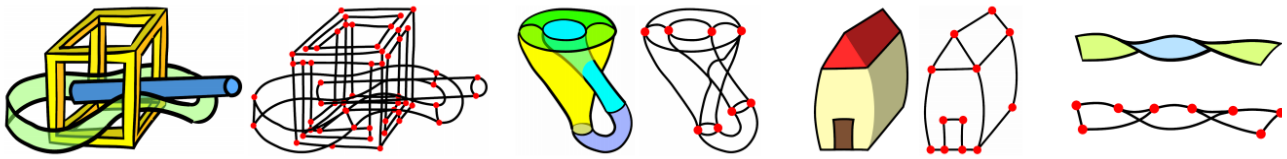
Vector Graphics and Topology

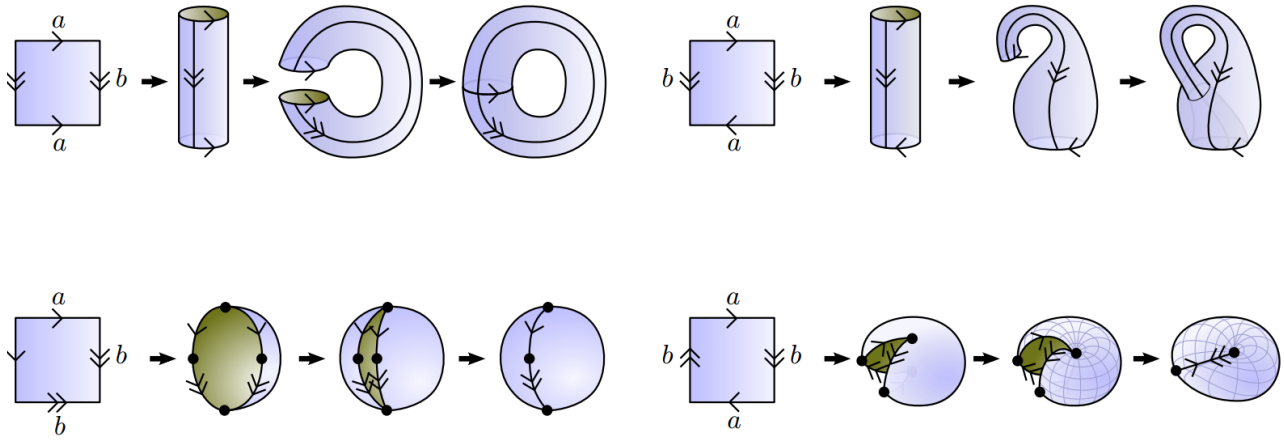


Boris Dalstein
University of British Columbia
CPSC 314
October 31st, 2014

Vector Graphics Complexes

SIGGRAPH slides: http://www.dalboris.com/research/vgc
Demo of VPaint: http://vpaint.org

Topology: The classification of surfaces

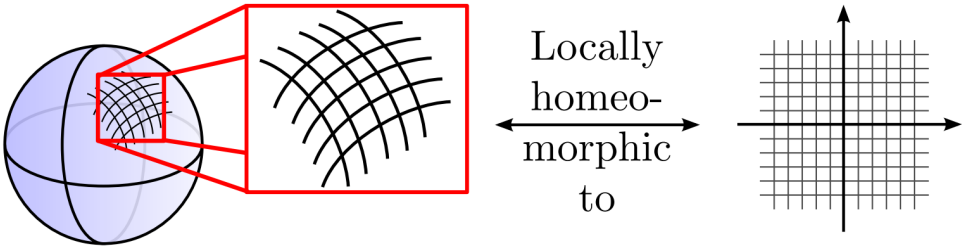


What is topology?
Why is it relevant to vector graphics?

Topology 101: neighbourhood, open set, closed set, interior, boundary, compactness, … (cf. Wikipedia ☺)

Topology 102: homeomorphism (things that “look” similar)

Surface = compact space everywhere locally homeomorphic to R^2



What is topology?
Why is it relevant to vector graphics?

Topology is the formal framework to define the concept of surfaces.

Vector Graphics is all about manipulating surfaces (defined by a 2D boundary).

So understanding the topology of surfaces is of primary importance for vector graphics (and many other fields of computer graphics).

Different surfaces => Different properties

Let's have some fun with paper and scissors!

Take a rectangle, choose two points on its boundary, and cut the surface along a curve connecting those two points.

You get two surfaces !

Do the same with a cylinder…

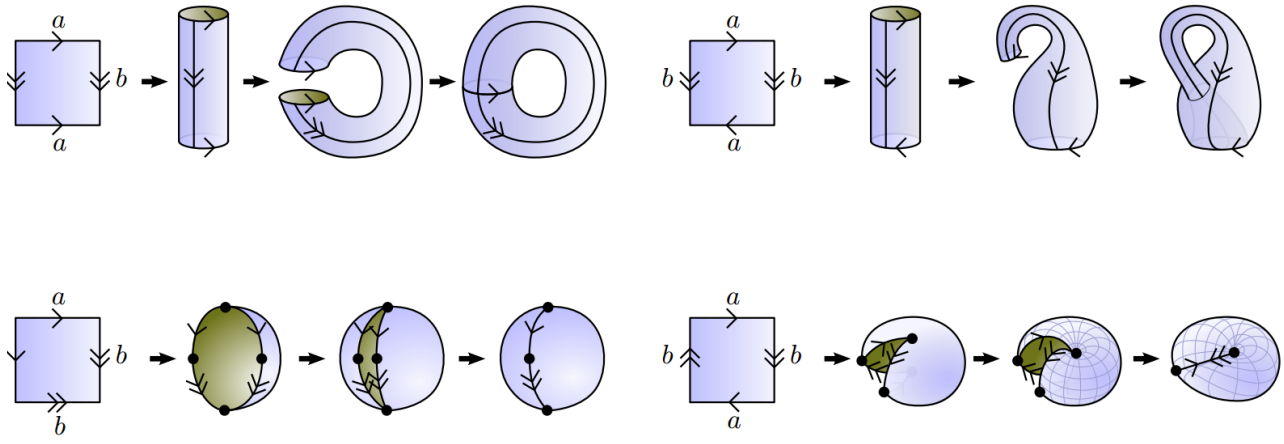
Möbius strips

Well… that was unfair: a cylinder has two “edges”, while a rectangle/ disk has only one. Obviously these surfaces are different.

What about a Möbius strip? (class activity. Summary: build one, observe that it has only one edge, like a disk. Cut it by joining two points on the boundary: you get either one or two surfaces)

With Vector Graphics, you don’t really know if you have a disk or a Möbius strip…. It’s more a matter of interpretation. (demo)

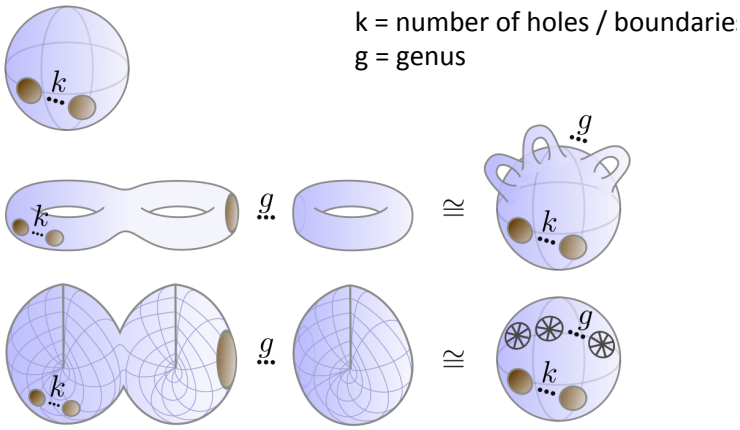
Polygonal scheme



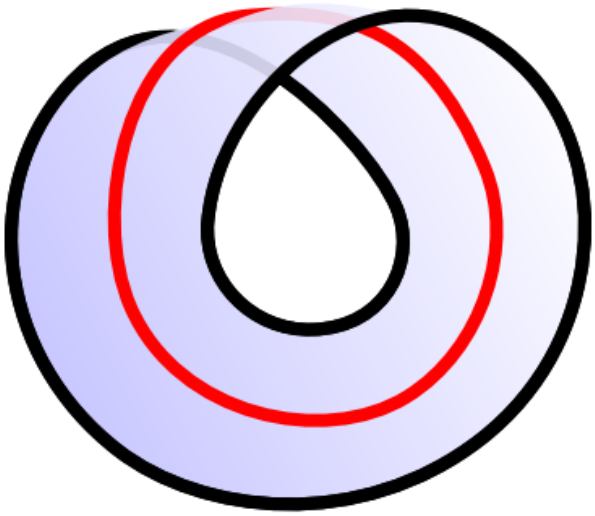
The classification of surfaces

Every surface is homeomorphic to one of the following:

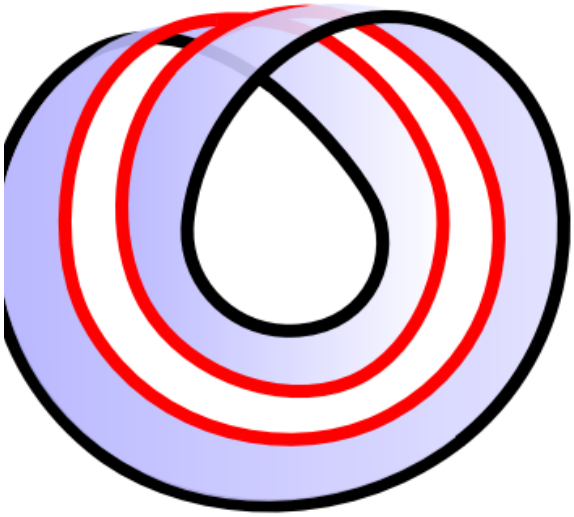
- Sphere with holes
- One or several torus glued together
- One or several projective planes glued together

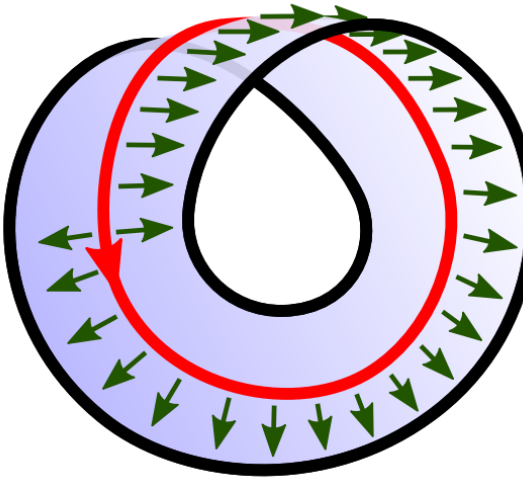


What happens when you cut them?

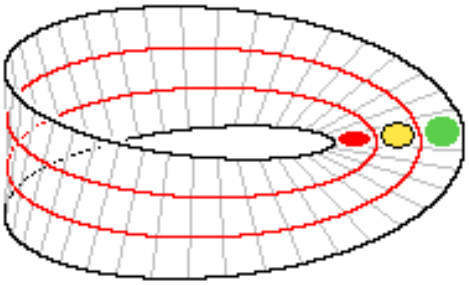


What happens when you cut them?

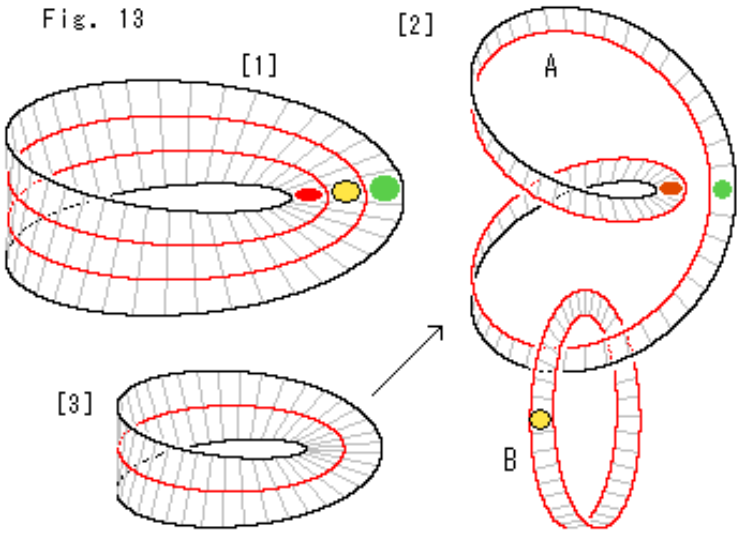




Cut it differently?



Cut it differently?



Cutting other things?

Experiment by yourself ☺

Or have a look at the VGC technical report!