# Topological Data Analysis

24 November 2022

## Exercise

Draw a persistent homology barcode and a persistence diagram for the Vietoris–Rips filtration of the following point cloud in $\mathbb{R}^2$:

$$X = \{(1,1),\ (1,2),\ (1,3),\ (2,1),\ (2,3),\ (3,1),\ (3,2),\ (3,3)\}.$$

*Please deliver through Campus Virtual as a pdf file before December 1 at 10:00.*

## Longer exercise (optional)

Draw landscape functions and a persistence silhouette for $H_1$ of the Vietoris–Rips persistence module of the following point cloud in $\mathbb{R}^3$:

| | | | |
|---|---|---|---|
| $(1.05, 2.00, 2.16)$ | $(2.96, 1.84, 2.09)$ | $(2.49, 2.77, 1.87)$ | $(1.99, 2.42, 2.82)$ |
| $(1.59, 1.42, 2.66)$ | $(2.27, 1.59, 1.16)$ | $(1.69, 1.24, 2.60)$ | $(2.22, 2.76, 2.53)$ |
| $(2.50, 2.74, 2.07)$ | $(2.55, 1.59, 1.30)$ | $(1.80, 1.15, 1.47)$ | $(1.31, 2.40, 1.44)$ |
| $(1.92, 1.06, 1.64)$ | $(2.29, 1.97, 1.01)$ | $(2.25, 2.94, 2.29)$ | $(2.38, 2.57, 2.71)$ |
| $(1.19, 1.83, 1.55)$ | $(1.53, 2.80, 2.24)$ | $(1.52, 2.82, 1.81)$ | $(1.66, 2.58, 2.66)$ |
| $(2.05, 1.76, 2.98)$ | $(1.41, 1.96, 1.29)$ | $(1.70, 2.51, 2.81)$ | $(1.79, 1.74, 2.88)$ |
| $(2.89, 1.84, 2.16)$ | $(2.16, 1.63, 1.08)$ | $(1.62, 1.27, 2.63)$ | $(2.91, 2.27, 2.29)$ |
| $(1.05, 2.05, 1.59)$ | $(2.60, 1.91, 2.82)$ | $(1.21, 1.68, 2.64)$ | $(1.67, 3.00, 1.80)$ |
| $(1.76, 1.09, 2.21)$ | $(0.99, 1.66, 2.29)$ | $(2.57, 1.95, 1.17)$ | $(1.31, 1.45, 2.63)$ |
| $(0.99, 1.90, 1.84)$ | $(2.88, 2.63, 2.05)$ | $(2.13, 1.96, 1.08)$ | $(2.62, 2.76, 2.47)$ |
| $(2.35, 2.64, 2.69)$ | $(2.52, 2.94, 2.19)$ | $(1.68, 1.25, 2.55)$ | $(1.03, 2.11, 1.74)$ |
| $(2.49, 2.15, 2.89)$ | $(1.37, 2.46, 1.35)$ | $(2.21, 1.05, 2.40)$ | $(1.20, 1.73, 2.36)$ |
| $(1.67, 1.15, 1.95)$ | $(2.45, 2.27, 1.14)$ | | |

The following resources of the R package TDA can be used:

https://rdrr.io/cran/TDA/man/landscape.html

https://rdrr.io/cran/TDA/man/silhouette.html

*Longer exercises can be delivered until December 20.*