

Introducing the labs

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Why have we included labs ?

Computer simulation is important in engineering in particular since it enables testing the behavior of complex systems that may not be fully accessible via closed form calculations. Simulations supply illustrations of the mathematical results presented in the videos, and playing with the parameters is encouraged for a better understanding of what occurs; Although not supplying the guarantees of mathematical proof, simulation experiments can supply, often rapidly, useful hints about systems behavior and can be used without requiring advanced mathematical skills;

In the labs of this MOOC, we will mainly restrict ourselves to systems for which the mathematical behavior is well established and compare theoretical and simulated results. Grasping the deviation between exact formulas and results supplied from computer experiments is an important issue when dealing with simulation of random phenomena. In particular, understanding, at least intuitively, the influence of data size for parameter estimation accuracy is key. This is well explained by the theory of statistics but falls out of the scope of this MOOC.

Python and notebooks

Most of the work in the labs involves computer programming. We have chosen to use the Python programming language because it is a popular language with easy learning that is used by many academic and non-

academic institutions. It also provides a rich ecosystem of scientific libraries. We assume that you have some knowledge of [Python](#) and some familiarity with [Ipython/Jupyter](#) notebooks. If not, you can look at many tutorials and WEB resources to learn how to use them. We shall only use standard scientific libraries available for Python: [Numpy](#) (for array manipulations), [Scipy](#) (for scientific calculations) and [Matplotlib](#) (for graphics). In general we will simply use *Pylab* library that imports Numpy and Matplotlib features and offers a programming experience close to that of Matlab and related languages such as Octave or Scilab.

Grading policy

The Labs count towards 30% of the overall grade. Note that as the pass level is 50%, you can get the certificate for the MOOC even if you do not perform the labs, if you manage to answer enough questions from the quiz or the bonus practice questions. However, even if you are not familiar with Python, we encourage you to have a look at them since most of the time you will just have to fill in a few lines of code.