

Numerical Solutions for PDEs: Lab 1

Starting MATLAB

The purpose of the laboratory sessions is to get familiar with MATLAB. To start MATLAB you can either

- type `matlab` in a terminal,
- or start it from the main menu.

A window headed “MATLAB” should open up. The central window is the MATLAB prompt, when the program is ready the symbol `>>` appears. Commands can either be typed directly at the prompt or read from `.m` files. To exit you can either type `exit` at the prompt or click on the top right “close” button.

Creating a directory

Before starting the exploration of MATLAB, create a directory to store all the scripts and sessions you will produce. At MATLAB prompt :

- type `cd ~` to move to your home folder,
- type `mkdir MATLAB_dir` to create the directory `MATLAB_dir` (you may choose the name of the directory at your convenience,
- type `cd MATLAB_dir` to move to this directory.

You are now ready to start.

To start with open a web browser and go to

<http://www.cyclismo.org/tutorial/matlab/>

this web page presents a clear and concise introduction to the basics of the MATLAB functionalities that are required for this course, covering vectors, matrices, vector operations, loops, For more informations on the commands go to the menu Help > Product Help, and type your query in the search bar.

1. Read the section “vectors”, within MATLAB, construct a vector X containing a discrete set of $N=10$ points regularly spaced between 0 and 4π (in MATLAB `pi` stands for the number π).
2. Read the section “vector operations”, construct a vector Y containing the values $\sin(x)$, for $x \in X$. Alternatively, read the section “loops” and construct the vector Y using a for loop.
3. Read the section “plot”, plot Y against X .
4. Repeat 1. 2. with $N = 30$, using the command “hold on” (see the Help) plot Y against X on the previous graph, then repeat with $N = 100$ (Instead of rewriting everything three times you should read the section “Executable Files”).
5. Approximate the derivative of \sin with respect to x using:

i) a forward difference operator, that is

$$\sin' x \approx \frac{\sin x_{i+1} - \sin x_i}{\Delta x},$$

ii) a backward difference operator, that is

$$\sin' x \approx \frac{\sin x_i - \sin x_{i-1}}{\Delta x},$$

iii) a central difference operator, that is

$$\sin' x \approx \frac{\sin x_{i+1} - \sin x_{i-1}}{2\Delta x}.$$

Plot your three approximations and the graph of $x \mapsto \cos x$ on the same graph with different colors. How do you handle the points x_0 and x_N in the three cases. Repeat these instructions with $N = 30$, $N = 100$.