UAB
Universitat Autònoma de Barcelona

Topological Data Analysis

Code: 104419
ECTS Credits: 6

2025/2026

Degree	Type	Year
Computational Mathematics and Data Analytics	OP	4

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this
document.

Prerequisites

Students are required to have followed inear algebra, to have familiarity of the geometric notions of previous
years, and to have some knowledge of Python.

Objectives and Contextualisation

The first goal is to introduce the topological features of data (namely, shapes and patterns). We shall learn the
methodology do release this information, as well as some applications

Learning Outcomes

1. CM43 (Competence) Calculate the basic topological invariants relevant to data analysis.
2. KM35 (Knowledge) Define the concepts of topological space and continuity of applications.
3. SM42 (Skill) Distinguish, among the different mathematical tools, those that are feasible for
   implementation from those that are not.

Content

1 Introducció a la topologia
2 Complexos simplicials i homologia
3 Homologia persistent
4 Vectoritzacions
5 Una aplicació: periodicitat de sèries temporals
6 UMAP

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lectures	25	1	
Practices with computer	24	0.96	
Type: Supervised			
Tutoring and consultations	10	0.4	
Type: Autonomous			
Independent study and preparation	46	1.84	
Use of sorftware	30	1.2	

There is a theoretical part (including exercises sessions) and a practical part with computer.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Continued evaluation practices	40	10	0.4	CM43, KM35, SM42
First partial test theory	30	2.5	0.1	CM43, KM35, SM42
Presentació final de curs	30	2.5	0.1	CM43, KM35, SM42

Evaluations is organized as follows:Assessment is distributed as follows:
Theory first partial exam (30%)
Practice assignments (40%)
Final course presentation (30%)

Practice assignments will be submitted at the end of certain sessions, which will be announced in advance.
The theory exam and the final presentation are recoverable, but continuous assessment is not.
A minimum grade of 3.5 is required in each of the three components (exam, assignments, and presentation). If the minimum is not achieved in any of them (after recovering the exam or the presentation), the final grade will be the lower of 4.5 or the grade calculated using the weights above.

The single assessment will take place on the same day as the final course presentations. It will consist of submitting practice assignments (different from those completed during the course), the final presentation, and subsequently taking the theory exam. If necessary, the theory exam and the final presentation can be retaken, but the assignments cannot, just as in the continuous assessment model.

- Disclaimer: I have made my best to translate into English the Catalan version. In the unlikely case of differences between versions, we'll follow the Catalan one.

Bibliography

- Edelsbrunner, Herbert; Harer, John L. Computational topology. An introduction. American Mathematical Society, Providence, RI, 2010. xii+241 pp. ISBN: 978-0-8218-4925-5.
- G. Carlsson, Topology and data, Bull. Amer. Math. Soc. 46 (2009), 255-308.
- R. Kraft, Illustrations of Data Analysis Using the Mapper Algorithm and Persistent Homology, KTH Master's Thesis, 2016
- Gunnar Carlsson, Mikael Vejdemo-Johansoon, Topological data analysis with applications. 2022
- Tamal Krishna Dey, Yusu Wang, Computational topology for data analysis. 2022.
- Jean-Daniel Boissonnat, Frédéric Chazal, Mariette Yvinec, Geometric and Topological Inference, to appear in Cambridge University Press (available at https://inria.hal.science/hal-01615863/)
- https://giotto-ai.github.io/gtda-docs/0.3.0/library.html

Software

Compùter practical sessions shall be in Python. We shall use giotto-tda, built on top of scikit-learn

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	first semester	morning-mixed
(TE) Theory	1	Catalan	first semester	morning-mixed