Topological Data Analysis and Persistence Theory

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Preparation

Assumed background

If you are not familiar with any of these topics, or have forgotten about them, then please look them up on Wikipedia, for example, before the conference.

Linear algebra: vector space; linear map; matrix; kernel, image, cokernel, and rank of a linear map; rank-nullity theorem; row reduction of a matrix; (real) inner product space; (real) Hilbert space; the sequence space, ℓ^2; the space of square-integrable functions, L^2

Statistics: statistical hypothesis testing; p value

Topology: simplicial complex; abstract simplicial complex; simplicial map; simplicial homology (with coefficients taken to be in a field instead of being integers so that one obtains vector spaces instead abelian groups)

Category theory: category; functor; natural transformation

Preparation for the lab sessions

Install R and RStudio. Download and install the following free software on your laptop. First R from `https://cran.rstudio.com/` and then RStudio Desktop from `https://www.rstudio.com/products/rstudio/download/`.

Introduction to R. Work through the following R introduction by typing (or copying and pasting) commands from `https://www.r-tutor.com/r-introduction` into the console in RStudio.

Suggested reading

To obtain a thorough background, it is recommended that you read (or skim) the beginning of one of the following two excellent recent books.

For the mathematically inclined reader: Chapters 1 and 2 in Topological Data Analysis for Genomics and Evolution, by Raúl Rabadán and Andrew Blumberg, Cambridge University Press, 2020.

For the computationally inclined reader: Chapters 1–3 in Computational Topology for Data Analysis, by Tamal Krishna Dey and Yusu Wang, Cambridge University Press, 2022. `https://www.cs.purdue.edu/homes/tamaldey/book/CTDAbook/CTDAbook.pdf`