



**KTH Computer Science
and Communication**



TOPOSYS

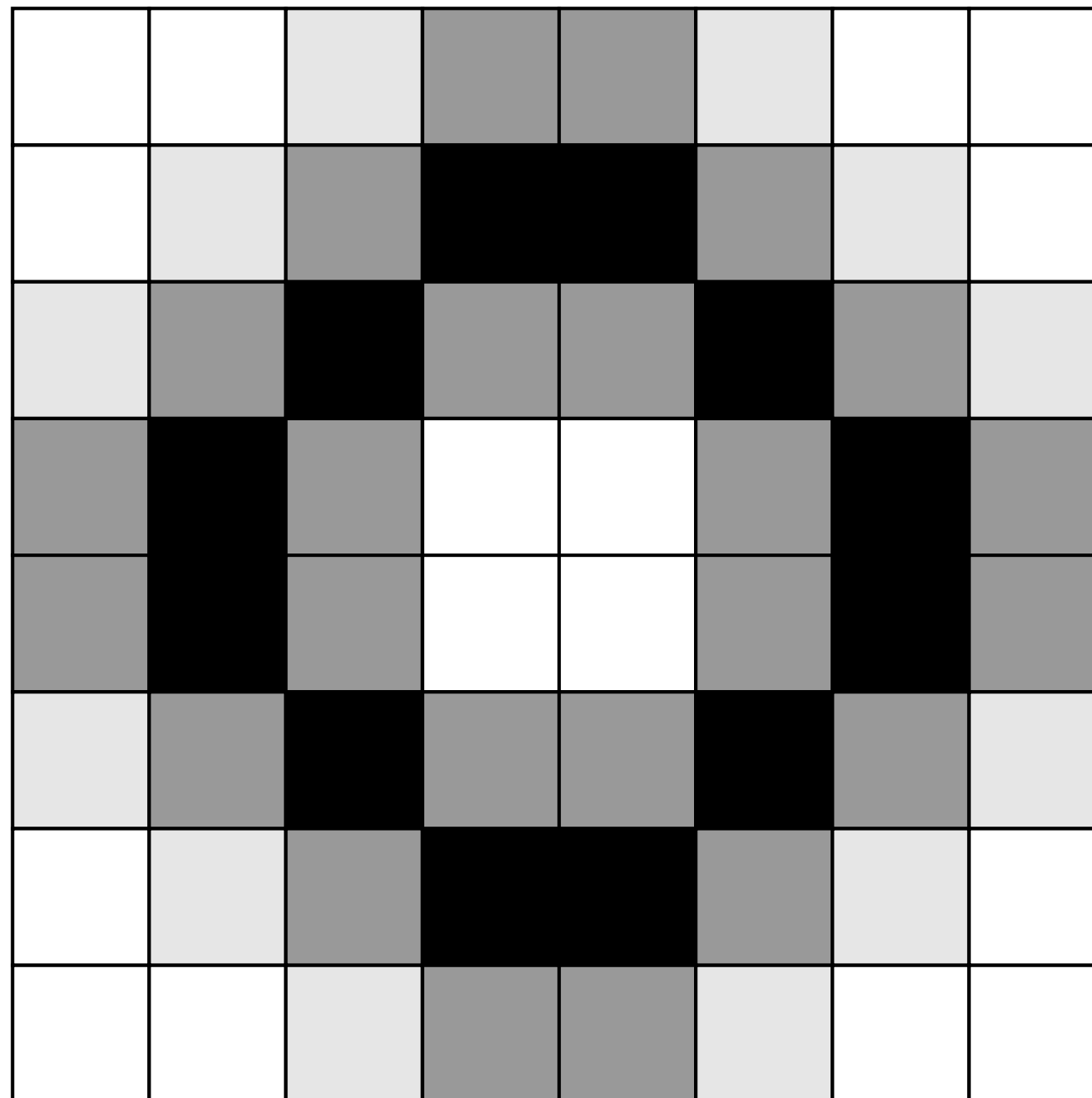
Topological Data Analysis

A software survey

Mikael Vejdemo-Johansson
Computer Vision and Active Perception Laboratory

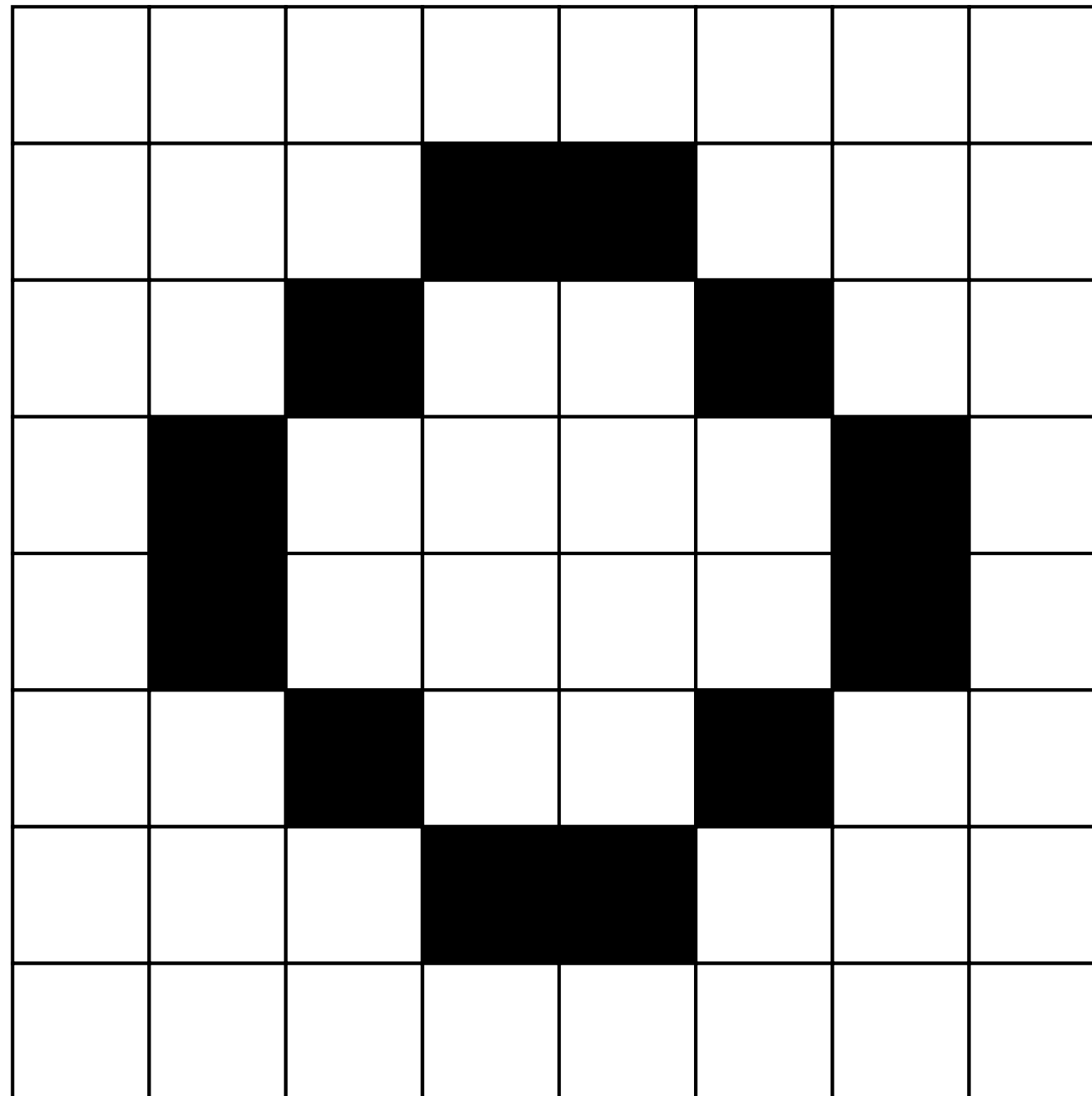
Cubical homology

Pixels and voxels



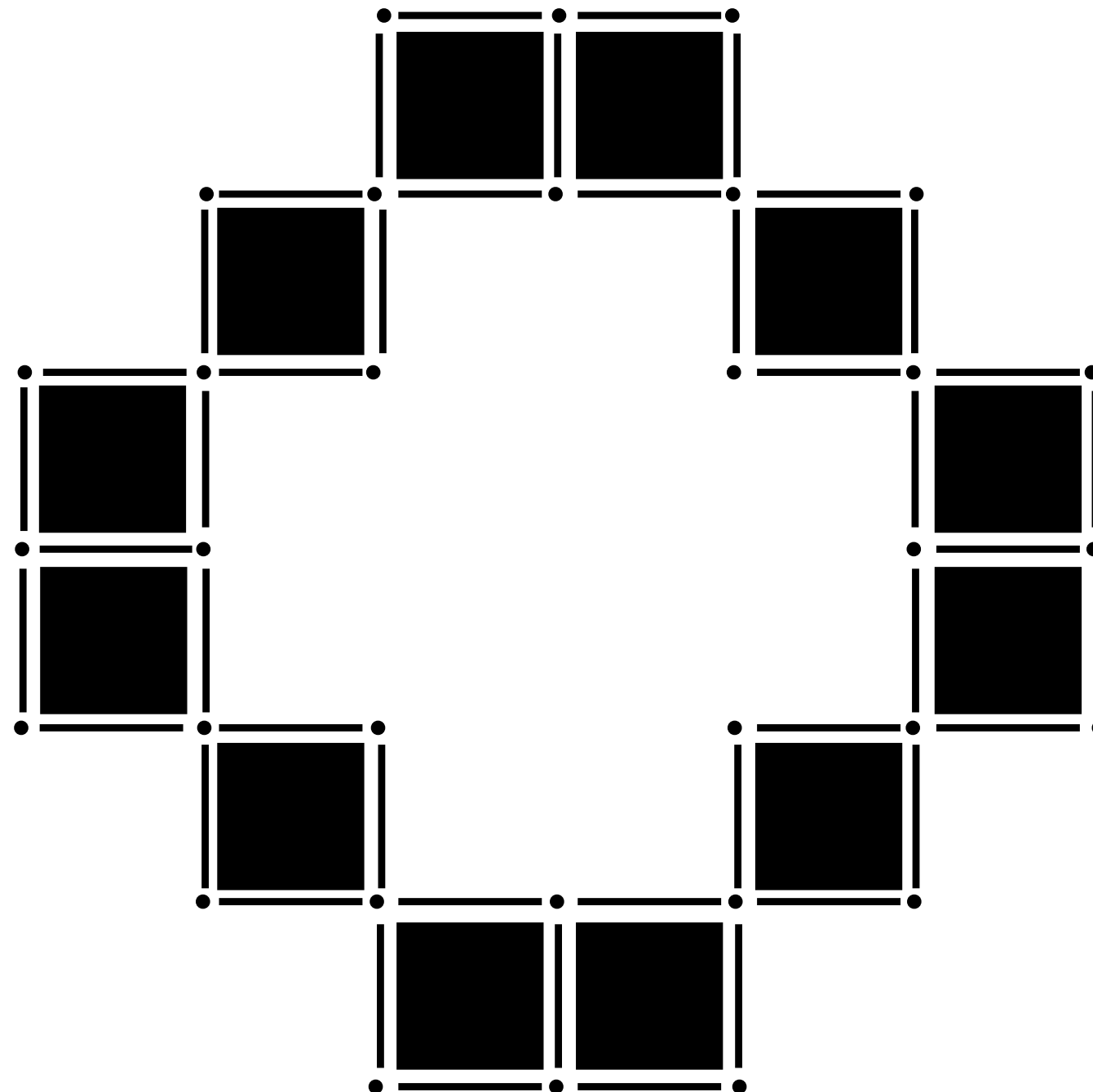
Cubical homology

Pixels and voxels



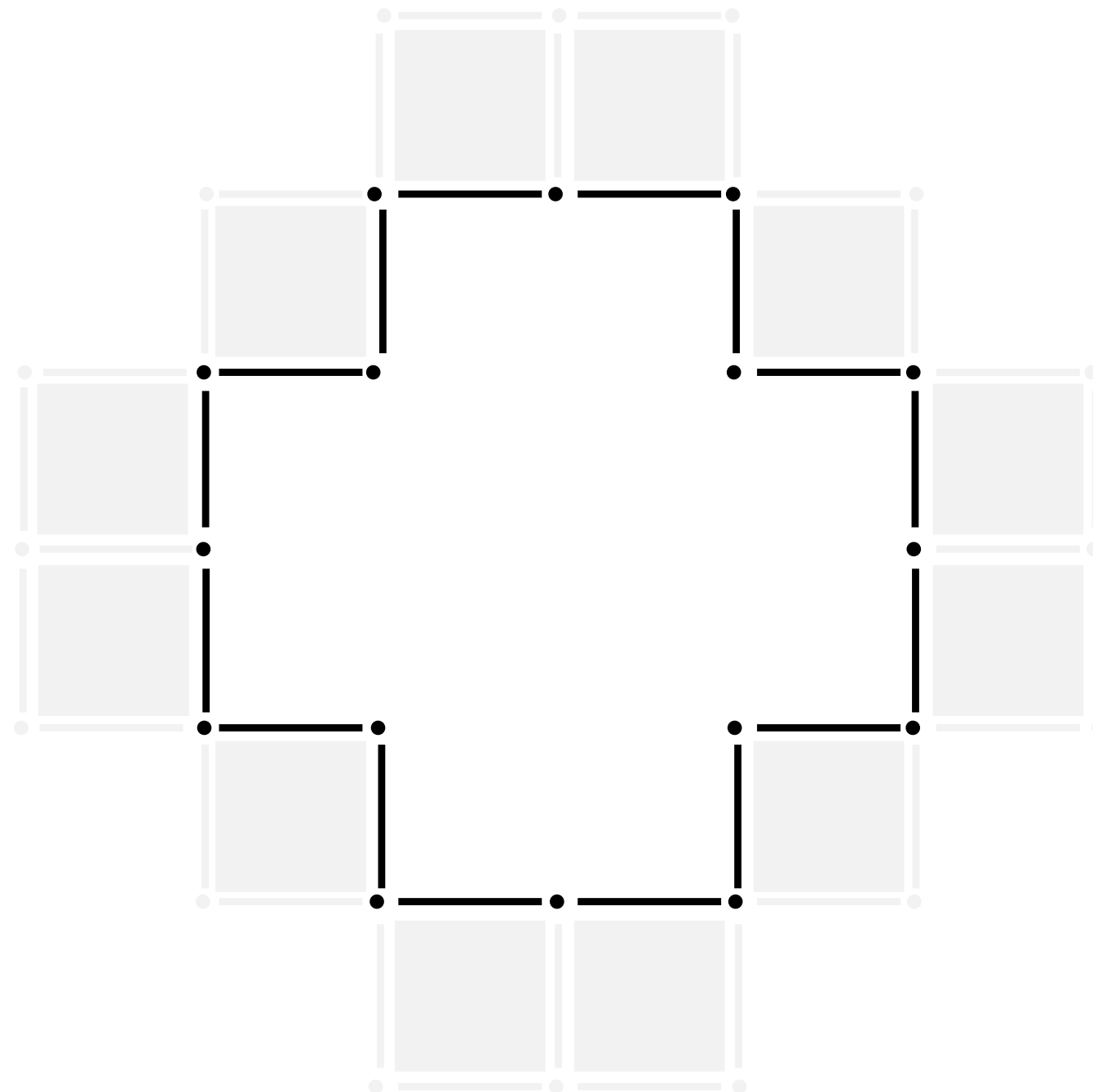
Cubical homology

Pixels and voxels



Cubical homology

Pixels and voxels



Chomp

- Cubical homology — with or without persistence
- GUI, command line interface, and C++ library
- Encodes a wide range of both space and mapping analyses
- Includes a wide range of homotopy-based optimizations

<http://chomp.rutgers.edu/Software.html>



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HAP

- Module for the GAP computer algebra system
- Primarily focused on research programming into group cohomology
- Includes support for cubical persistent homology

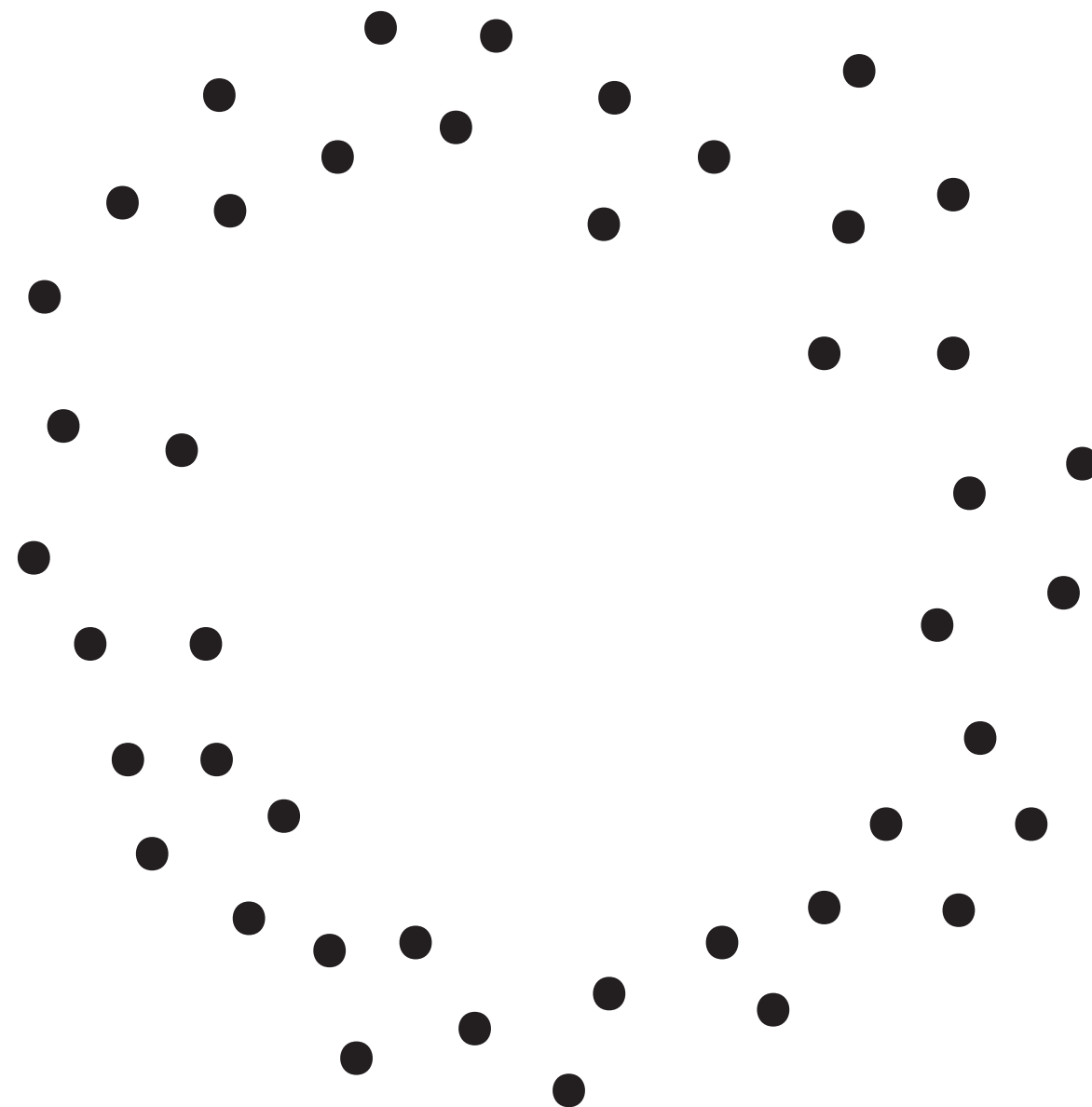
<http://www.gap-system.org/Packages/hap.html>



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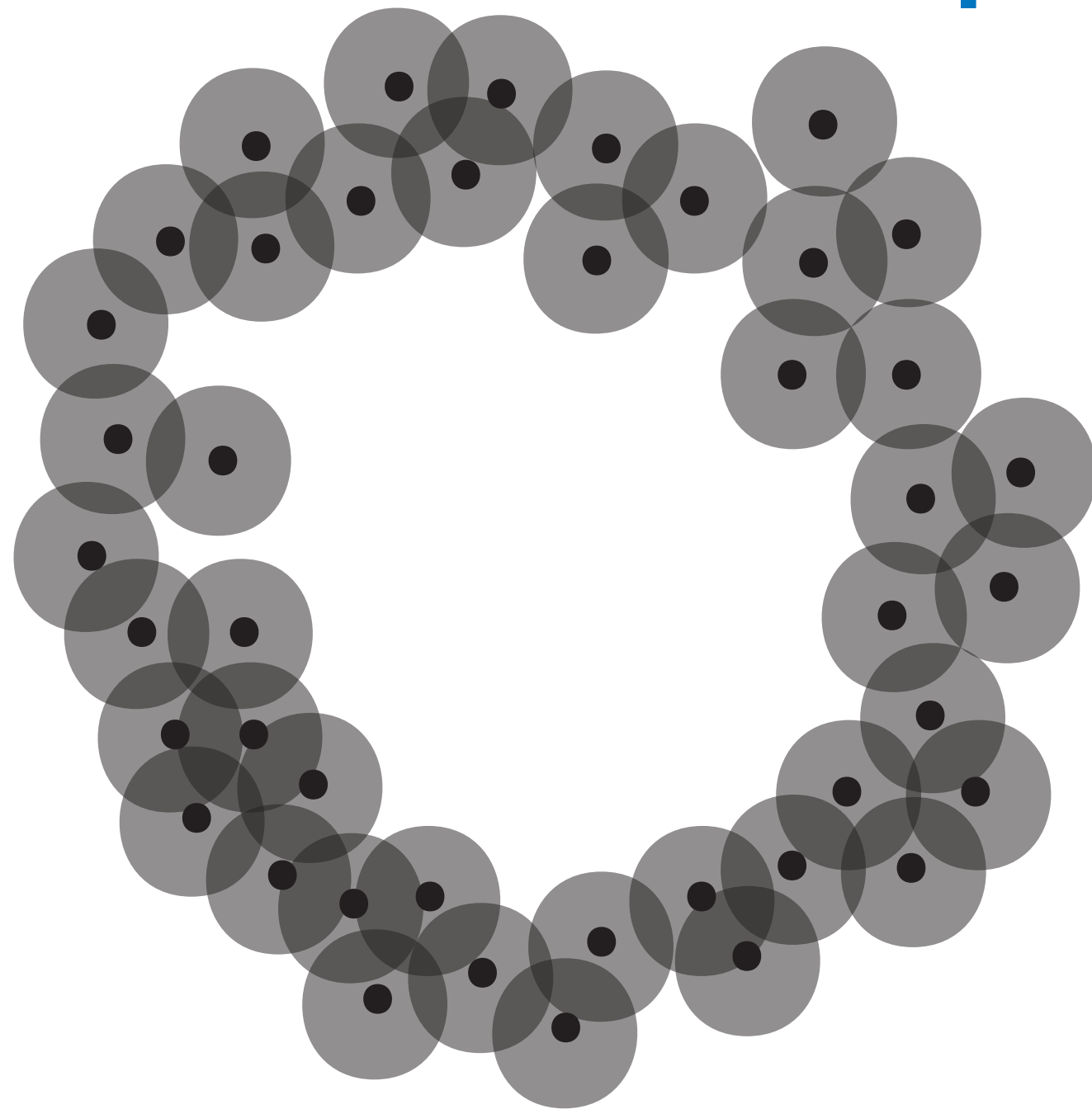
Persistent (co)homology

Point cloud topology



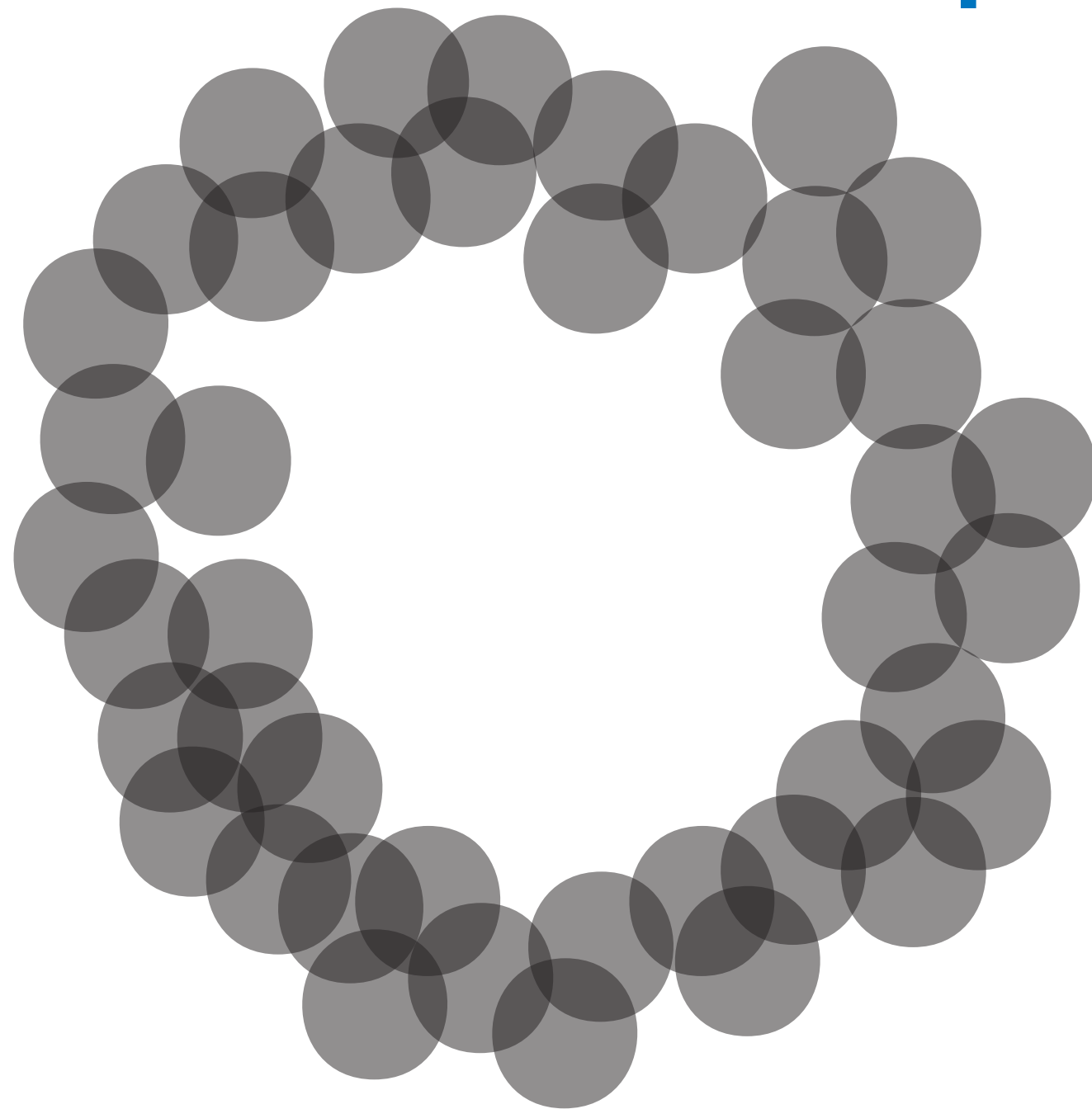
Persistent (co)homology

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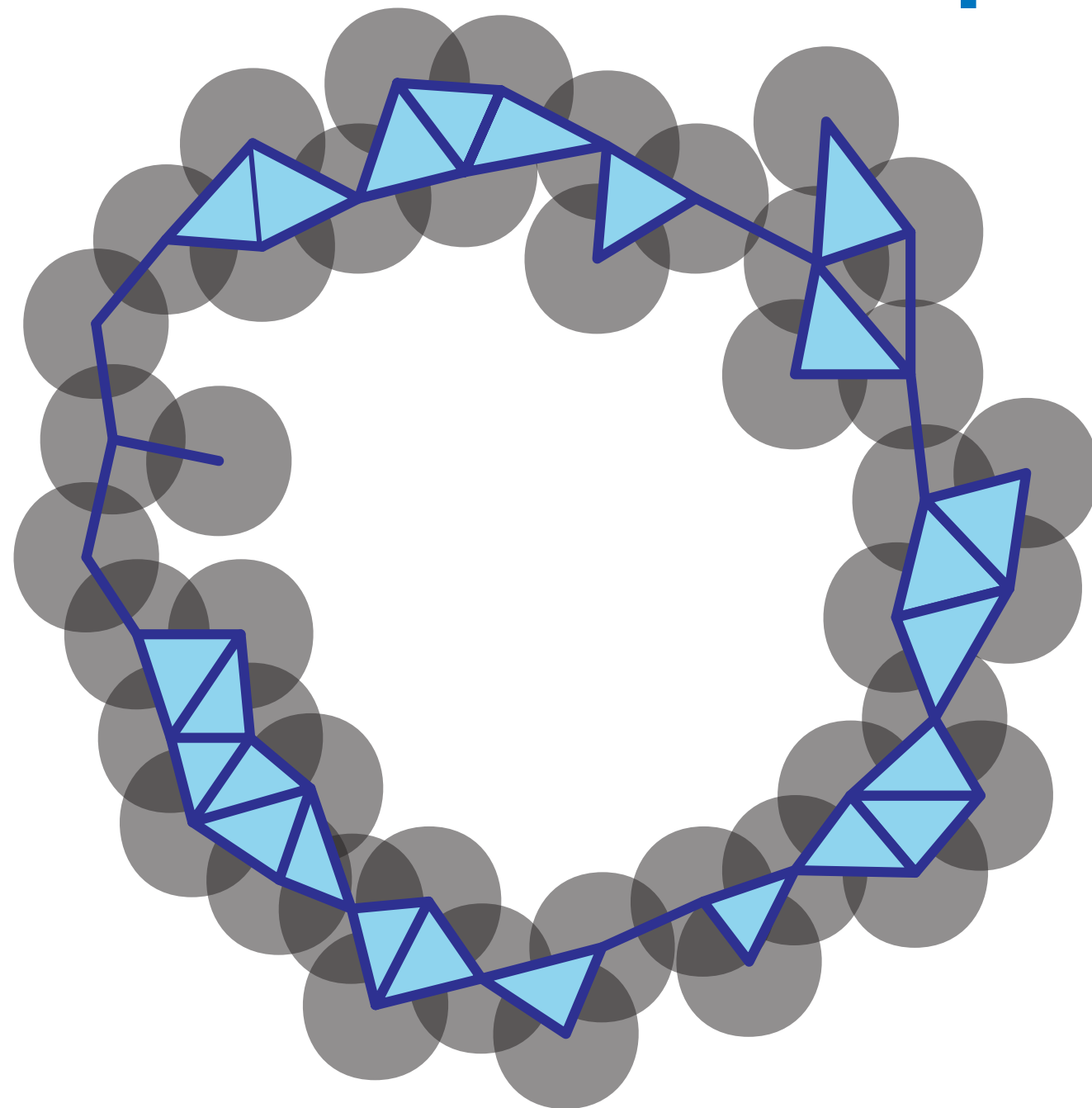
Persistent (co)homology

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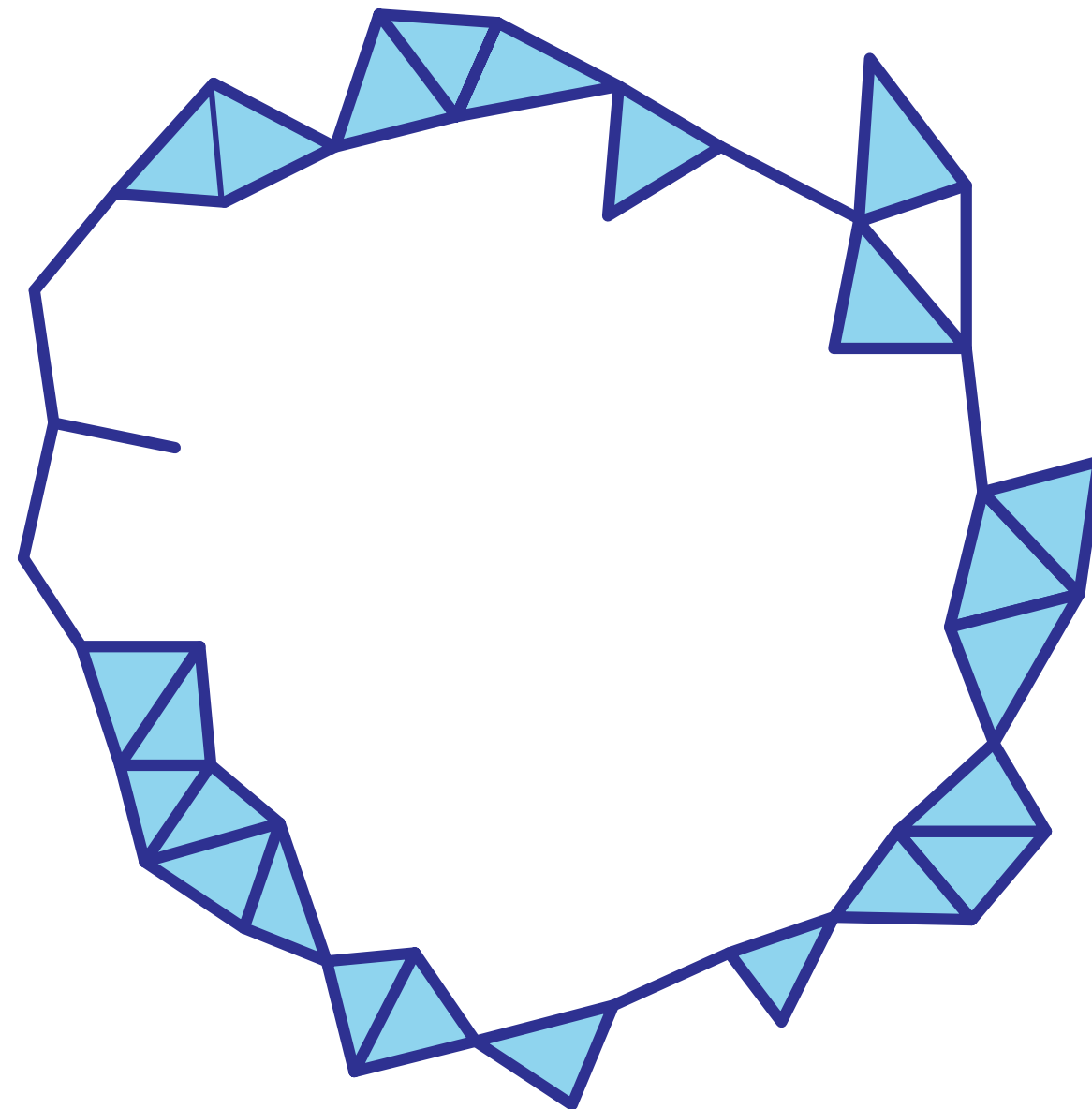
Persistent (co)homology

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Persistent (co)homology

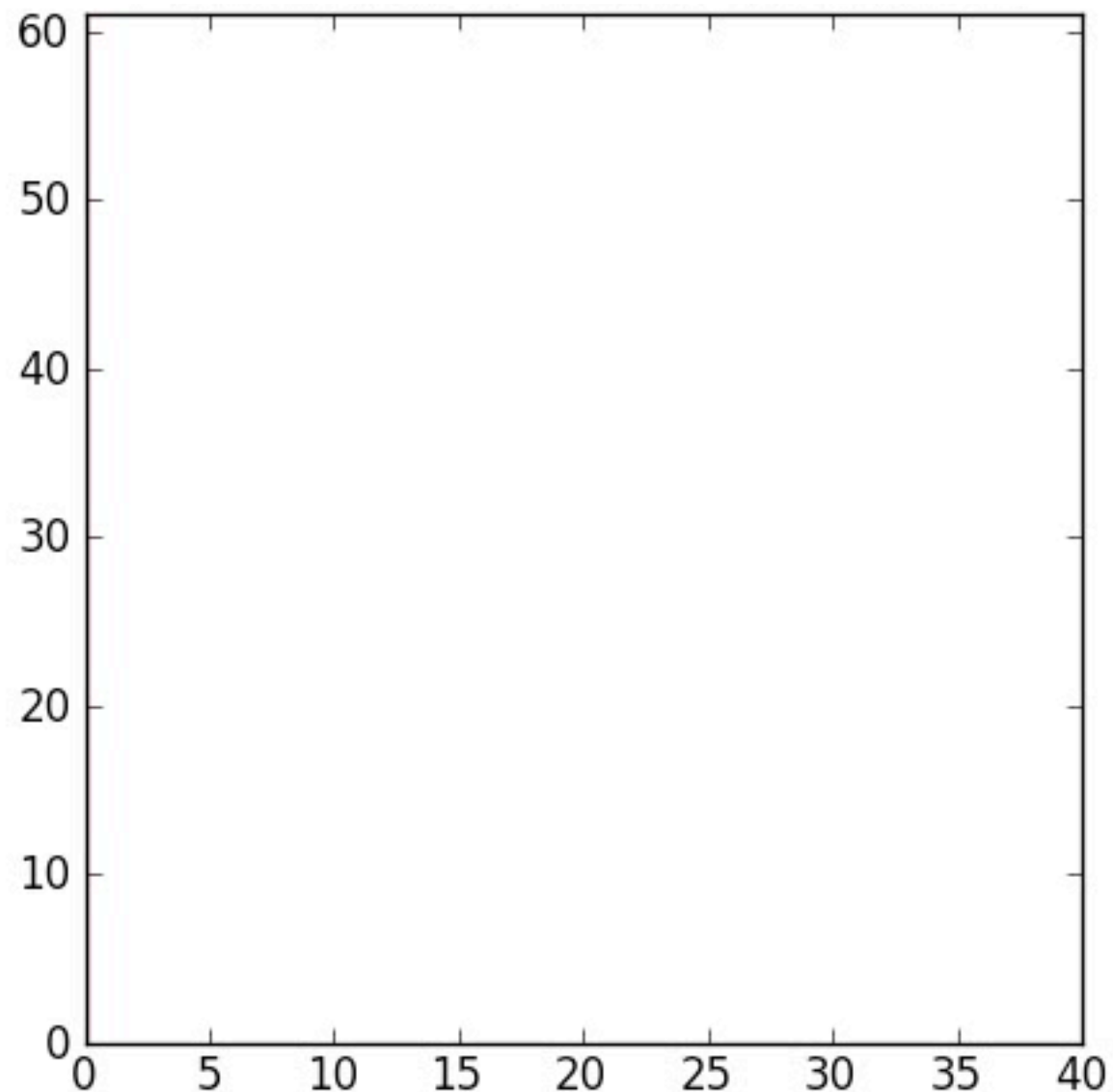
Point cloud topology



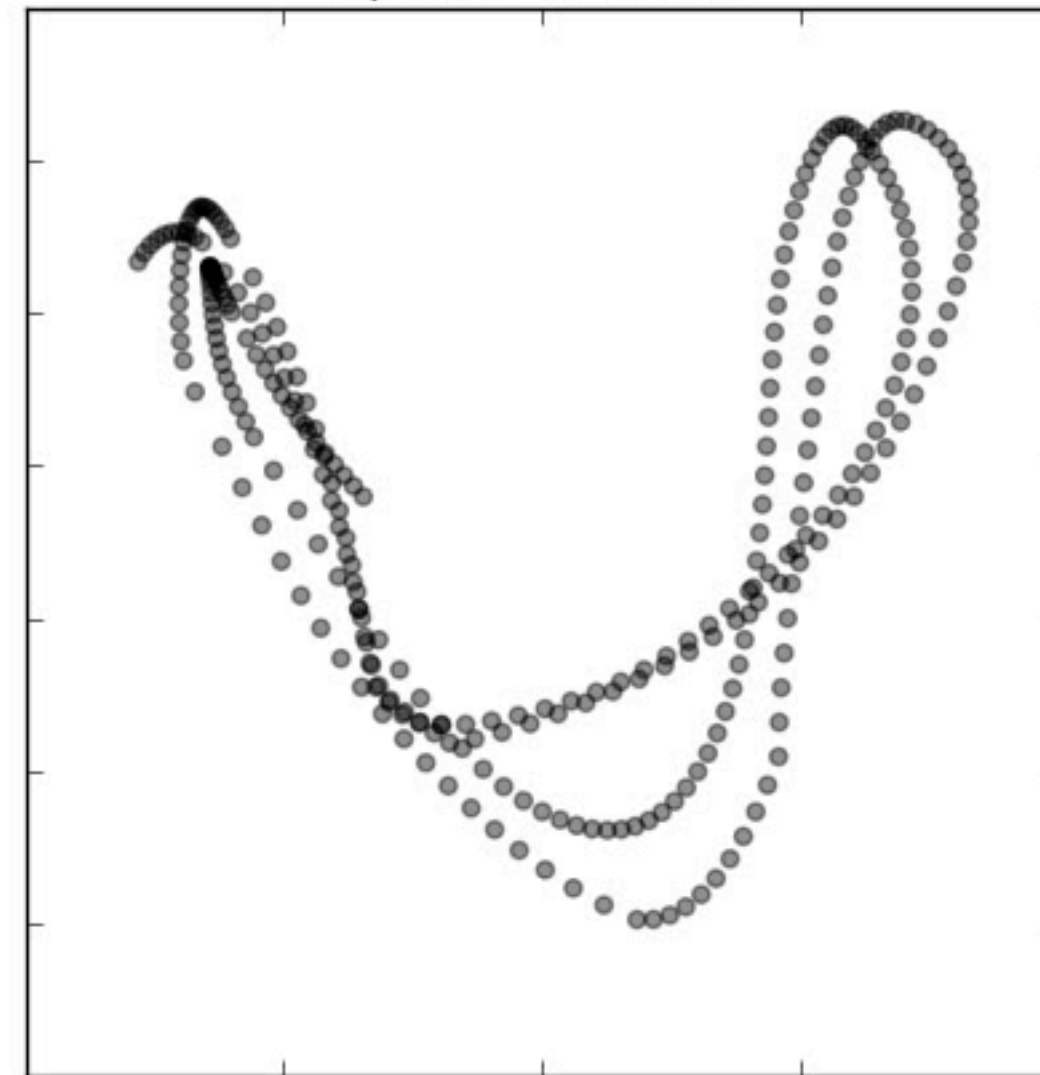
Persistent (co)homology

Point cloud topology

1-dimensional features barcode



Epsilon is 0.000



Plex / jPlex / javaPlex

- Family of software packages developed at Stanford, adapted for use from Matlab
- Implements a range of algorithms — both for constructing complexes and computing their persistent (co)homology
- Current **recommended** incarnation: javaPlex
<http://javaplex.googlecode.com>

Dionysus

- Library for computational homology
- Contains example applications implementing persistent homology and cohomology, as well as time-varying persistence (vineyards) & low-dimensional optimizations
- Relies on Boost, and optionally on CGAL for low-dimensional optimizations
- Includes a Python interface through Boost::Python

<http://www.mrzv.org/software/dionysus>

pHat

- Recent released software package and C++ library
- Implements several optimizations to the persistence algorithm
- Does not (currently) construct the complex for you
- (currently) restricted to \mathbb{Z}_2 coefficients
- Some support for SMP parallelization using OpenMP

<http://phat.googlecode.com>

Perseus

- Cubical and simplicial complex representation and several different construction methods
- Uses discrete morse theory to speed up computation

<http://www.math.rutgers.edu/~vidit/perseus>



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ToMaTo

- C++ library for topological analysis
- Relies on libANN for approximate nearest neighbors

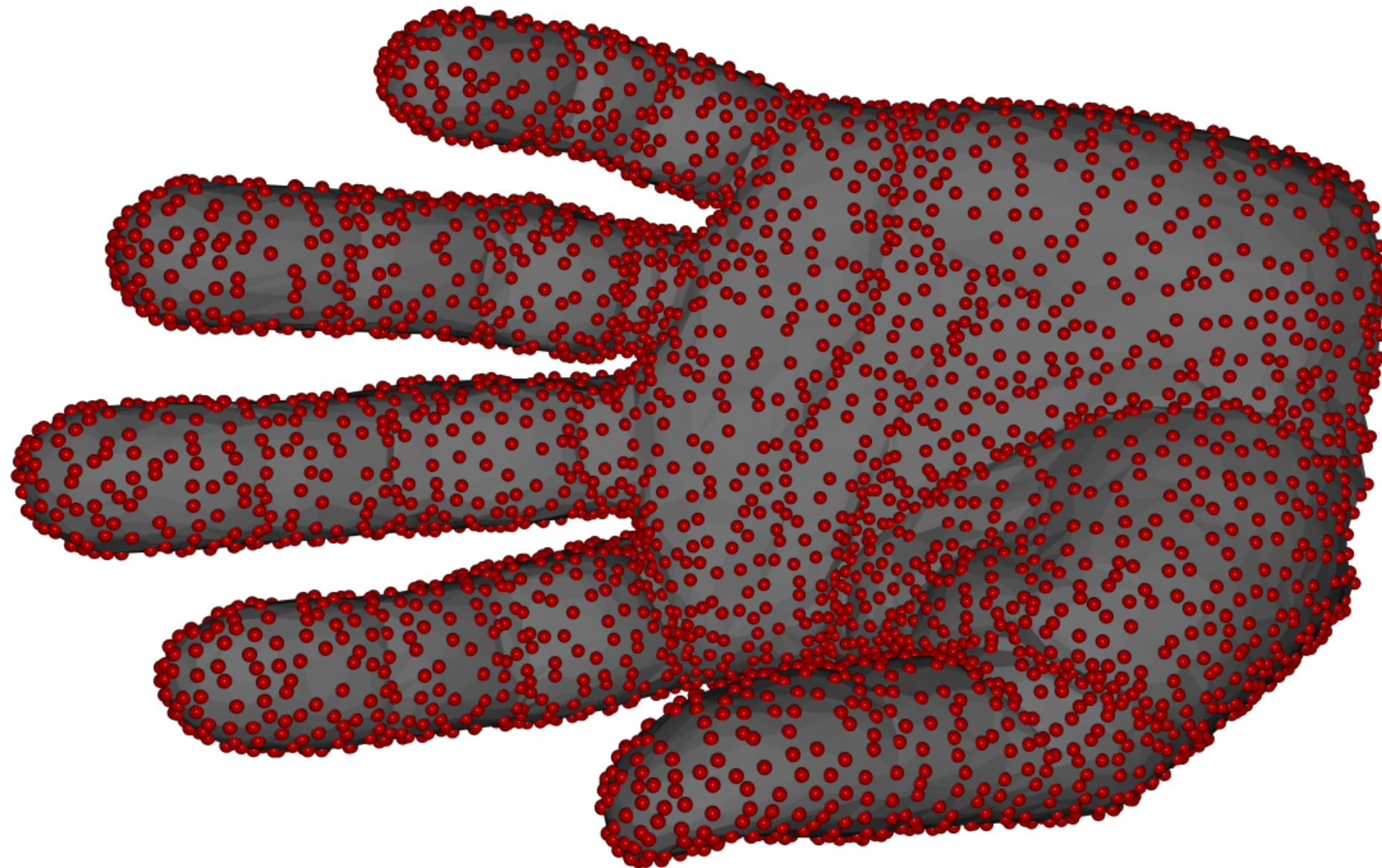
<http://geometrica.saclay.inria.fr/data/ToMATo/>

GAP Persistence

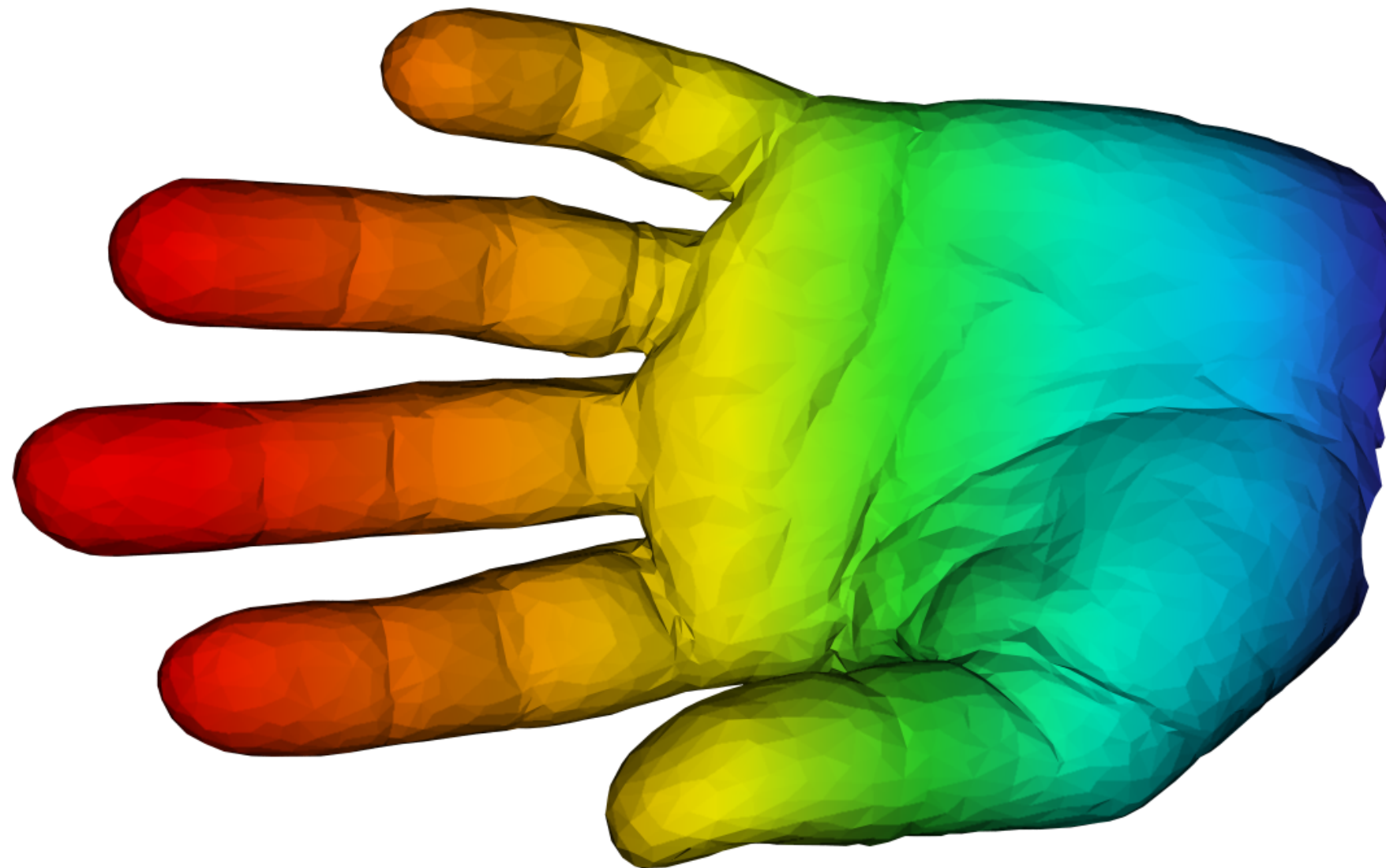
- Persistent homology and complex construction in the GAP computer algebra system

<http://www-circa.mcs.st-and.ac.uk/~mik/persistence/>

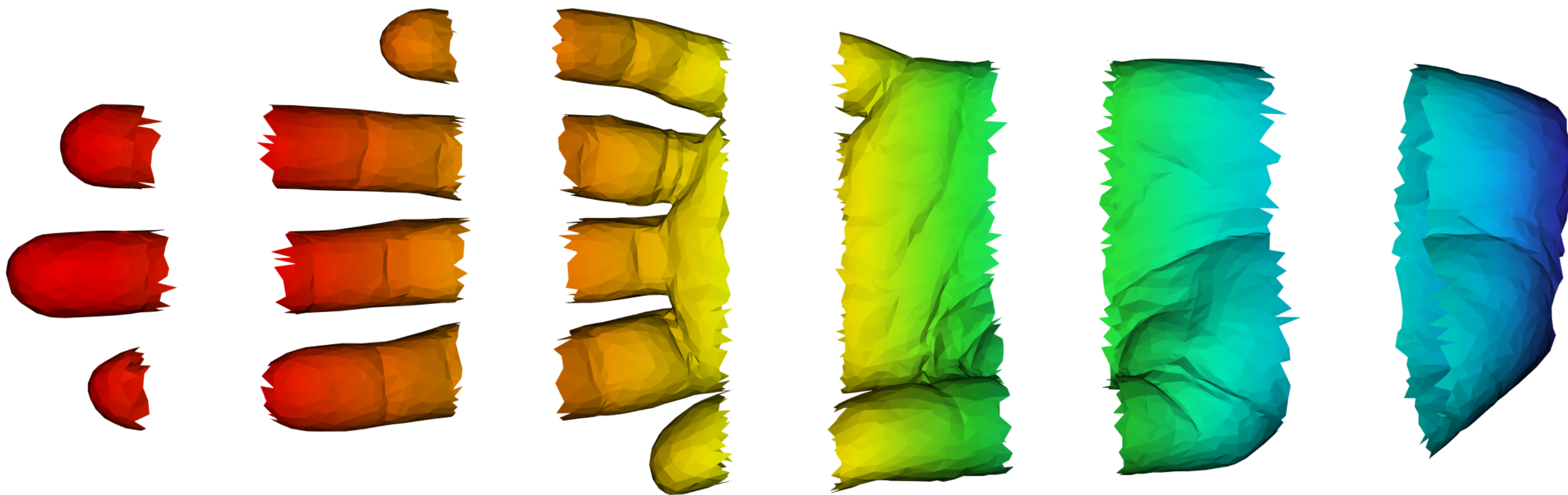
Mapper



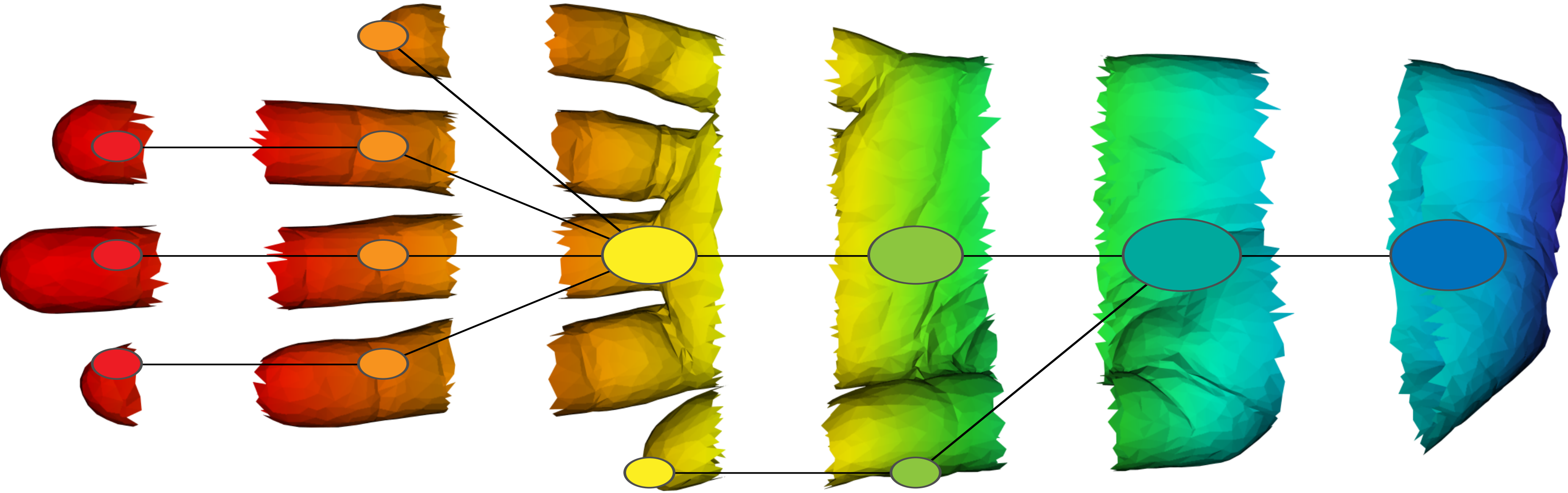
Mapper



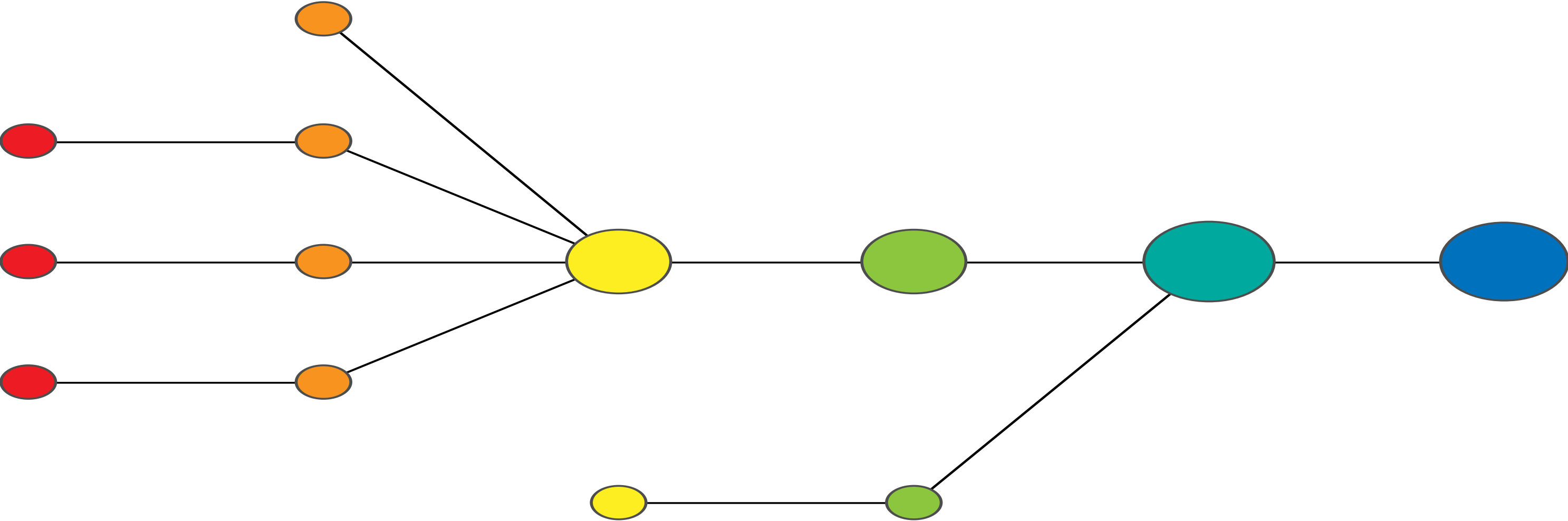
Mapper



Mapper



Mapper



Ayasdi / Iris

- Proprietary software package for Mapper-based topological data analysis
- Very intuitive graph display interaction UI
- Statistical tests and factor identification built-in

<http://www.ayasdi.com>

Python Mapper

- Open source solution
- Developed by Müllner & Babu at Stanford University
- Focused on being a research tool
- Exports graph structure in several formats:
 - GraphViz .dot
 - d3.js JSON graph representation

<http://math.stanford.com/~muel1ner/mapper>



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Thank you for listening;
now go forth and experiment