EMAp Summer Course

Topological Data Analysis with Persistent Homology

https://raphaeltinarrage.github.io/EMAp.html

Lesson 0: Introduction
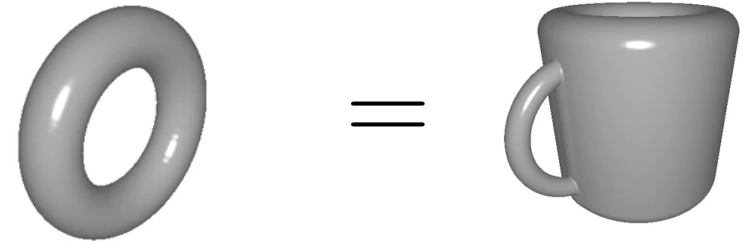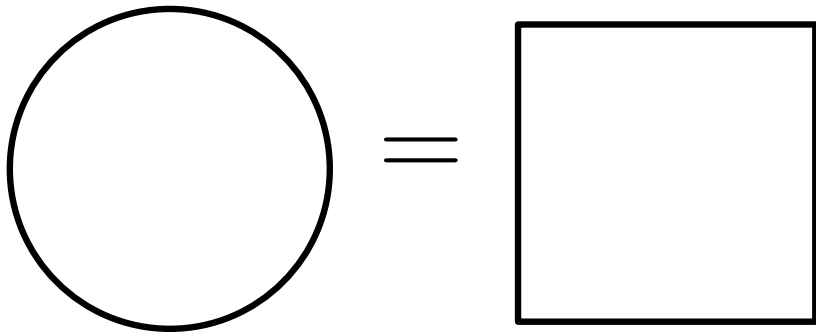
To give a short (but intense) overview of Topological Data Analysis.
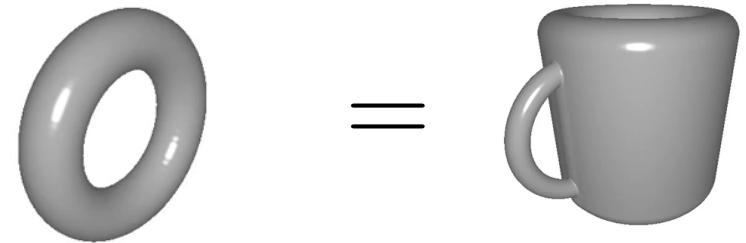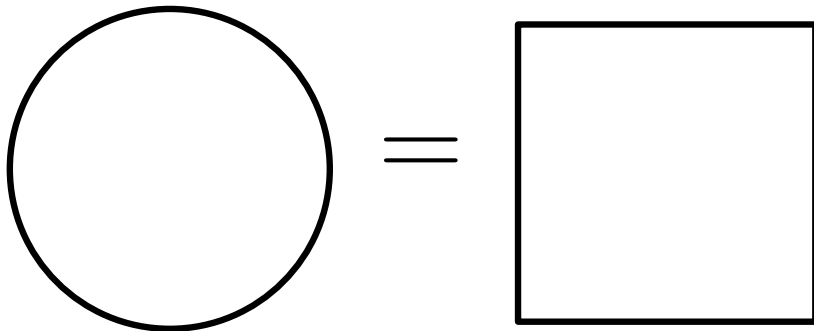
↳ adopt a *topological point of view* on geometry

use this point of view to analyse data

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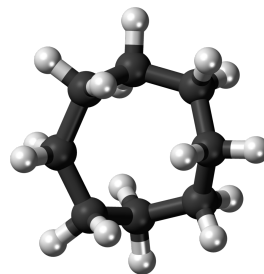To give a short (but intense) overview of Topological Data Analysis.

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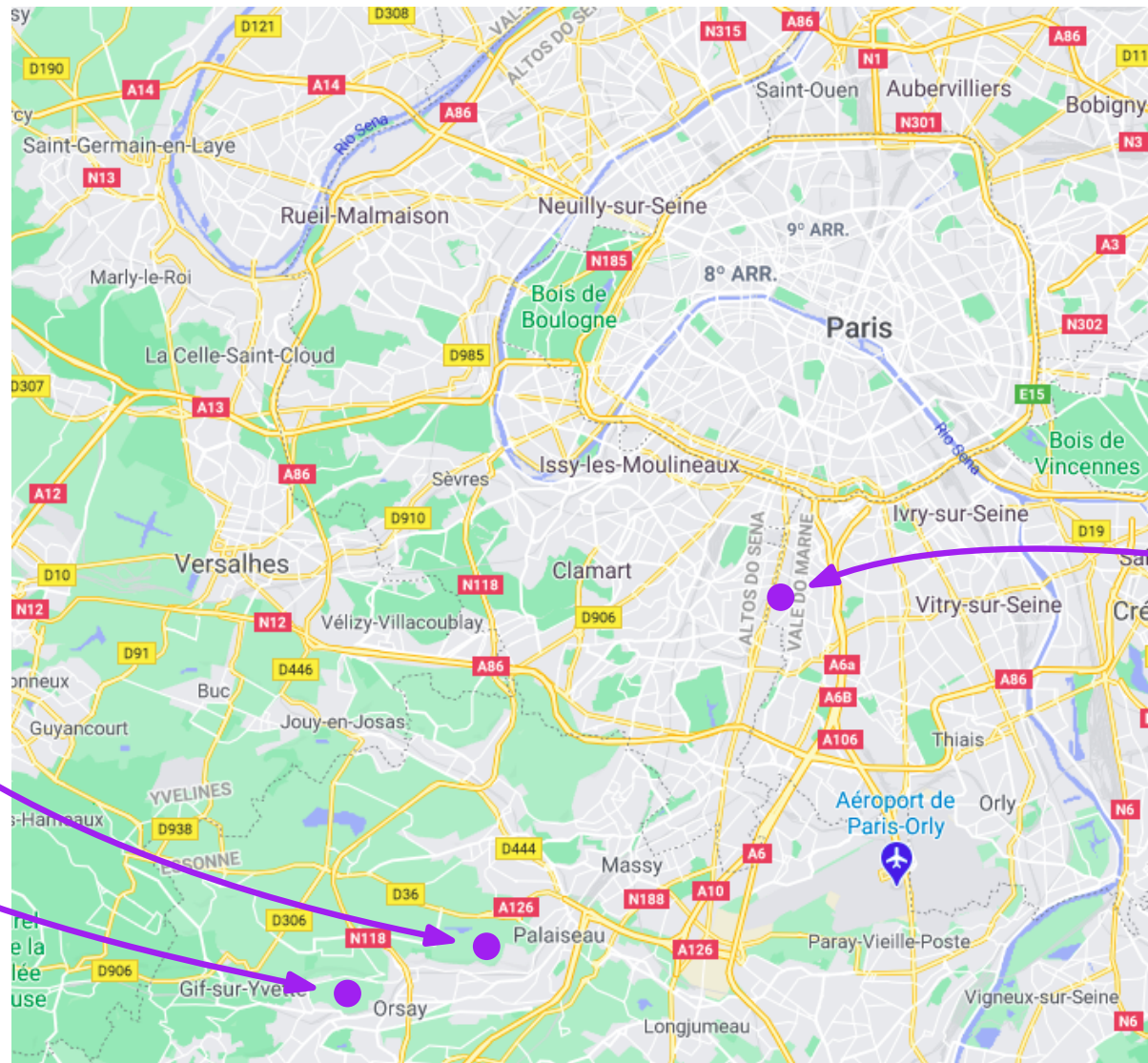

use this point of view to analyse data

medicine
chemistry
images

I obtained my PhD in October 2020: *Topological inference from measures and vector bundles*.

I have been hired in FGV EMAp as a specialist of Topological Data Analysis.

Course requirements

There will be no exam.

What you can do:
- Interrupt me anytime during the lesson (ask question, ask me to repeat or speak slower, ...)
- Get in touch with me anytime by email
- Send your homework so I correct them

What you cannot do:
- Not doing your homework
- Being afraid of interrupting me

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What I have to do:
- Being available for questions
- Giving you interesting and understandable lessons

Information available at

$$https://raphaeltinarrage.github.io/EMAp.html$$

First week:
- Topological spaces
- Homeomorphisms
- Homotopies
- Simplicial complexes + Python Tutorial

Second week:
- Simplicial Homology
- Simplicial Homology II
- Topological Inference
- Python Tutorial

Third week:
- Persistence modules - Decomposition
- Persistence modules - Stability
- Python Tutorial

Schedule

Information available at

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First week: ──────────────────────────────⟶ General topology
- Topological spaces ★★★
- Homeomorphisms ★★
- Homotopies ★★
- Simplicial complexes + Python Tutorial ★

Second week: ──────────────────────────────⟶ Algebraic topology
- Simplicial Homology ★★★
- Simplicial Homology II ★★
- Topological Inference ★
- Python Tutorial ★

Third week: ──────────────────────────────⟶ Persistent homology
- Persistence modules - Decomposition ★★★
- Persistence modules - Stability ★★
- Python Tutorial ★

★   Abstract
★★   Very abstract
★★★   Very very abstract

We will code in Python. Please install:

- Jupyter Notebook
- NETWORKX
- the GUDHI library:

    `https://gudhi.inria.fr/python/latest/installation.html`

───────────▶ you should be able to run the following notebook before the first tutorial:

`https://github.com/raphaeltinarrage/EMAp/blob/main/Tutorial0.ipynb`

Webpage of the course:

`https://raphaeltinarrage.github.io/EMAp.html`

The pdf of the course is available at:

`https://raphaeltinarrage.github.io/files/EMAp/SummerCourseTDA.pdf`

If you want to go (way) further in algebraic topology, have a look at Hatcher's book:

`https://pi.math.cornell.edu/~hatcher/AT/AT.pdf`

If you want to explore the GUDHI library:

`https://github.com/GUDHI/TDA-tutorial`
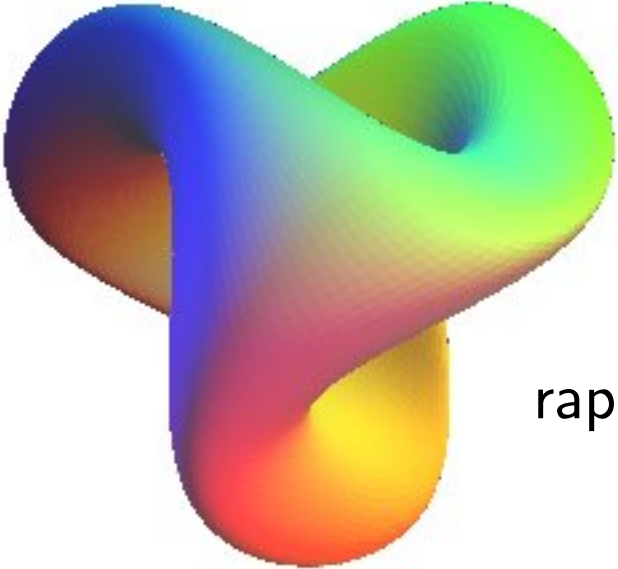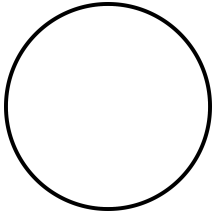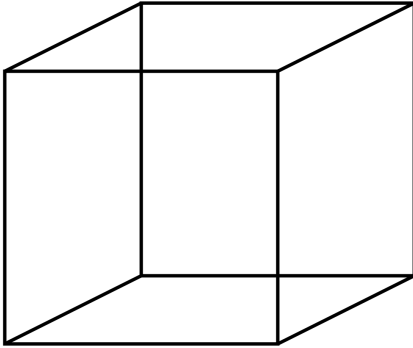
Exercise 0: Send me an email answering the following questions:
- Do you understand English well?
- Have you ever studied topology?
- Have you ever coded? In which language?
- Any remarks?

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