EMAp Summer Course

Topological Data Analysis with Persistent Homology

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

Lesson 0: Introduction

Last update: January 17, 2021

Aim of this course

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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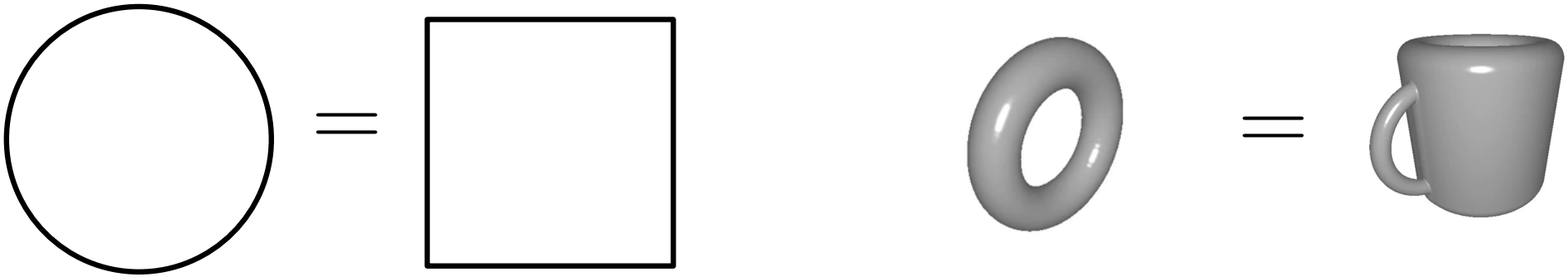

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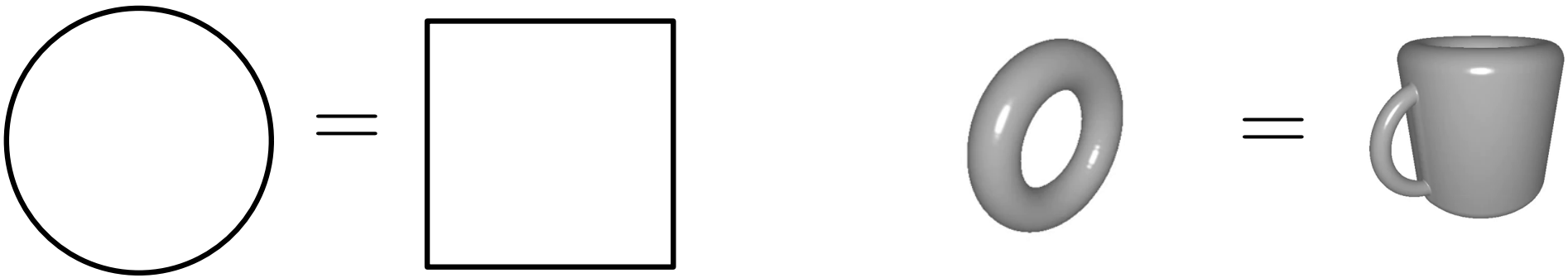

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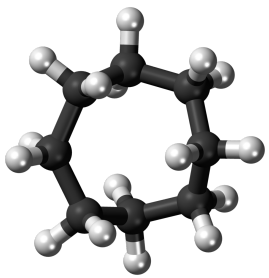
medicine

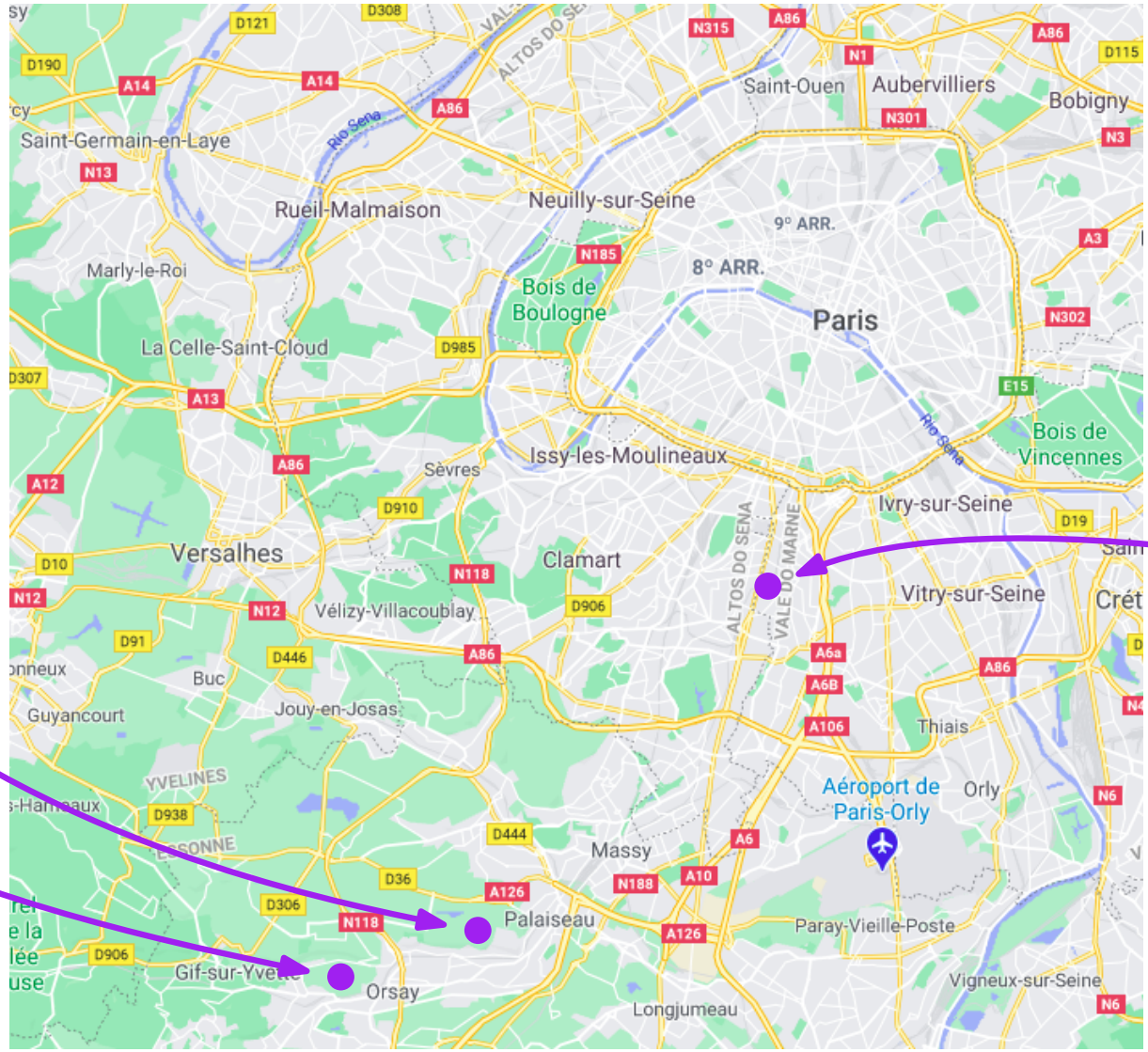


chemistry

images

About me

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 homeworks 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

Schedule

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

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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

Python coding

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`

References

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:

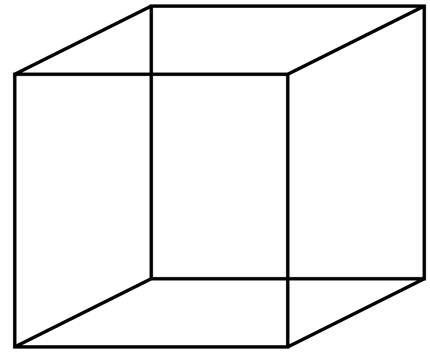
`https://github.com/GUDHI/TDA-tutorial`

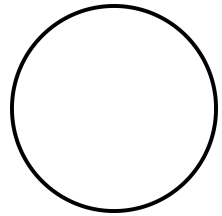
First homework

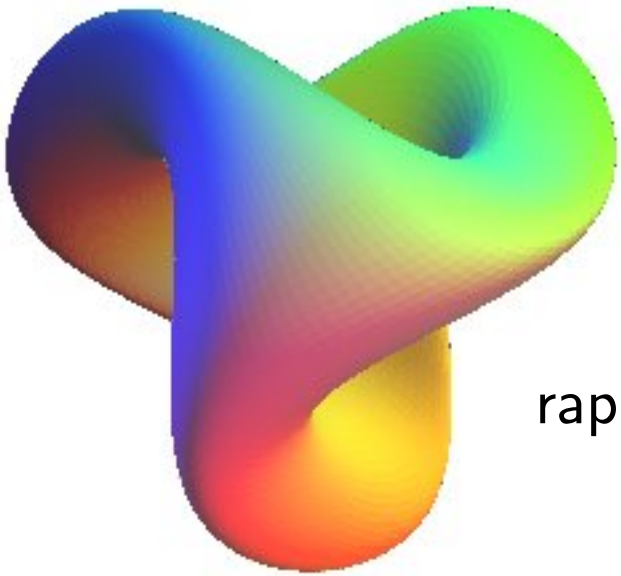
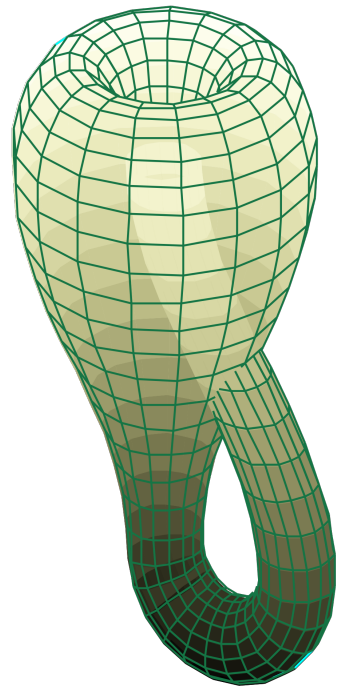
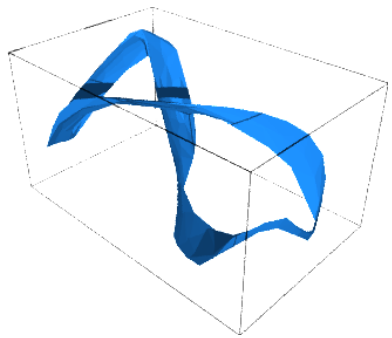
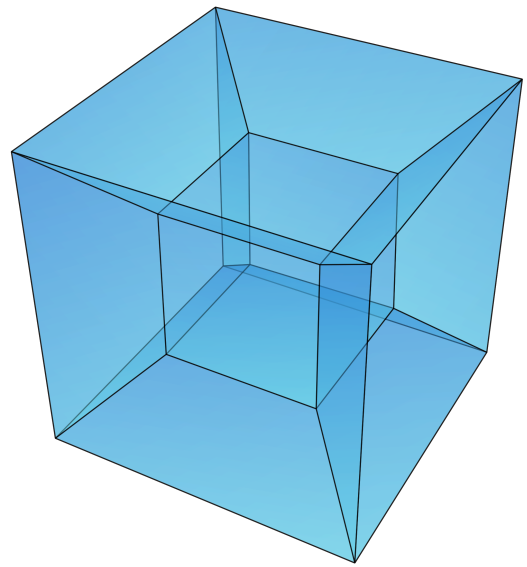
Exercise 0: Send me an email answering the following questions:

- Do you understand English well?
- Have you ever studied topology?
- Have you ever coded? In which language?
- Any remarks?

raphael.tinarrage@fgv.br



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