Exercise 00

Introduction to Linux and MATLAB

1 Linux I

1. Create a folder called "TCexercises" in your home directory.
2. Enter in the folder and create a subdirectory "exercise00".
3. Create a file for your report. You can decide the format.
4. Give the command "matlab" to run MATLAB and start to do the exercises. For each exercise you have to create a file "00-n.m" where "n" is the number of the exercise. You have to save all the MATLAB scripts in the folder "exercise00".
   NB: Opening MATLAB from the directory "exercise00" will set automatically the folder "exercise00" as the working directory.

2 MATLAB

1. (a) Create one 5×5 magic square M with magic(). What is the sum of the rows? What is the sum of the columns?
   (b) Exchange the first row with the first column.
   (c) Create a vector $\vec{u} = (1, 2, 3, 4, 5)$ and sum each element of the first column with each element of the vector.
   (d) Multiply by 2 the last two elements of the first and of the second column.
   (e) Replace by 3 all the elements of the matrix greater than 15;
   (f) Compute the trace of the matrix M. Try to write an algorithm using a *for* loop, then try to vectorize the algorithm and finally check the results with the function trace(). Several solutions are possible.
   (g) Find the eigenvalues and the eigenvectors of the matrix M and verify the relation $M\vec{v} = \lambda\vec{v}$
   (h) Create a second 5×5 matrix A of random integer numbers in the interval [0,9].
   (i) Compute the determinant of the matrices and verify the relation $\det(M \cdot A \cdot M^{-1}) = \det(M) \cdot \det(A) \cdot \det(M^{-1})$
   (j) Compute $C = A \cdot B$, its determinant and check that $\det(C) = \det(A) \cdot \det(B)$.
2. (a) Generate a vector x of $N = 10^8$ random numbers.
   (b) Write an algorithm with a *for* loop to compute the mean $m = \frac{\sum_{i=1}^{N} x_i}{N}$ and the standard deviation $s = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(x_i - m)^2}$. Use the function $tic - toc$ to record the elapsed time.
   (c) Rewrite the algorithm using a *while* loop and record the elapsed time with the function $tic - toc$.
   (d) Try to vectorize the algorithm and record the elapsed time. Hint: Use the function sum() instead of the for/while loop.
   (e) Check the results of the three algorithms with the functions mean() and std().
   (f) Plot the elapsed times with the function bar(), add title, x-label, y-label and save the graph in the EPS format. What is the fastest method?
3. (a) Generate a column vector x of $N = 10000$ equally spaced points in the interval $[-10, 10]$ and compute $y_1 = \sin(x)$ and $y_2 = 2\cos(x)$.
   (b) Store the data x, y_1, y_2 in a matrix $N \times 3$ and save the data in a file ".txt" as comma-separated values.

(c) plot y_1 and y_2 using two different colors and two different line styles.

(d) Reduce the x-axis to $[0, 2\pi]$ and set ticks only for $x = \left[0, \frac{\pi}{2}, \pi, \frac{3\pi}{2}, 2\pi\right]$.

(e) Add title, x-label, y-label and legend to the graph and save it in the EPS format.

(f) Compute $y_3 = \exp(x)$ with $x \in \mathbb{R}$ and $y_4 = \log(x)$ with $x \in \mathbb{R}^+$.

(g) Plot in a new figure y_1 and y_2 using two different colors and two different line styles.

(h) Reduce the y-axis to $[-3, 2]$.

(i) Add title, x-label, y-label and legend to the graph and save it in the EPS format.

3 Linux II

Now that you have some files in your folder, you can try some linux command.

1. List the created files and check their dimension
2. Create a folder "backup" and copy all the files in it.
3. Enter in the folder "backup" and delete the files 00-1.m and 00-2.m.
4. Go back in the up directory and delete the full directory "backup".
5. At the end of the exercises you have to create a "tar" archive and send it by e-mail to luca.donati@fu-berlin.de