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 IMA Short Course:
 Applied Algebraic Topology
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Introduction to JPlex

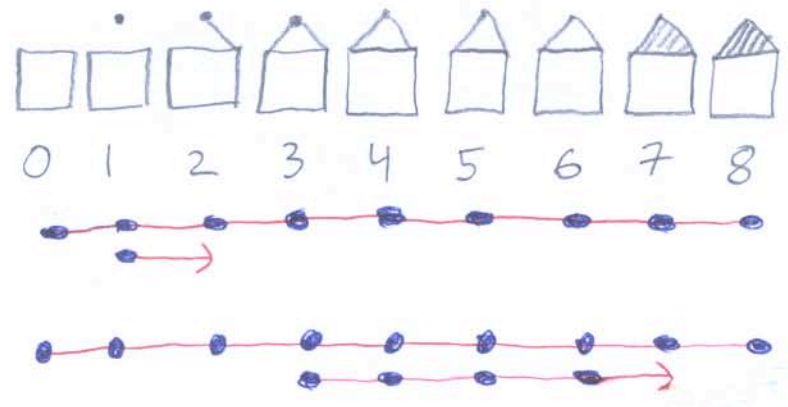
① Filtered simplicial complexes (streams)

Two rules:

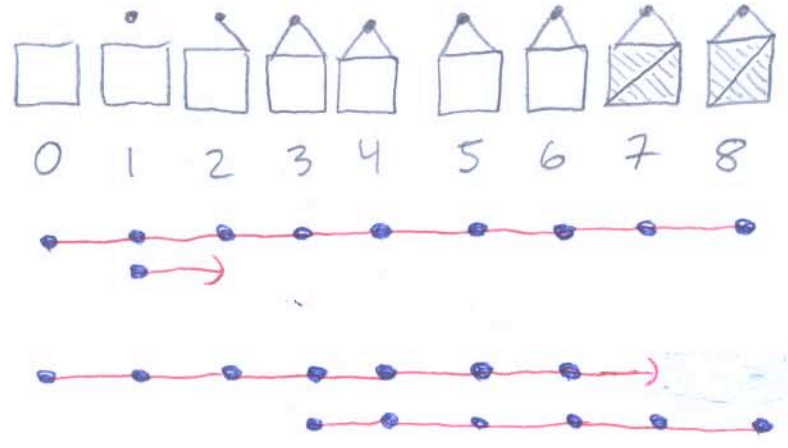
- At each filtration time, you have a simplicial complex.
- The simplicial complexes increase with time.

Two examples:

"No walls"



"No roof"



Note that the two house filtrations have the same Betti numbers at all filtration times. However, functoriality distinguishes the filtrations.

② Application: data analysis

Motivating problem is "What space is this?"



Answer is "It's a circle."

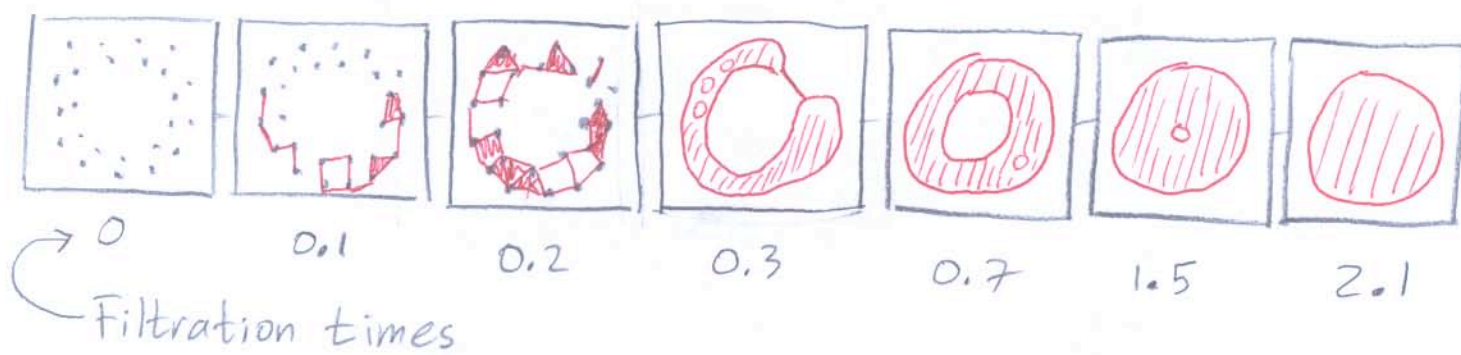
How do you see it's a circle?

Plot in 2D or 3D and squint your eyes.

But what if you have a point cloud in 25-dimensional space? What if you have a point cloud in a non-Euclidean space? These point clouds are hard to visualize.

One idea is to build a filtered simplicial complex on the point cloud, and to compute its persistent homology.

Example: consider below the Vietoris-Rips (or witness or lazy witness) filtered simplicial complex on our 'circular point cloud data.



Betti barcode:



Betti₁ barcode:

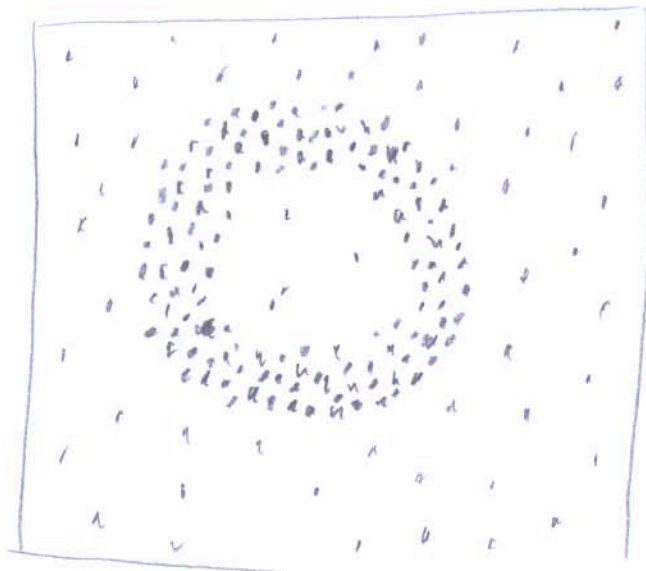


We consider short intervals to be noise, and long intervals to correspond to significant

topological features. We see one long $Betti_0$ and one long $Betti_1$ interval above, which corresponds to the homology of a circle.

Remember that this process (implemented in JPLex) is an algorithm, not magic.

For instance, convince yourself that you should threshold the following point cloud by density before building a filtered Simplicial complex and computing its persistent homology.



Next: Try out JPLEX and the JPLEX Tutorial!