Reeb Graphs   topological skeleton of a geometric model

$f: D \to \mathbb{R}$ D does not need to be a manifold, it just needs to
be a complex

equivalency
class
based on connected
components

→ graph

different from merge tree
↓
deals with sub-level sets
and is one sweeping in one
direction (can only split or
merge, not both)

connected components

So we can compute the number of cycles
on some domain by building a reeb graph
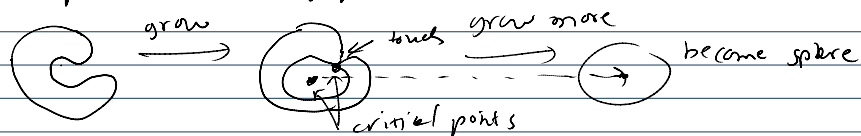and count the number of cycles on this graph
(we need a good function on the domain)

in 3D, when a critical point happens, it does not neccessarily change the
number of connected components (for reeb graphs)

grow →   touch   grow more →   become sphere

critical points

application: find topological noises in meshes
        ↳ problematic for processing (eg. smoothing)
It is true in 2D that critical points are always nodes in the graph
but in 3D there are critical points that change the
topology of level sets without merging & splitting.

algorithm to compute reeb graph

1
—0.3
—1
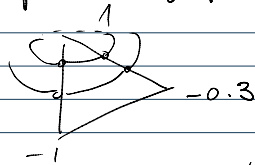
add a vertex: → add a node
add an edge: → add an arc
add a triangle —— if 2 vertices are connected, collapse to 1 edge
                    if not, do nothing

$O(h^2)$ algorithm
        but behaves more like $O(n \log n)$

Finalization

For 3D, can take ⌈ skeleton → level sets
                  ⌊ levelset → skeleton
basically, toss the simplices of dimension > 2 in the input stream

merge
by adding triangles