UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Meccanica Superiore

2021-1-F4001Q078

Aims

At the end of the course, students will have acquired the following:

- *competence* : understanding of the techniques and methods related to the theory together with the ability to deepen specific topic independently;

- *skills*: useful to apply the theory to the investigation of some simple dynamical systems, to solve exercise of increasing level of difficulty, to analyse (even computationally) symbolic sequences of different origin, with particular attention towards applications to biological or literary data.

Contents

The course aims to provide the student with an in-depth knowledge of the theoretical framework underlying the analysis of symbolic sequences of different origin. The main contents include: statistical approach to dynamical systems, information sources, algorithmic information content.

Detailed program

The course is divided into three parts:

1. _____

2. Shannon entropy. Relative entropy, mutual information. Asymptotic equipartition. Entropy rate for stationary stochastic processes. Codes: Kraft inequality, optimal codes, efficiency of a code. Universal compressors. LZ78 algorithm.

3. _____

Prerequisites

No course of the Master Degree in Mathematics is strictly required for attending the present course. The only prerequisites are the mathematical knowledge, competences and skills acquired during the three-year grade, especially in the courses of Dynamical Systems and Classical Mechanics, Measure Theory, Probability.

Teaching form

During the COVID-19 emergency, videos of the lectures will be posted on-line. Some events will take place via webex meetings.

Textbook and teaching resource

There is not a single textbook covering all topics.

Many of the topics are covered by:

P.Walters, "*An Introduction to Ergodic Theory*", GTM 89, Springer-Verlag
T. M. Cover & J. A. Thomas, "*Elements of Information Theory*", 2nd ed., Wiley-Interscience

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Semester

II Semester.

Assessment method

Oral exam (of about 45 minutes) in which the student will be assessed both on mathematical aspects of the theory (definitions, statements, proofs), on the application of the theory (examples discussed during lectures), as well as on the ability to handle the topic independently. Optionally, the student can integrate the exam with the presentation of a project (the choice of the project should be discussed in advance with the instructor). In this case the relative weight of the project and of the oral examination is equal.

During the Covid-19 emergency period, exams will only be held online, using the WebEx platform. A public link will be available on the e-learning page of the course.

Office hours

Upon appointment.