



C O M P A S

```
def smooth_mesh(mesh, lmin, lmax, fixed=None, kmax=10, callback=None):
    """Smooth a mesh by iteratively averaging vertex positions.

    Parameters
    ----------
    mesh : trimesh.Trimesh
        The mesh to be smoothed.
    lmin : float
        Minimum number of iterations.
    lmax : float
        Maximum number of iterations.
    fixed : list of int
        Vertices to keep fixed during smoothing.
    kmax : int
        Maximum number of neighbors to consider.
    callback : callable
        Function to call after each iteration.

    Returns
    -------
    trimesh.Trimesh
        The smoothed mesh.
    """
    if not callable(callback):
        raise Exception('Callback is not callable.')

    fixed = fixed or []
    fixed = set(fixed)

    for k in range(kmax):
        # Update vertex positions
        for key in mesh.vertices():
            if key in fixed:
                continue

            p = key_xyz[key]

            nbs = mesh.vertex_neighbours(key, ordered=True)
            c = center_of_mass_polygon([key_xyz[nbr] for nbr in nbs])

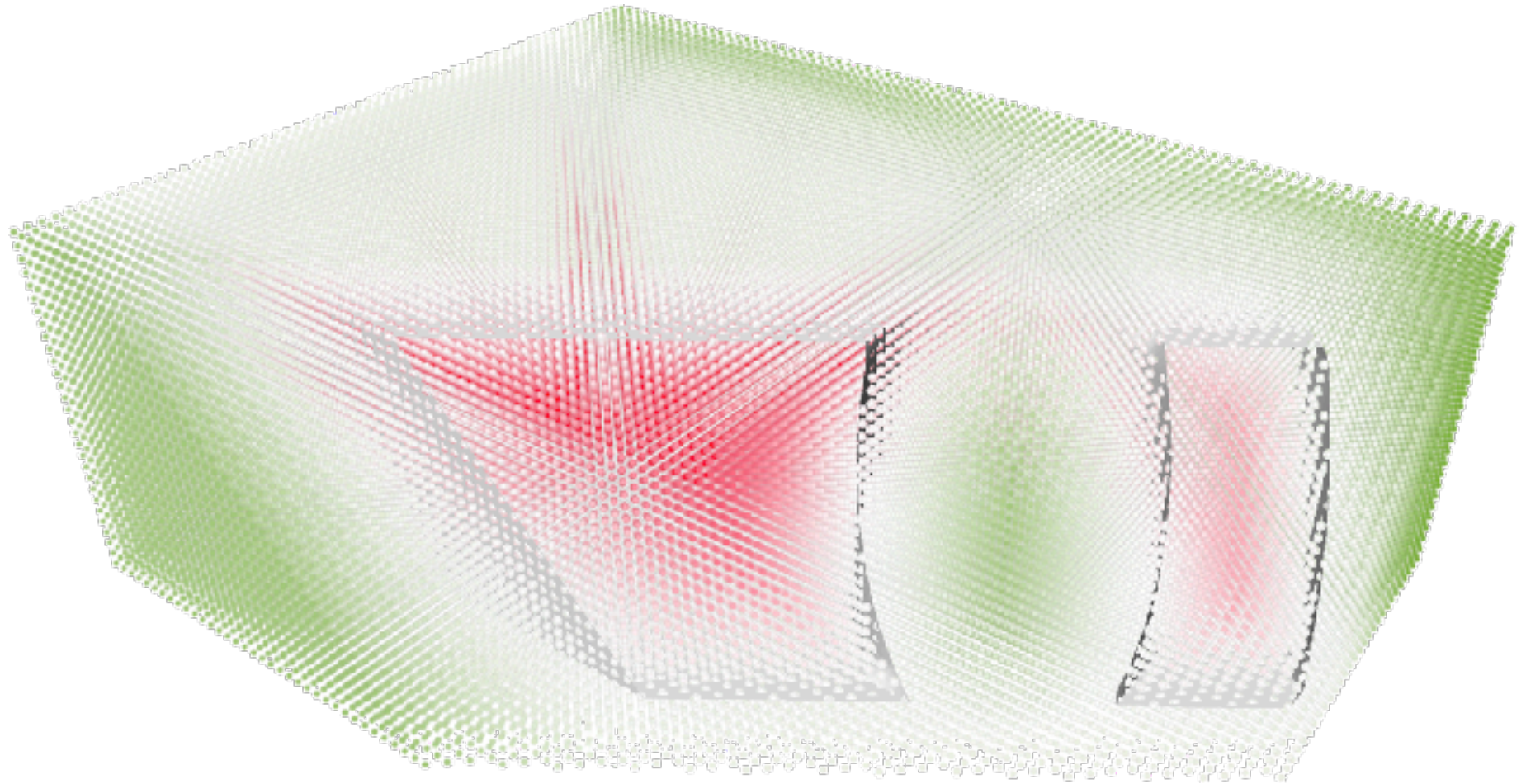
            # Update
            attr = mesh.vertex[key]
            attr['x'] += d * (c[0] - p[0])
            attr['y'] += d * (c[1] - p[1])
            attr['z'] += d * (c[2] - p[2])

        if callback:
            callback(mesh, k, callback_args)
```

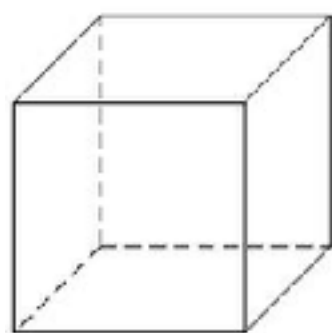
Update

```
pip install --upgrade git+https://github.com/dbt-ethz/compas_vol
```

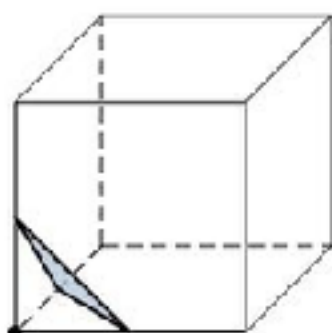
Discrete Grid



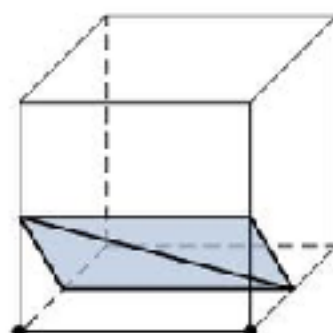
Marching Cubes



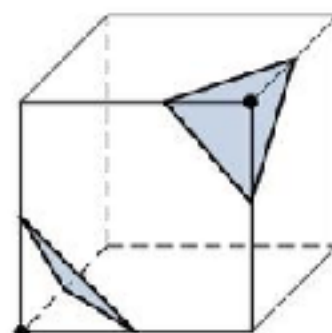
case 0



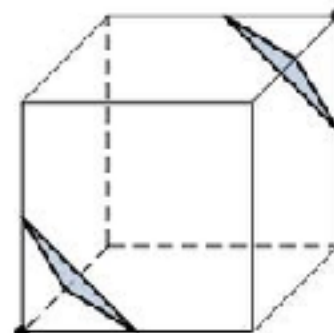
case 1



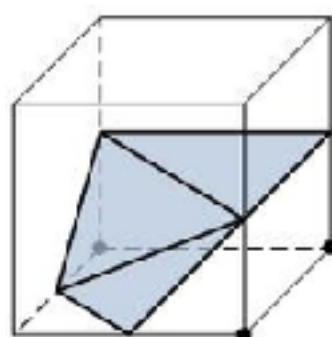
case 2



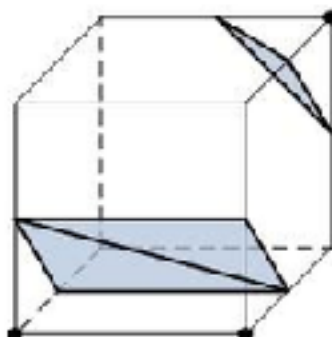
case 3



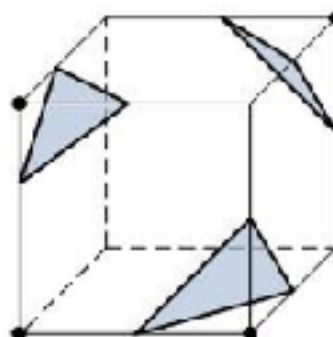
case 4



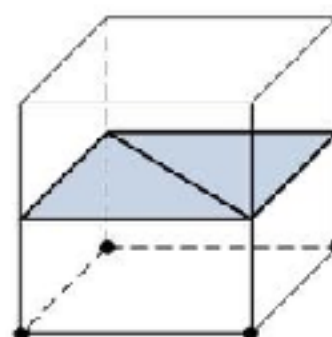
case 5



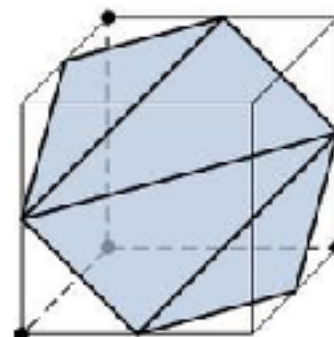
case 6



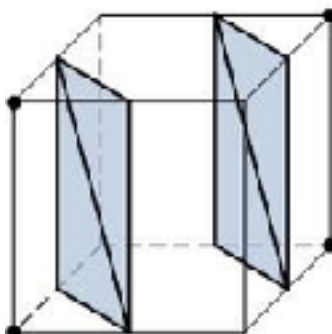
case 7



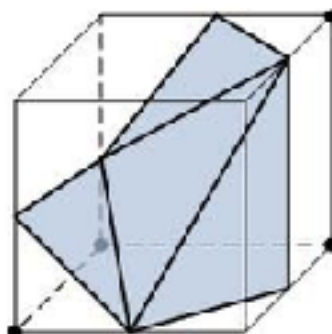
case 8



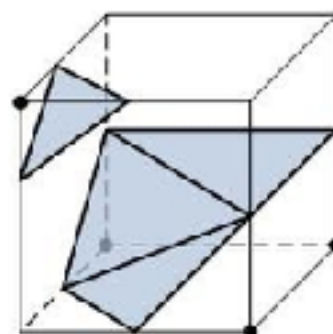
case 9



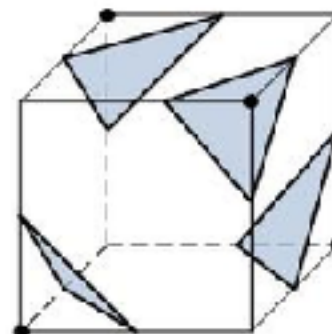
case 10



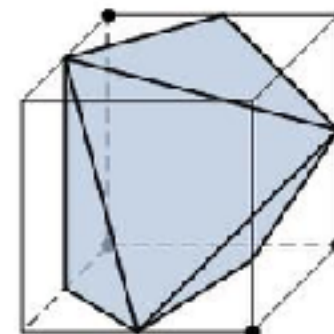
case 11



case 12



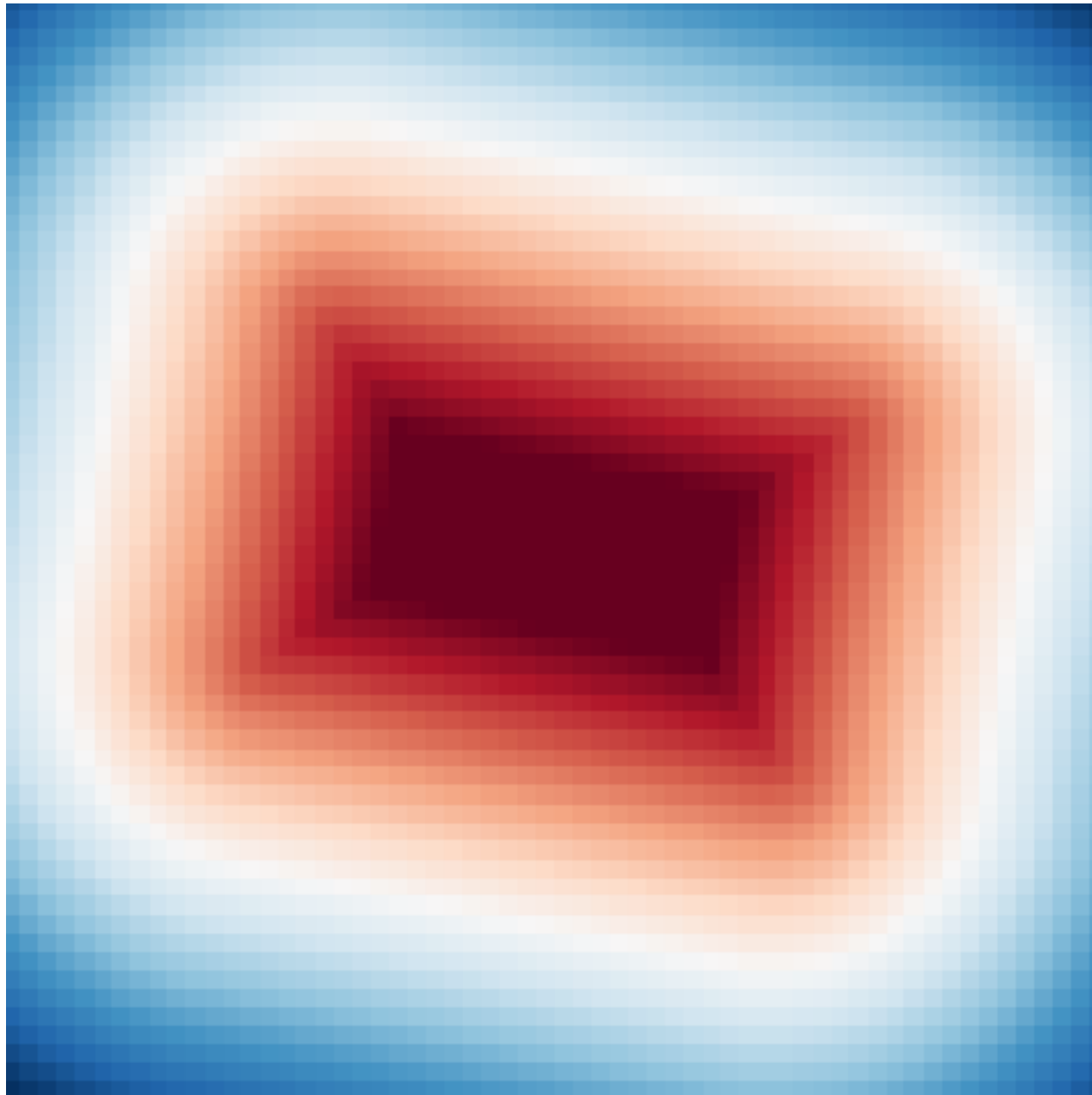
case 13



case 14

8 vertices, inside or outside
 $2^8 = 256$ cases
reduced to 15 cases
rotation / mirroring

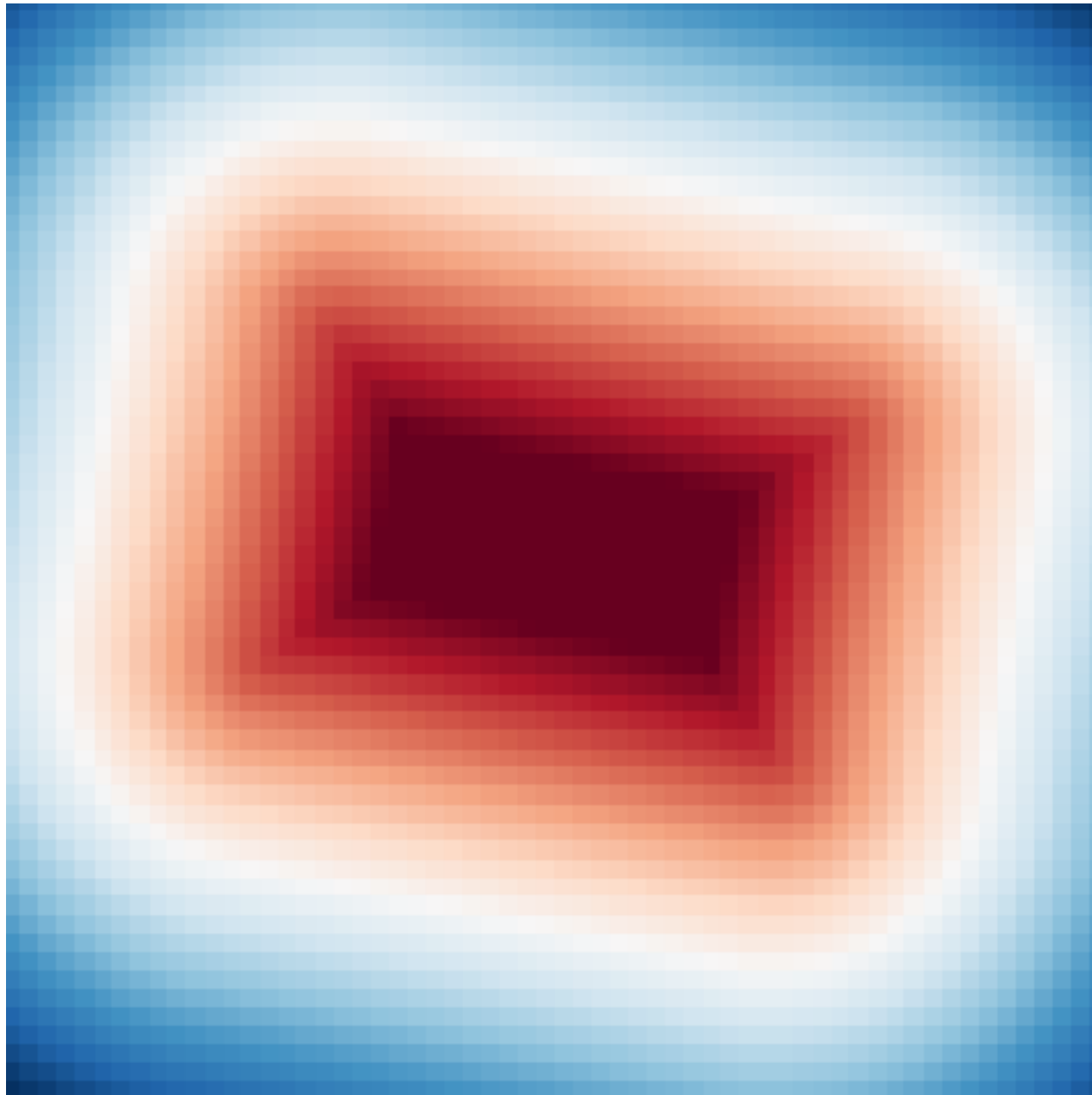
Distances



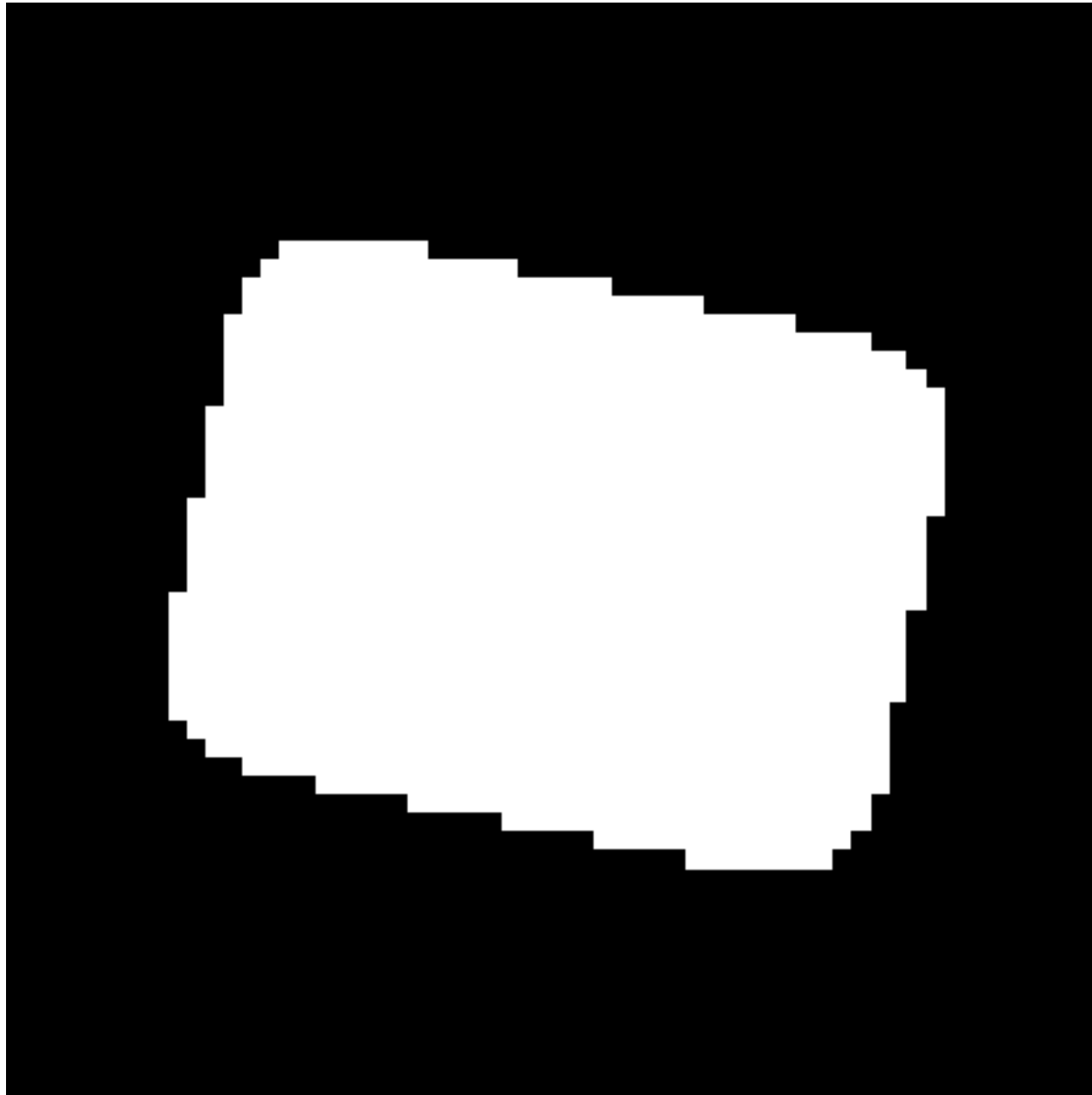
The universe is made up of matter
and doesn't matter.

Moose Allain

Distances



Binary

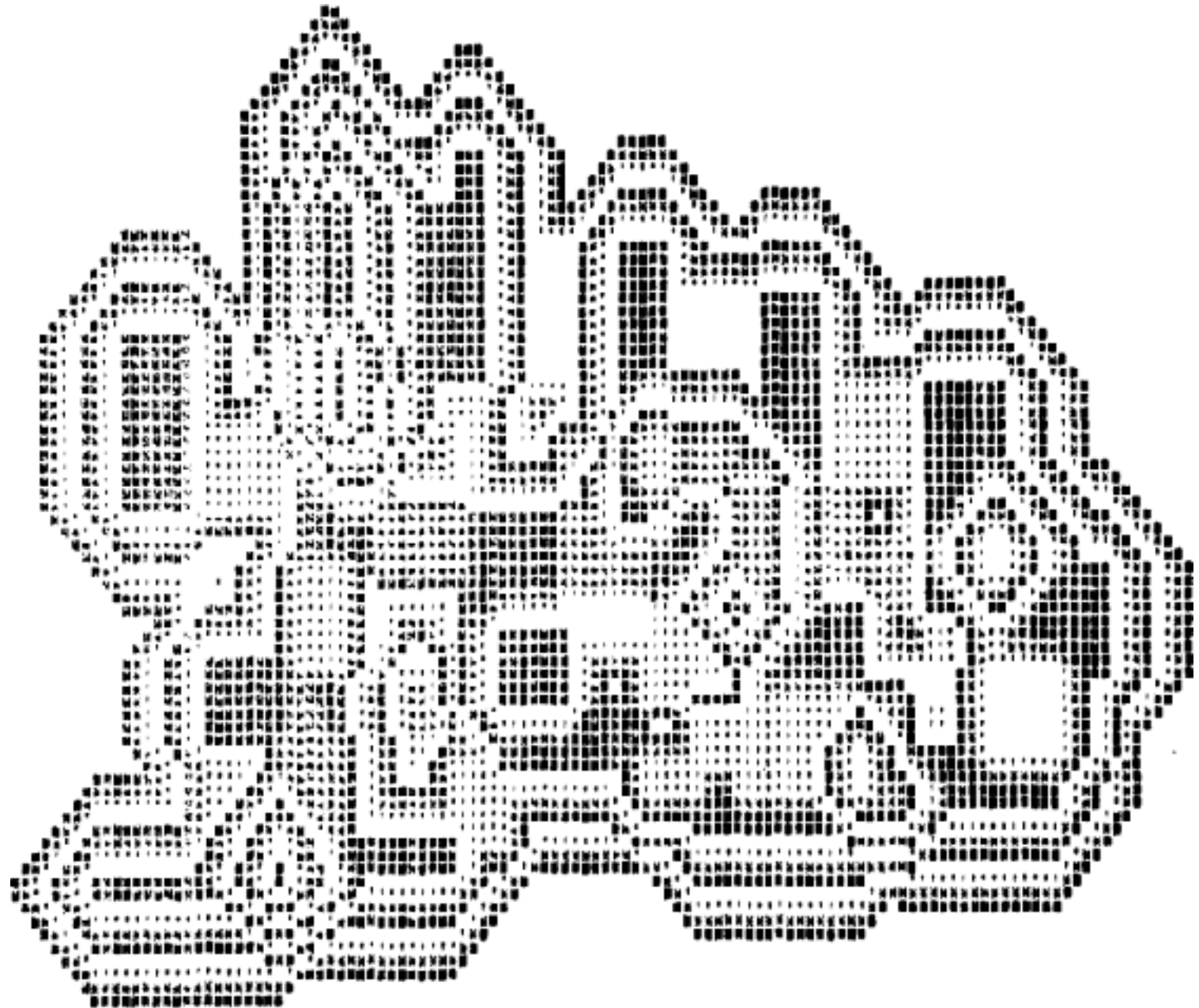


compas_vol Debug Console

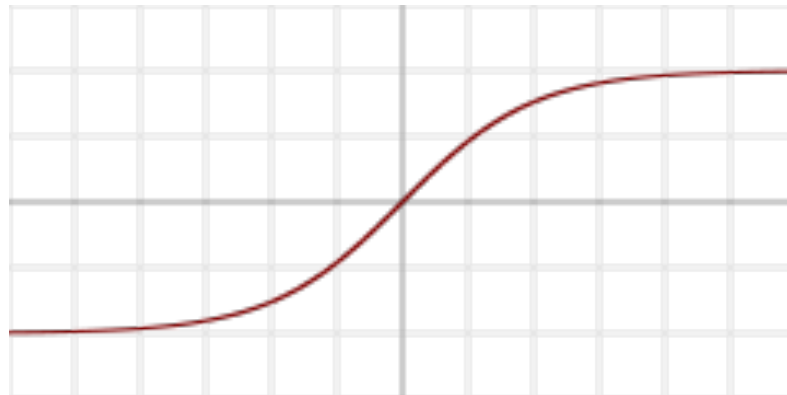
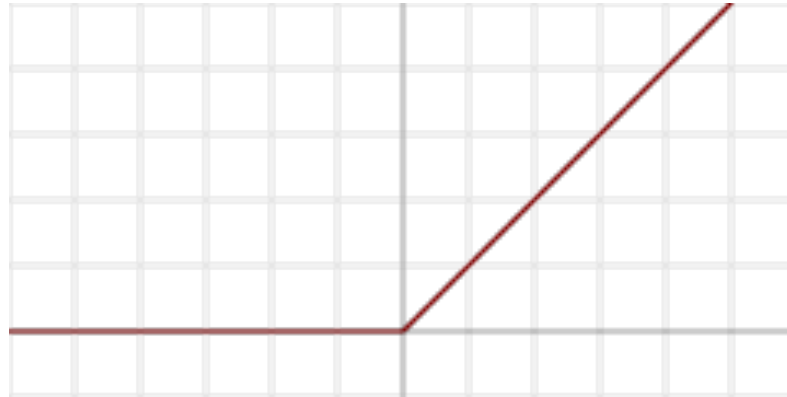
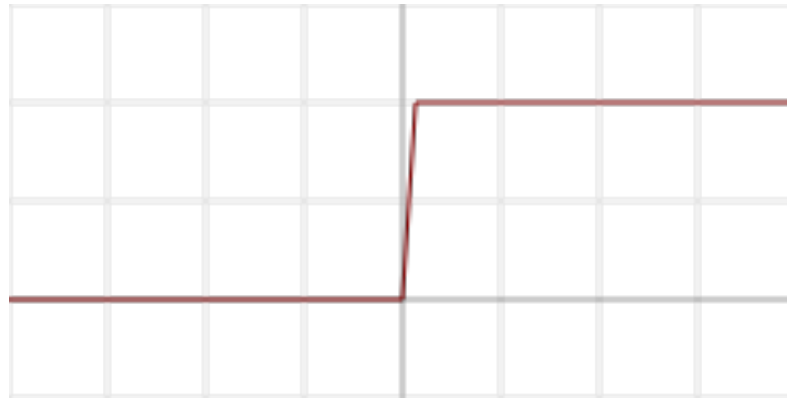


Mini-Explor

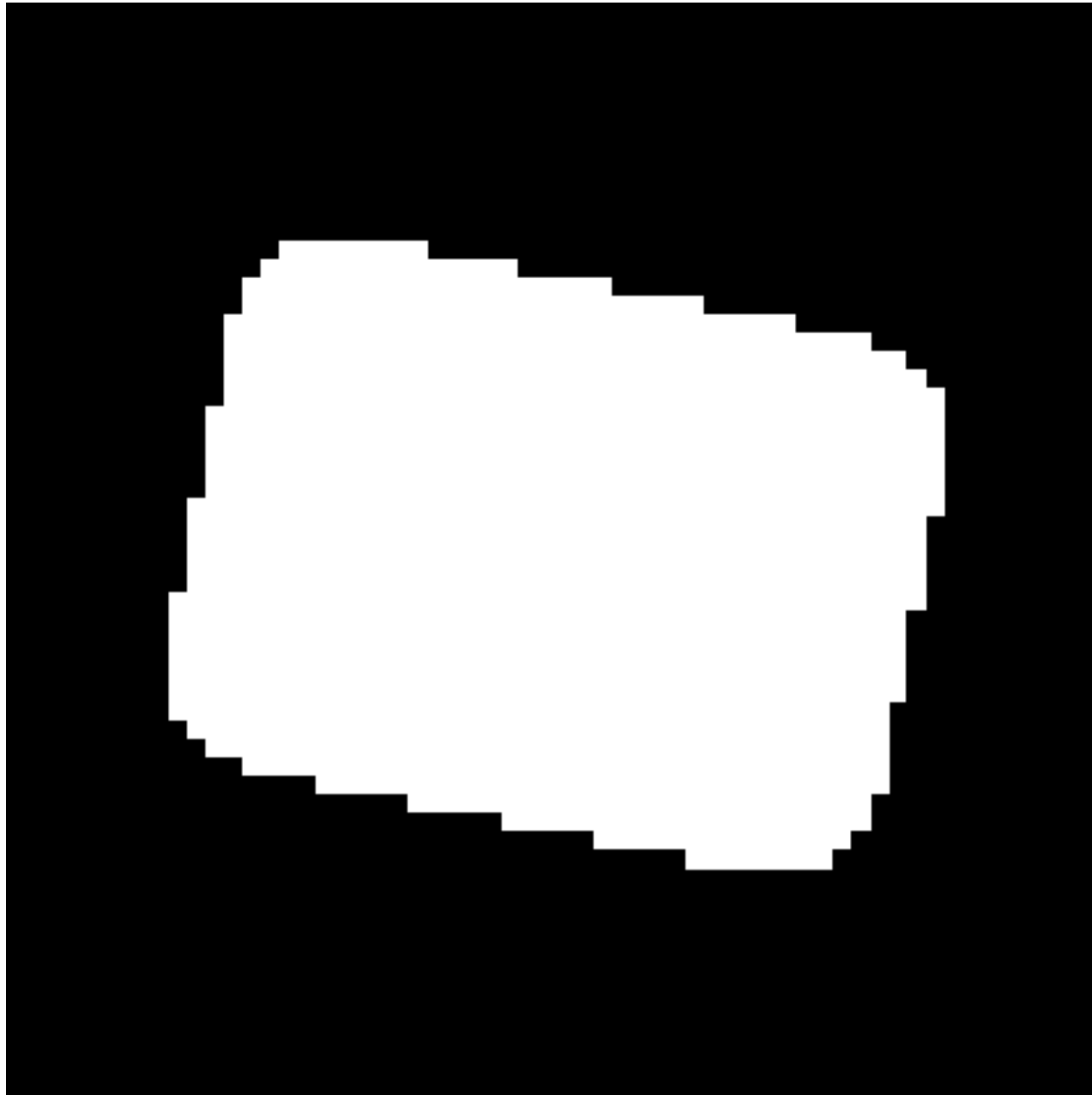
Knowlton, Ken. 1975. "MINI-EXPLOR - A FORTRAN-Coded Version of the EXPLOR Language for Mini (and Larger) Computers." ACM SIGGRAPH Computer Graphics 9 (3): 31-42.



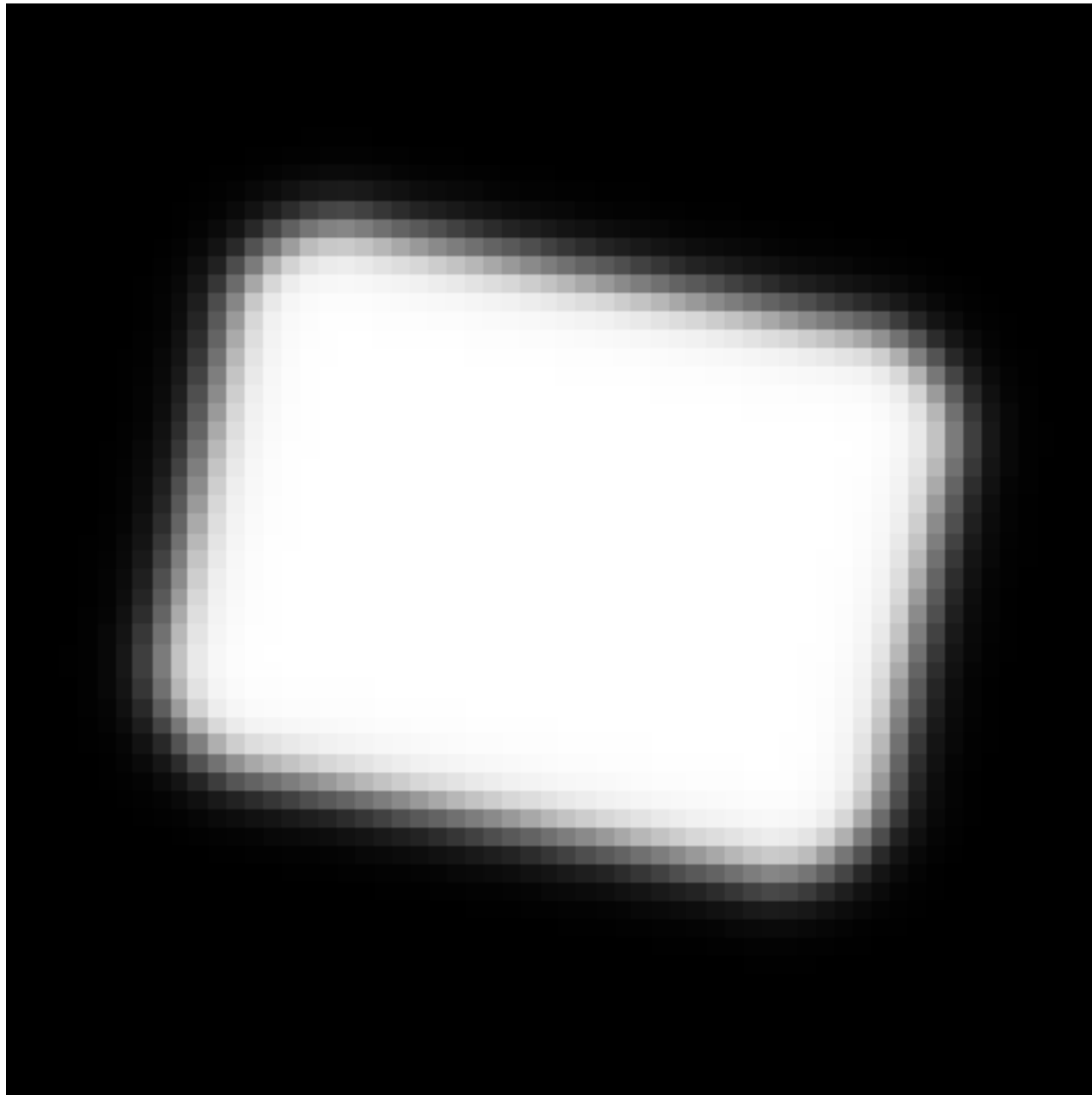
Binderjet Printing



Binary



Anti-Aliasing
tanh Function

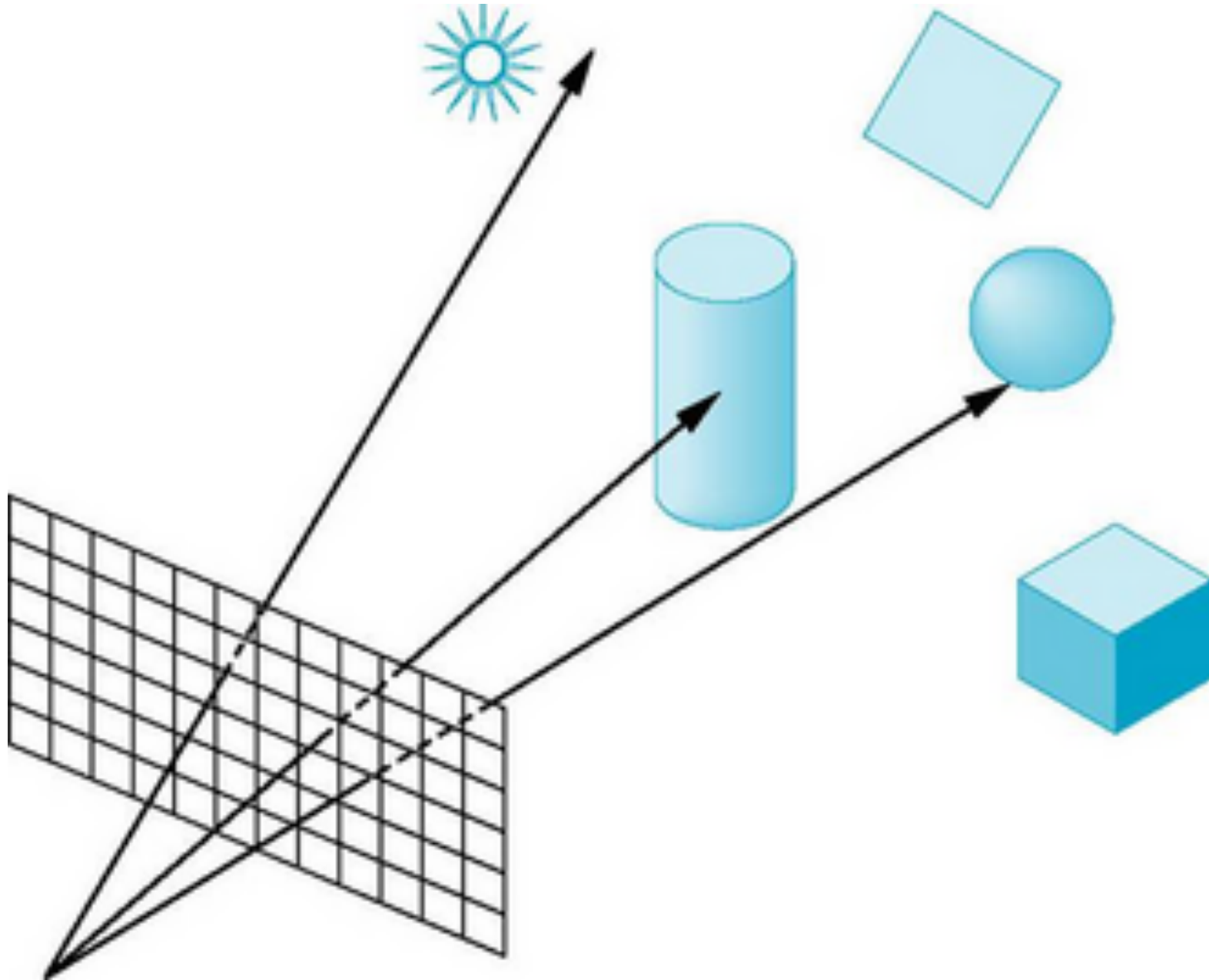


nTopology:
Death to .stl



Ray Casting
Ray Tracing
Ray Marching

*Tong Yu, California State
University, cse.csusb.edu*



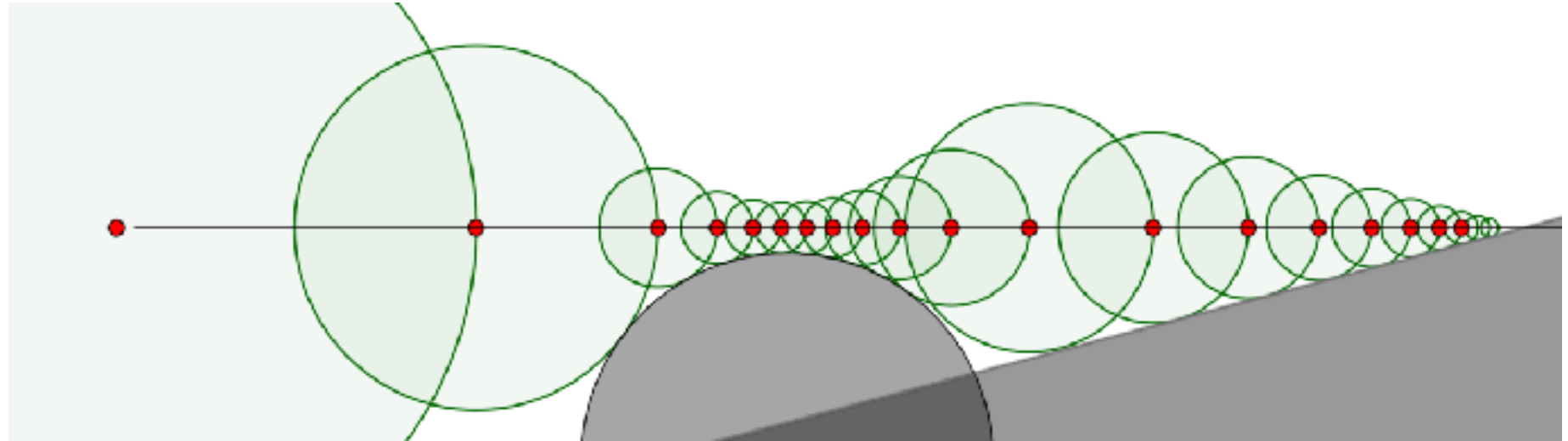
POV Ray

*Gilles Tran, Persistence of
Vision Raytracer (POV-Ray),
Still life*



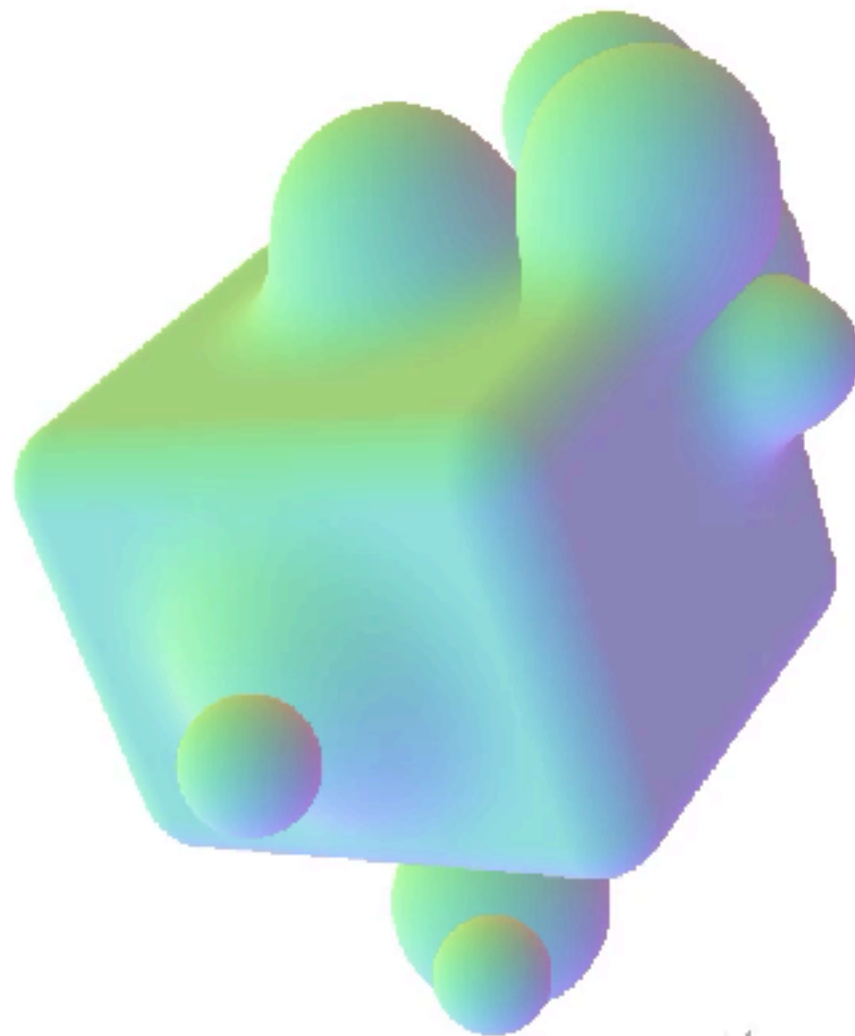
Sphere Tracing

Csaba B., Gabor V. : *Interactive
Rendering Framework for
Distance Function
Representations. In: Annales
Mathematicae et Informaticae
(2018)*



Ray Marching

Ioanna Mitropoulou
PhD researcher at DBT
compas_vol to shader language
using Panda3D



Slice model, axis : x -5 15
Slice model, axis : y -5 15
Slice model, axis : z -7 15

Ray Marching

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PhD researcher at DBT
compas_vol to shader language
using Panda3D



Slice model, axis : x -3 3

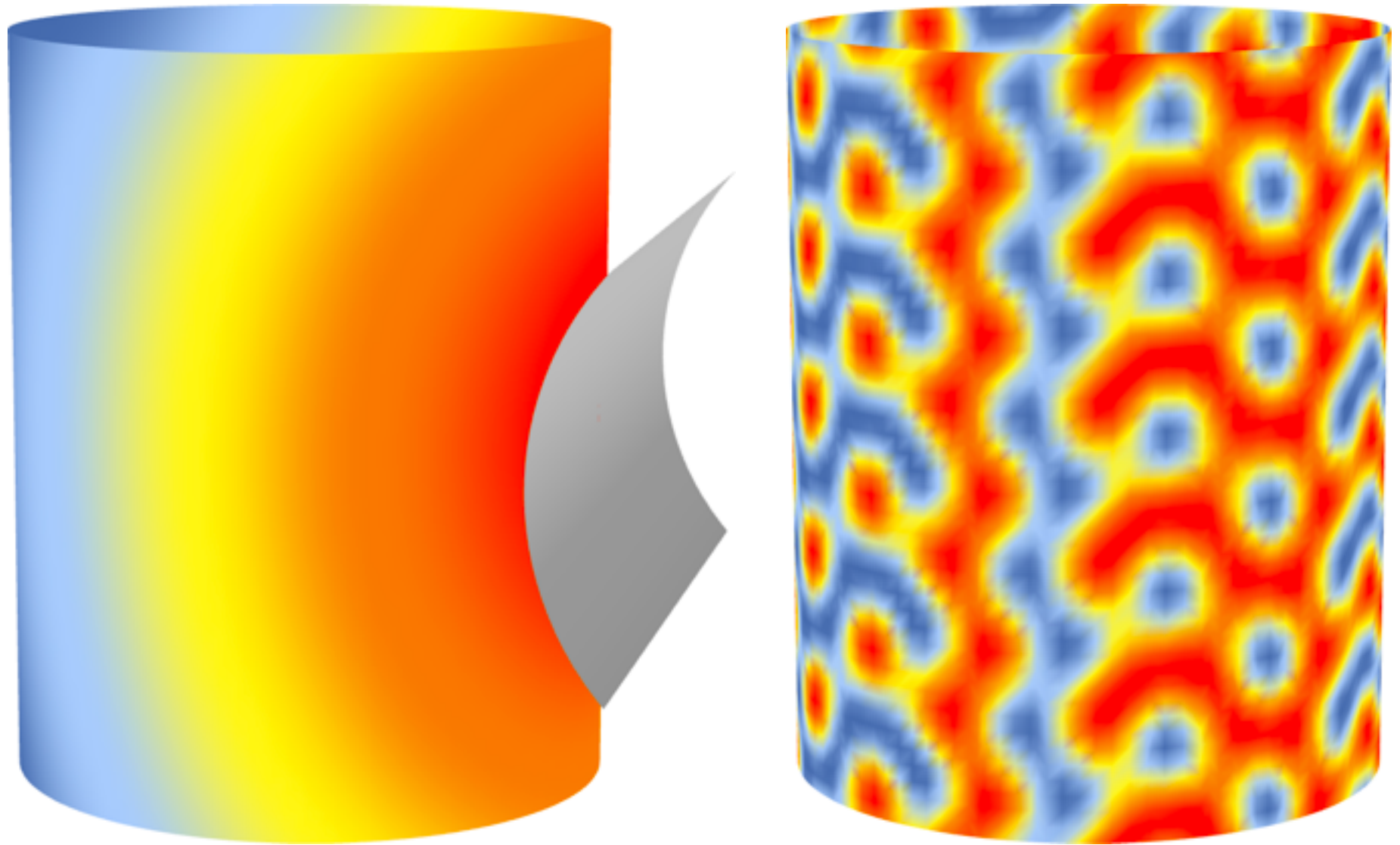
Slice model, axis : y -3 3

Slice model, axis : z -7 7

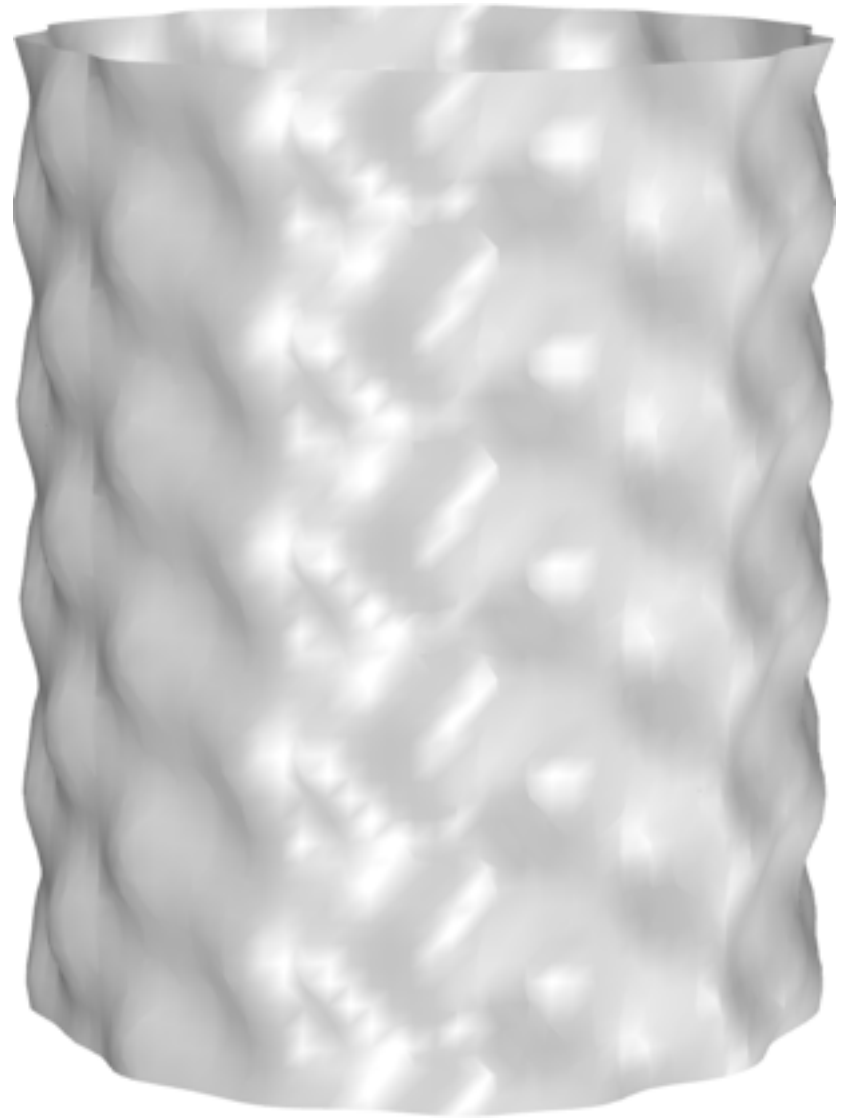
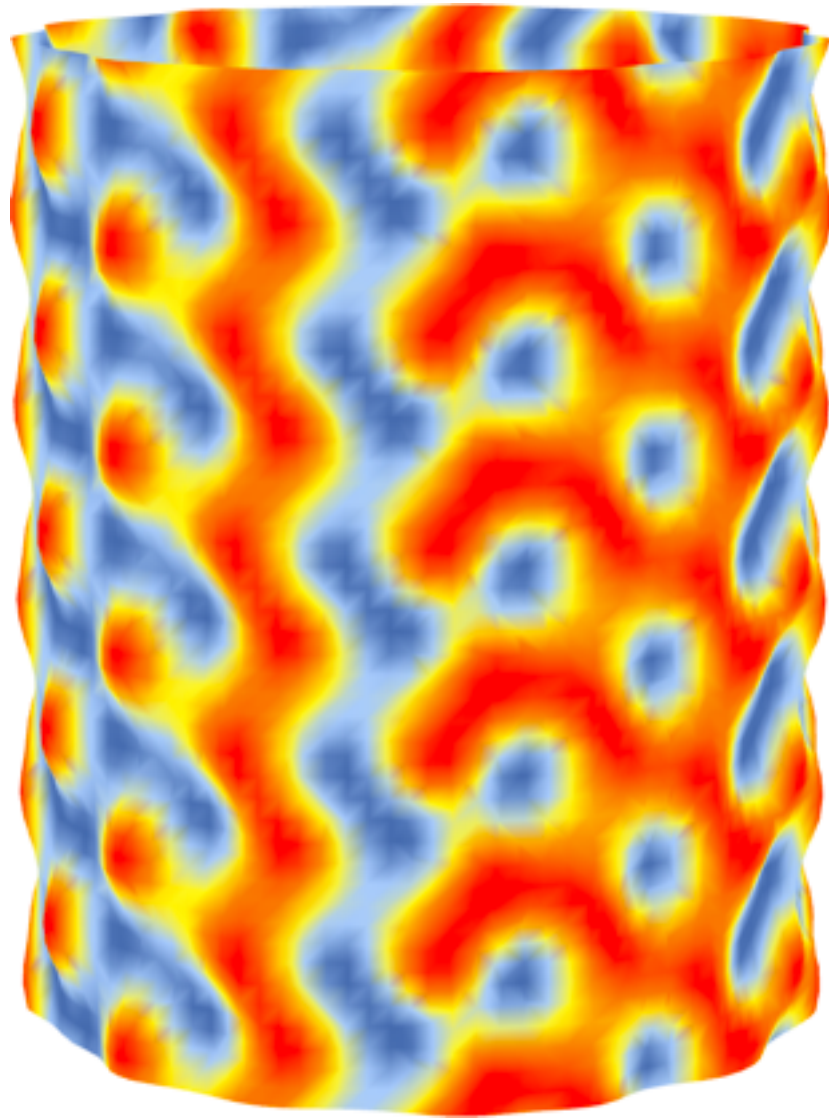
Update

```
python -m compas_rhino.install -p compas_vol
```

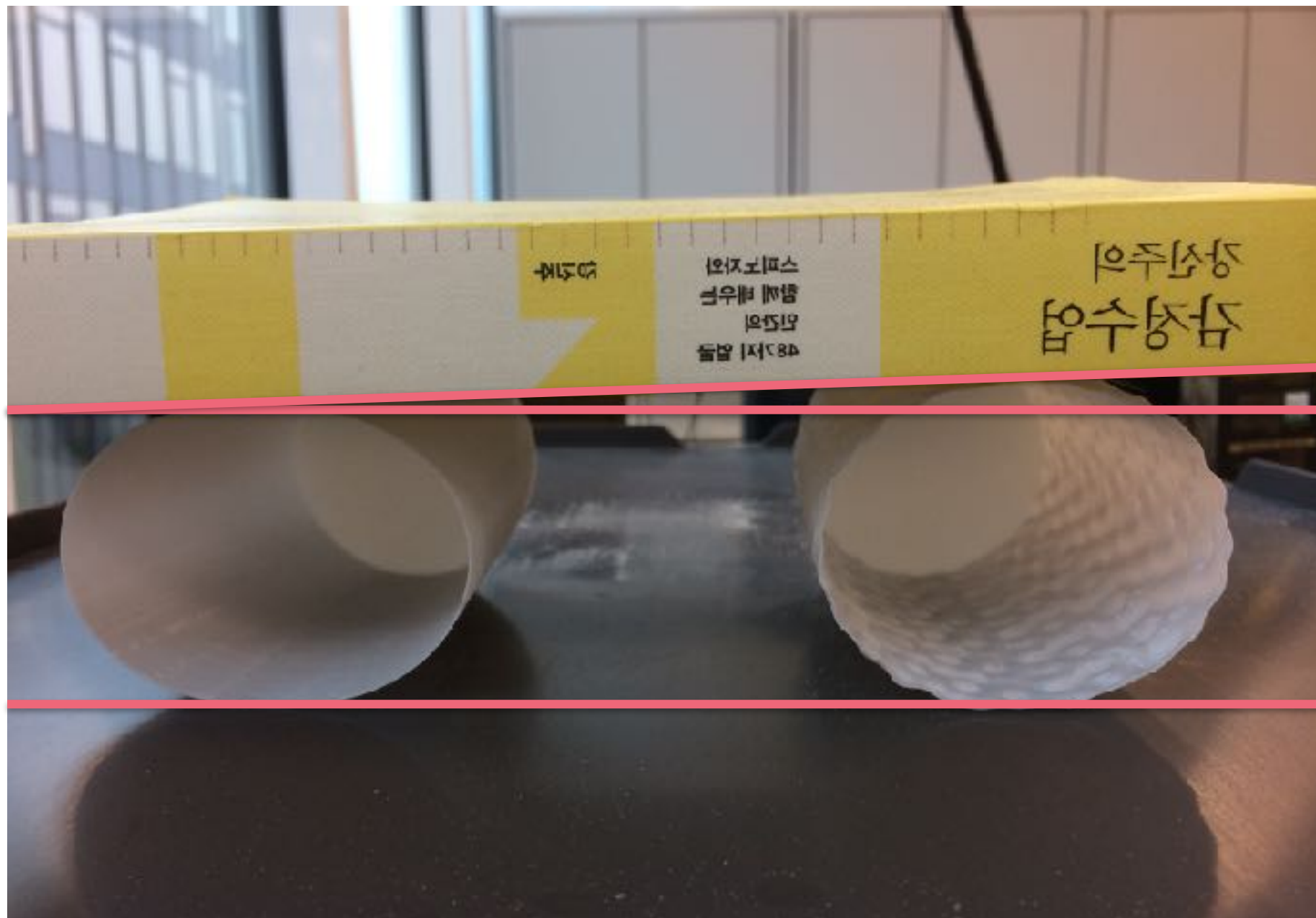
Multilayer



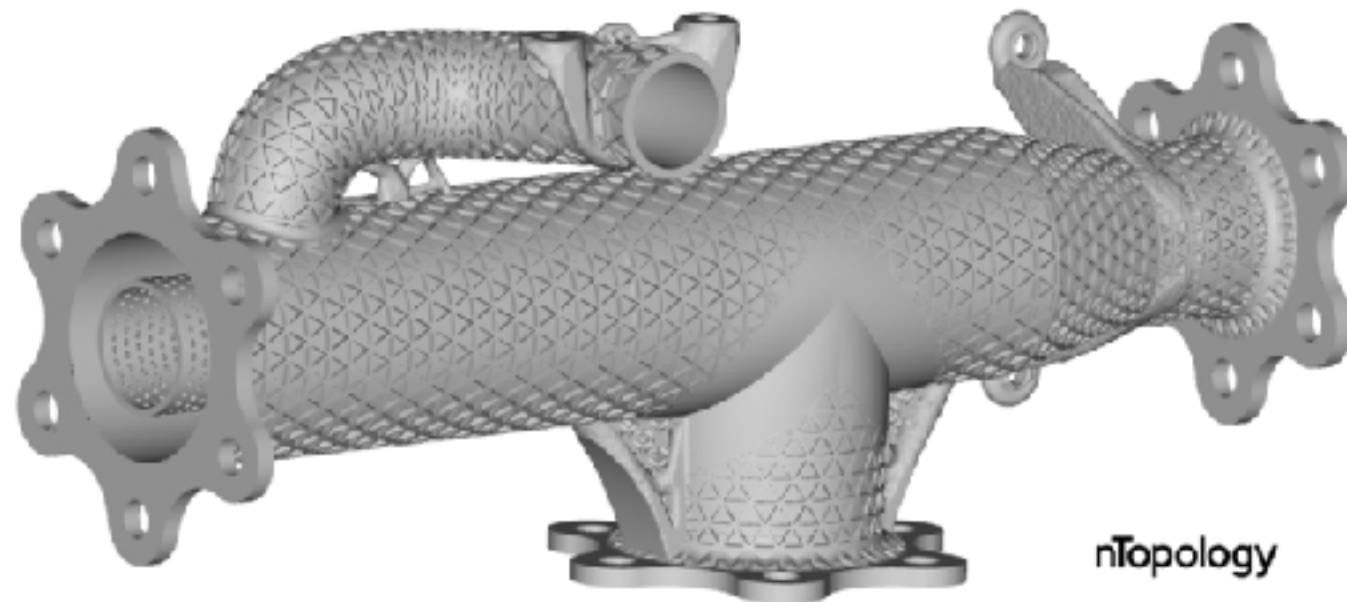
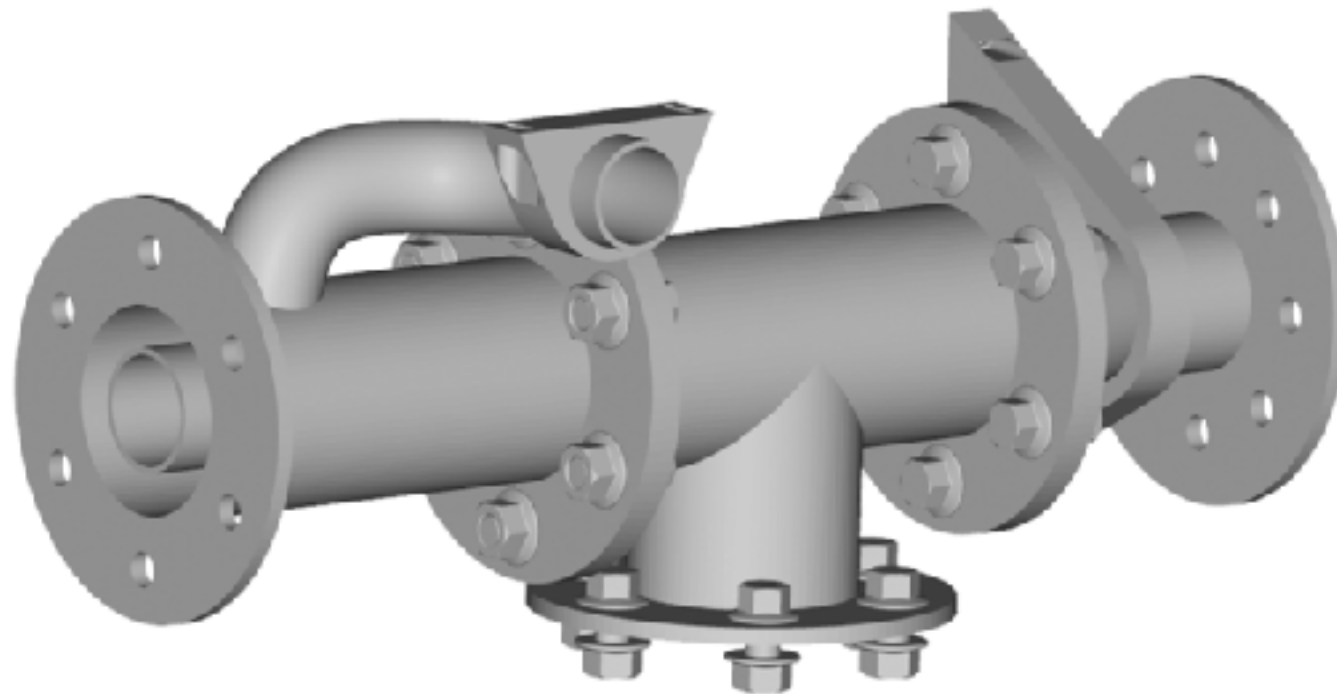
Deformation



Functional
Texture



Weight
Reduction



Weight
Reduction



Weightiness

*Marcel Breuer
St. John's University,
Alcuin Library*



Fassade

*Marcel Breuer
Abbey Church, St. John's*



Architecture



Architecture



Assignment 1

