

# MATLAB Assignment 2

Spring 2019, Section B

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](https://github.com/guybaryosef/ECE210-materials). This homework is due at 11:59 PM on January 30th to [guybymatlab@gmail.com](mailto:guybymatlab@gmail.com).

**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  $10 \times 10$  matrix  $A$  where  $A = \begin{bmatrix} 1 & 11 & \dots & 91 \\ 2 & 12 & \dots & 92 \\ \vdots & \vdots & \ddots & \vdots \\ 10 & 20 & \dots & 100 \end{bmatrix}$ .
- (b) Use ***magic*** to create a  $10 \times 10$  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  $300 \times 500$  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.