



PyQB

Monga

Why Python

Python
fundamentals

Programming in Python¹

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Lecture I: Programming in Python for quantitative biologists

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Programming in Python (for quantitative biologists)

The course introduces imperative programming by referring to the Python language.

- ① Python3 and its object-oriented features;
- ② Python3 libraries that can be useful in scientific computation and data analysis, in particular NumPy and pandas.



Everything will be available on:
<https://mameli.docenti.di.unimi.it/pyqb>

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Course schedule

- Tuesdays: 10:30 **309**, Thursday: 8:30 **B6**, Fridays: 8:30 **Delta**
- Lectures: 40h, Labs: 16h **Not every week we will have three lectures, check the schedule on the web site**
- Labs mainly on Friday, will start on Oct 25
- We will explore different setups: (1) a “scaffolded” one for the first steps, (2) the plain python interpreter, and finally (3) the notebooks popular in scientific practice
- Tutor: TBD (computer science master student)
- Text: every Python3 reference/book/tutorial is ok, you can access freely to the book linked on the website
- Final test: write (small) python programs without help

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Attendance requirements



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- For Quantitative Biology students, since 2024/25 **attendance is mandatory**.
- To be admitted to the exam, a QB student must have attended ≥ 10 lectures and ≥ 6 labs.
- Doing a (github) homework **within a week**, counts as $\frac{1}{3}$ of a lecture.

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Why Python?



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Programming can be approached in many “languages”, the fundamental skills are general. . . but you cannot learn without referring to a specific language.

- A precise requirement of the teaching committee
- Very popular in the scientific landscape
- Easy to learn, many useful libraries, free software
- Alternatives: Fortran, C, Matlab, Mathematica, R, Julia, . . .
- Python is slower, but it is considered easier to understand and manage

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Which Python?



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We will use Python3 (current version is 3.12): be careful when looking around, Python2 is still common (but deprecated) and incompatible. Python supports different “paradigms”, we will focus on:

- Imperative programming: programs describe **changes** in *registers* and the *executing environment*;
- Object-oriented: complex (imperative) programs are organized around objects in order to hide and isolate complexity.

This is a **programming course**: I will try to propose example that I believe could be useful in your daily practice, but I’m not a biologist.

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Programming



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Programming in science can serve two (almost opposite) goals:

- ① Understanding every detail of a computational process;
- ② Compose computational process by assembling powerful build blocks of which you understand very little.

Most of the current popularity of programming is related to goal 2. . . with many *sorcerer’s apprentices*. But this course will focus mainly on goal 1. In the last part of the course we will bend towards 2, hopefully with a solid background.

Programming can be both hard and addictive: Teach Yourself Programming in Ten Years

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Fundamental concepts of Python



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The programmer describes computational processes in terms of:

objects : all the entities manipulated by the program, each has an identity (can be distinguished) and a value, that is an element in a specific type (a set of values together with the operations that make sense on them)

basic types : integers (`int`), floats, strings (`str`), functions; they can be composed in more complex, user-defined, types

variables : **names** used to refer to objects; the same name can refer to different objects during the same process

special commands : the only way to change the execution environment (i.e., the “virtual machine” provided by the operating system) is to use system calls; syscalls change from system to system (e.g., Linux vs. Windows), but Python wraps them and they appear like the functions written by the programmers (e.g., `print`), even if they could not be programmed in Python.

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Let's try!



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<https://python.di.unimi.it/>

You can use it without any personal account, but if you want support you must create one, putting me as the “guru”: `mmonga`

This platform will be used for the first lessons, since it requires no setup at all: everything happens in the browser (and the server).

(Thanks to the University of Waterloo, Canada for providing the CS Circles)

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