MA 302 – Spring 2019
Homework 1: Due on Friday, January 25

Exercise 1: Scalar Variables and Expressions

1. What are the values of the reserved variables `pi, eps, realmax, realmin` in MATLAB?

2. Use the `format long` command to display `pi` in full precision and `format short` (or just `format`) to return MATLAB to its default, `short`, display.

3. Note: No matter how it is printed, the internal precision of any variable is always 15 decimal digits. The value for `pi` printed in the short format is 3.1416. What is `pi -3.1416`? What about the difference between the printed value and `pi` when we `format long`?

4. Use MATLAB to demonstrate the identity $\cos^2\left(\frac{x}{2}\right) = \dfrac{\tan x + \sin x}{2\tan x}$ for $x = \dfrac{\pi}{5}$

5. Use MATLAB to evaluate the following mathematical expressions. *To see a list of elementary math functions available in MATLAB you can use the command* `>> help elfun`.

   (a) $\dfrac{23^2}{5} + \dfrac{81^{3/4}}{11} + 35 \cdot 4^{-3}$

   (b) $|e - 1|$

   (c) $\dfrac{9}{\pi}\cos^{-1}(0.5) + \ln 8$

   (d) $\cos(135^\circ)$

6. Define the variables $x = 4, y = 3$ and $z = \frac{1}{8}$ and calculate the following expressions

   (a) $\dfrac{5(y-x)}{4z - 19}$

   (b) $e^{\frac{z+y}{x}} + 6\sqrt[3]{x}$

   (c) $2\sin x \sec y$

   (d) Compute $(-x)^{\frac{1}{4}}$ using MATLAB exponential function and $\sqrt[4]{-x}$ using the `nthroot` function. What difference do you notice?. Explain.

7. Use the `help` function or experiment to answer the following questions (justify your reasoning)

   (a) Is `fix(3.5)` the same as `floor(3.5)`?

   (b) Is `fix(3.4)` the same as `fix(-3.4)`?

   (c) Is `fix(3.2)` the same as `floor(3.2)`?

   (d) Is `fix(-3.2)` the same as `floor(-3.2)`?

   (e) Is `fix(-3.2)` the same as `ceil(-3.2)`?

8. Use the MATLAB `rand` function to generate:

   (a) a random number between $(0, 1)$.

   (b) a random number between $(1, 10)$.

   (c) a random integer between $(1, 10)$.

Exercise 2: Vector and Matrix Variables

1. Use both the `colon` operator and `linspace` functions to create the following row vectors:

```
v1=[4   6   8   10]
v2=[1.0000   1.5000  2.0000  2.5000  3.0000]
v3=[-3  -6  -9  -12 -15]
```

2. Use the `linspace` function to create a row vector called `meshPoints` containing 1000 values evenly spaced between -1 and 1. Please do not print all these values!

   (a) What expression will yield the 90th element? What is this value?

   (b) Double-click on the variable `meshPoints` in the `Workspace` window and confirm that this is indeed a vector of length 1000.

   (c) Plot a sine wave on the interval $[-1, 1]$ using the command

```
>>plot(meshPoints,sin(2*pi*meshPoints))
```

   Save your image as a `jpeg` file and send it along with your summary. You can use "File $\rightarrow$ Save as" from the plot window and choose file type "JPEG image" OR from the command line you can type

```
>>print -djpeg plotname.jpg
```

   where "`plotname`" is a descriptive name of your choice.

3. Write an expression that refers to only the odd-numbered elements in a vector, regardless of the length of the vector. Test your expression on vectors with an odd number of elements as well as an even number of elements.

4. The built-in function `clock` returns a vector that contains six elements: the first three are the current date (year, month, day) and the last three represent the current time in hours, minutes, and seconds. The seconds is a real number but, all others are integers. Store the result from clock into a variable called `myc`. Then, store the first three elements from `myc` in a variable `today` and the last three elements in a variable `now`. Use the MATLAB `fix` function on the vector variable `now` to get an integer representation of the time in seconds.

5. Create a vector variable `vec`, it can have any length. Then write assignment statements that would store the first half of the vector in one variable and the second half in another variable. Make sure that your assignment statements are general and will work whether `vec` has even or odd number of elements. Test your code on 2 different vectors.

6. Extend your code from problem 5 to create a new vector `vec1` that switches the left and right sides of a vector. For example if `vec = [1 2 3 4 5]`, the new vector `vec1` should be `vec1 = [4 5 3 1 2]` or `vec = [1 2 3 4]`, the new vector `vec1 = [3 4 1 2]`. Test your code on 2 vectors (both even and odd number of elements)

7. Find an efficient way to generate the following matrix by generating each row using the mathematical pattern present.

$$A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 9 & 8 & 7 & 6 \\ 1 & 4 & 9 & 16 \\ -1 & 1 & -1 & 1 \end{bmatrix}$$

(a) Create a vector `v1` consisting of the third column of A and `v2` consisting of the second row of A.

(b) Create a 4×3 matrix $B1$ consisting of the second through fourth columns of A.

(c) Create a 3×4 matrix $B2$ consisting of the first through third rows of A.

(d) Create a 2×3 matrix $B3$ consisting of the second and third rows and last three columns of A.

(e) Sort each column of A and store the result in a new matrix $B4$

8. Use the MATLAB `rand` function to create a 5×5 matrix C of random integers.

   (a) Switch the first and third rows of your matrix and store the result in a new matrix $C1$

   (b) Delete the third column and store the result in a new matrix $C2$

   (c) Replace the third column by the vector `v=[1;2;3;4;5]` and store the result in $C3$.

9. Download the provided `matlab.mat` and load the saved matrix variable `B`. Use MATLAB commands to answer the following questions.

   - What is the size of the matrix `B`.?
   - Find the maximum and minimum entries of the matrix `B`.
   - Use the MATLAB function `spy` to plot the structure of the matrix. Save your plot as a jpeg file and include it with your summary. From your plot, what can you say about the sparsity of the matrix?

Submission of exercises

Place all your files (`m-files, summary.txt, diary.txt`) in a folder named `lastname_hwN` and zip the folder to create a file `lastname_hwN.zip`. Email your zip file `lastname_hwN.zip` to `pchidyagwai@loyola.edu` with subject `MA302_hwN`.