The background of the slide is a light pink color with a pattern of white, wavy, irregular lines that resemble topographic contour lines or a marbled texture. The lines are thin and vary in thickness and curvature, creating a complex, organic pattern.

# **Topologische Datenanalyse für Bildanalyse und Segmentierung**

**Welcher Buchstabe passt nicht dazu?**

A

P

R

B

Q

D

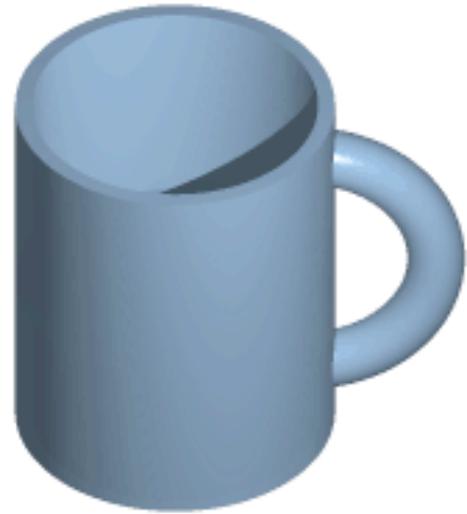
**Welcher Buchstabe passt nicht dazu?**

A P R B Q D

# Was ist Topologie?

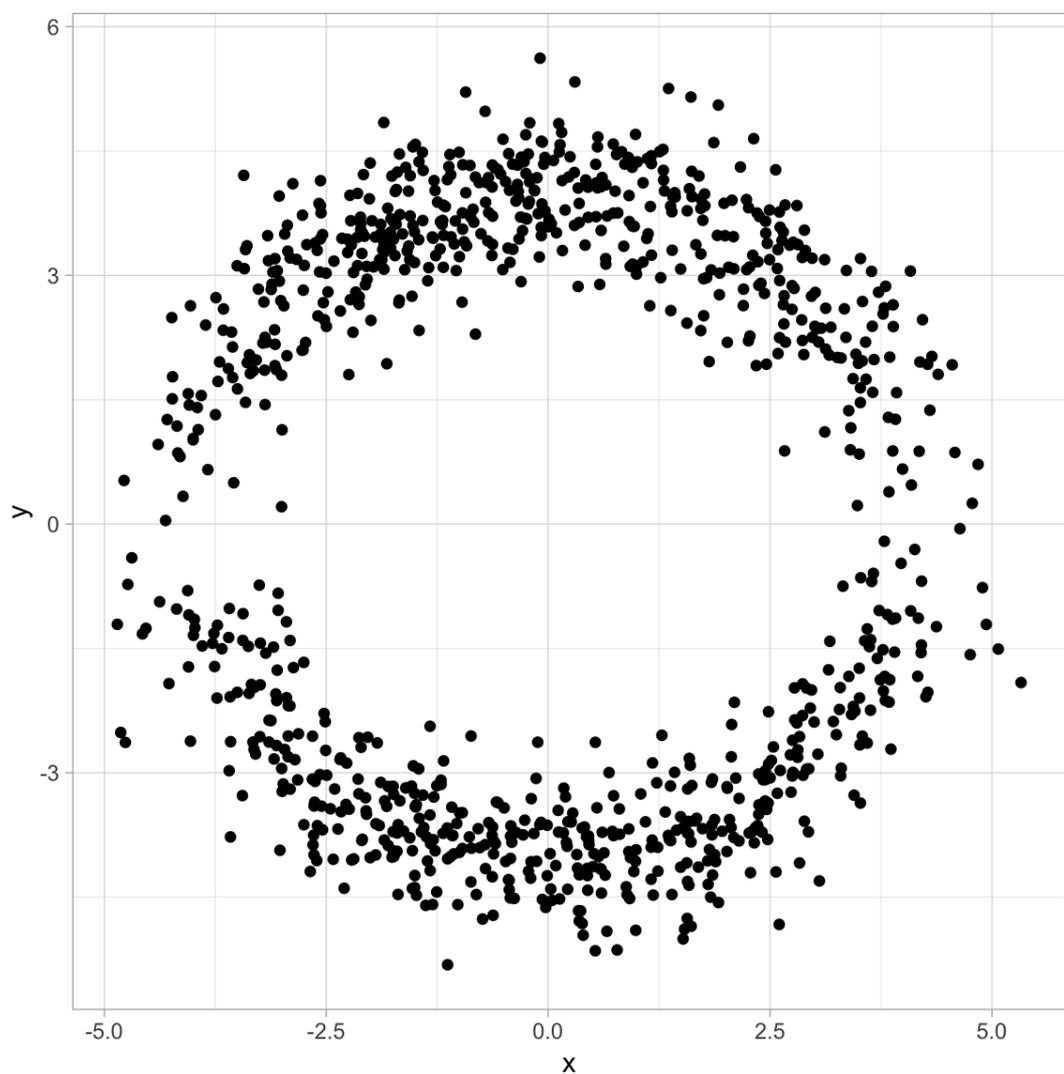
Analyse der Eigenschaften geometrischer Figuren, die bei kontinuierlicher Verformung bestehen bleiben:

- Komponenten
- Löcher
- Hohlräume



# Datenanalyse

- Wir erkennen die Form
- Computer erkennt nur Punkte
- Wie erkennt er die Form?



A



D

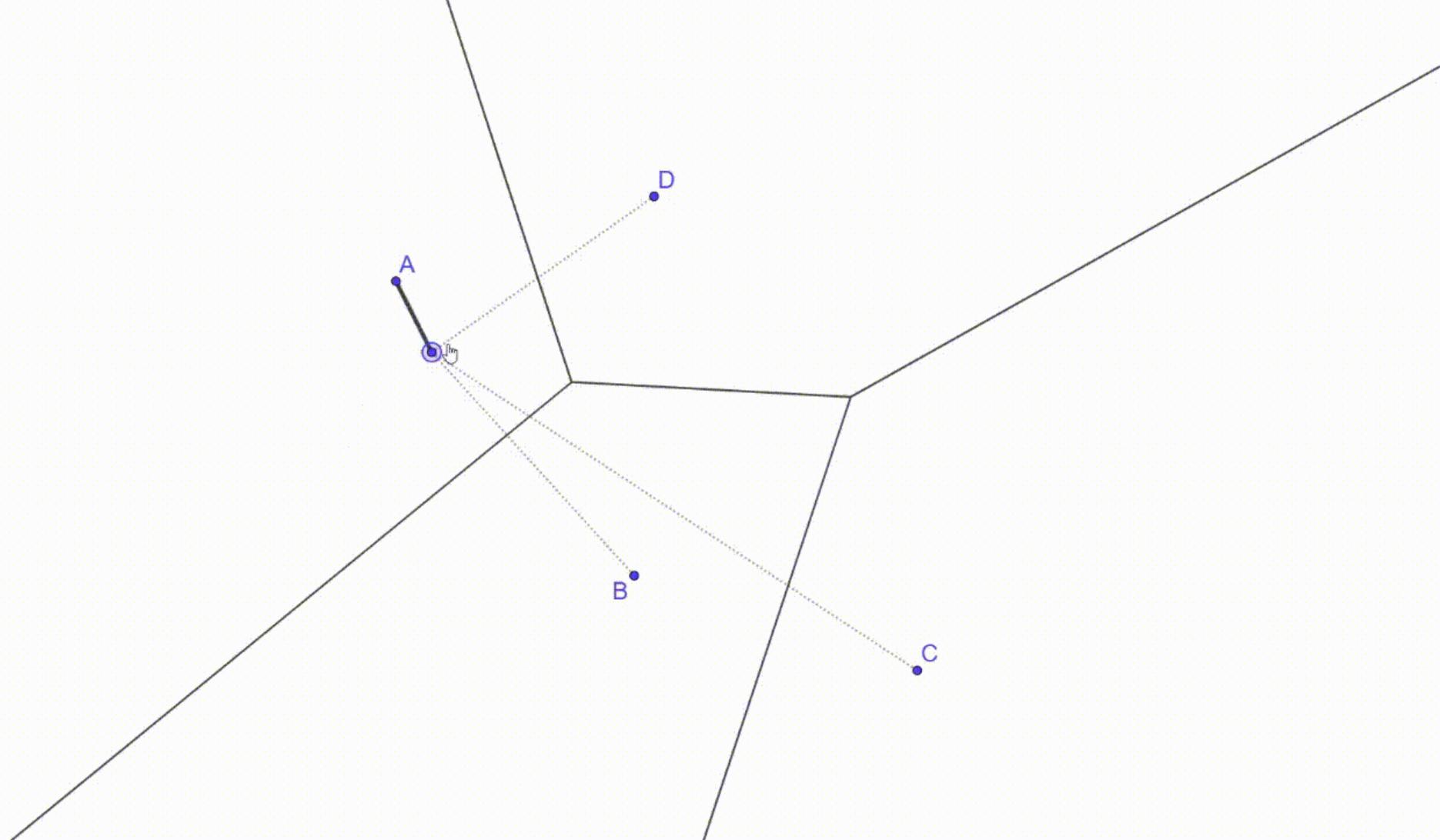


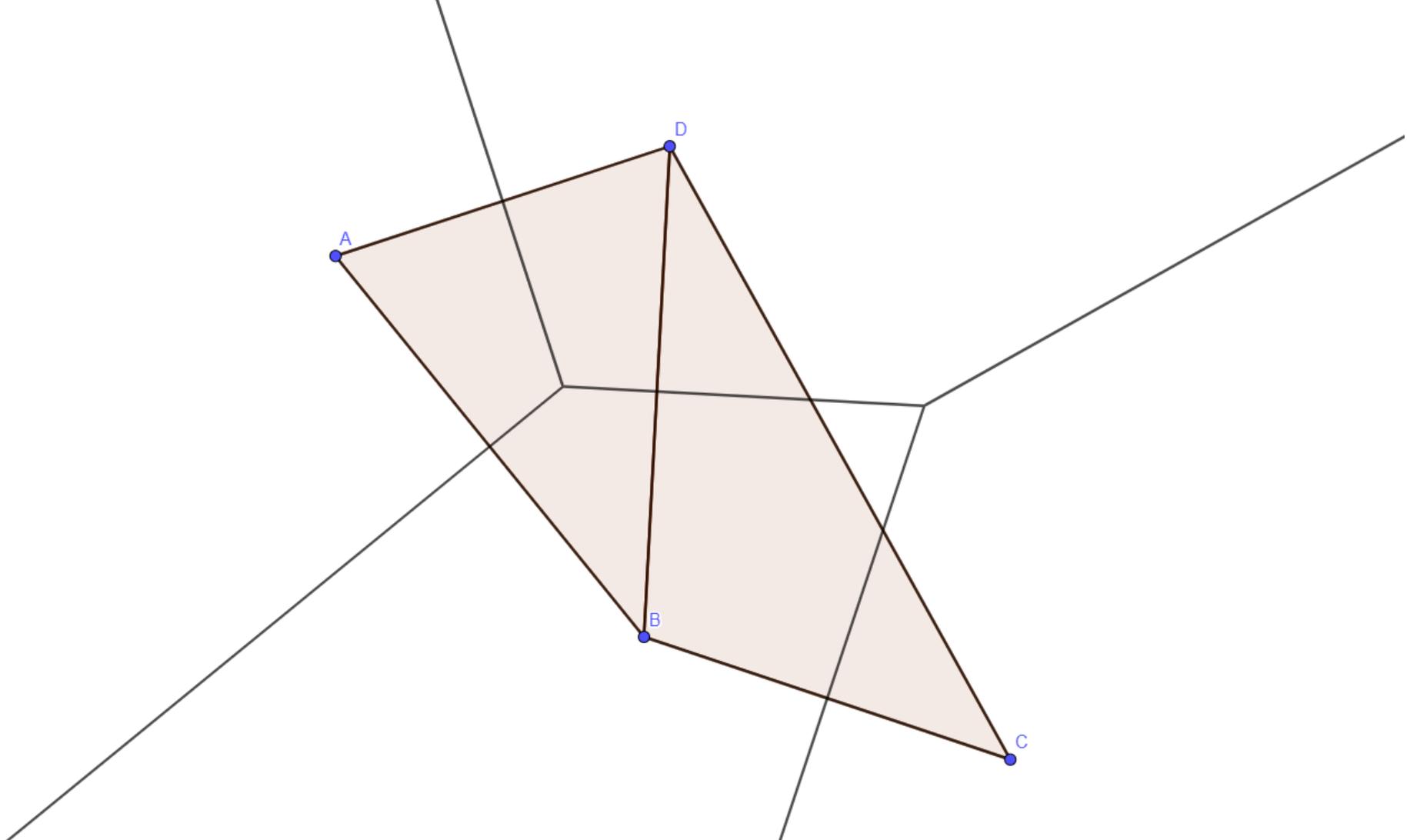
B

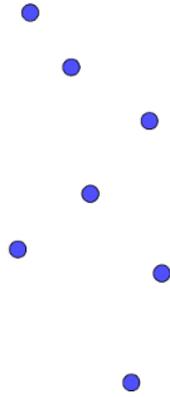
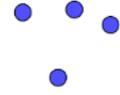


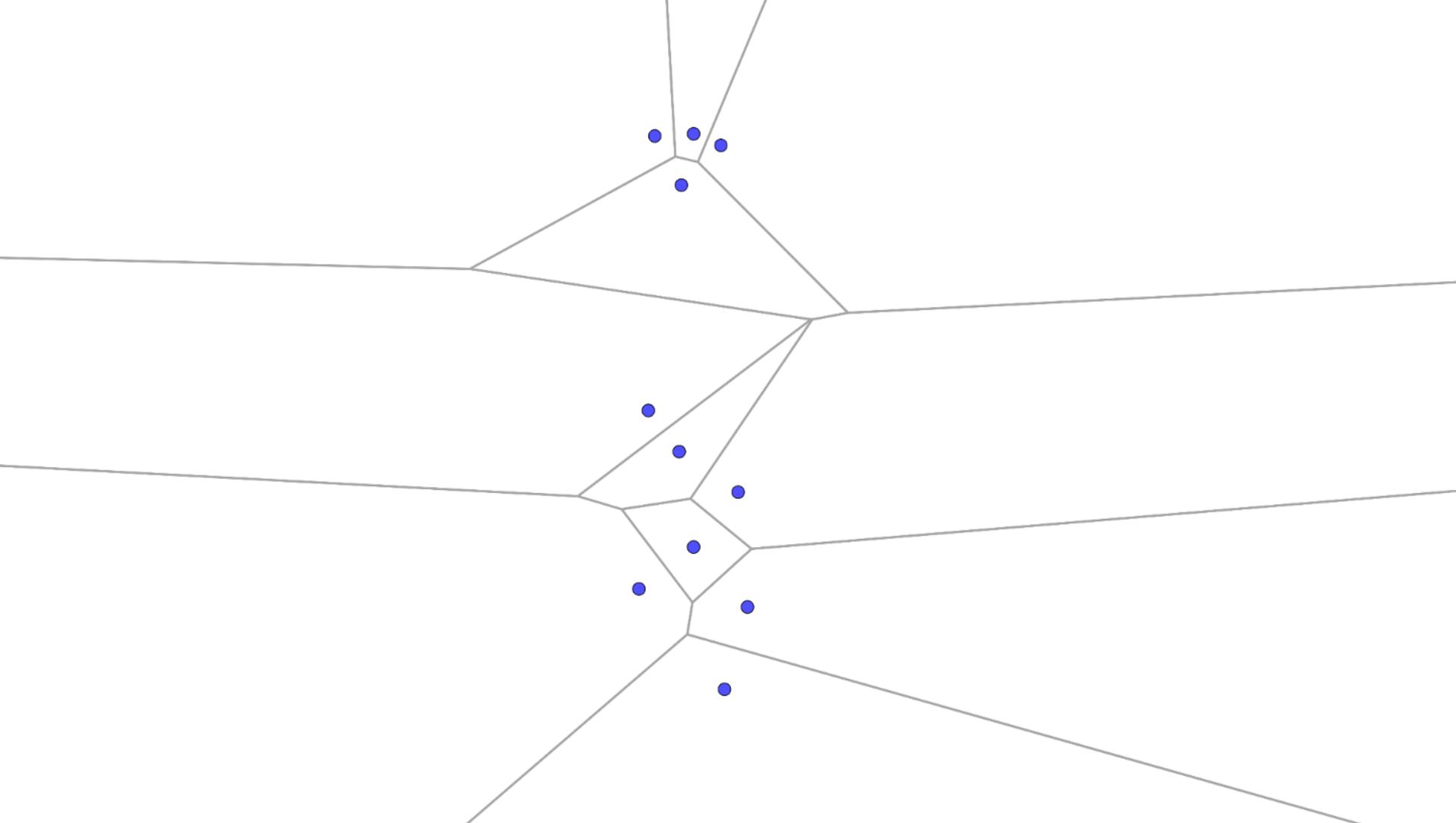
C

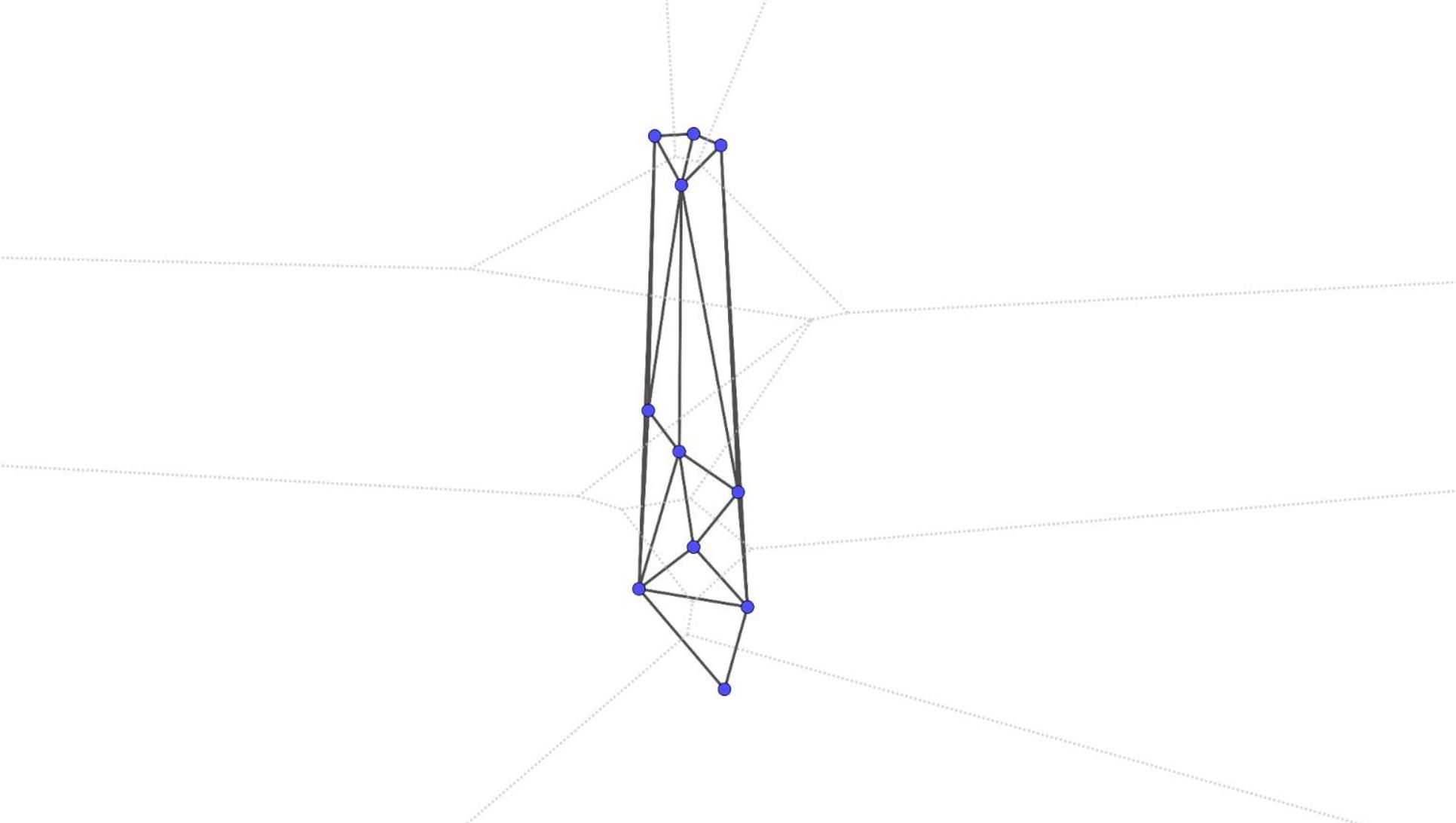


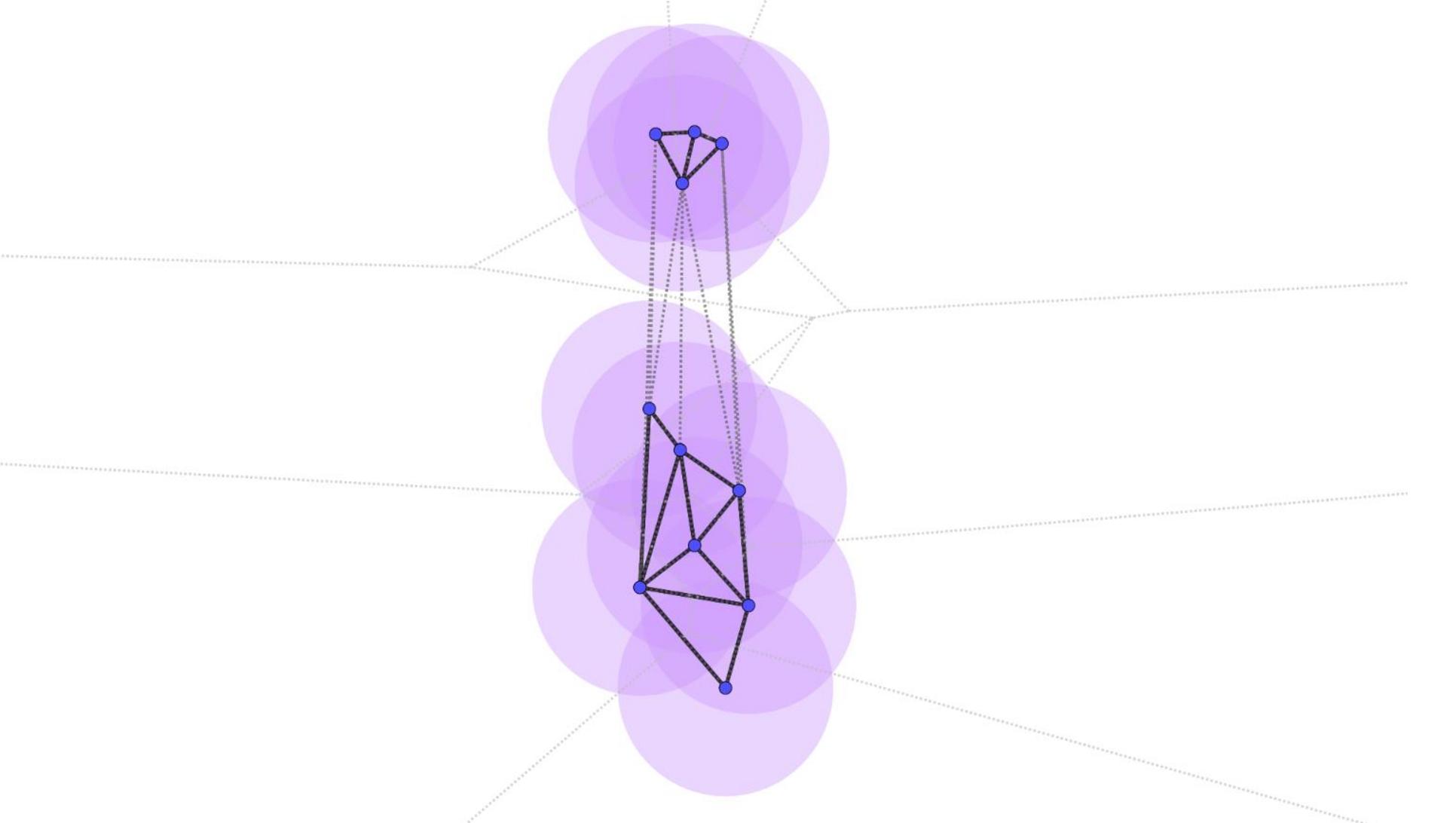


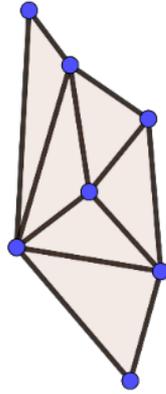
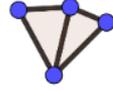






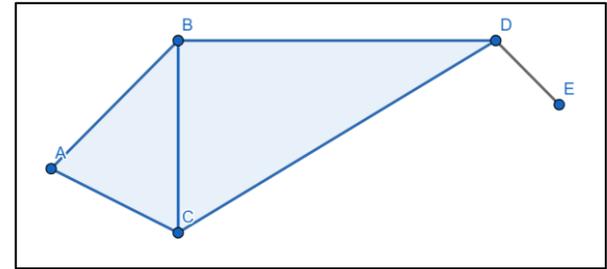
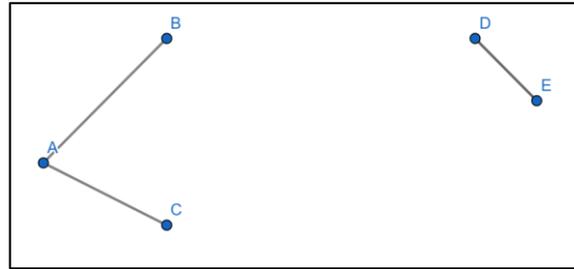
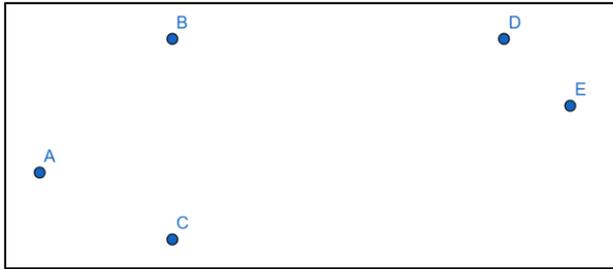




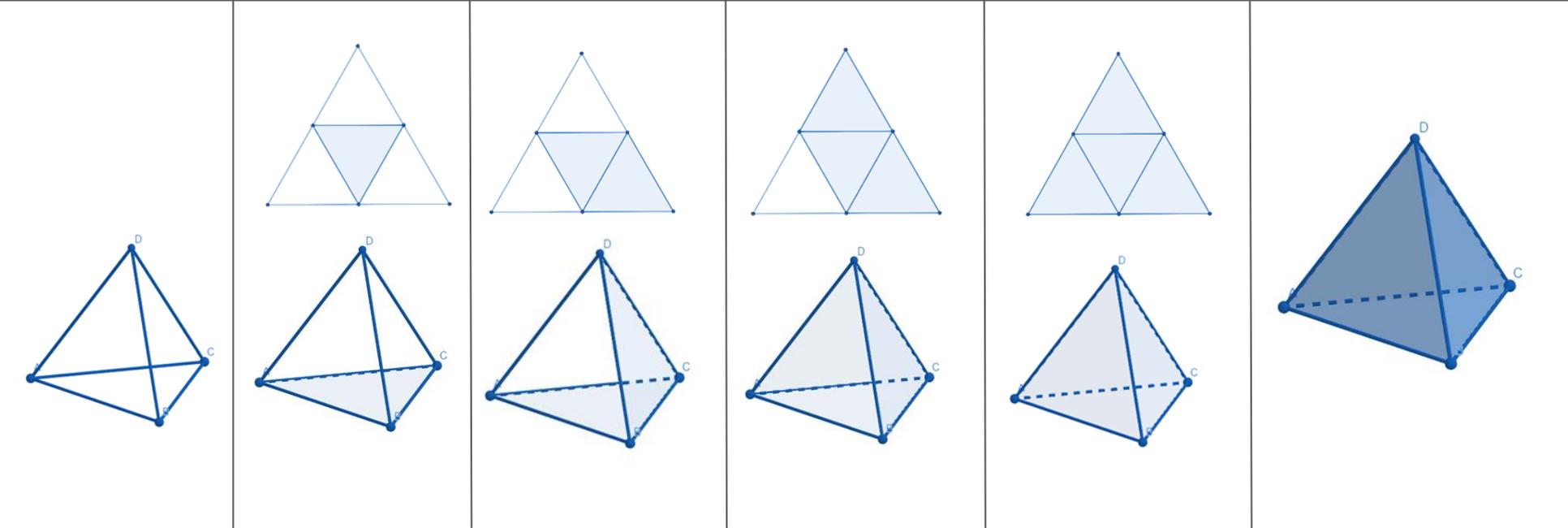
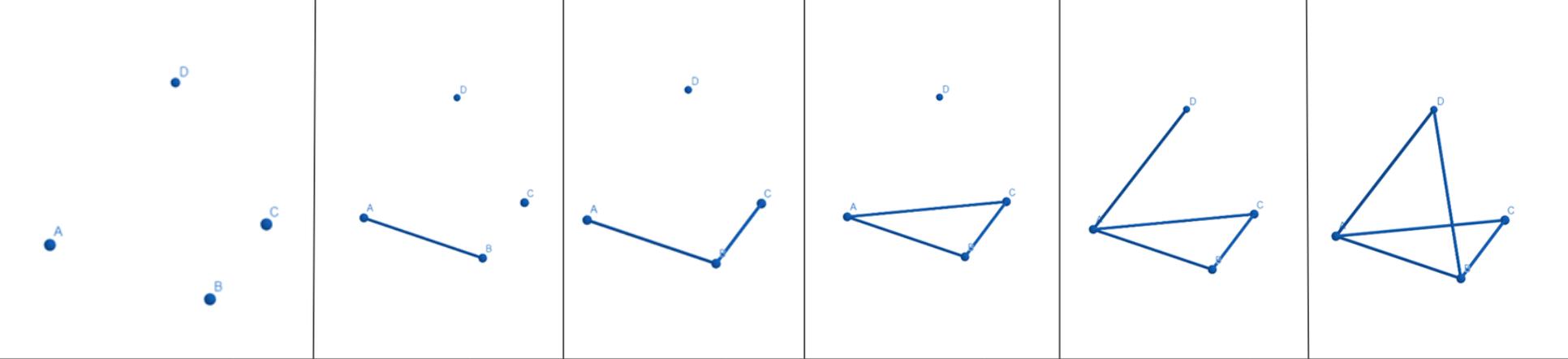


# Filtration

Welchen Radius soll man wählen?



=> Alle, bei denen sich etwas verändert



## Betti-Numbers:

$\beta_0$  = Anzahl der Komponenten

$\beta_1$  = Anzahl der Löcher

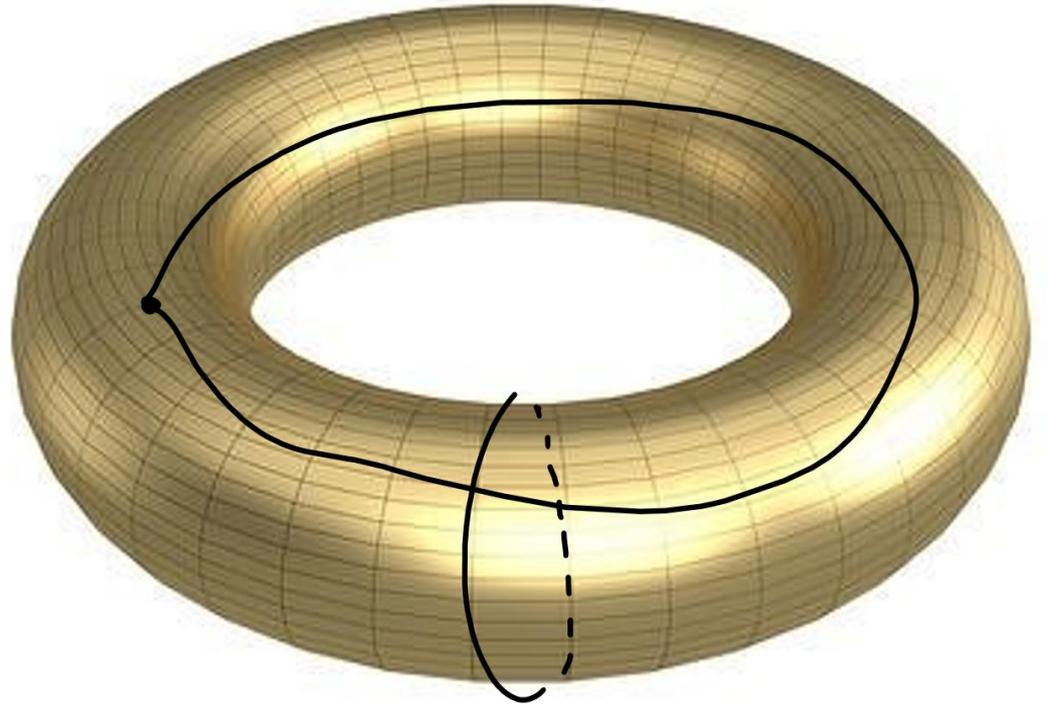
$\beta_2$  = Anzahl der Hohlräume

Torus:

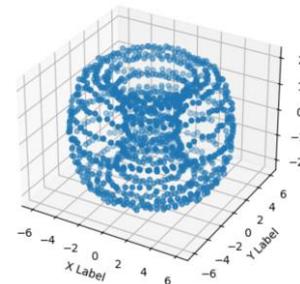
$\beta_0 = 1$  (Komponente)

$\beta_1 = 2$  (Löcher)

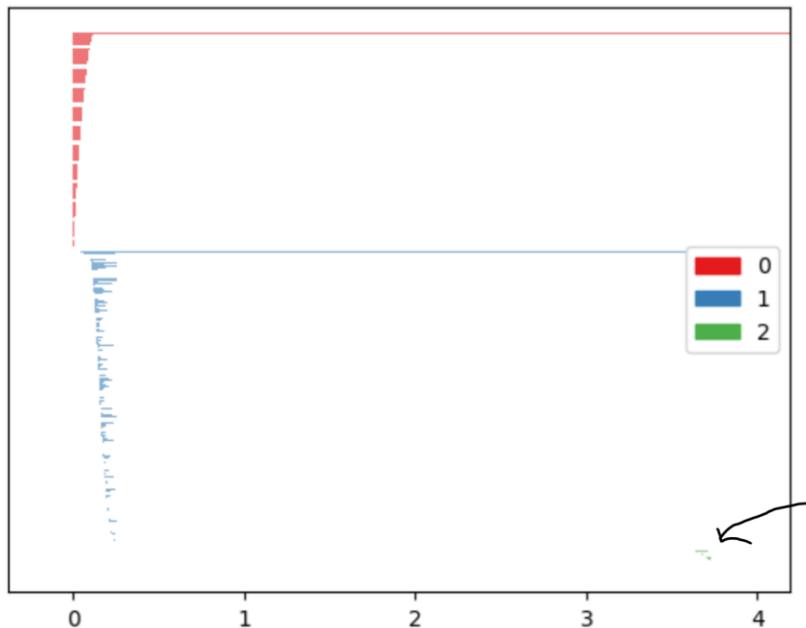
$\beta_2 = 1$  (Hohlraum)



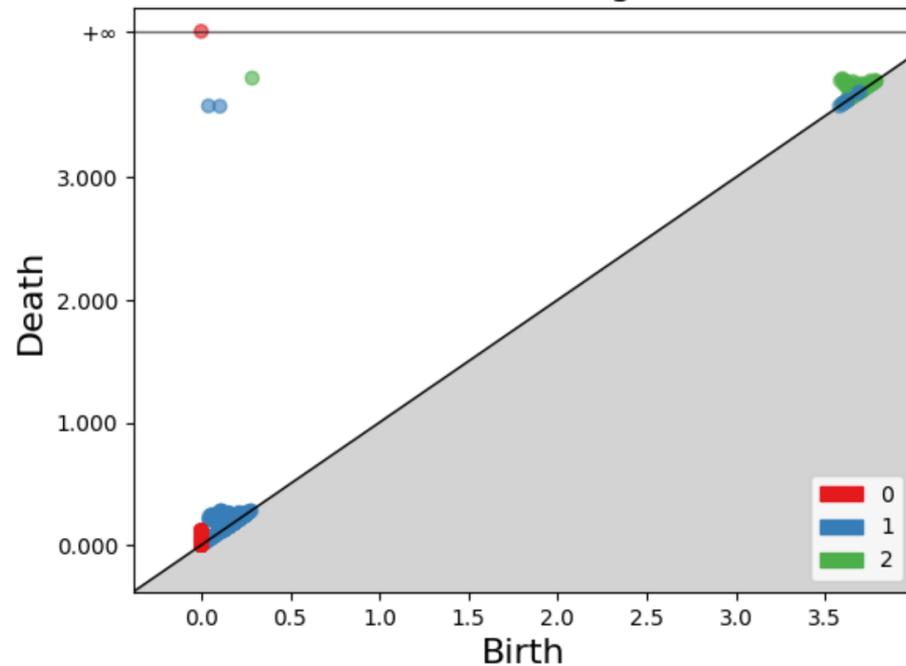
# Barcodes und Diagramme



Persistence barcode

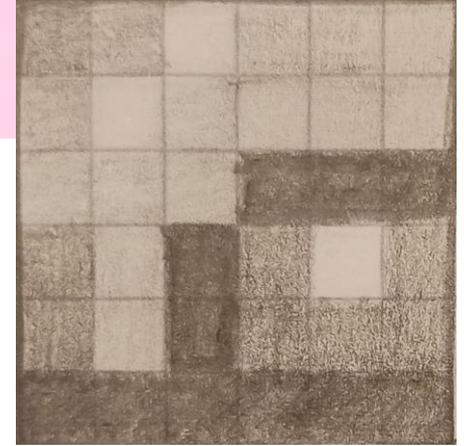
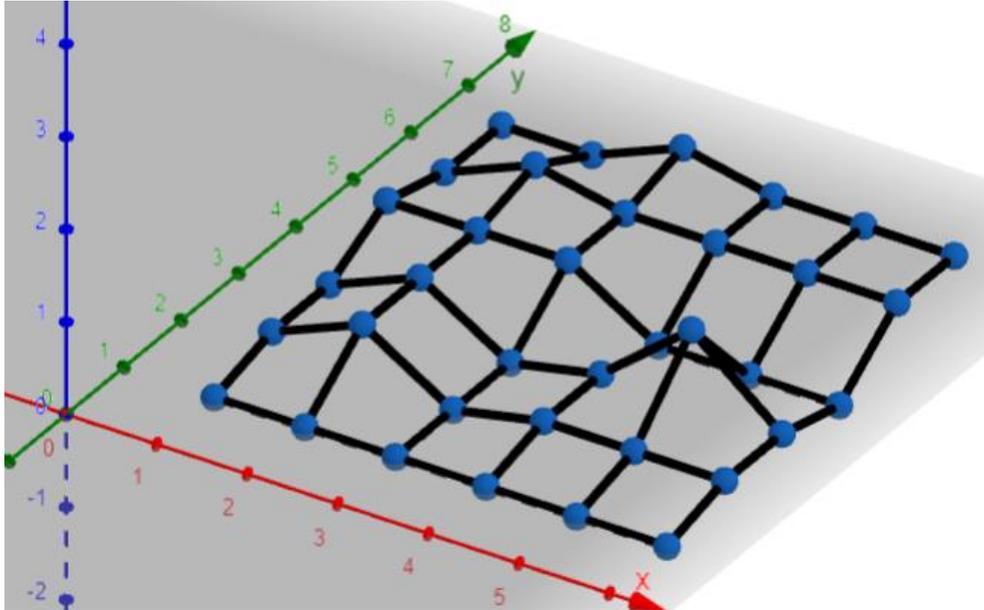


Persistence diagram

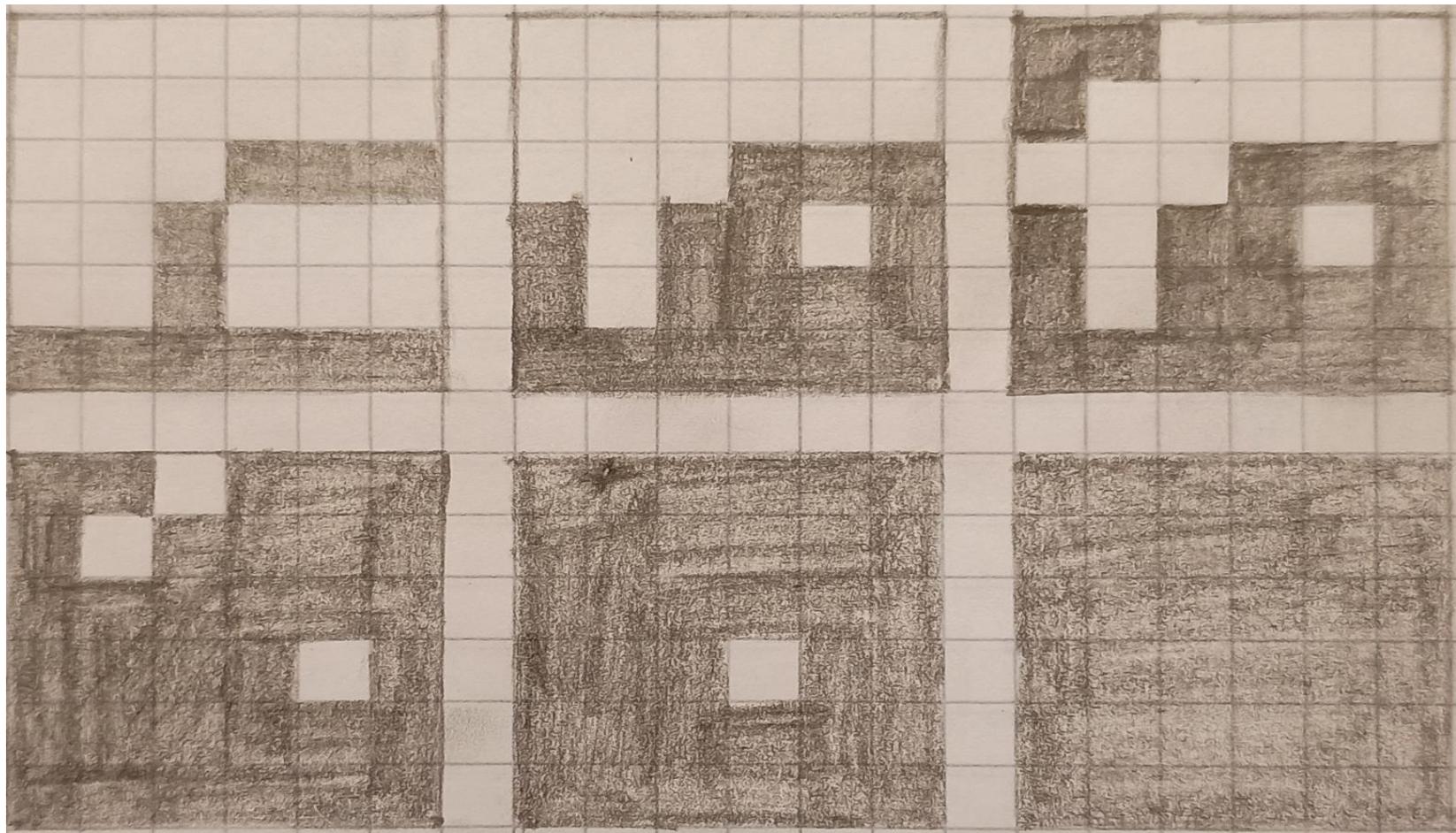


# Bildanalyse (Segmentation)

- mit cubical complexes
- Filtration basiert auf dem Wert der Pixel



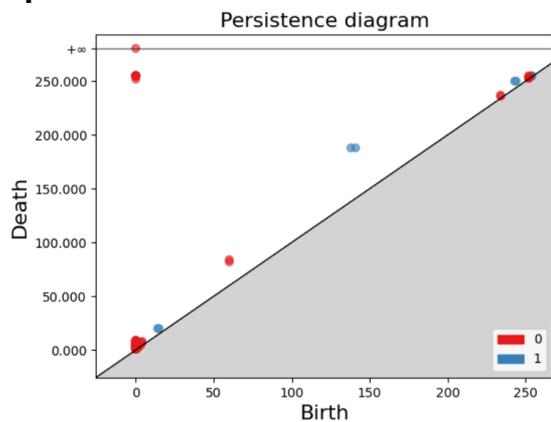
4	4	8	6	6	6
4	8	6	6	6	6
6	6	6	0	0	0
2	6	0	2	10	2
2	6	0	2	2	2
0	0	0	0	0	0



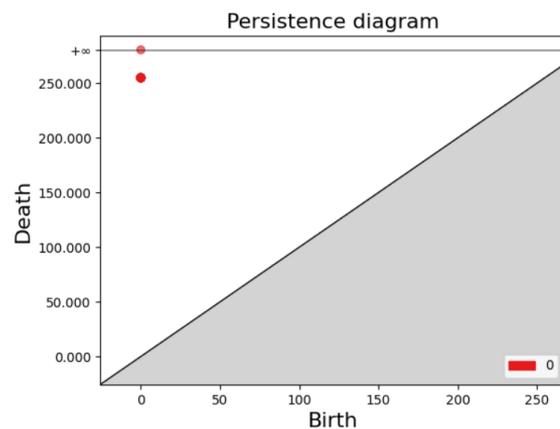
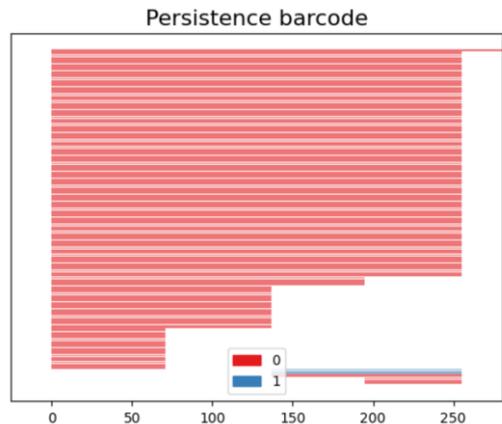
# Bildanalyse (Segmentierung)

Klassifikation von Buchstaben:

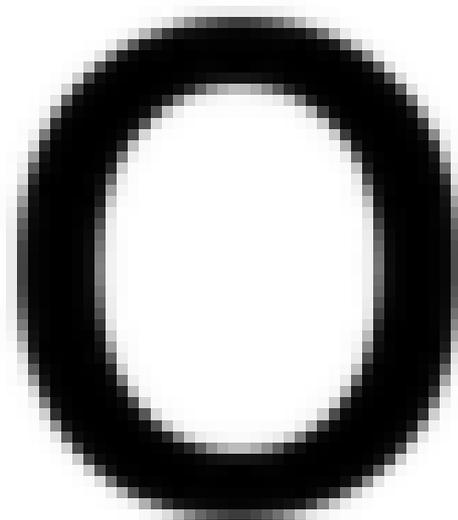
O:



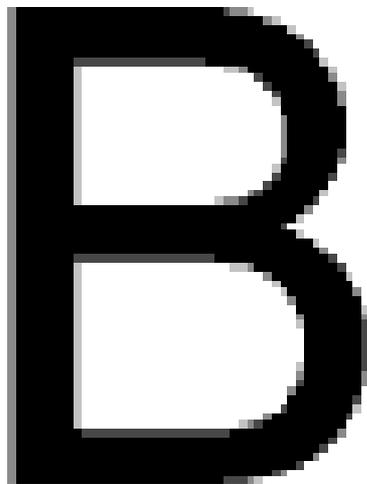
B:



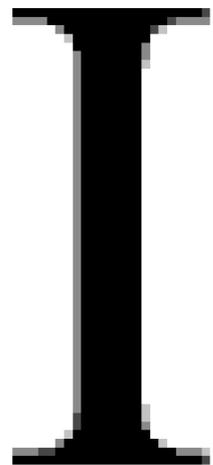
## Bildrauschen (Noise)



O

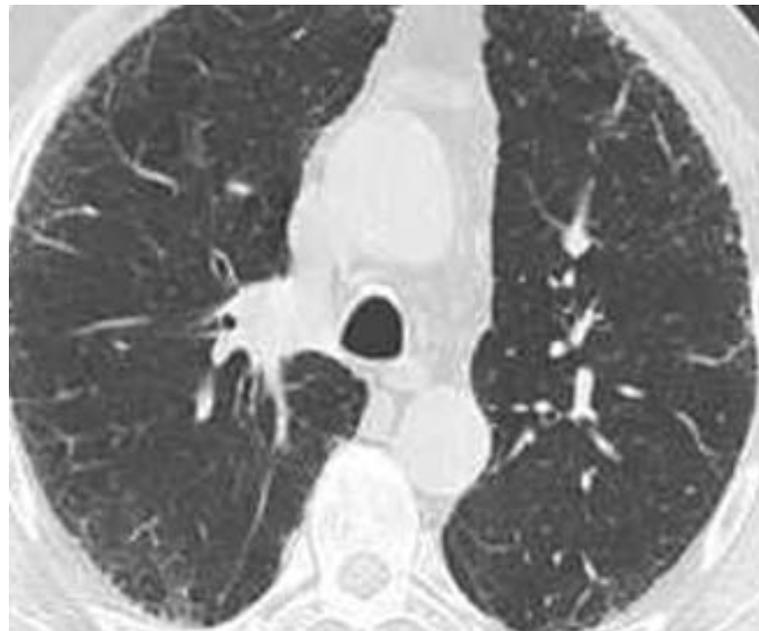


B



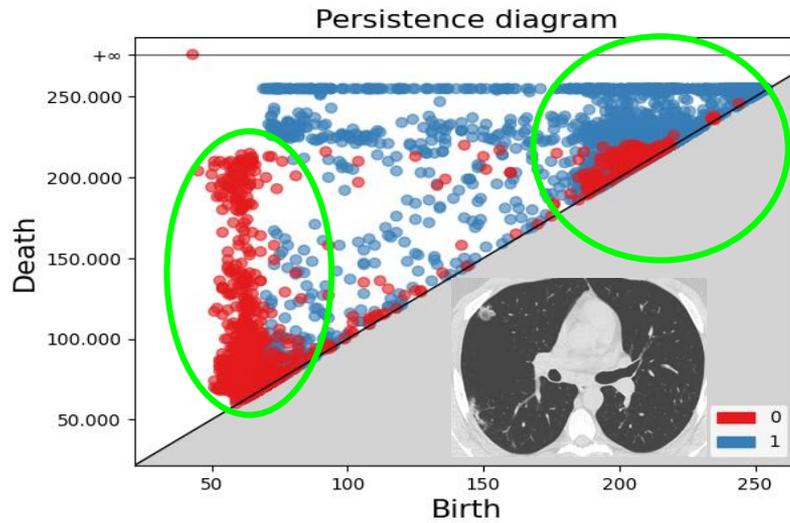
I

# Gehirne

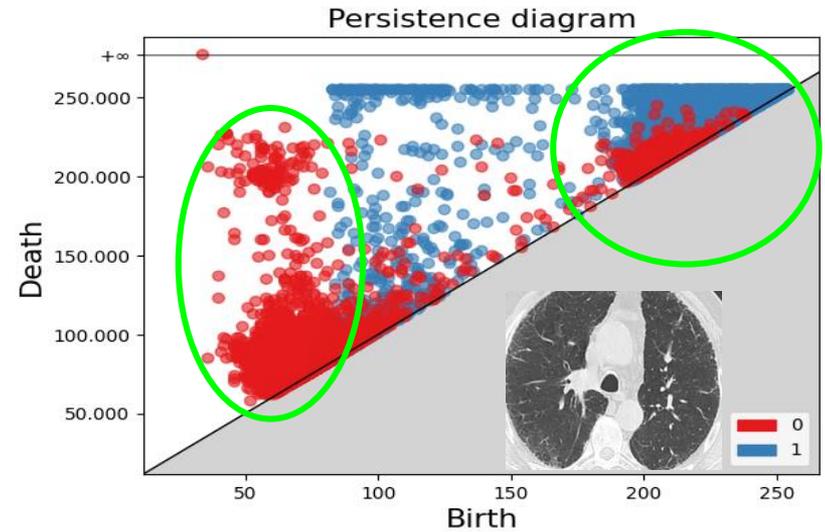


# Gehirne

Corona:



Gesund:



The background of the slide is a solid light pink color with a pattern of white, wavy, concentric lines that resemble topographic map contours or a wood grain pattern. The lines are irregular and flow across the entire frame.

**Danke für eure  
Aufmerksamkeit!**

**Henry, Albin, Luca, Sarah, Caro, Yannik, Lana, Keanu, Louisa**