CH2013
Computational Programming and Simulations Lab
July-Nov 2023
Problem Sheet #1a

9 Aug 2023

This serves as your introduction to MATLAB. Please note that you need to upload the codes for each question separately in the appropriate location at grader.mathworks.com, pass the pre-tests, and then submit. For this Problem Sheet, I am allowing unlimited submissions/attempts.

1. Make a new script file and do the following. You will be prompted to save the file before you can run the commands. Save it in a (temporary) folder on the desktop, with your roll number as the folder name. The syntax is usually intuitive, and you can google otherwise.

a) Define variable **a** which has a value of 4.556789, and variable b that has a value of 5.678342
b) Define variable **sum1** that contains the sum of a and b
c) Define variable **difference1** that contains b subtracted from **a**
d) Define variable **product1** that contains the product of **a** and **b**
e) Define variable **power1** that is a raised to b.
f) The command **round** in MATLAB is occasionally useful. Look at the help file to understand it. Variables **sum2**, **difference2**, **product2**, and **power2** are same as above, but with only 3 significant digits in each case. Use the round command to calculate these.
g) Now try these commands
fprintf('%.3f\n', 1.4986)
fprintf('%.2e\n', 1.4986)
and note the results.

2. You can continue to work with the same script file as above or open a new one. When you submit your code in grader, you can copy paste the lines of code from your MATLAB window into grader.

a) Define a column vector **a** containing the elements 1, 4.5, and 9.6
b) Define a row vector **b** containing the elements 1.6, 8, and 7.3
c) Create a column vector **c** = [1 2 …n]’ with n=5 (don’t explicitly write out the numbers, use the ‘:’ command)
d) Perform the calculation, **d** = transpose(**a**) + **a** to get a new vector **d**
e) Find the second element of vector **a** and assign the value to variable **e**
f) Add the third element of vector **a** to the second element of vector **b**. Assign this to a variable **f**
g) Create a matrix $\boldsymbol{G} = \begin{bmatrix} 7 & 2 & -3 \\ 2 & 5 & -3 \\ 1 & -1 & -6 \end{bmatrix}$
h) Find **H** = inverse of **G**.
i) Find $\boldsymbol{x} = \boldsymbol{G}^{-1}\,\boldsymbol{z}$ where $\boldsymbol{z} = \begin{bmatrix} -12 \\ -20 \\ -26 \end{bmatrix}$

j) If $\mathbf{P}=\begin{bmatrix} 2 & 5 & -3 \\ 2 & 5 & -3 \\ 1 & -1 & -6 \end{bmatrix}$, can you find the inverse of **P**? What is the warning message you get? Do you understand what that means?

k) In MATLAB "element by element" multiplication is achieved using the symbol "**.***" (without quotes). Check that **G**.***P** yields the result you expect. Put this in a new variable **Q**. Perform regular (not element by element) matrix multiplication of **G** and **P** and save the output in **R**. Check that **Q** & **R** are not the same.

l) Create a 4x4 identity matrix **S** (don't explicitly type out the 16 numbers, use MATLAB's in-built commands – google to find out what the command is)

m) Pick out the diagonal elements of matrix **S** and put it in a vector **t**

n) The command to extract the second row of a matrix **A** is **A**(2,:) in MATLAB. Find the third COLUMN of the matrix **P** defined above and assign to the vector **u**

3. This question pertains to some simple codes using the **for** loop function in MATLAB. Again, the syntax is simple, look it up.

a) Create a **for loop** that prints the following statement 10 times

```
fprintf("%i\n", i^2)
```

where ***i*** is an index/integer variable.

4. In this question we want to make several plots (graphs). Please make sure you use the "help" feature in the command window to get the correct syntax. The commands you should read up about include – **linspace, plot, figure, hold on, hold off, semilogx.**

a) Consider an independent variable **x**$\in[0,\pi]$; use 10 equally spaced intervals to get the discrete values of **x**.

b) Create a (linear) plot of **y** vs. **x** where $y = \mathbf{cos}\ (x)$**.** Make sure that the plot uses a green solid line with "+" sign used as markers. In the same plot, create a (linear) plot of **z** vs. **x** where $z = \mathbf{exp}\ (-x)$. Make sure that the plot uses cyan-colored dotted line with "+" markers.

c) Create a new figure having two subplots and plot ***y vs. x*** and ***z vs. x*** in the first and second subplot, respectively.

d) Create a new figure with a semilog plot of ***z vs. x***.

In total there are going to be three 'figures' in the solution to this question.

Note that once the figures are plotted (a new window will pop for each figure), you can click on the plot and do some editing. You can change the axis, add some text, change the font, modify the legend etc. Try this out. This is not required for submission, but worthwhile for learning.

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