

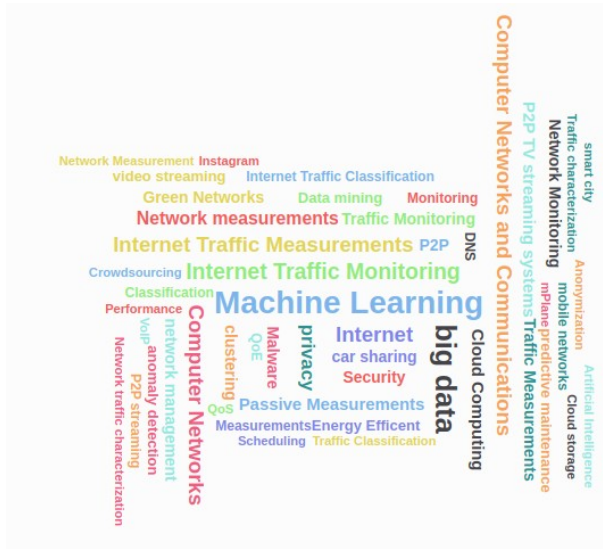
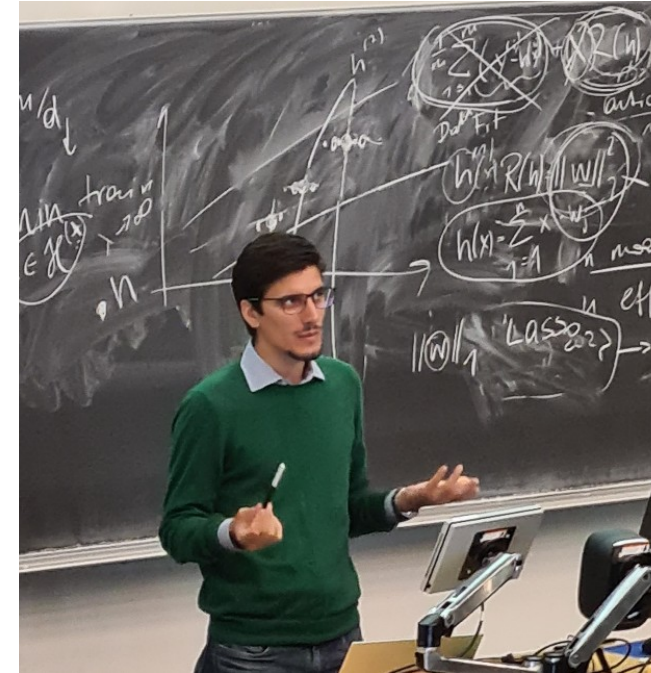
Machine Learning for Networking

ML4N

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Gabriele Ciravegna
Zhihao Wang
Tailai Song

Luca Vassio

- Assistant professor @ DAUIN
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- ML lectures and practical activities
- ~50 hours



Gabriele Ciravegna

- PostDoc @ DAUIN
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- Python lectures and Python and ML labs
- ~20 hours



Zhihao Wang

- PhD student @ University of Electronic Science and Technology of China
- Visiting PhD student @ DAUIN
- zhihao.wang@polito.it
- ML labs
- ~25 hours



Tailai Song

- PhD student @ DET
- Tailai.song@polito.it
- ML labs
- ~25 hours



Timetable



- Tuesdays: 11:30-14:30, classroom R4
- Thursday: 16:00-19:00, classroom R4
- In-presence teaching
- Lectures will be recorded and made available to students

Timetable



- Frontal lectures (L)
 - 40 hours, in presence
- Labs and programming activities (EL)
 - 40 hours, in presence

Provisional Calendar



Week	Day	Date	Hour	Classroom	Topic
1	Tuesday	24/09/2024	11:30-13:00	R4	Introduction to the course
	Tuesday	24/09/2024	13:00- 14:30	R4	Data exploration and visualization
	Thursday	26/09/2024	16:00-17:30	R4	Python: introduction
	Thursday	26/09/2024	17:30-19:00	R4	Python: introduction
	Tuesday	01/10/2024	11:30-13:00	R4	LAB 1: Python
2	Tuesday	01/10/2024	13:00- 14:30	R4	LAB 1: Python
	Thursday	03/10/2024	16:00-17:30	R4	Python: Numpy
	Thursday	03/10/2024	17:30-19:00	R4	Python: Numpy
	Tuesday	08/10/2024	11:30-13:00	R4	Data exploration and visualization
3	Tuesday	08/10/2024	13:00- 14:30	R4	Preprocessing and dimensionality reduction
	Thursday	10/10/2024	16:00-17:30	R4	LAB 2: Numpy
	Thursday	10/10/2024	17:30-19:00	R4	LAB 2: Numpy
	Tuesday	15/10/2024	11:30-13:00	R4	Preprocessing and dimensionality reduction
4	Tuesday	15/10/2024	13:00- 14:30	R4	Preprocessing and dimensionality reduction
	Thursday	17/10/2024	16:00-17:30	R4	Python: Pandas
	Thursday	17/10/2024	17:30-19:00	R4	Python: Matplotlib
	Tuesday	22/10/2024	11:30-13:00	R4	LAB 3: Pandas + Matplotlib
5	Tuesday	22/10/2024	13:00- 14:30	R4	LAB 3: Pandas + Matplotlib
	Thursday	24/10/2024	16:00-17:30	R4	ML preliminaries
	Thursday	24/10/2024	17:30-19:00	R4	Empirical risk minimization
	Tuesday	29/10/2024	11:30-13:00	R4	Empirical risk minimization
6	Tuesday	29/10/2024	13:00- 14:30	R4	Model validation and selection
	Thursday	31/10/2024	16:00-17:30	R4	LAB 4: Data exploration and visualization
	Thursday	31/10/2024	17:30-19:00	R4	LAB 4: Data exploration and visualization
	Tuesday	05/11/2024	11:30-13:00	R4	PROJECTS presentation
7	Tuesday	05/11/2024	13:00- 14:30	R4	Model validation and selection
	Thursday	07/11/2024	16:00-17:30	R4	LAB 5: Preprocessing and dimensionality reduction
	Thursday	07/11/2024	17:30-19:00	R4	LAB 5: Preprocessing and dimensionality reduction

8	Tuesday	12/11/2024	11:30-13:00	R4	Metrics and hyper-parameter tuning
	Tuesday	12/11/2024	13:00- 14:30	R4	Learning through gradient descent
	Thursday	14/11/2024	16:00-17:30	R4	LAB 6: classification from scratch
	Thursday	14/11/2024	17:30-19:00	R4	LAB 6: classification from scratch
9	Tuesday	19/11/2024	11:30-13:00	R4	Techniques for classification and regressions
	Tuesday	19/11/2024	13:00- 14:30	R4	Techniques for classification and regressions
	Thursday	21/11/2024	16:00-17:30	R4	LAB 7: supervised learning
	Thursday	21/11/2024	17:30-19:00	R4	LAB 7: supervised learning
10	Tuesday	26/11/2024	11:30-13:00	R4	Clustering
	Tuesday	26/11/2024	13:00- 14:30	R4	Clustering
	Thursday	28/11/2024	16:00-17:30	R4	LAB 8: supervised advanced
	Thursday	28/11/2024	17:30-19:00	R4	LAB 8: supervised advanced
11	Tuesday	03/12/2024	11:30-13:00	R4	Clustering
	Tuesday	03/12/2024	13:00- 14:30	R4	LAB 9: clustering
	Thursday	05/12/2024	16:00-17:30	R4	LAB 9: clustering
	Thursday	05/12/2024	17:30-19:00	R4	LAB 9: clustering and PROJECTS Q&A
12	Tuesday	10/12/2024	11:30-13:00	R4	Artificial neural networks (NN)
	Tuesday	10/12/2024	13:00- 14:30	R4	Artificial neural networks (NN)
	Thursday	12/12/2024	16:00-17:30	R4	LAB 10: NN with PyTorch
	Thursday	12/12/2024	17:30-19:00	R4	LAB 10: NN with PyTorch
13	Tuesday	17/12/2024	11:30-13:00	R4	Regularization techniques
	Tuesday	17/12/2024	13:00- 14:30	R4	LAB 10: NN with PyTorch
	Thursday	19/12/2024	16:00-17:30	R4	EXAM preparations
	Thursday	19/12/2024	17:30-19:00	R4	EXAM preparations
WINTER HOLIDAYS					
14	Tuesday	07/01/2025	11:30-13:00	R4	EXAM preparations
	Tuesday	07/01/2025	13:00- 14:30	R4	EXAM preparations
	Thursday	09/01/2025	16:00-17:30	R4	PROJECT Questions&Answers
	Thursday	09/01/2025	17:30-19:00	R4	PROJECT Questions&Answers

Feedbacks and improvement



- **Questions and interactions** strongly suggested, just interrupt me!
- This is the second year for this course for me (third year overall), hence still partially **work in progress**
- Please, provide me **feedbacks**, also to improve the course for next year: if you want me to go slower, faster, if some topics need more details and others are not necessary, etc.

Feedbacks and improvement



- **Joint committee on teaching** (Comitato Paritetico per la Didattica CPD)
- Anonymous **questionnaire** measuring satisfaction about the course and teachers (to fill before the exam – ~January)
- Important to fill free text **comments for the teachers**
- Very useful: I already implemented changes according to the suggestions from last year's students

How to



- We'll use the **Portale della didattica** tools to:
 - Share material on the “Materiale” section – also available through Dropbox
 - Communicate with you via post on the “Avvisi” section
 - Share recording of the lectures “Virtual classroom”

How to



- We'll use **Moodle** to:
 - Form project groups
 - Choose projects
 - Submit projects
 - Peer-review the projects
 - Receive grades

Shared material



- Presentation slides of the lectures
- Exercises (and solutions) on Jupyter notebooks
- Laboratory tasks (and solutions) on Jupyter notebooks
- Projects
- Written exam examples
- ...

References



- Two textbooks for the course
- More reference material will be suggested/shared for each topic

References



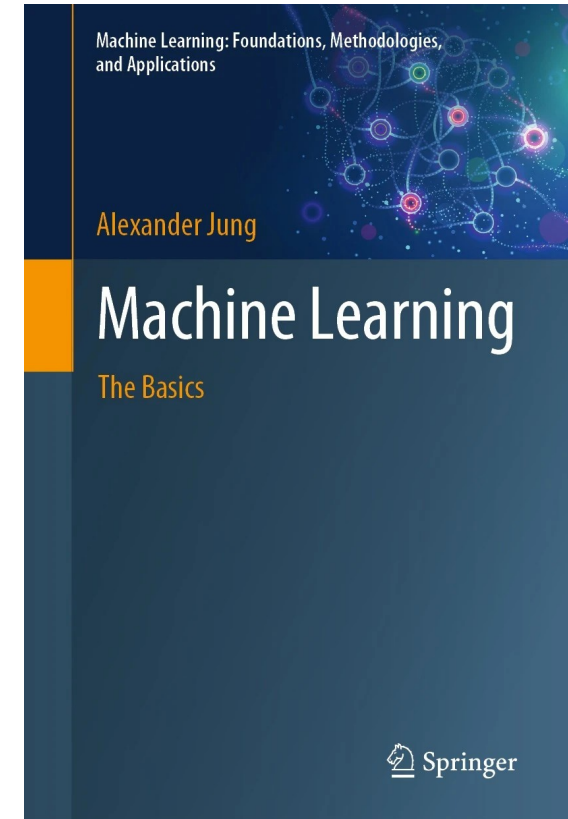
- For theory

- A. Jung

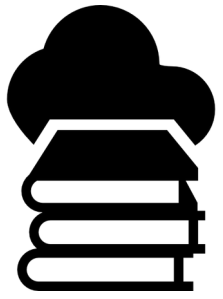
Machine Learning: The Basics

Springer, 2022

- <https://alexjungaalto.github.io/MLBasicsBook.pdf>
- <https://link.springer.com/book/10.1007/978-981-16-8193-6>



References



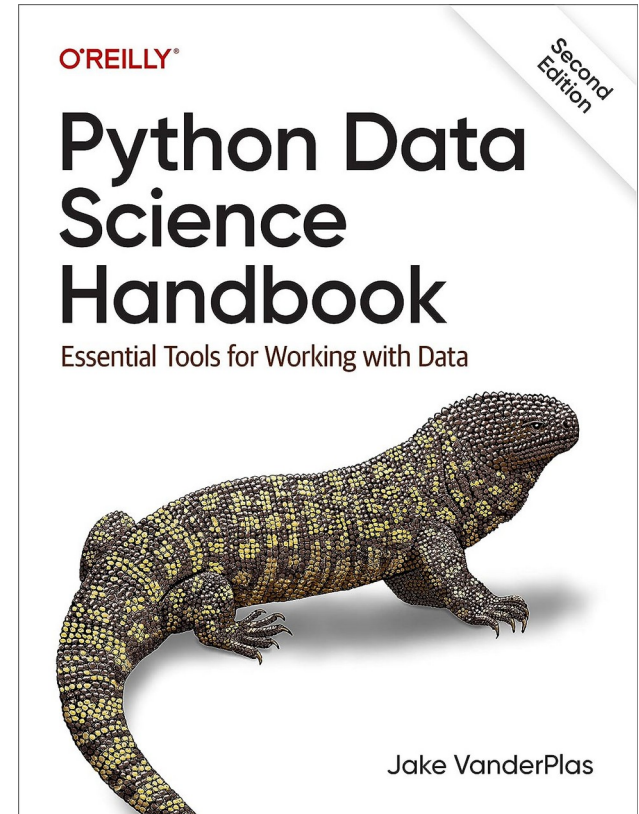
- For Python

- J. VanderPlas

Python Data Science Handbook:
Essential Tools for Working with Data

O'Reilly, 2016

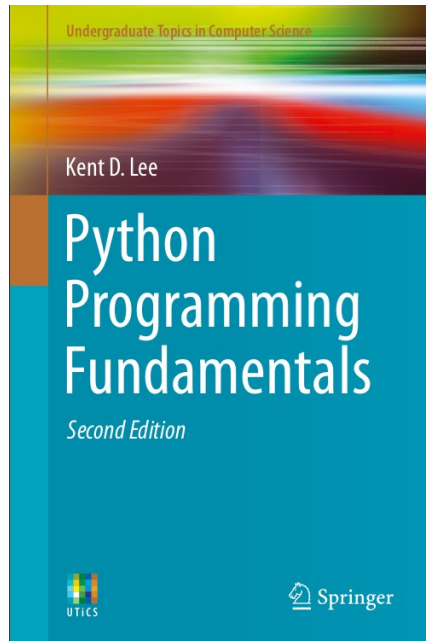
- <https://jakevdp.github.io/PythonDataScienceHandbook/>



References



- Two other books:

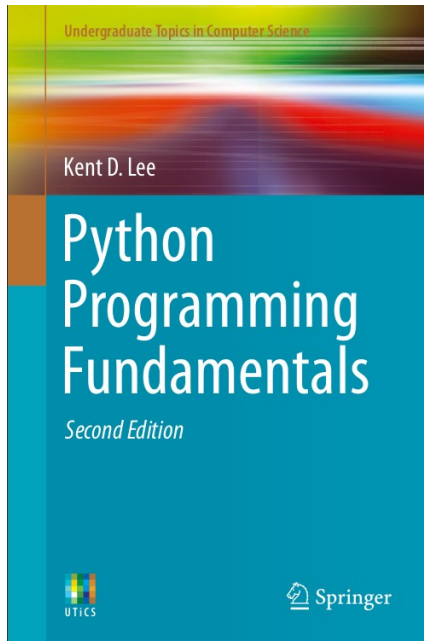


For beginning
programming with
Python

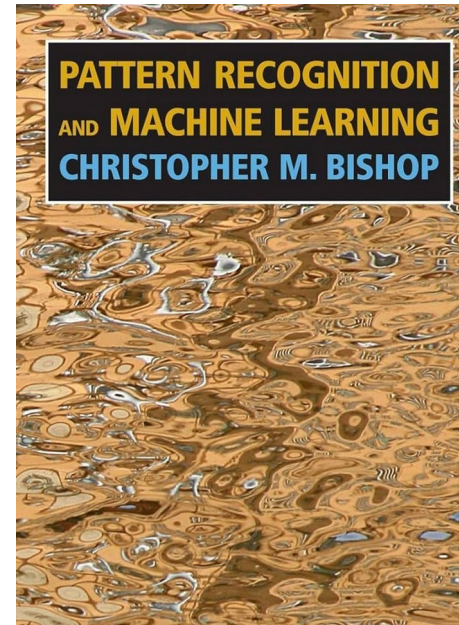
References



- Two other books:



For beginning
programming with
Python



For more math and
details related to ML

Laboratories and exercises



- Students can work individually or in groups
- Everything will be done in Python (and Jupyter Notebooks)
- Bring your own device: laptop, tablet, ...
- A browser and an Internet connection are enough
- We will give you access to the PoliTo cluster

Group project



- Large and complex tasks related to Machine Learning application to networking and cybersecurity case studies
- Students will work in groups of 3-4 people
- Projects will be assigned by mid of November
- You are encourage to interact with the professors and ask for feedbacks

Group project reports



- Each group has to write a report on the project assignment
- The report consists in:
 - A textual document (pdf) – with template provided
 - Source code: Jupyter notebooks and/or Python scripts
- The group report must be uploaded on Moodle

Group project report deadlines



- Deadline for winter session: **Monday 20/01/2025**
- Deadline for summer session: Wednesday 11/06/2025
- Deadline for autumn session: Wednesday 03/09/2025

Exam: project report evaluation



- The teachers will evaluate each report (maximum 30/30)
 - If the grade is insufficient (less than 18/30), the group **must update** the insufficient reports by the next deadline
 - If the grade is sufficient (at least 18/30) but the students are not satisfied, the whole group **can** reject the grade within 48 hours and develop a new project (assigned by the teacher) by the next deadline

Exam: project report evaluation



- Each student will receive a report to correct/evaluate from one of the other groups (through Moodle)
 - The student will have around 10 days to submit the corrections
 - The evaluation given to the report will **not** be considered for the evaluated group's grade
 - According to how the report was corrected/evaluated, each student (evaluator) can receive bonus points (up to 2/30)

Exam: project report evaluation



- The projects evaluation will be valid for 2 academic years for all students
 - Students that repeat the written exam do not have to prepare other reports
 - For 2024/2025 -> up to September 2026



Exam: written part

- Each student will need to pass a written exam (maximum 30/30 cum laude)
 - Topics discussed during the lectures and addressed during the exercises and laboratories
 - Theoretical questions and practical numerical exercises to solve
 - 90 minutes long
- Students **can** always repeat the exam
- Students with an insufficient grade (less than 18/30) **must** repeat the exam
- If the student do not submit the group report or it is insufficient, the grade of the written part will be kept (unless the student repeat the written exam)

Exam: final grade



- The final grade will be given by the **weighted average** of the written grade and the group's report grade:
 - Group's project report grade (**60%**, at least 18/30)
 - Individual written exam (**40%**, at least 18/30)
- The maximum grade will be 30 cum laude

Exam: Oral part



- The teacher **may request** an integrative oral test to confirm the obtained evaluations or for clarifying some aspects of the project and/or the written exam
- Involved students will be notified after the written exam

Any questions?

