

# Scientific Programming

## Course introduction

Andrea Passerini

Università degli Studi di Trento

2021/09/23

This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.



# 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

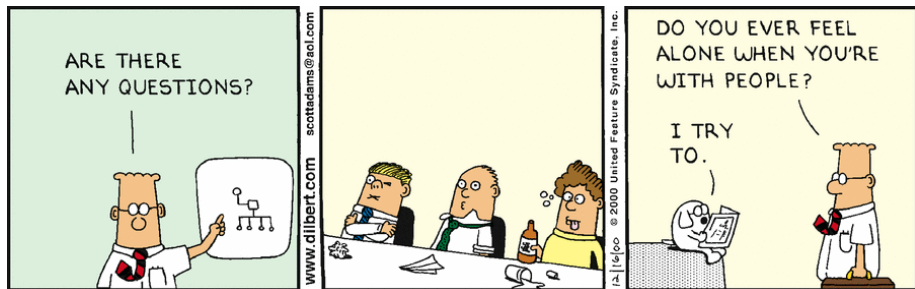
# About interaction during the lecture

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/2021-2022/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: Dr. Luca Marchetti
  - Python lab sessions (QCB)
  - [luca.marchetti \[AT\] unitn.it](mailto:luca.marchetti@unitn.it)
- Teaching assistant: Dr. David Leoni
  - Python lab sessions (data science)
  - [david.leoni \[AT\] unitn.it](mailto:david.leoni@unitn.it)

# Instructors: Part B - Algorithms

- Instructor: Dr. Erik Dassi
  - Theory lectures, algorithmic exercises
  - [erik.dassi \[AT\] unitn.it](mailto:erik.dassi@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. David Leoni
  - Lab sessions on algorithms (data science)
  - [david.leoni \[AT\] unitn.it](mailto:david.leoni@unitn.it)

# Schedule

<b>Week day</b>	<b>Time</b>	<b>Room</b>	<b>Description</b>
Monday	14.30-16.30	a107	Lecture
Thursday	11.30-13.30	circ. 1	Lecture
Tuesday	14.30-16.30	a110	QCB Lab
Thursday	14.30-16.30	a107	QCB Lab
Thursday	15.30-17.30	b106	DS Lab
Friday	17.30-19.30	a207	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

# Mark Registration

## 145540,145685 Scientific Programming (12 credits)

- If you pass **both** midterm exams, you can register the mark
- The mark is computed as the average of the marks of the midterm exams, rounded up (e.g.  $(25+26)/2 = 26$ )
- To register your mark you need to enroll to one of the regular sessions (not the midterm ones). Please write an email to the instructors of both parts to inform us that you want to register the mark.

## continued

- If you passed both midterm exams but you are not happy with the mark you can enroll to a regular session to take the full exam. The result of the full exam will be your new mark, you cannot backtrack to the midterm mark.
- If you did not pass both midterm exams (i.e., you failed in at least one), you need to take the full exam at a regular session.
- 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).



## 145912 Scientific Programming (6 credits, Math)

- 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 enroll 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).