



UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Algebraic and Computational Topology

2425-1-F4001Q123

Aims

The aim of the course is to take some classical topics in algebraic and computational topology of simplicial complexes, introducing homology theory, cohomology theory, with some recent applications.

Contents

Simplicial complexes, homology and cohomology of polyhedra, triangulable manifolds, applications to data analysis and dynamical systems.

Detailed program

Fundamental concepts: topological spaces, connectedness, compactness, function spaces, general ideas on Categories, push-out diagrams. Simplicial complexes. Chain complexes. Homology. Axioms for homology. Introduction to homological algebra. Category of polyhedra. Homology of polyhedra. Triangulable manifolds.

Cohomology ring, cap product. Triangulable manifolds. Surfaces and classification. Poincaré Duality. Fundamental group of polyhedra. Fundamental group and homology. Applications to: computational homology, persistent homology, data analysis and dynamical systems.

Prerequisites

Basic topics covered in bachelor courses of geometry and algebra

Teaching form

A hybrid teaching approach is used, that combines lecture-based teaching (DE) and interactive teaching (DI). DE involves detailed presentation and explanation of theoretical content. DI includes active student participation through exercises and problems, short presentations, group discussions, and group or individual work. It is not possible to precisely determine in advance the number of hours dedicated to DE and DI, as these methods are dynamically intertwined to adapt to the course's needs and promote a participatory and integrated learning environment, combining theory and practice.

Lectures (56 hours) are conducted in person and are primarily in Italian, and when necessary, in English.

Textbook and teaching resource

Ferrario, Piccinini, "[Simplicial structures in topology](#)". CMS Books in Mathematics, Springer, New York, 2011. xvi+243 pp. ISBN: 978-1-4419-7235-4

Munkres, J.R., "Elements of algebraic topology", Addison-Wesely Pub. 1984

Rotman J.J. "Advanced Modern Algebra", Graduate Studies in Mathematics, American Mathematical Society, 2010.

Rotman J.J. "Algebraic Topology. An Introduction" Graduate Texts in Mathematics, Springer-Verlag, 1998.

Semester

2S

Assessment method

Oral examination on the topics covered in the course, with in-depth analysis and re-elaboration of them with a personal perspective. The date and the content of the seminar, which is part of the exam, have to be first discussed with the teacher.

Office hours

By appointment.

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | QUALITY EDUCATION | INDUSTRY, INNOVATION AND INFRASTRUCTURE
