

Introduction to Matlab programming

Class 2: *Plots, strings and scripts*

1. Vectors can be used as indexes to access certain elements from matrices. Open the “TableExample.txt” file (use the function *dlmread*). The columns of this matrix are: [Experiment | Time | Cell | GFP | mCherry | DAPI]. Based on this knowledge, extract the following submatrices:
 - a) *me1* = table for only experiment 1 (the result should not contain the column experiment)
 - b) *me2* = table for only experiment 2 (the result should not contain the column experiment)
 - c) *me1c1* = table for experiment 1 and cell 1
 - d) *me1c2* = table for experiment 1 and cell 2
 - e) *me1c3* = table for experiment 1 and cell 3
 - f) *me1c4* = table for experiment 1 and cell 4
2. Use the function *plot* to create the following figures using the previous matrices:
 - a) From *me1c1* plot the intensity of GFP over time. After that, graphically,
 - label x axis as “Time” and y axis as “Intensity”
 - add a title “GFP”, but in a larger fontsize and in bold.
 - b) Create a single figure with three plots (GFP, mCherry and DAPI) over time, also from *me1c1*. Use different colors to differentiate them and add a legend.
 - c) Create a single figure to compare the evolution of GFP over time of each cell in experiment 1. Again use different colors for each plot and show a legend.
 - d) Imagine that the time column in TableExample actually refers to number of intervals of 20 minutes; i.e. there is an interval of 20 minutes between samples. Correct the x axis of the plot in (a) accordingly.
 - e) Either graphically or programmatically, change the color, line width and type, font size of the axis ticks, etc. of one of the graphics.
 - f) Zoom-in some part of a figure (Use the figure menu/toolbar).
 - g) Copy a figure into a Word document (Use the figure menu).
3. Use the function *plotyy* to create a figure using the matrix *me1c1* (exercise 1). The left y axis should contain the “mCherry” intensity and the right y axis the “DAPI” intensity.
4. Define the following 3 string variables:

$s1 = 'A', \quad s2 = 'This is my second string', \quad s3 = 'a long string'$

 - a) Measure the length of the strings using the *size* and the *length* functions. What is the difference between both functions?
 - b) Create a variable *s4* with the first 8 characters of *s2*
 - c) Create a variable *s5* with the horizontal concatenation of *s4* and *s2*. Use “[,]”.
 - d) Use the *disp* function to display the string *s5*
 - e) Concatenate *s1*, *s2* and *s3* vertically, using “[;]”. What are the problems? Find a way to overcome them?

5. Define the following 3 variables:

$q1 = \text{'My number is '}$, $q2 = -10$, $q3 = 0.2300$

- Create a string qs as the concatenation between $q1$ and $q2$. If you face any problem, you can use the function *num2str*. What happens when *num2str* is not used?
 - Use the function *disp* to display $q1$, and qs . Do you find any difference in the result?
 - Create a string $qs2$ as the concatenation between $q1$ and $q3$. Be sure that the resulting string also contains 0.2300, including the 3 zero digits. (read function *num2str*)
6. Create an script, named “question.m” that ask the user for a number of minutes (use the function *input*). After that, divide the number by 24, and display the result in a message like “The equivalent number in hours is ... ” (use the function *disp*)
7. Create a script called “tableanalysis1.m” that perform the following tasks:
- Define a text variable with the path and filename of the file “TableExample.txt”
 - Use the function *dlmread* to read this file (Use the previous text variable as argument)
 - Calculate and display the minimum and maximum value for each column (Use the *min* and *max* functions)
 - Calculate and display the mean value and the standard deviation for each column (Use the *mean* and *std* functions)
8. Modify the previous script (exercise 7) in a way that it also creates a bar plot with the information of the minimum, maximum and mean value of GFP, mCherry and DAPI columns. Use the *bar* function, and show the results in a single figure.
9. Modify the previous script in a way that it also plots the value of the GFP column over time for the 4 cells in experiment 1. It should be only one figure/graph with 4 plots.
10. Repeat exercise 6, but now showing the results in a single figure with 4 separate subplots. Use the *subplot* function.
11. Create the following three matrices and perform the next tasks

$$a = \begin{pmatrix} 1 & -2 \\ 0 & 4 \end{pmatrix}, \quad b = \begin{pmatrix} -1 & 0 \\ 5 & 0 \\ 3 & 4 \end{pmatrix}, \quad c = \begin{pmatrix} 1 & 2 & 3 \\ 5 & 6 & 7 \end{pmatrix}$$

- Compare the result of doing of $a \cdot a$ vs $a.*a$. Are they different?
 - Try to perform the following **matrix** multiplications (use $*$ without the dot):
 $a \cdot a$, $a \cdot b$, $b \cdot a$, $a \cdot c$, $c \cdot a$, $b \cdot b$, $b \cdot c$, $c \cdot b$, $c \cdot c$
 - Based on the previous results, what are the necessary conditions to multiply two matrices?
 - Apply the *length* and *size* functions to measure the dimensions of the matrices a , b and c . What is the difference between both functions?
 - Create two vectors: $v1$ as the first column of b , and $v2$ as the first row of c .
 - Apply again the *length* and *size* functions. Is there any difference when they are applied to matrices or vectors?
12. Transform the script of exercise 7 (or 8) “tableanalysis1.m” into a function, called “tableanalysis” with one input argument: the name of the file to be opened and analysed.