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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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/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
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