Programming lab

Statistical Methods for Engineering

Degree in Mechatronics

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Set-up of the work environment

The programming lab exercises will be developed in Python.

Python is a high-level, general-purpose programming language. Its design philosophy seeks readability in code, and its syntax allows programmers to express concepts in fewer lines of code than in other languages.

Although there are statistics-specific programming languages, such as R, that offer a lot of statistical functionality, we will use the Python language as it allows you to do pretty much everything these other languages offer and is much more versatile.

The necessary steps to install and configure one Python environment are the following[1]:

- Download Anaconda distribution, available at https://www.anaconda.com/products/individual
- Follow the steps in order to install it

Code and execution

Programming lab code is located in the following repository:

https://github.com/miquelcamprodon/sme-materials

[1] In this guide it is detailed one installation and configuration of python. Of course, the student is free to perform any other installation and configuration of the environment in order to work across the programming lab.

It is possible to download it with the command “git clone” or by downloading the source code directly in a .zip format.

Programming lab codes are Python Notebooks. In order to make them work, one option is to have the Jupiter Notebook server activated.

To do that, type the command from the shell where you have Python installed as follows:

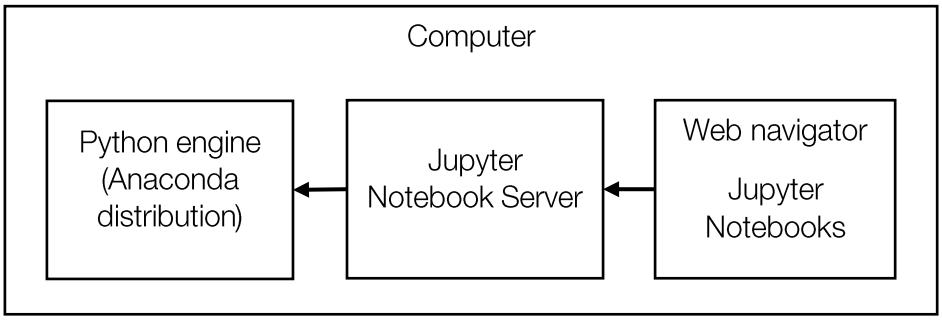
```
> jupyter notebook
```

Then copy the URL provided on the screen and paste it in a browser. You'll have everything ready to start!

Architecture of the working environment

The previous working environment architecture is a web architecture in which all components are executed inside your computer. These components are the following:

- Python engine (Anaconda distribution), installed in your computer
- Jupyter server, that will be executed in your computer and will have as a back-end the Python engine installed previously
- Web navigator, from which you will access the Jupyter server in order to work with Jupyter Notebook



With this architecture, code can be developed directly from the web navigator.

Programming labs

01-Simulating dice rolls

Introduction to simulation with Python. It analyzes the results of the experiment of rolling m dices n times. Experimental results are in concordance with the law of large numbers.

02-Descriptive statistics in Python

Introduction to Pandas: Data Analysis Library in Python, and how to use it to perform descriptive statistics of a dataset.

03-Probability models

Probability models. Topics are: programming codes to calculate probability functions, cumulated probability distribution functions, and percentiles.

04-Probability distributions

Empirical checks to show that Chi-Square, T-Student, and F-Fisher distributions follow the expected distributions.

05-Confidence intervals

Tools that allow to perform confidence intervals analysis. It consists of different types of tests depending on the specific case analyzed.

06-Hypothesis testing

Tools that allow to perform hypothesis testing analysis. It consists of different types of tests depending on the analyzed case: one sample tests, two sample tests, and two sample paired tests.

07-Linear regression

Basics of one variable linear regression. It contains the fit functions and different methods in order to check the quality of the fitted models.

08-Multiple linear regression

More detailed examples of linear regression. Full work example and regressions with regressions with more than one explanatory variable.

09-Recap

Exercise compendium of all course labs.