Exercise 00

Introduction to Linux and MATLAB

1 Linux I

1. Create a folder called "MDexercises" 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 $C = A \cdot M$, its determinant and check that $\det(C) = \det(A) \cdot \det(M)$.
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,adjust x-label and y-label font size to 20, mark it bold, adjust ticks font size to 15 and mark it bold as well, 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 space-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, adjust x-label and y-label font size to 20, mark it bold, adjust ticks font size to 15 and mark it bold as well, and save the graph 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_3 and y_4 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, adjust x-label and y-label font size to 20, mark it bold, adjust ticks font size to 15 and mark it bold as well, and save the graph 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 saleksic@zedat.fu-berlin.de