



UNIVERSITÀ DI PAVIA

Anno Accademico 2021/2022

MACHINE LEARNING

Anno immatricolazione	2020/2021
Anno offerta	2021/2022
Normativa	DM270
SSD	ING-INF/05 (SISTEMI DI ELABORAZIONE DELLE INFORMAZIONI)
Dipartimento	DIPARTIMENTO DI FISICA "ALESSANDRO VOLTA"
Corso di studio	SCIENZE FISICHE
Curriculum	Fisica delle tecnologie quantistiche
Anno di corso	2°
Periodo didattico	Secondo Semestre (01/03/2022 - 15/06/2022)
Crediti	6
Ore	59 ore di attività frontale
Lingua insegnamento	English
Tipo esame	ORALE
Docente	CUSANO CLAUDIO (titolare) - 2 CFU CUSANO CLAUDIO (titolare) - 4 CFU
Prerequisiti	Students are expected to have a basic knowledge of linear algebra, vector calculus, probability and statistics. They are also expected to be able to design and write simple computer programs.
Obiettivi formativi	At the end of the course students will be able to understand and discuss the principles of machine learning. They will be able to analyze a problem, and to design and implement a solution. They will be familiar with the most important techniques in the field and will be able to use them to build machine learning systems by using the Python programming language.
Programma e contenuti	After a general introduction to machine learning, the first lectures will focus on the main techniques used to tackle the problem of classification by supervised learning. More in detail the following topics will be presented:

- logistic regression;
- generalization and regularization;
- the perceptron algorithm;
- linear and non-linear Support Vector Machines;
- cross validation and model selection;
- feature selection and normalization;
- generative models and naive Bayes.

Artificial neural networks will be the main topic of the second part of the course. The lectures will cover:

- the biological inspiration;
- feed forward networks;
- the backpropagation algorithm;
- introduction to deep learning;
- convolutional neural networks;
- recurrent networks;
- sequence-to-sequence models;
- deep reinforcement learning (introduction).

The last part of the course will present some application domains in which machine learning models are widely used:

- document classification;
- audio processing;
- image recognition.

Metodi didattici

About two thirds of the course will be delivered in the form of lectures in which machine learning principles and techniques will be illustrated, also through the presentation of case studies. A third of the course will take place in a laboratory, where students will learn how to solve machine learning problems using the Python programming language.

Testi di riferimento

The course is based on a set of notes that are supplemented by a selection of articles.

Modalità verifica apprendimento

The exam consists of an interview in which the student will discuss the topics of the course. To assess their capabilities in solving small-scale machine learning problems, students are also required to provide their own solution to a short programming assignment.

Altre informazioni

Obiettivi Agenda 2030 per lo sviluppo sostenibile

[\\$lbl legenda sviluppo sostenibile](#)