Worksheet 1: The Basics

This homework is designed to teach you to think in terms of matrices and vectors because this is how Matlab organizes data. You will find that complicated operations can often be done with one or two lines of code if you use appropriate functions and have the data stored in an appropriate structure. The other purpose of this homework is to make you comfortable with using help to learn about new functions.

1.

Make the following variables

a.) a = 10

b.) b = $2.5 \cdot 10^{23}$

c.) c = 2 + 3i , where i is the imaginary number

d.) d = $e^{\frac{2}{3}\pi \cdot i}$

(Use exp,i,pi)

2.

a) aVec = [3.14 15 9 26]

b) bVec = column([2.71 8 28 182]) % column is not a Matlab function.

c) cVec= [5 4.8 ... −4.8 −5] % (all the numbers from 5 to -5 with increments of -0.2)

d) dVec = [10^0 10^0.01 ... 10^0.99 10^1] logarithmically spaced numbers between 1 and 10.

e) eVec = 'Hello there' (eVec is a string, which is a vector of characters)

3.

Make the following variables:

a)A = 9x9-matrix filled with values 2. Use *ones* or *zeros*

b) B= 9x9-matrix with zeros except [1 2 3 4 5 4 3 2 1] on the main diagonal. Use diag (or zeros and linear indexing of type 1:k:81)

c) a 10x10-matrix, where the vector 1:100 runs down the columns. Use reshape

d) $D = \begin{bmatrix} NaN & NaN & NaN & NaN \\ NaN & NaN & NaN & NaN \\ NaN & NaN & NaN & NaN \end{bmatrix}$

e) E=[13 -1 5;-22 10 -87]

f) F = a 5x3-matrix of random integers with values on the range. (use rand, ceil, floor)

4.

a) Given vector x, evaluate vector y defined by the formula.

$$y = \frac{1}{\sqrt{2\pi}} e^{-x^2/2}$$

Let x be the interval [-1,1] divided into 10 pieces of equal length and make a plot of y vs. x

Hint: remember to use elementwise operations where needed, i.e. .* and ./ etc.

5.

The Taylor expansion of e^x is:

$$\sum_{k=0}^{\infty} \frac{x^k}{k!}$$

Observe the convergence of the sum with the help of cumsum and exp

6.

Solve the system of linear equations

$$\begin{cases} 2x + y = 3 \\ x - 2y = -1 \end{cases}$$

Check the result.

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A = [2 1; 1 -1]; b = [3;-1];
x = A\b
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Using the same technique, solve the system and check.

$$\begin{cases} 35x_1 + 14x_3 + 16x_4 + 2x_5 = 67 \\ 27x_1 + 7x_2 + 14x_3 + 4x_4 + 7x_5 = 45 \\ -13x_1 - 2x_2 + 6x_3 + 10x_4 + 8x_5 = 9 \\ 30x_1 - 1x_2 - 12x_3 + 7x_4 - 11x_5 = 13 \\ 7x_1 + 14x_2 + 7x_3 - 3x_4 - 10x_5 = 15 \end{cases}$$

7.

Using Matlab indexing, compute the perimeter sum of the matrix "magic(8)".

Perimeter sum adds together the elements that are in the first and last rows and columns of the matrix. Try to make your code independent of the matrix dimensions using "end".

8.

a) Plot the graph of f(x) = sin(x) on interval [0,1]

b) Plot the graph of the function $f(x) = \frac{1}{4}x\sin(x)$ on interval [0,40] and in the same picture, plot lines $g_1(x) = \frac{1}{4}x$ and $g_2(x) = -\frac{1}{4}x$.

c) Plot a curve with y coordinate of $\sin(t)$ and x coordinate of $\cos(t)$ when $t \in [0, 2\pi]$.

d) Plot a curve

$$\begin{cases} x = \sin(t)\left(e^{\cos(t)} - 2\cos(4t) - \sin\left(\frac{t}{12}\right)\right) \\ y = \cos(t)\left(e^{\cos(t)} - 2\cos(4t) - \sin\left(\frac{t}{12}\right)\right) \end{cases}$$

Test different intervals for t; you'll probably need a fairly long interval.

In some cases the picture may look nicer using axis square, axis equal

9.

Suppose we have

$$f(x) = x - e^{-x^2}$$

and

$$f'(x) = 1 + 2xe^{-x^2}$$

Use Newton's method (teachers and Google will help if you've forgotten what it is) and for or while loop to find the root of $f(x)$.