



# UNIVERSITÀ DI PISA

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## CONTINUAL LEARNING

### ANTONIO CARTA

Anno accademico	2023/24
CdS	INFORMATICA
Codice	791AA
CFU	6

Moduli	Settore/i	Tipo	Ore	Docente/i
CONTINUAL LEARNING	INF/01	LEZIONI	48	ANTONIO CARTA

#### Obiettivi di apprendimento

##### *Conoscenze*

The course teaches how to design machine learning systems (with a strong focus on deep learning methods) that are robust to domain shifts and able to learn continuously in the presence of ever-changing data. The course will provide a characterization and overview of the several problems in this area, including transfer learning, online learning, continual learning, open set recognition, domain adaptation, meta learning.

The course is targeted at students specialized in Artificial Intelligence and Machine Learning. Previous attendance of a Machine Learning course and some knowledge of deep learning (ISPR course) is strongly recommended.

##### *Modalità di verifica delle conoscenze*

The evaluation consists of a final project and an oral examination:

- The final project is a nontrivial machine learning model that is relevant to the course' topics. Students can propose their own projects but the final topic must be approved beforehand with the professor.
- The oral examination consists of a set of questions to test the theoretical knowledge of the course.

##### *Capacità*

At the end of the course, the student will be able to:

- recognize the source of domain shift in a typical application with precise terminology and design an effective learning strategy for the problem.
- implement advanced and state-of-the-art continual learning models using popular frameworks.
- Understand and critically discuss the research literature, identifying strength and weaknesses of each approach.

##### *Modalità di verifica delle capacità*

The final project will assess the student's ability to discuss and implement a complex continual learning method.

##### *Prerequisiti (conoscenze iniziali)*

Students are expected to be familiar with:

- machine learning fundamentals ("Machine Learning" course);
- deep learning ("Intelligent Systems and Pattern Recognition" course);
- convex optimization, probability, calculus ("Computational Mathematics" course)

##### *Indicazioni metodologiche*

The course and all the supporting material will be in english. The slides, literature references and other supporting material will be provided in the course website

##### *Programma (contenuti dell'insegnamento)*

The topics of the course include:

- Online Learning
- Lifelong Learning / Continual Learning
- Meta-Learning
- Multi-Task Learning
- Transfer Learning
- Domain Adaptation
- Few-Shot Learning



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- Out-Of-Distribution Generalization
- Foundational Models and Generalization

### Bibliografia e materiale didattico

- Lifelong Machine Learning. Zhiyuan Chen and Bing Liu
- "An Introduction to Lifelong Supervised Learning" <https://arxiv.org/abs/2207.04354>
- Annotated bibliography and papers from the scientific literature

### Indicazioni per non frequentanti

Working students and other non-attending students will need to do a final project and an oral examination. The final project must be agreed upon with the professor beforehand, while the oral exam will include a presentation of the project and a test on the theoretical topics of the course.

### Modalità d'esame

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- The oral examination consists of a set of questions to test the theoretical knowledge of the course.

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