith, ID 123456')`. Print a copy of the plot to be handed in as part of this lab.
  - (e) Type `r` to see the 100 numbers that you got. Then type `r'`. What is different about the way MATLAB displays your numbers when you type `r'`?
  - (f) Repeat steps (b) and (c) generating 1,000 numbers rather than 100. Type `figure` to open a new plot window, then make a new histogram. Repeat several times. What is different about this series of histograms versus the ones you got with 100 numbers? (You need not print this plot.)
3. On your own (optional, do not submit). If you have time left and want to play around, here are some suggestions:
- (a) Try a different number of bins in your histogram.
  - (b) What fraction of the numbers 1:10 are prime? 1:100? 1:1000? Hint: `sum(isprime(1:n))/n`
  - (c) What is the largest known prime number? Open a browser and Google “largest prime.”