MATLAB Assignment 2

Spring 2020, Section A

This problem set will cement your understanding of vector operations and go over several important built-in functions. It will also provide an example of the efficiency to be gained by pre-allocating your data structures.

As with all the homeworks, please submit it as a *.m* file, with suppressed output. Remember that all lectures and homeworks may be found at *github.com/guybaryosef/ECE210-materials*. This homework is due by 4:00 PM on February 5th to guybymatlab@gmail.com. Remember to also bring a hardcopy in to class!

1. Vector? I hardly know her! Here we will look at some applications of built-in vectorized functions. Label your variables appropriately.

(a) Create a vector of 100 evenly spaced samples of the exponential function over the interval [0,1].

(b) Approximate the integral using the trapezoidal method (use ***trapz*** and multiply by the interval) as well as the rectangular method (sum over all points and multiply by the interval).

(c) Approximate the cumulative integral using the trapezoidal method (use ***cumtrapz***) and the rectangular method (use ***cumsum***). Looking at the pair of cumulative values, did you get the same answers as in part (b)?

(d) Approximate the derivative by taking the difference between all adjacent elements and dividing by the time spacing. Similarly, approximate the second derivative. What are the lengths of each derivative vector?

2. Array Foray Perform the following matrix operations.

(a) Use ***reshape*** to create a 10×10 matrix A where $A = \begin{bmatrix} 1 & 11 & ... & 91 \\ 2 & 12 & ... & 92 \\ \vdots & \vdots & \ddots & \vdots \\ 10 & 20 & ... & 100 \end{bmatrix}$.

(b) Use ***magic*** to create a 10×10 magic matrix B. Use B to create a matrix C which has the same diagonal values of B and is zero elsewhere. **Note**: You might want to look up ***diag*** to see how to do this elegantly.

(c) Flip the second column of B such that it is inverted upside down.

(d) Flip the matrix A from left to right.

(e) Find the column-wise sum of every column of AB (normal matrix multiplication). The result should be a row vector.

(f) Find the row-wise mean of every row of AB (element-wise matrix multiplication). The result should be a column vector.

(g) Delete the last column of A.

3. Gotta Go Fast Generate a 300×500 matrix with entries $a_{i,j} = \frac{i^2+j^2}{i+j+3}$ using the following methods and use ***tic toc*** to time the speed of each. Report the times in a table (using the ***table*** function).

(a) Using *for* loops and no pre-allocation.

(b) Using *for* loops and pre-allocating memory with ***zeros***.

(c) Using only element-wise matrix operations. **Note**: ***repmat*** and/or ***meshgrid*** will be useful here.