Topological Data Analysis
A software survey

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Cubical homology
Pixels and voxels

- Cellular homology theory
  Building blocks are *n*-cubes
- Admits very efficient matrix processing methods
- Homotopy reduction techniques reduce to matrix traversals
- Well adapted for 2d and 3d images or pixel/voxel clouds

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

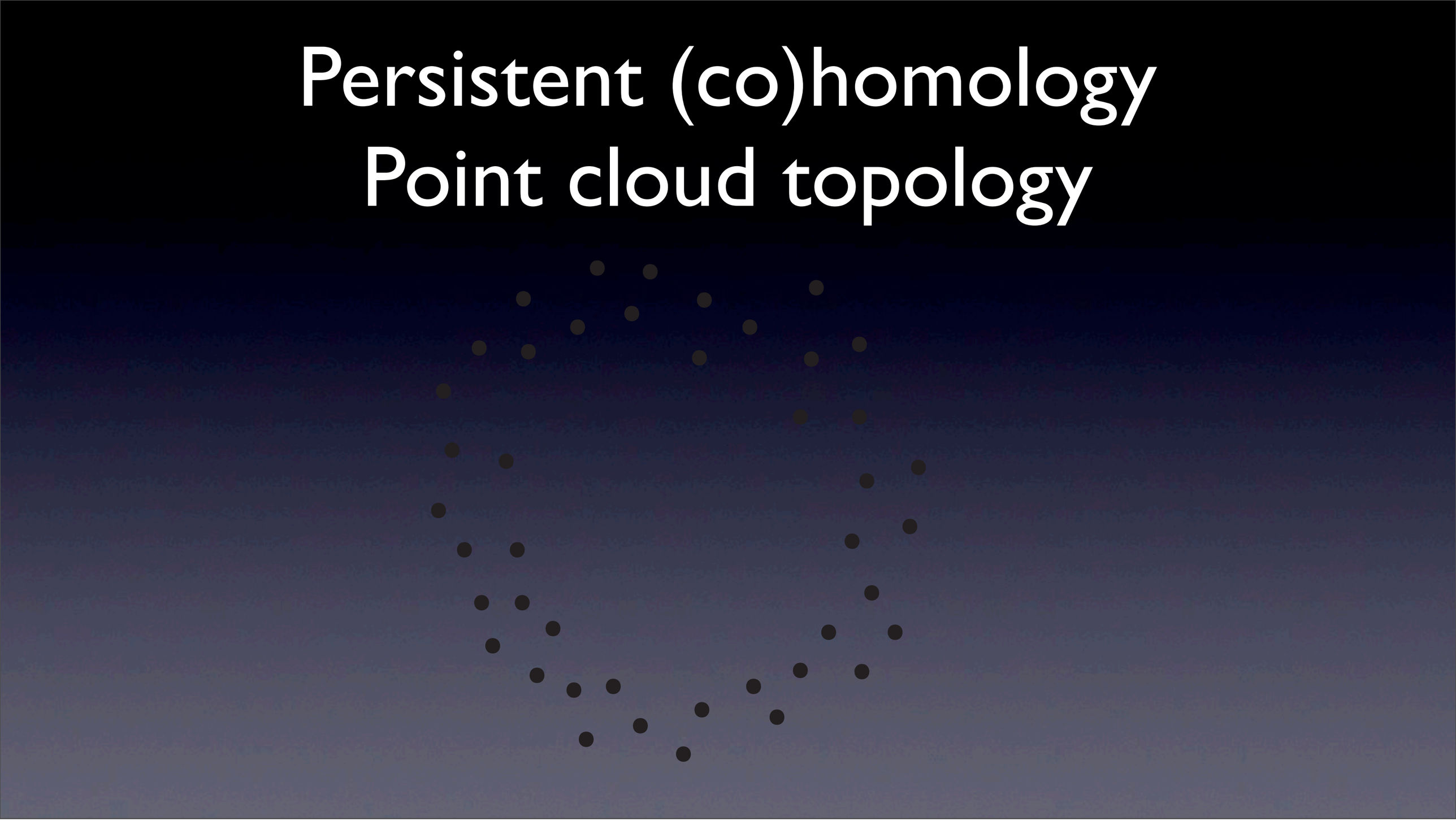
http://chomp.rutgers.edu/Software.html

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

Persistent (co)homology
Point cloud topology



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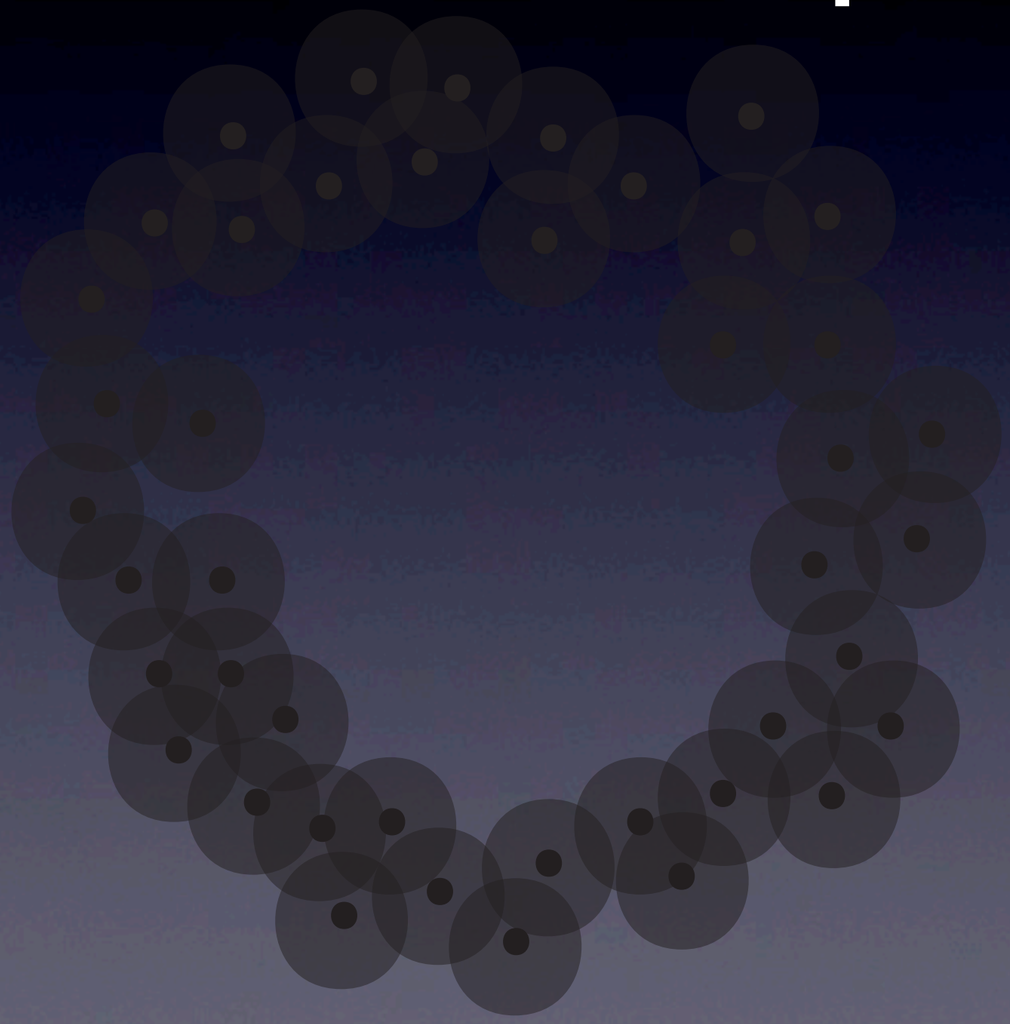

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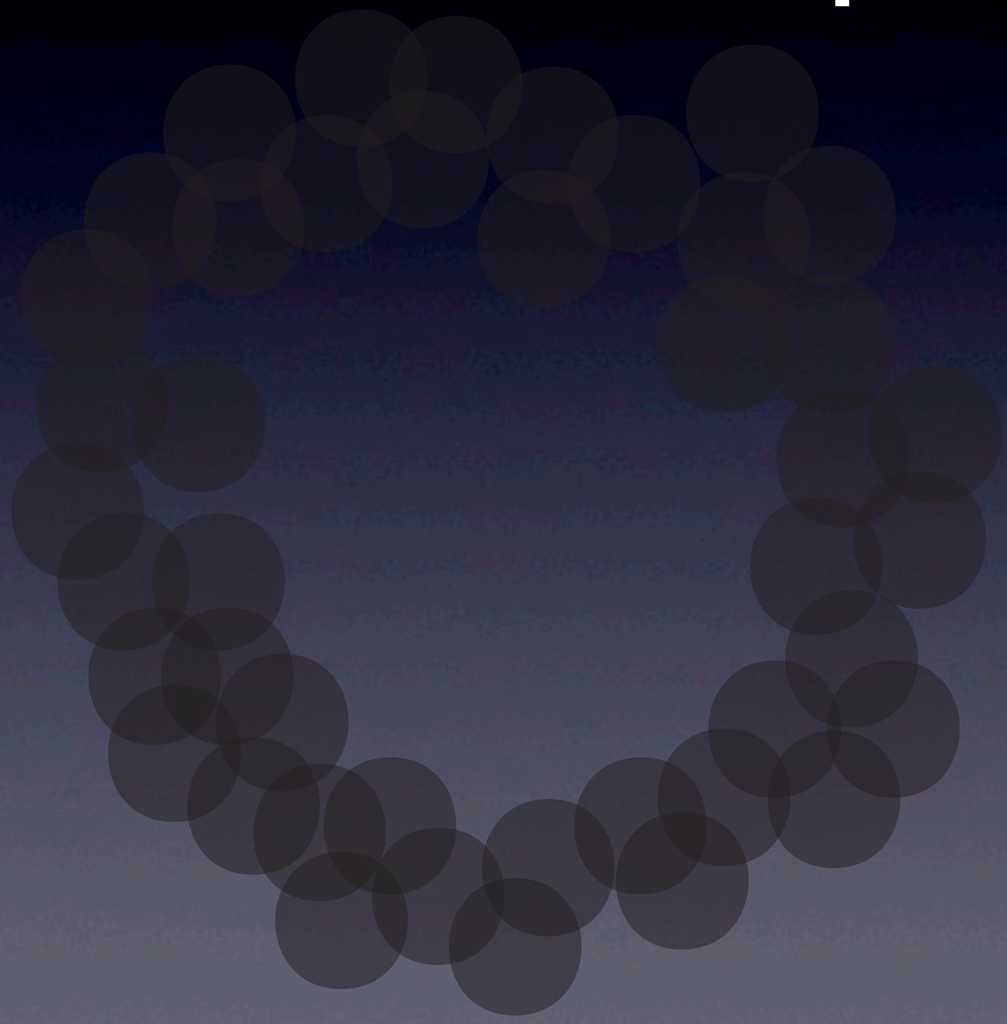

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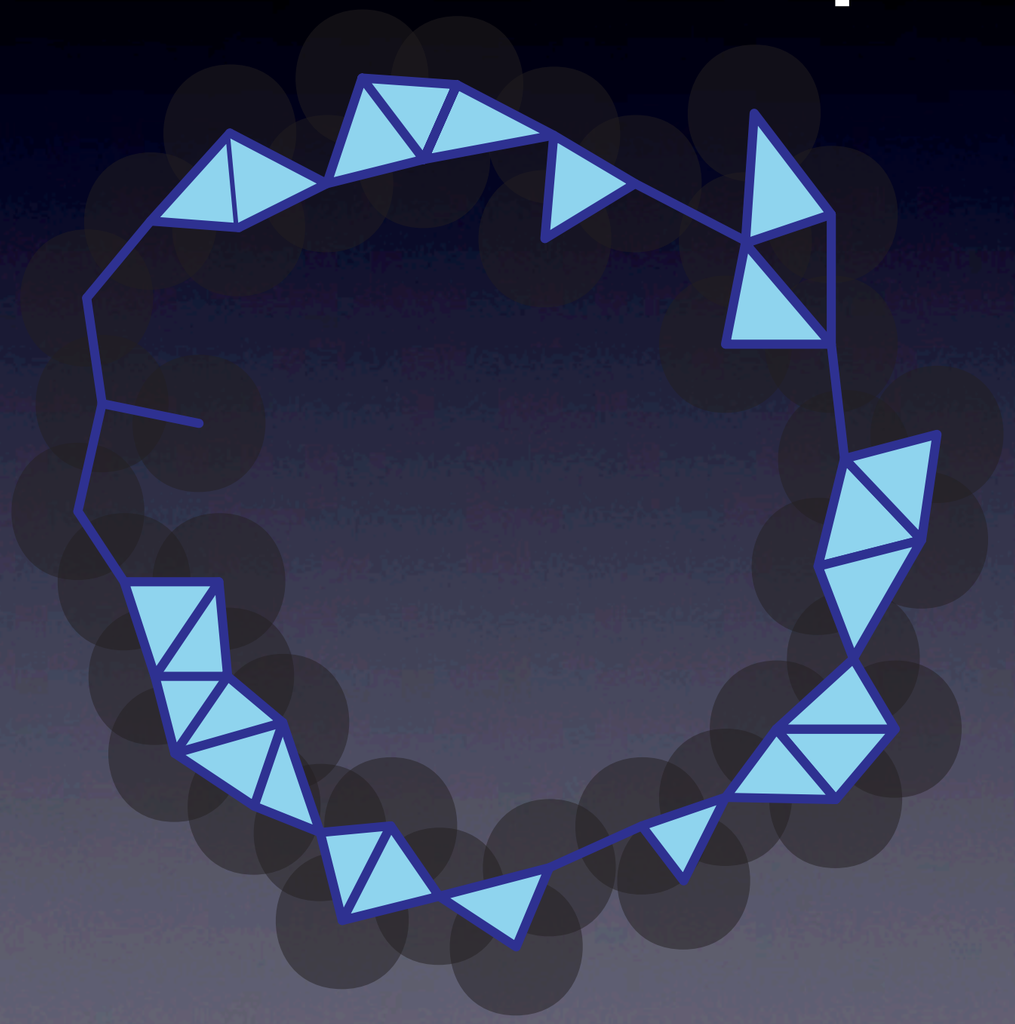

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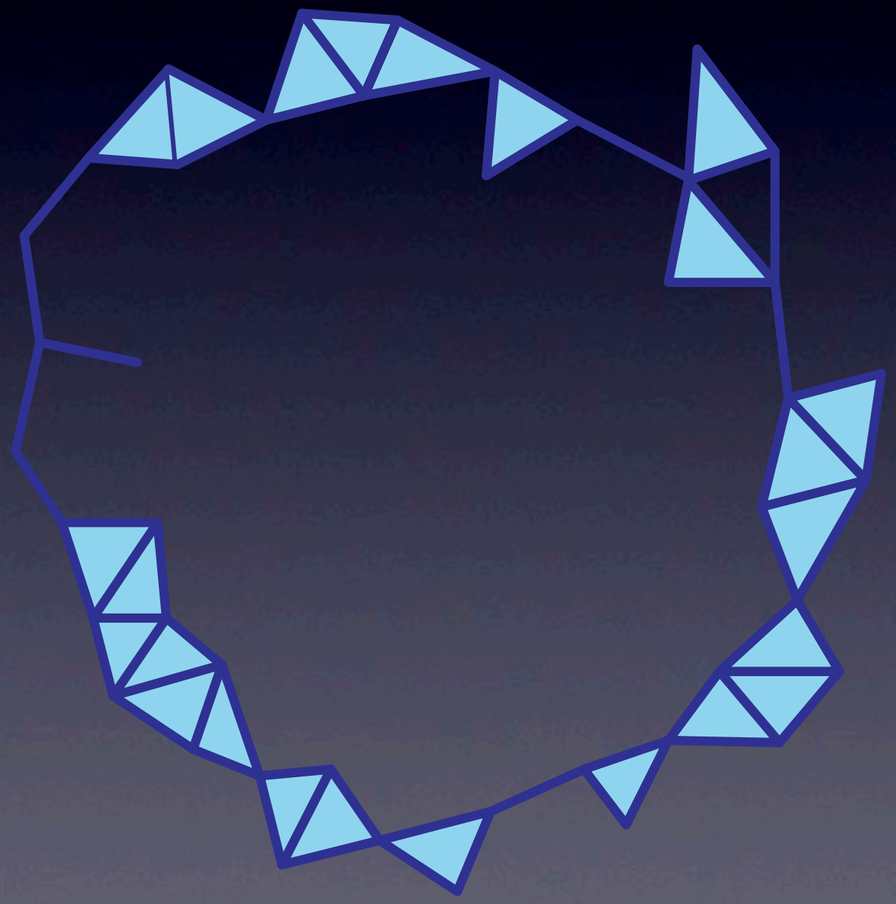

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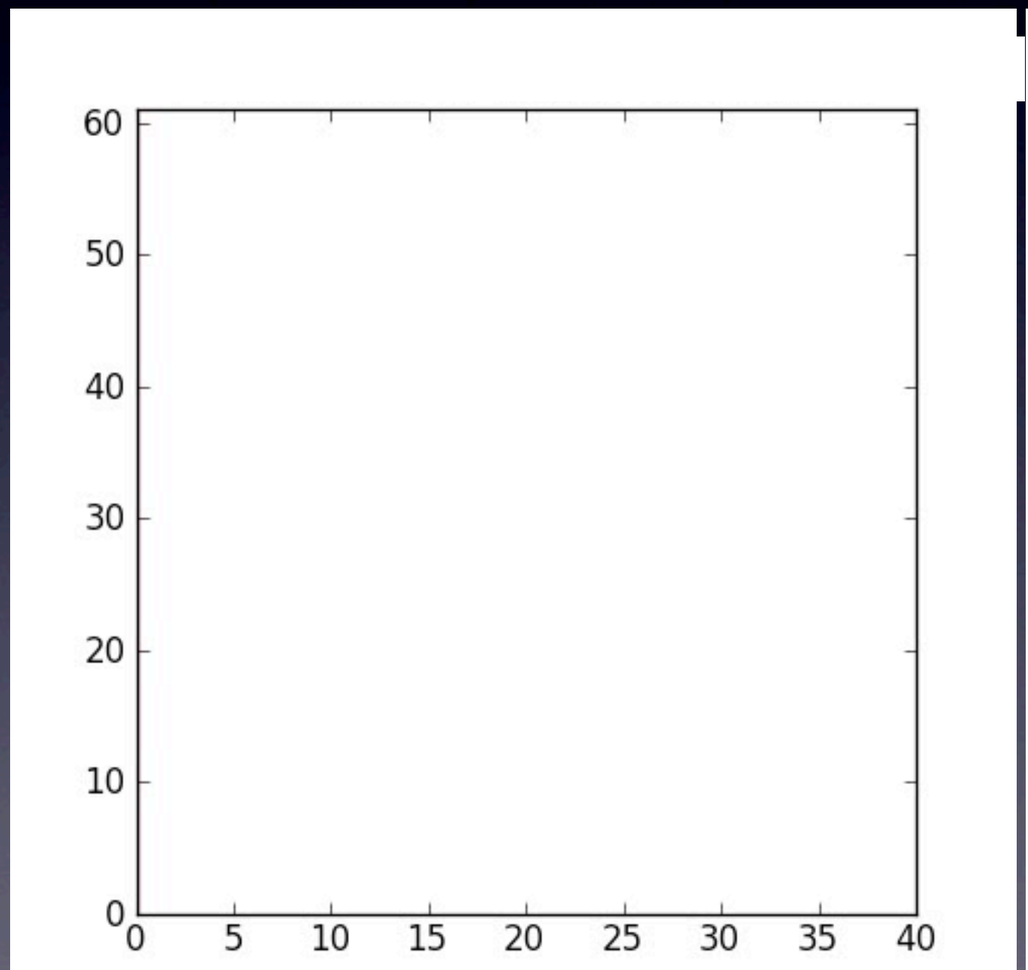
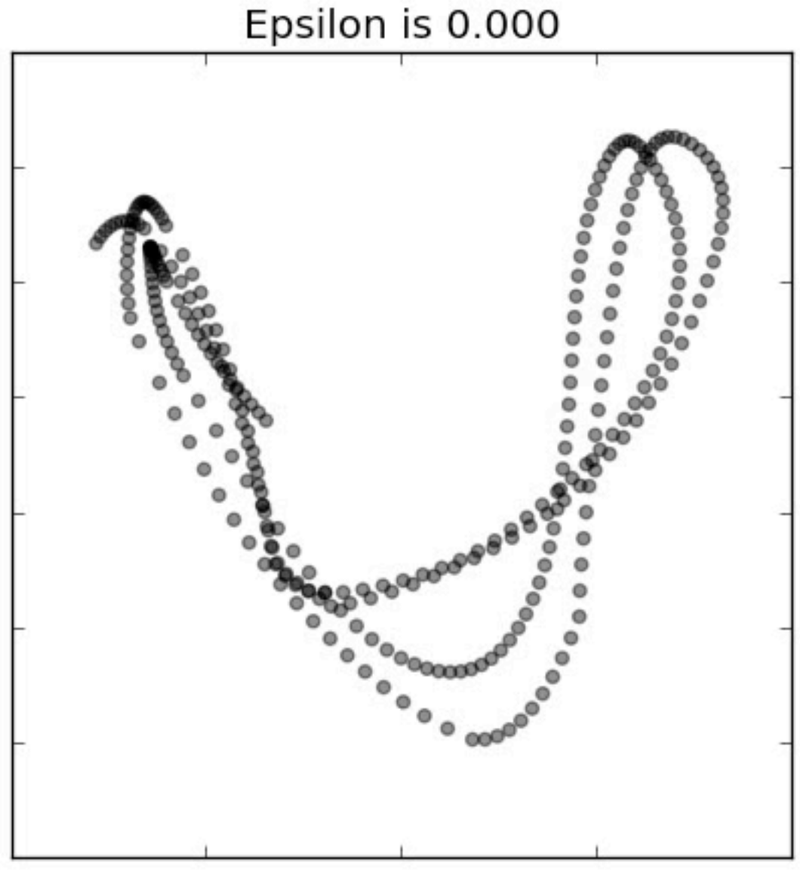




Plex / jPlex / javaPlex

- 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

ToMaTo

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

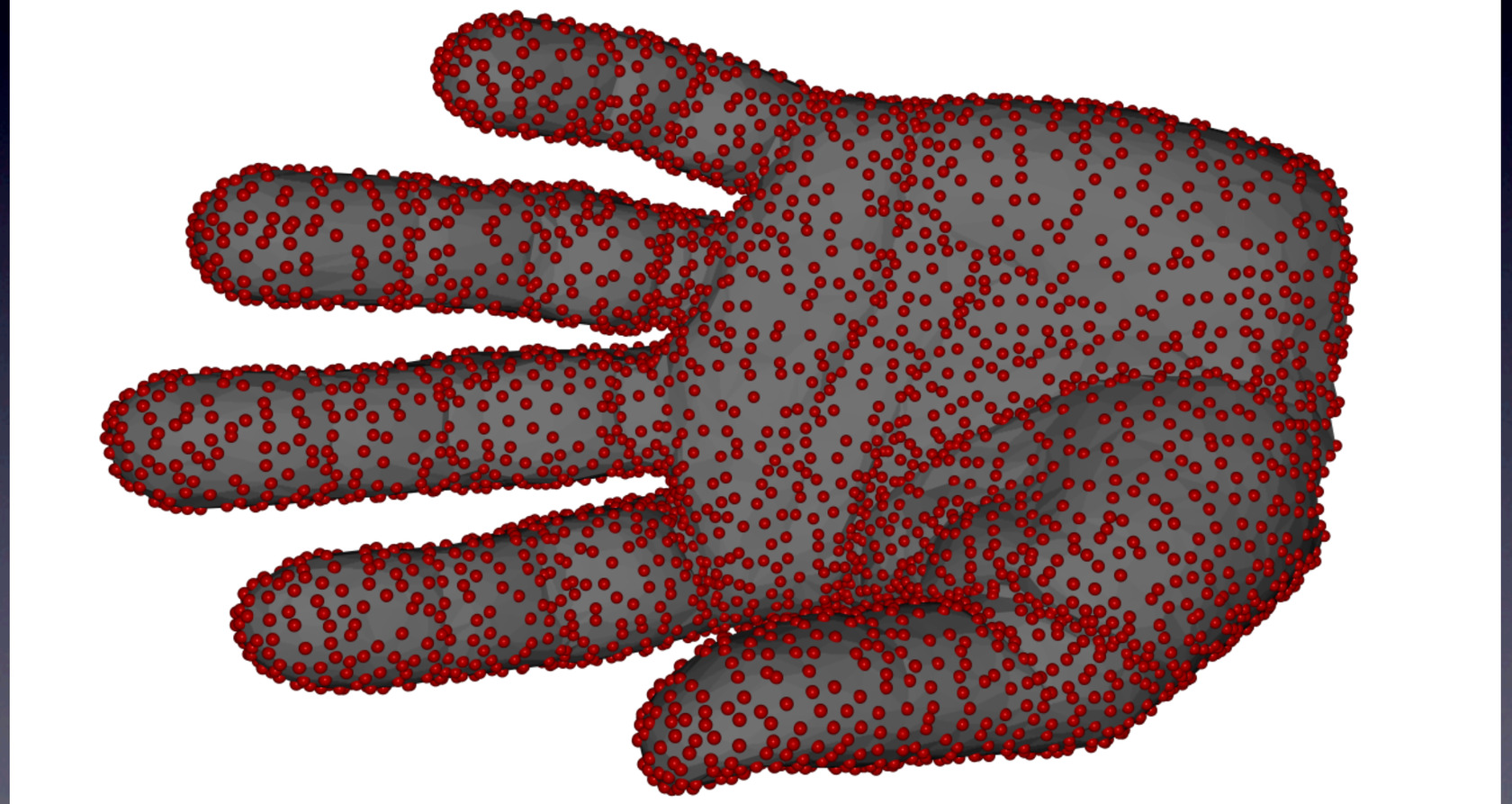
`http://geometrica.saclay.inria.fr/data/ToMATo/`

GAP Persistence

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

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

Mapper



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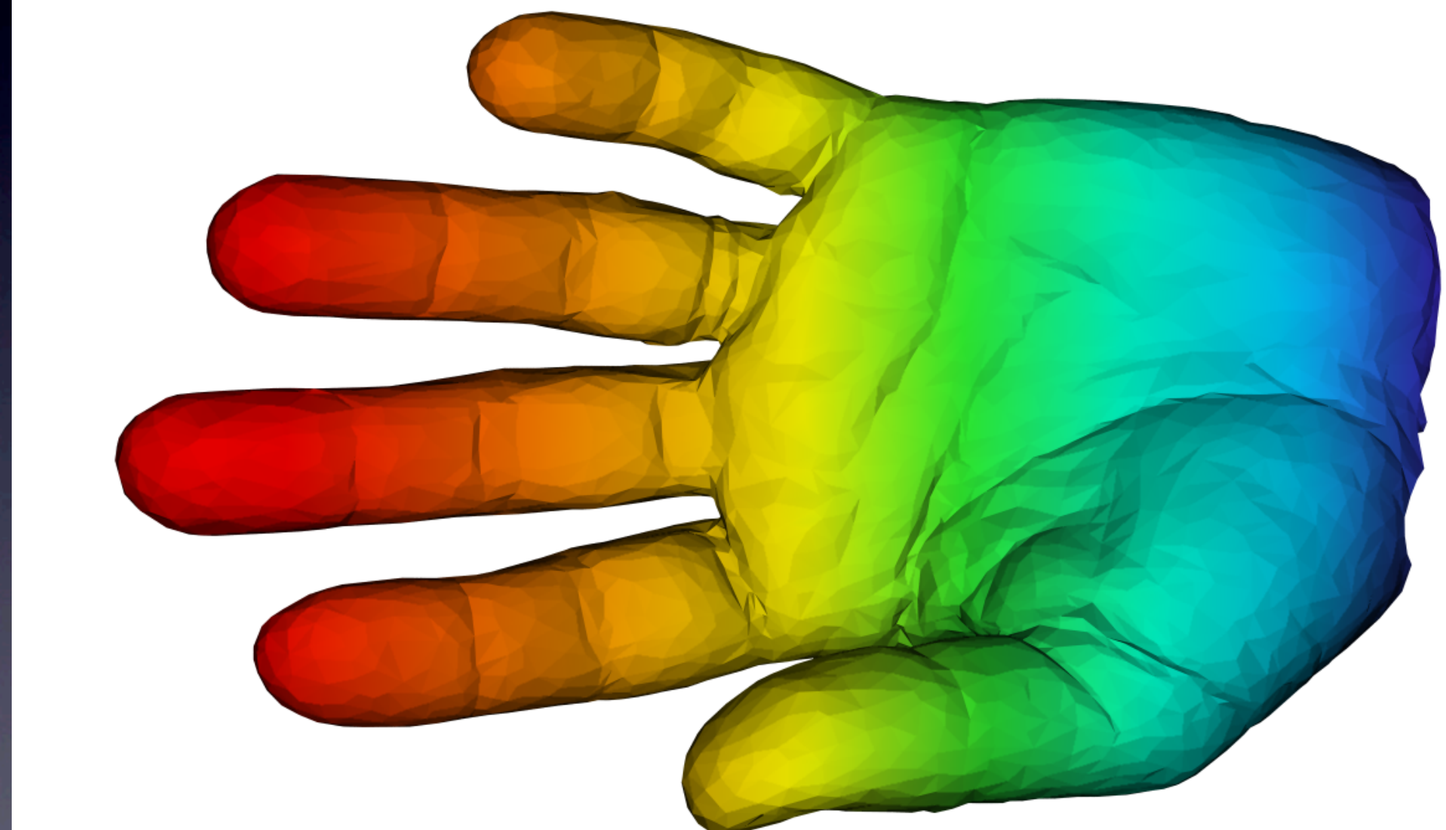

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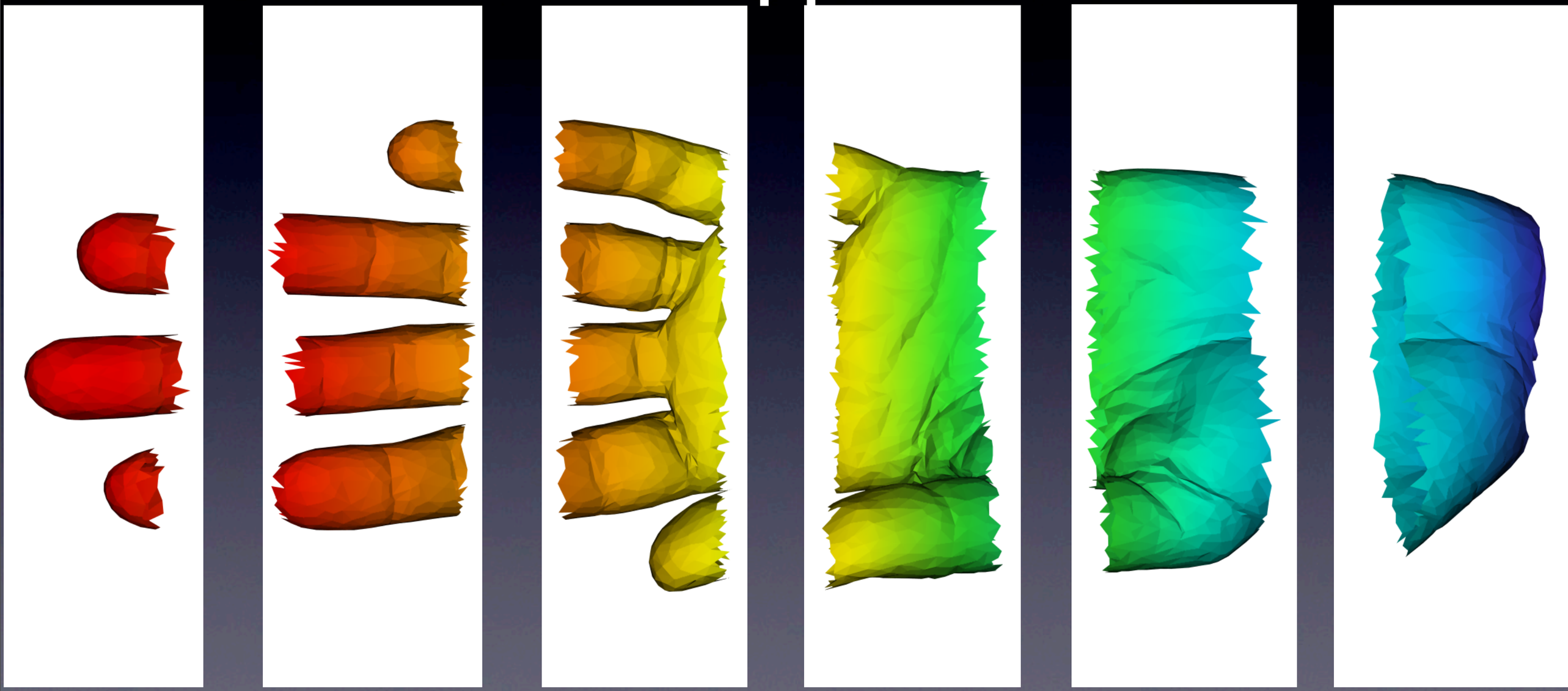

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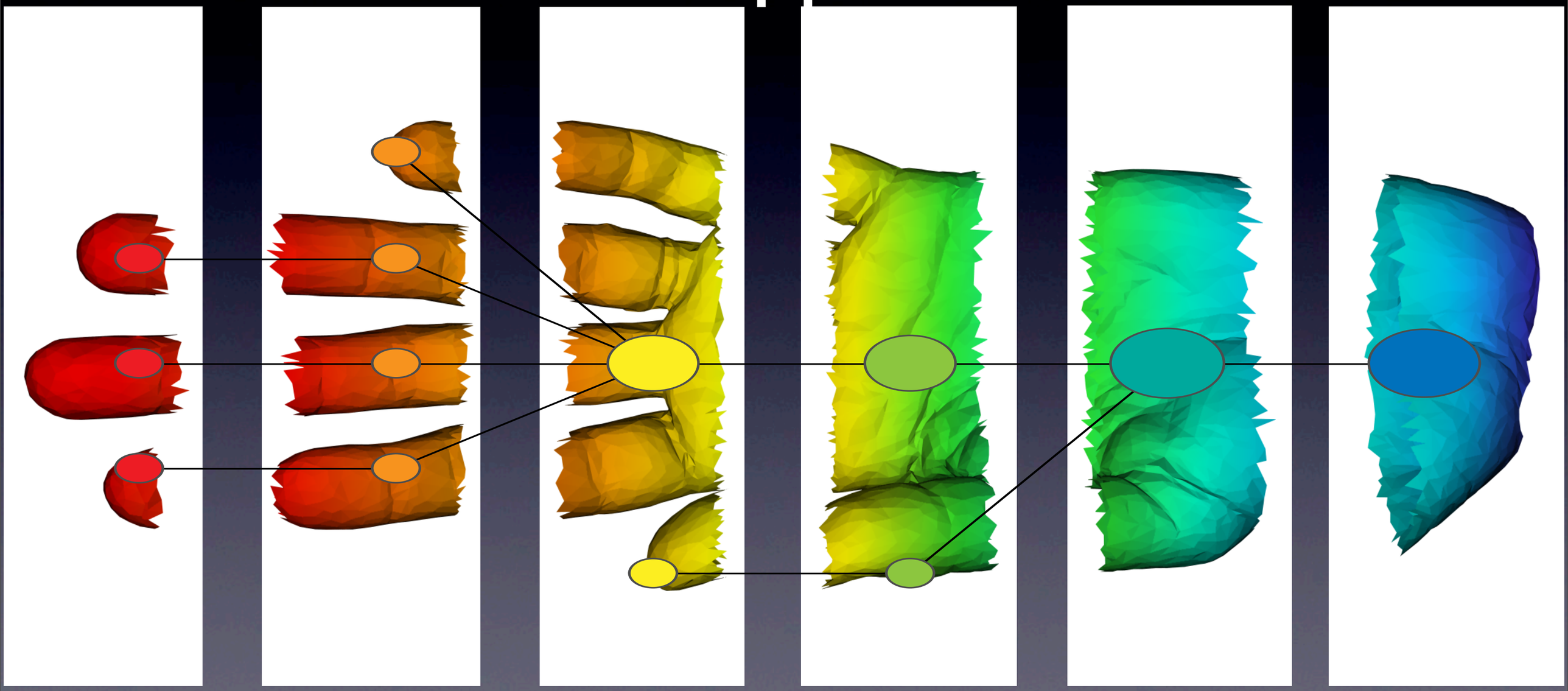

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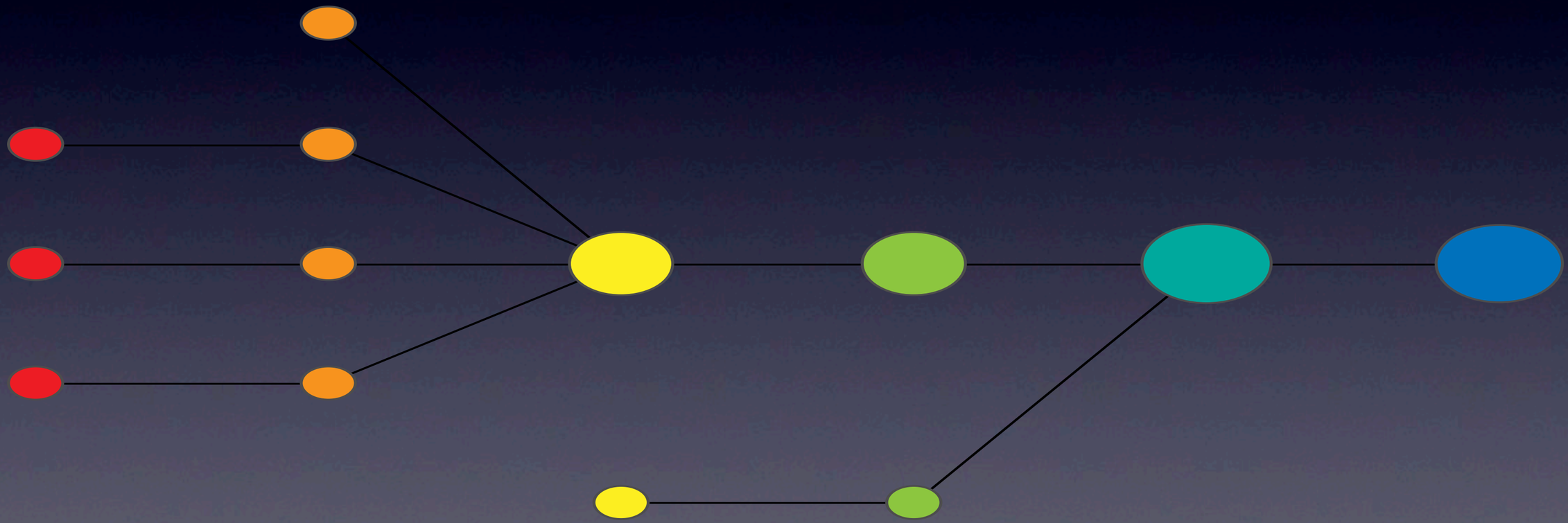

Ayasdi / Iris

- 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/~muellner/mapper`

Thank you for listening;

now go forth and experiment