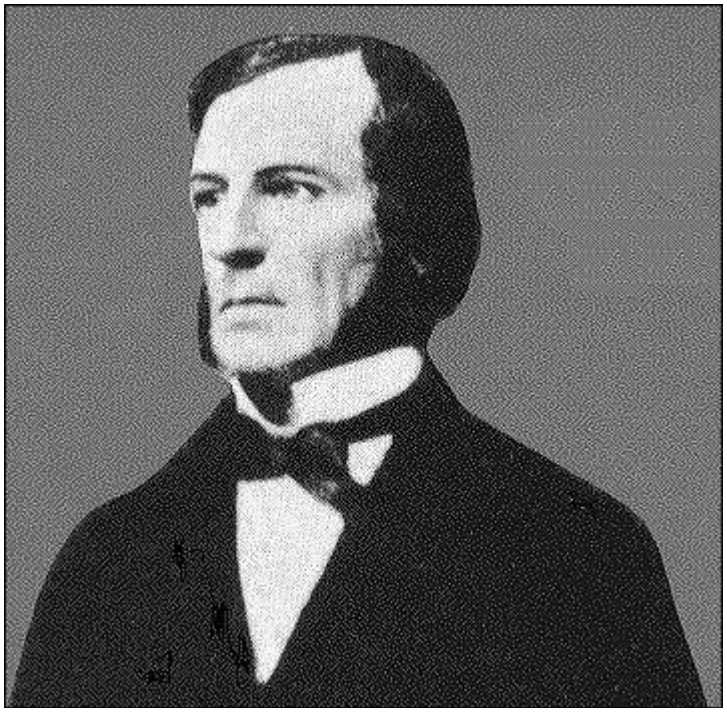
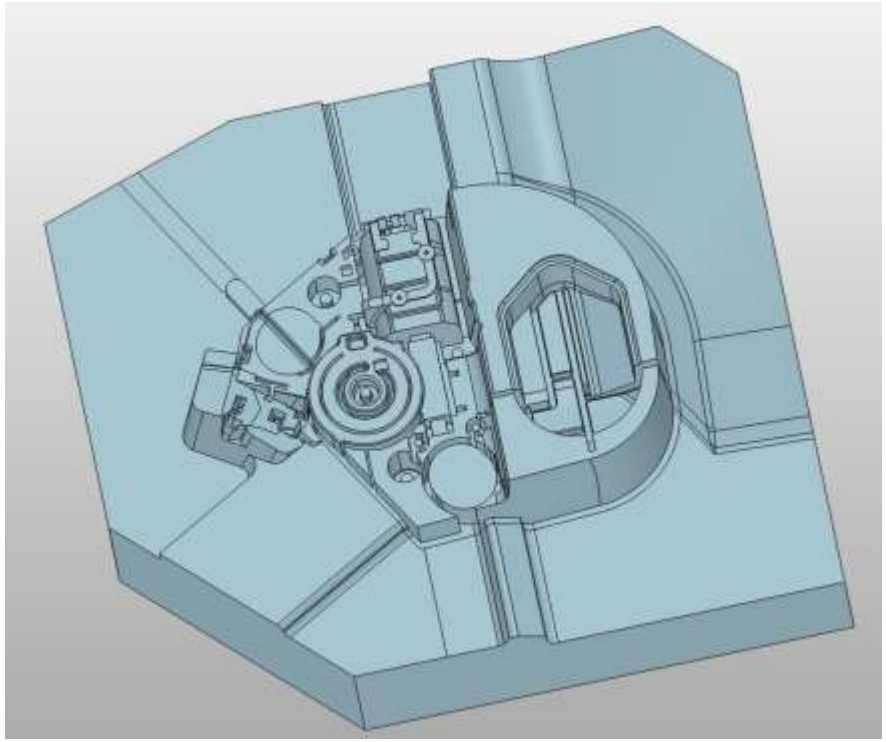
Boolean Operations in ZW3D

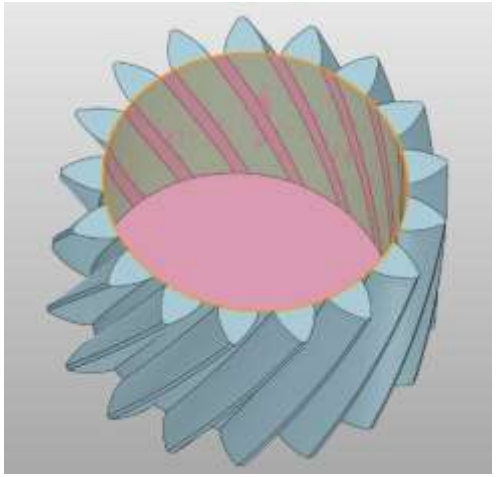


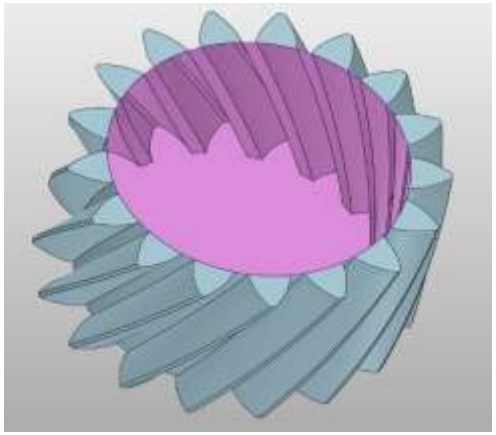
George Boole 1815 - 1864

Why

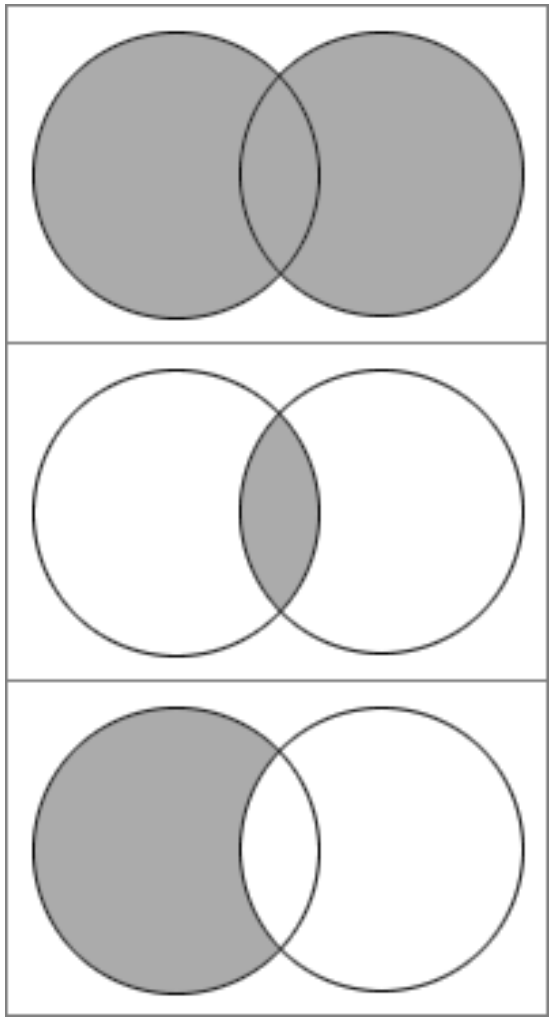
编辑、组合、修剪模型，构造出复杂的模型







Set operations in 2D



$$A \cup B = \{x \in A \quad or \quad x \in B\}$$

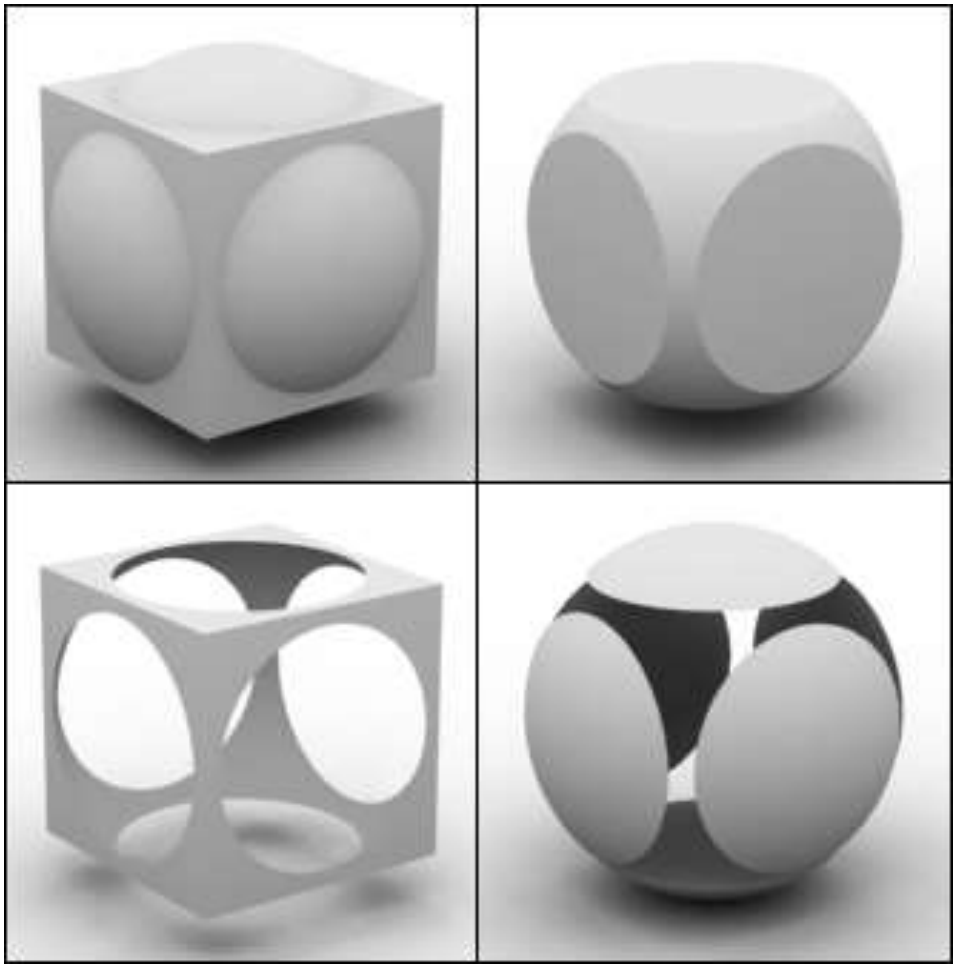
$$A \cap B = \{x \in A \quad and \quad x \in B\}$$

$$A - B = \{x \in A \quad and \quad x \notin B\}$$

Set Operations in 3D

$S \cup B$

ADD



$S \cap B$

INTERSECT

$B - S$

REMOVE

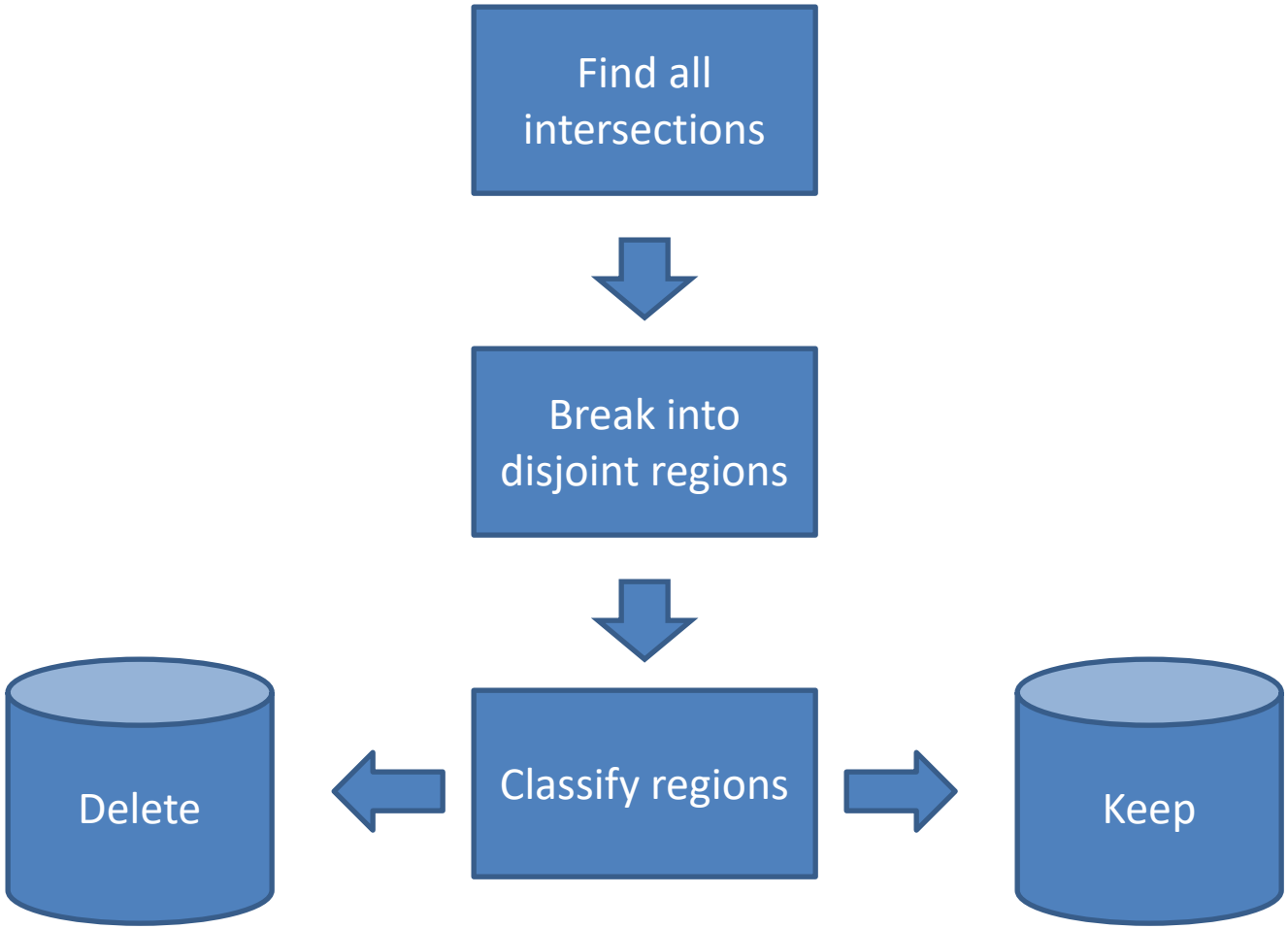
$S - B$

REMOVE

Commands related to Boolean

- Combine(Add Shape,Remove Shape,Intersect Shape)
- Divide
- Trim
- Split with Faces
- Interference Check

The basic algorithm



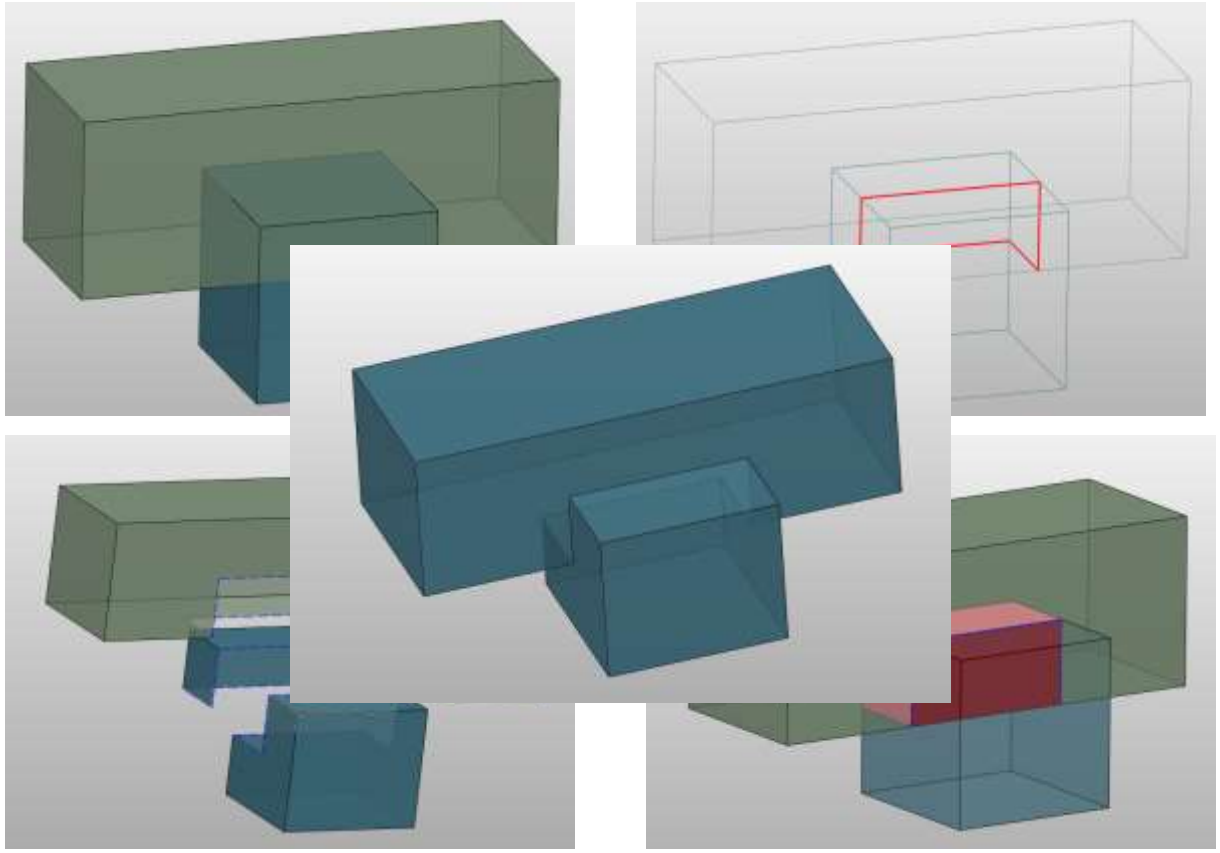
The basic algorithm

1. 求交线

2. 面分割

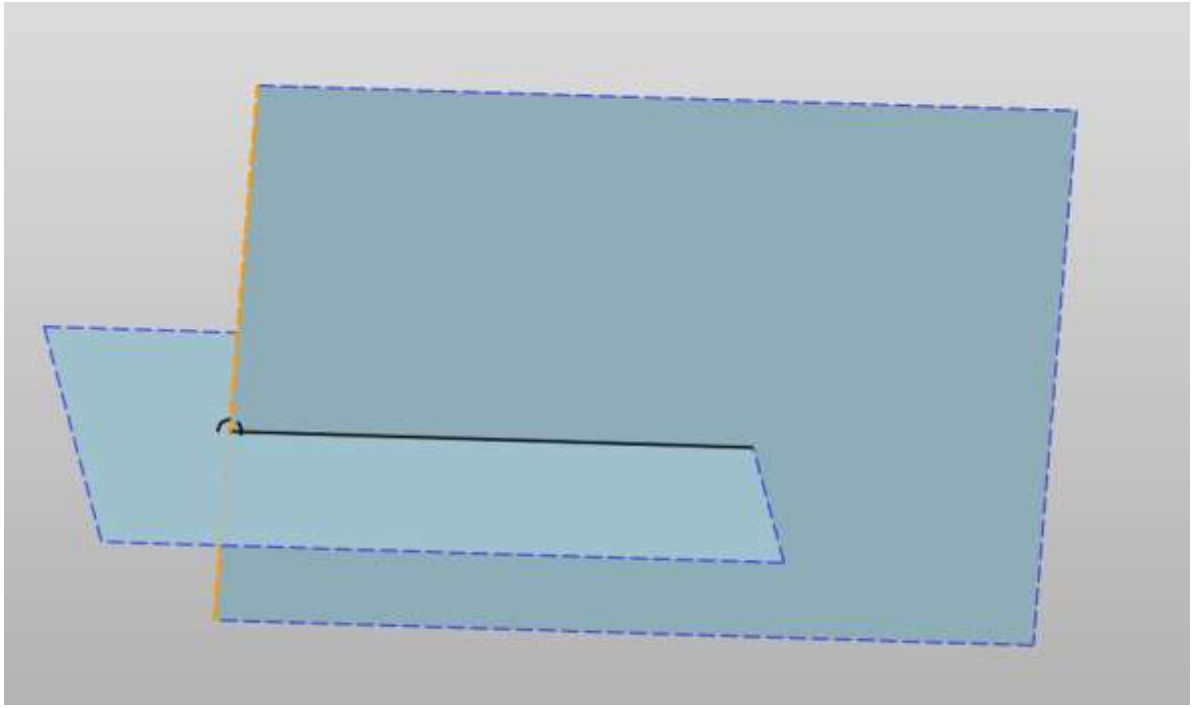
3. 区域划分

4. 拓扑重构



SSi

面面求交使用的是交线追踪法



Find intersections

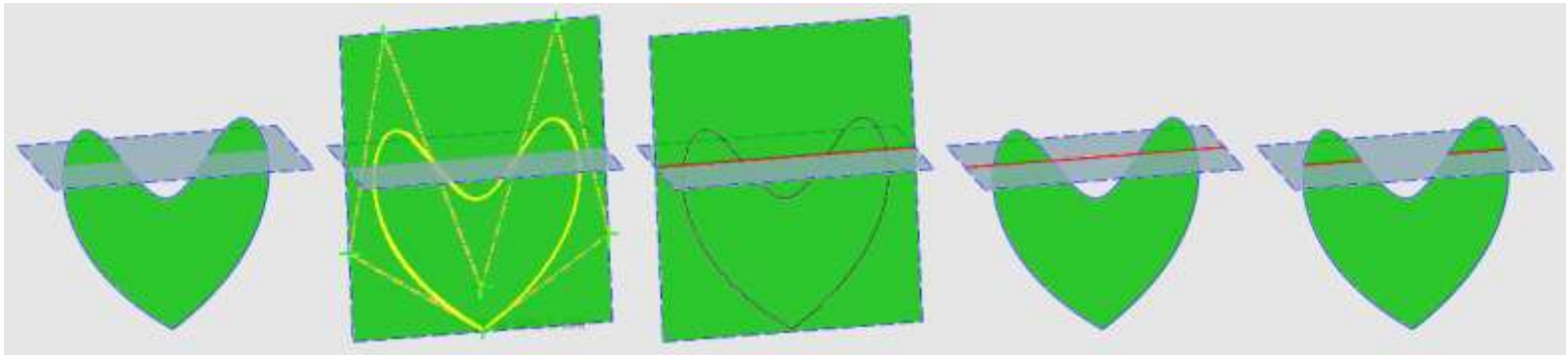
非裁剪面相交

SSI

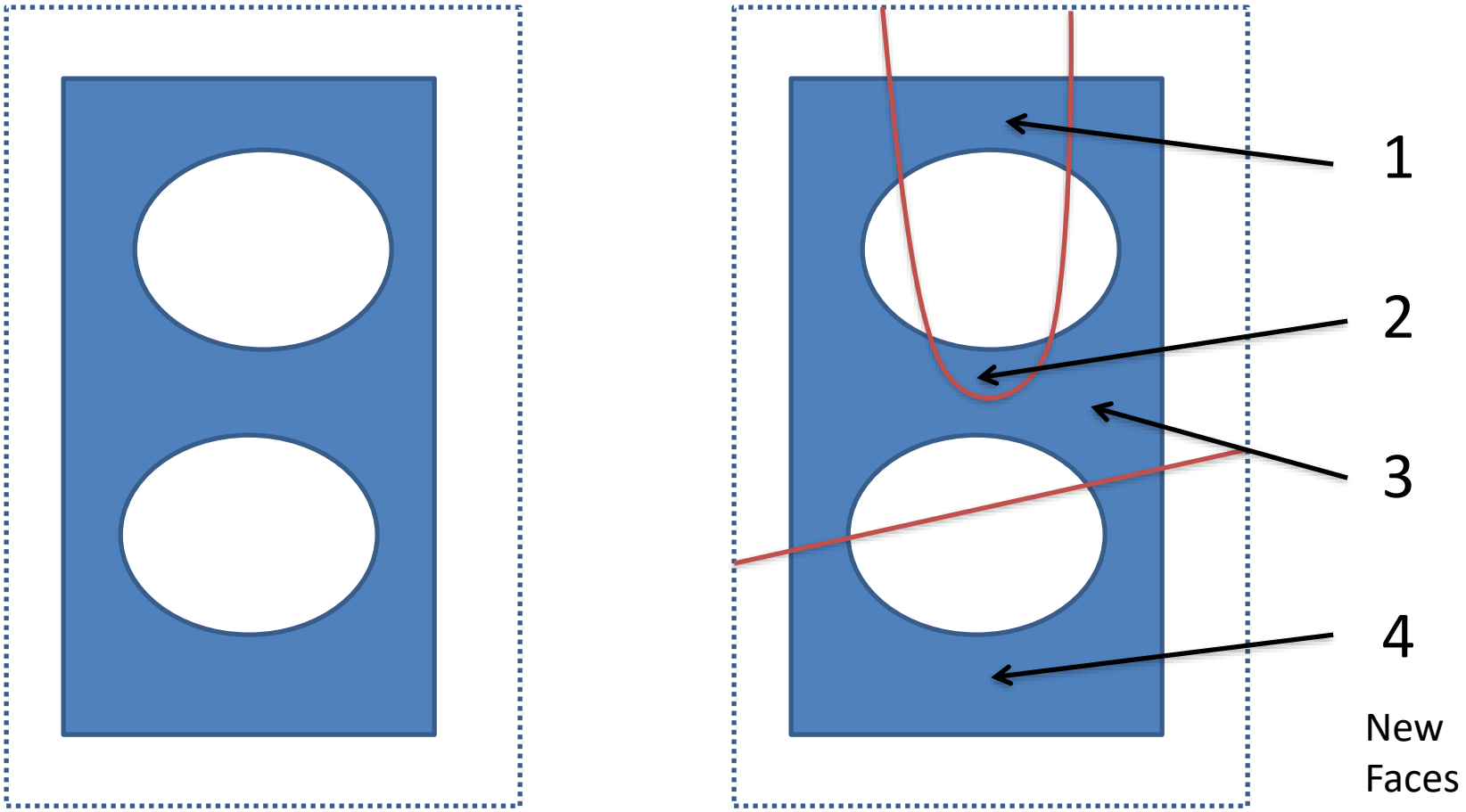
超出裁剪面边界的交线

裁剪面边界内的交线

CCI



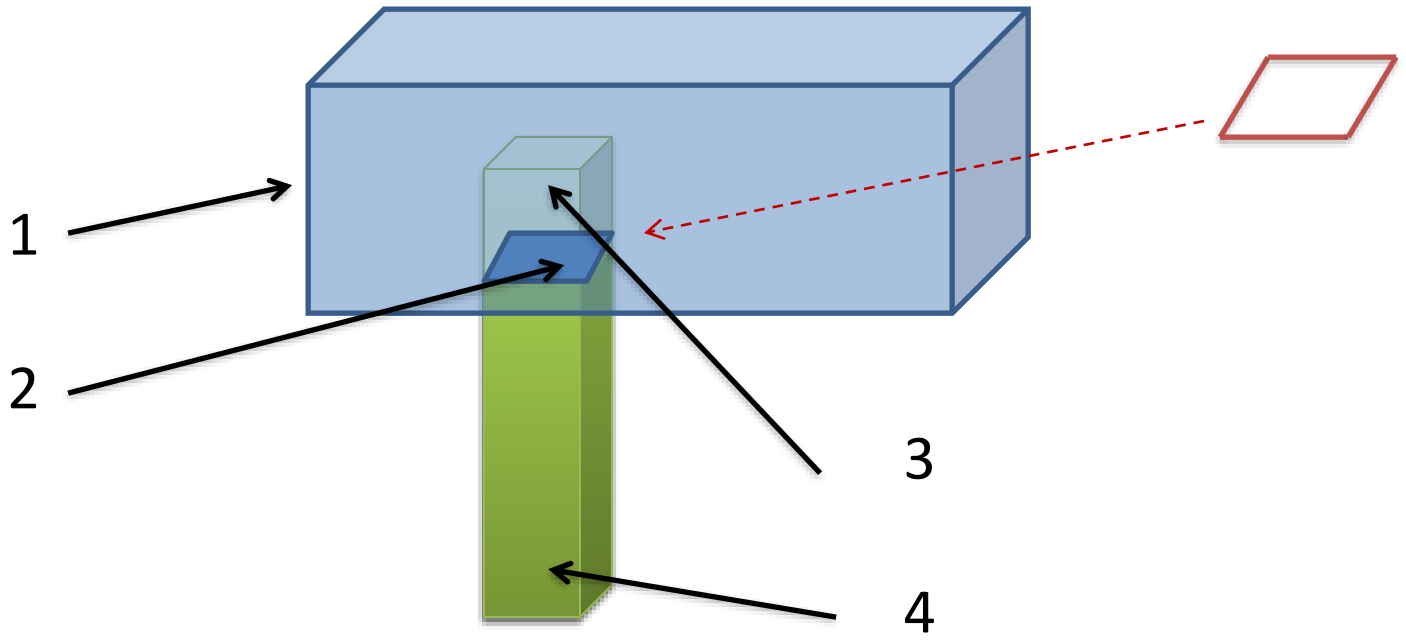
Break into disjoint regions – Face Split



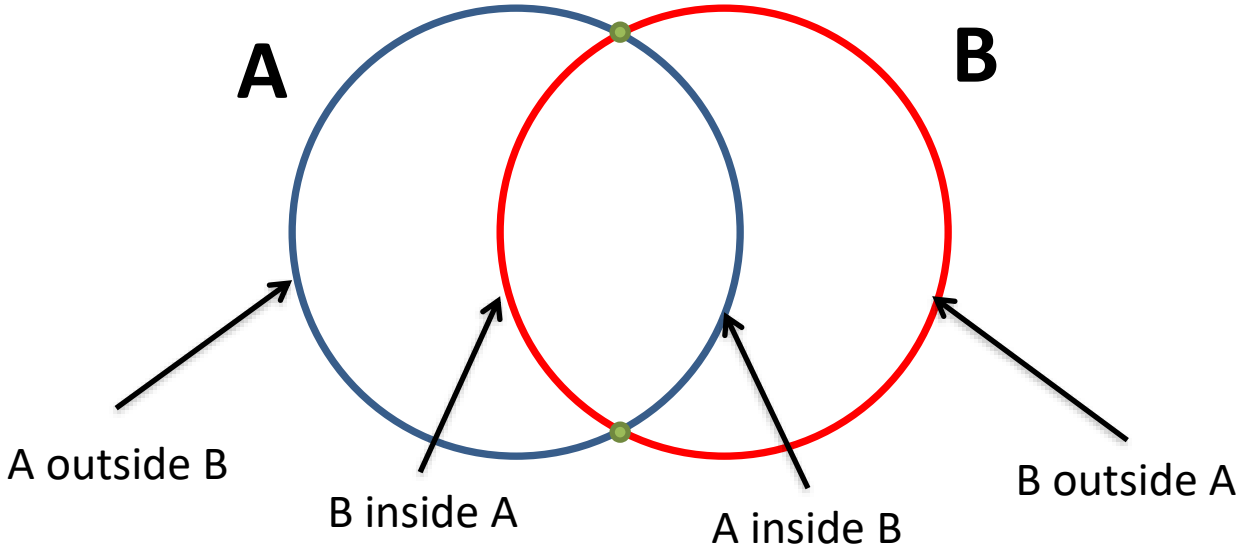
Break into regions

- Join intersection curves into boundaries.

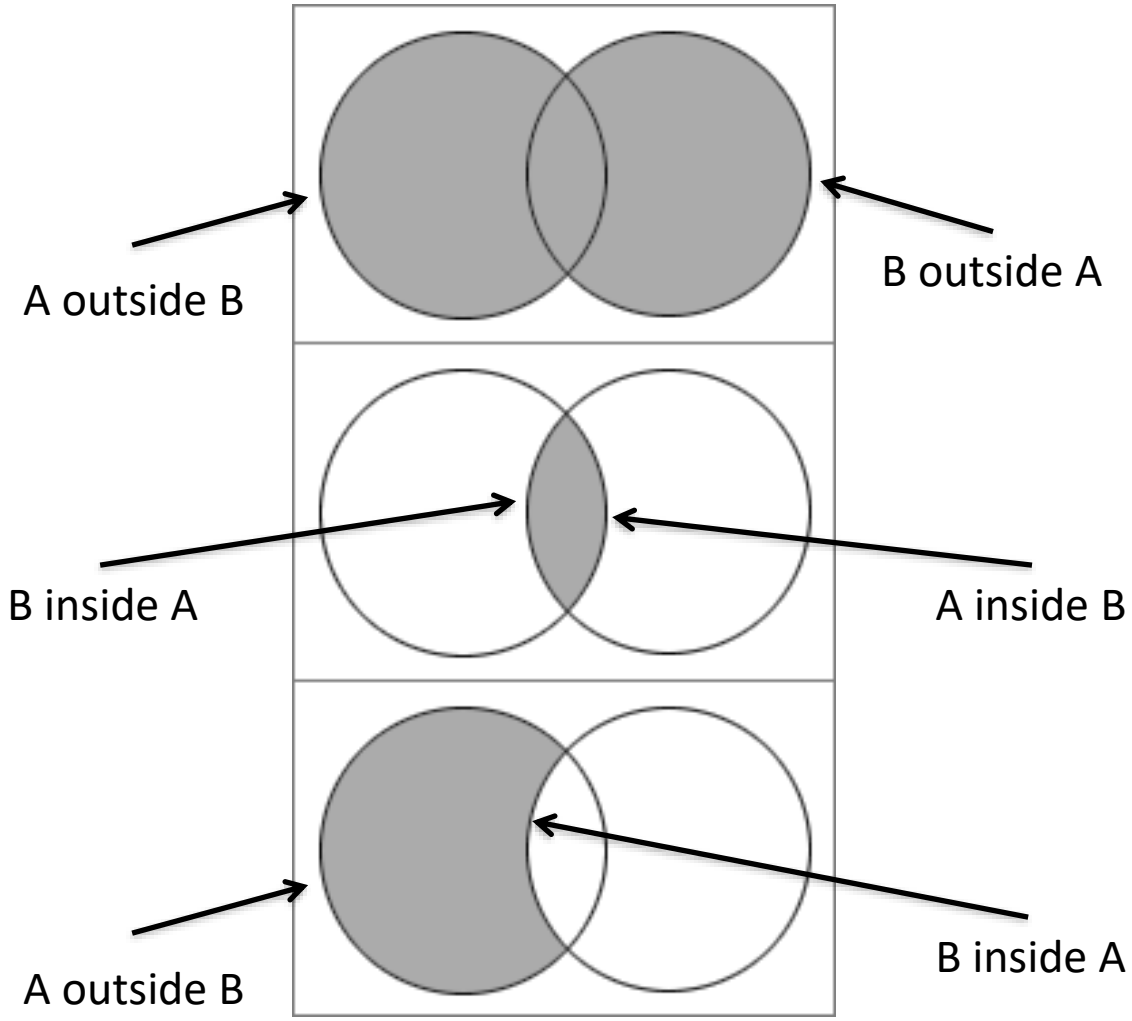
- Create separate shells on different sides of boundary



Classify each region

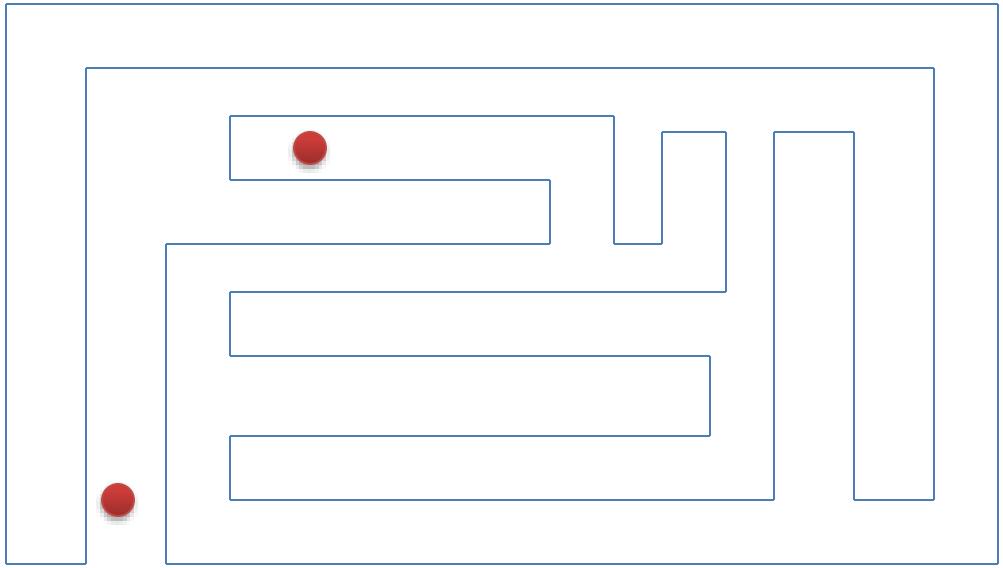


Operation	A out B	B in A	A in B	B out A
Union	Keep	Delete	Delete	Keep
Intersection	Delete	Keep	Keep	Delete
Remove (A-B)	Keep	Keep	Delete	Delete



Operation	A out B	B in A	A in B	B out A
Union	Keep	Delete	Delete	Keep
Intersection	Delete	Keep	Keep	Delete
Remove (A-B)	Keep	Keep	Delete	Delete

In or Out?

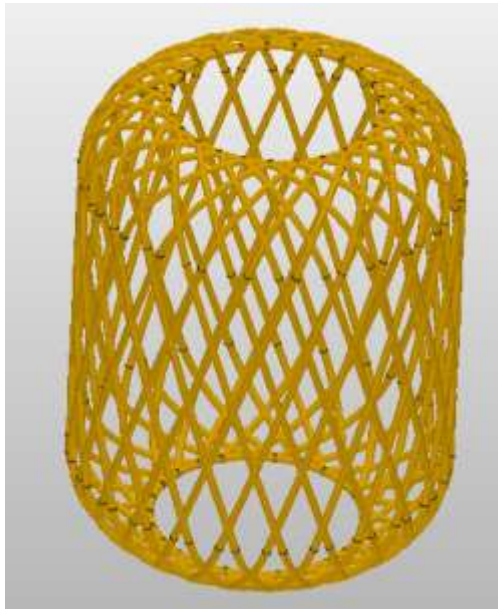


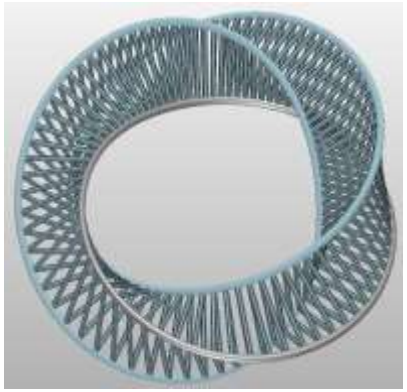
If shape is **closed** you can use ray-casting.
-Even number of hits means outside
-Odd number of hits means inside

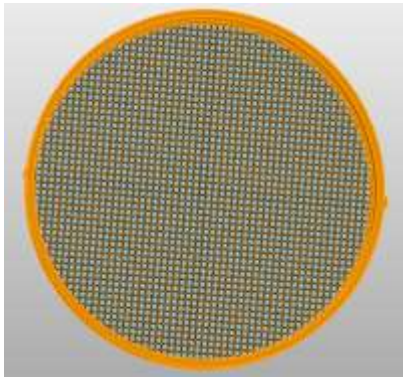
Using topological direction

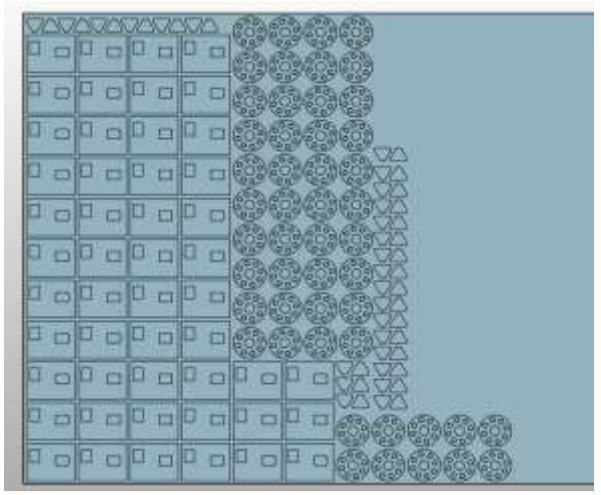
Testing cases

Many operand shells



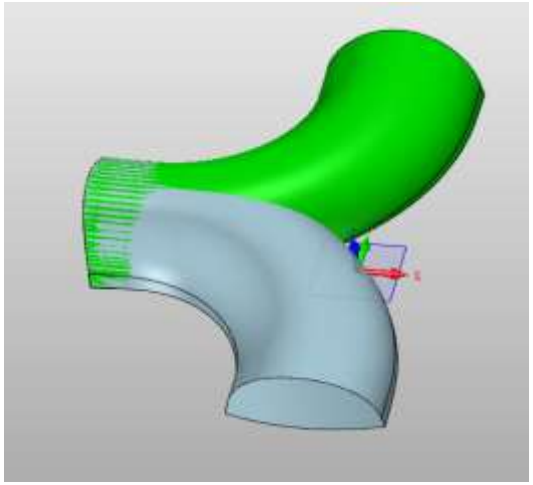


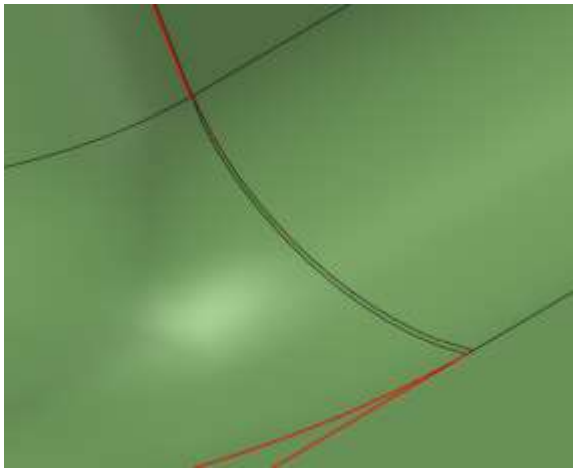


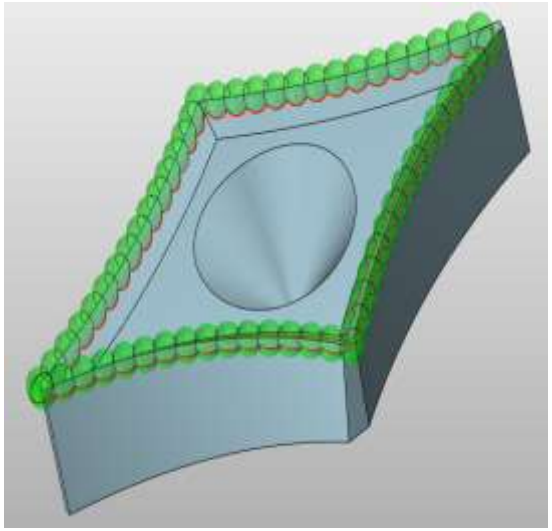


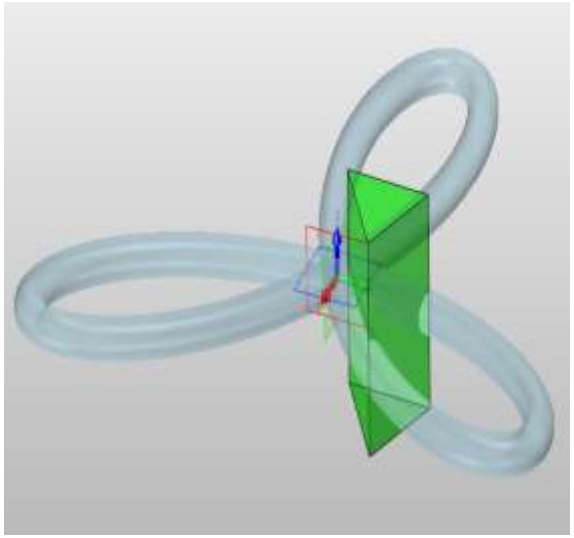
Testing cases

- Tolerant models
- High continuity
- Sliver faces
- Type of Spheres
- Type of torus









Testing cases

- Coincident faces
- Non-manifold
- Trim at tolerant vertex