

# Scientific Programming

## Course introduction

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# Organization

145540 Scientific Programming (12 ECTS, LM QCB)

145685 Scientific Programming (12 ECTS, LM Data Science)

## Part A - Programming (Sept-Oct)

Introduction to the Python language and to a collection of programming libraries for data analysis.

- Mutuated as 145912 Scientific Programming (LM Math, 6 credits)

## Part B - Algorithms (Nov-Dec)

Design and analysis of algorithmic solutions. Presentation of the most important classes of algorithms and evaluation of their performance.

# Course syllabus - Part A

- Introduction to Python
- Data types
  - Numbers
  - Strings
  - Lists, tuples, dictionaries
- Input-Output
  - Raw input
  - File system
- Complex statements
  - If
  - For, while
  - Nested statements
- Functions
  - Definition
  - Calls
  - Return values
- Programs
  - Structuring a program
  - Importing external modules
- Libraries
  - Pandas
  - Numpy
  - Matplotlib

# Course syllabus - Part B

- Introduction
  - Recursion
  - Algorithm analysis
  - Asymptotic notations
- Data structures
  - High level overview
  - Sequences, maps (ordered/unordered), sets
  - Data structure implementations in Python
- Trees
  - Data structure definition
  - Visits
- Graphs
  - Data structure definition
  - Visits
  - Algorithms on graphs
- Algorithmic techniques
  - Divide-et-impera
  - Dynamic programming
  - Greedy
  - Backtrack
  - NP class: brief overview

# Objectives of the course – Part A

At the end of the module, students are expected to:

- Remember the syntax and semantics of the Python language;
- Understand programs written by others individuals;
- Analyze a simple data analysis task and reformulate it as a programming problem;
- Evaluate which features of the language (and related scientific libraries) can be used to solve the task;
- Construct a Python program that appropriately solves the task;
- Evaluate the results of the program.

## Objectives of the course – Part B

At the end of the module, students are expected to:

- evaluate algorithmic choices and select the ones that best suit their problems;
- analyze the complexity of existing algorithms and algorithms created on their own;
- design simple algorithmic solutions to solve basic problems.

# What you will learn

## Programming expertise

- **Content:** a brief overview of the main problems in algorithmics and their solution
- **Approach:** the principles and the techniques that can be used to solve such problems

### Content: list of algorithms

- Read their code
- Understand why they work
- Try to implement them

### Approach: abstract thinking

- Develop new solutions for unusual problems

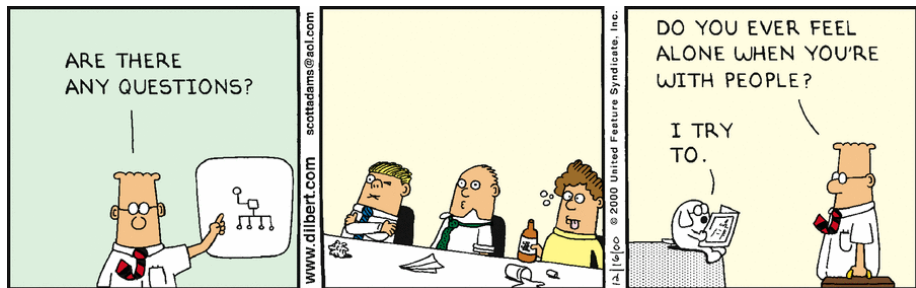
# About interaction during the lecture

Ask questions!!

- If I'm not clear enough, stop me!
- If you want additional information, ask!

He who asks a question is a fool for a minute; he who does not ask a question remains a fool forever

*Chinese proverb*





# Course material

<http://disi.unitn.it/~passerini/teaching/2024-2025/sci-pro/>

- Slides and notes (in development)
- Links to additional material

Moodle course page

- Communications
- Lecture recordings

# Instructors: Part A - Programming

- Instructor: Prof. Andrea Passerini
  - Theory lectures, programming exercises
  - [andrea.passerini \[AT\] unitn.it](mailto:andrea.passerini@unitn.it)
- Teaching assistant: Prof. Erik Dassi
  - Python lab sessions (QCB)
  - [erik.dassi \[AT\] unitn.it](mailto:erik.dassi@unitn.it)
- Teaching assistant: Antonio Longa
  - Python lab sessions (data science)
  - [antonio.longa \[AT\] unitn.it](mailto:antonio.longa@unitn.it)

# Instructors: Part B - Algorithms

- Instructor: Prof. Alessandro Romanel
  - Theory lectures, algorithmic exercises
  - [alessandro.romanel \[AT\] unitn.it](mailto:alessandro.romanel@unitn.it)
- Teaching assistant: Dr. Luca Marchetti
  - Lab sessions on algorithms (QCB)
  - [luca.marchetti \[AT\] unitn.it](mailto:luca.marchetti@unitn.it)
- Teaching assistant: Dr. Riccardo Scandino
  - Lab sessions on algorithms (data science)
  - [riccardo.scandino \[AT\] unitn.it](mailto:riccardo.scandino@unitn.it)

# Schedule

<b>Week day</b>	<b>Time</b>	<b>Room</b>	<b>Description</b>
Monday	14.30-16.30	a107	Lecture
Tuesday	16.30-18.30	a201	QCB Lab
Tuesday	16.30-18.30	a202	DS Lab
Thursday	11.30-13.30	b108	Lecture
Friday	15.30-17.30	a201	QCB Lab
Friday	15.30-17.30	b106	DS Lab

## 145540,145685 Scientific Programming (12 credits)

- Lab exam
  - Python programming
  - Simple algorithmic problems
  - Questions about computational complexity

## 145912 Scientific Programming (6 credits, Math)

- Lab exam
  - Python programming

# Dates

## Midterms

Midterm 1 (1.5h)	beg of Nov
Midterm 2 (1.5h)	half Dec

## Full exams

January (3h)	TBD
February (3h)	TBD
June (3h)	TBD
July (3h)	TBD
September (3h)	TBD

## 145540,145685 Scientific Programming (12 credits)

- If you need to pass **both** parts to pass the exam. The mark is computed as the average of the marks of the two parts, rounded up (e.g.  $(25+26)/2 = 26$ )
- A part is passed if you take at least 18 in the corresponding midterm exam, or the corresponding part of the full exam (which contains both parts)
- You enrol to the full exam by enrolling to the part(s) you want to take (both, if you want to take both). If you enrol to a single part, you have 1.5h. If you enrol to both parts, you have 3h.
- You can take a part in one session (e.g., January/February), and the other in another session (e.g., June/July).

## continued

- If you are not happy with the mark you took in a part, you can enrol for that part in a new session. Note that upon enrolling for a part in a session, you lose the previous mark you had (even if you then fail that part).
- You cannot take an exam if you are not enrolled. If you cannot enrol (e.g., because you don't have a matricola yet), you need to enrol by sending an email to the instructor (this implies losing the previous mark, as for the formal enrollment)
- Once you successfully passed both parts, you need to enrol to a registration session to have your mark registered.



## 145912 Scientific Programming (6 credits)

- If you pass the midterm exam, you can register the mark by enrolling to a regular session. Please write an email to the instructor of the first part to inform him that you want to register the mark.
- If you passed the midterm exam, but you are not happy with the mark you can enrol to a regular session to take the exam again. The result of the regular session exam will be your new mark, you cannot backtrack to the midterm mark.
- After the mark of a regular session have been published, you have a week to refuse it, after which it will be registered (silent assent registration).