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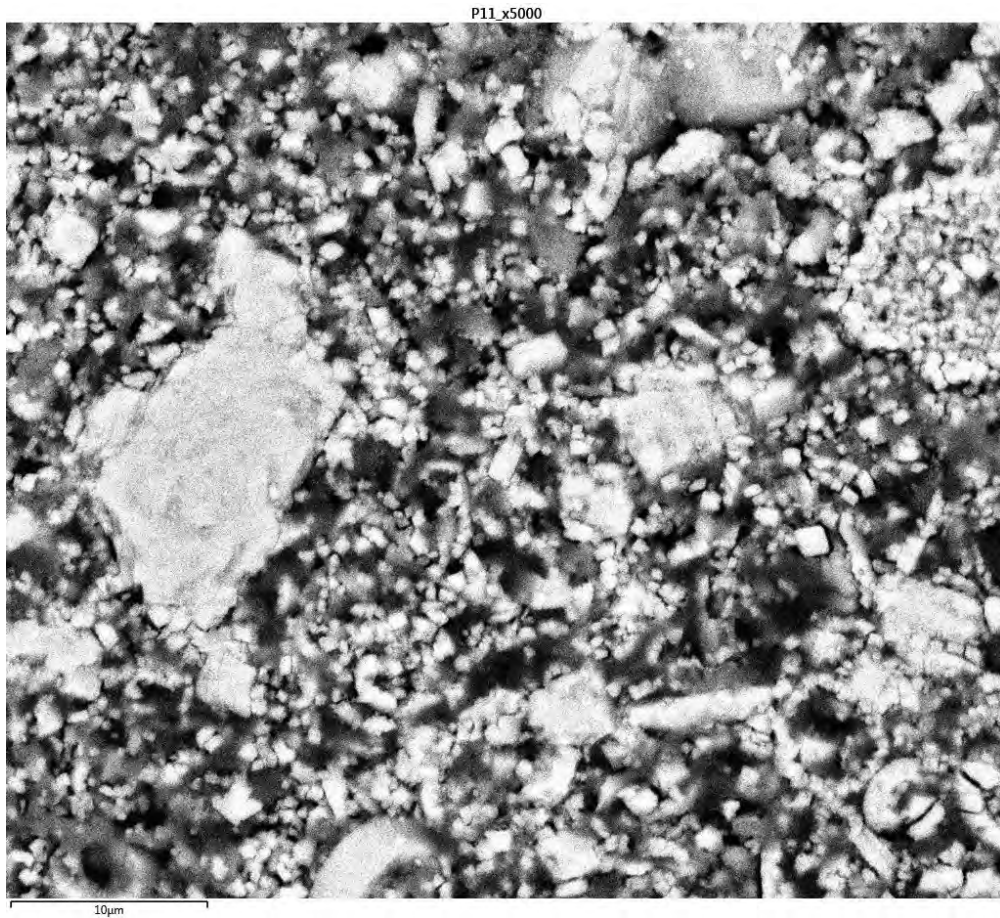
PES  **GB**

Gaussian Mixture Models for Robust Unsupervised Scanning-Electron Microscopy Image Segmentation of North Sea Chalk

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¹Technical University of Denmark

- Scanning Electron Microscopy
- Neural Networks
- Histogram Thresholds
- Gaussian Mixture Models
- Coffee & Hubris

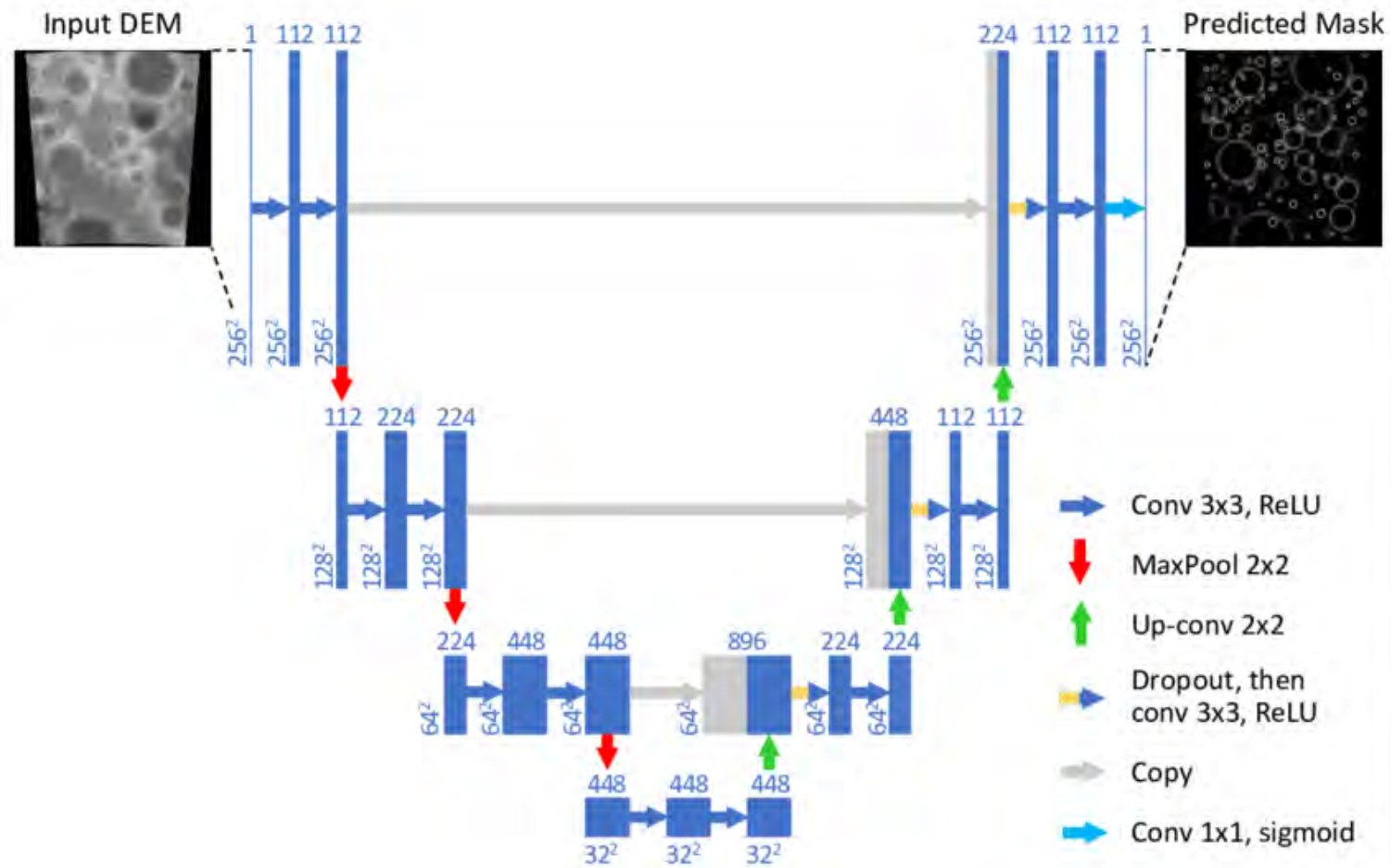


- Micrometer Scale Images
- North Sea Chalk
- Measure
 - Area
 - Perimeter
 - Orientation
 - By Hand
 - With a Ruler

Why am I here?

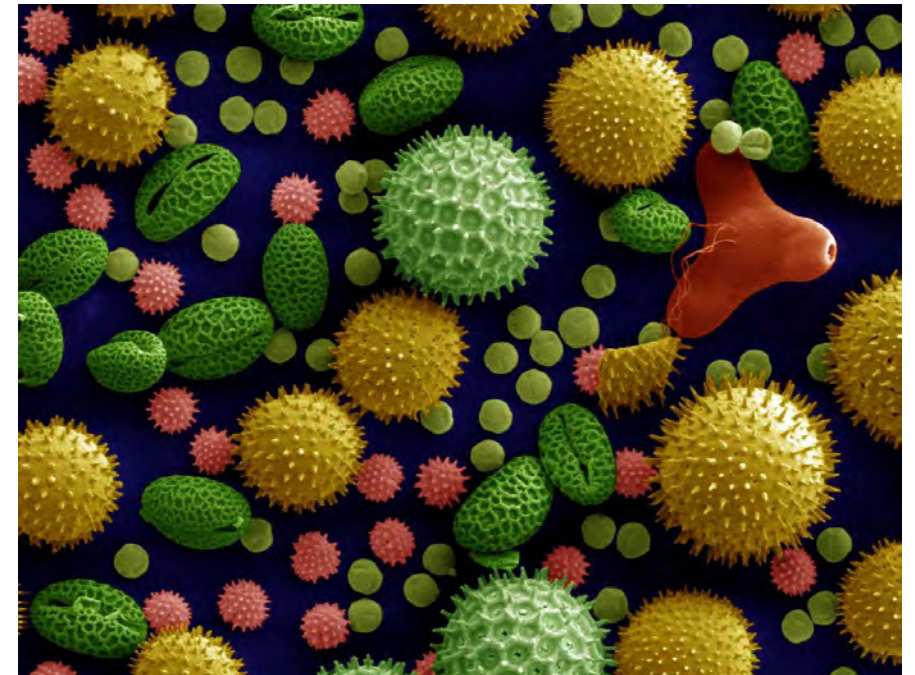
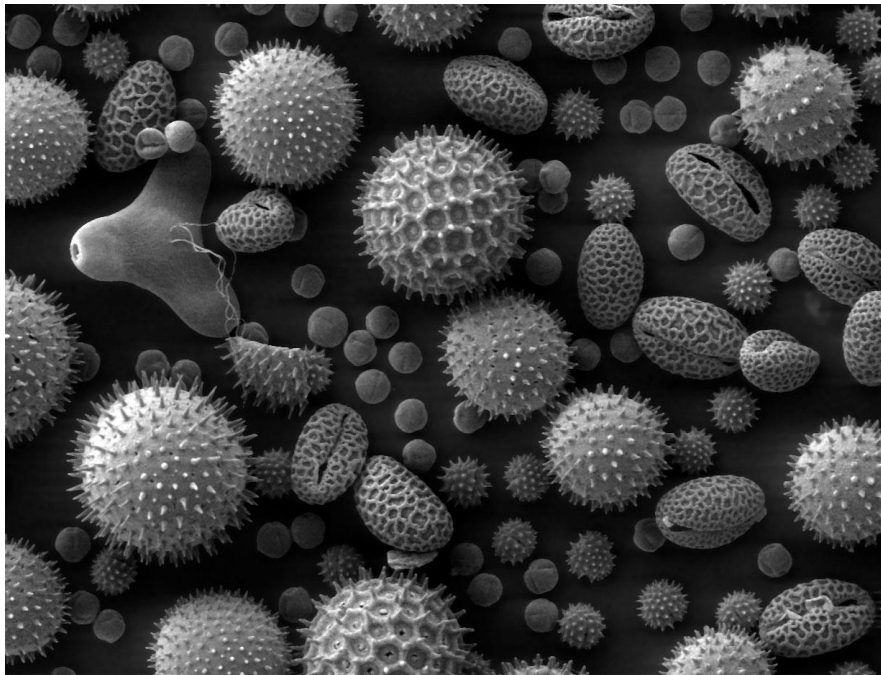


What has been done.



Ronneberger 2015

What has been done.

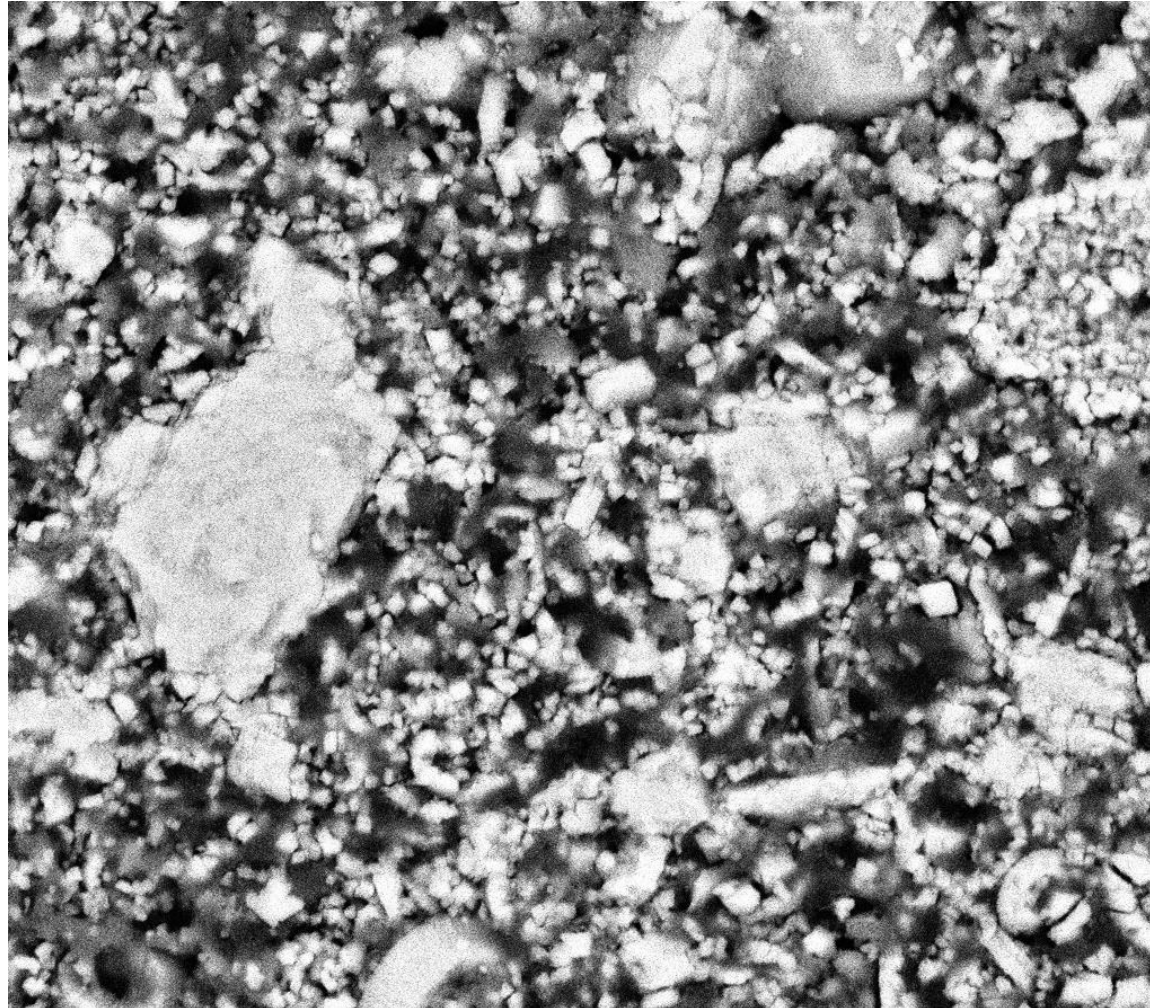


Why am I here?

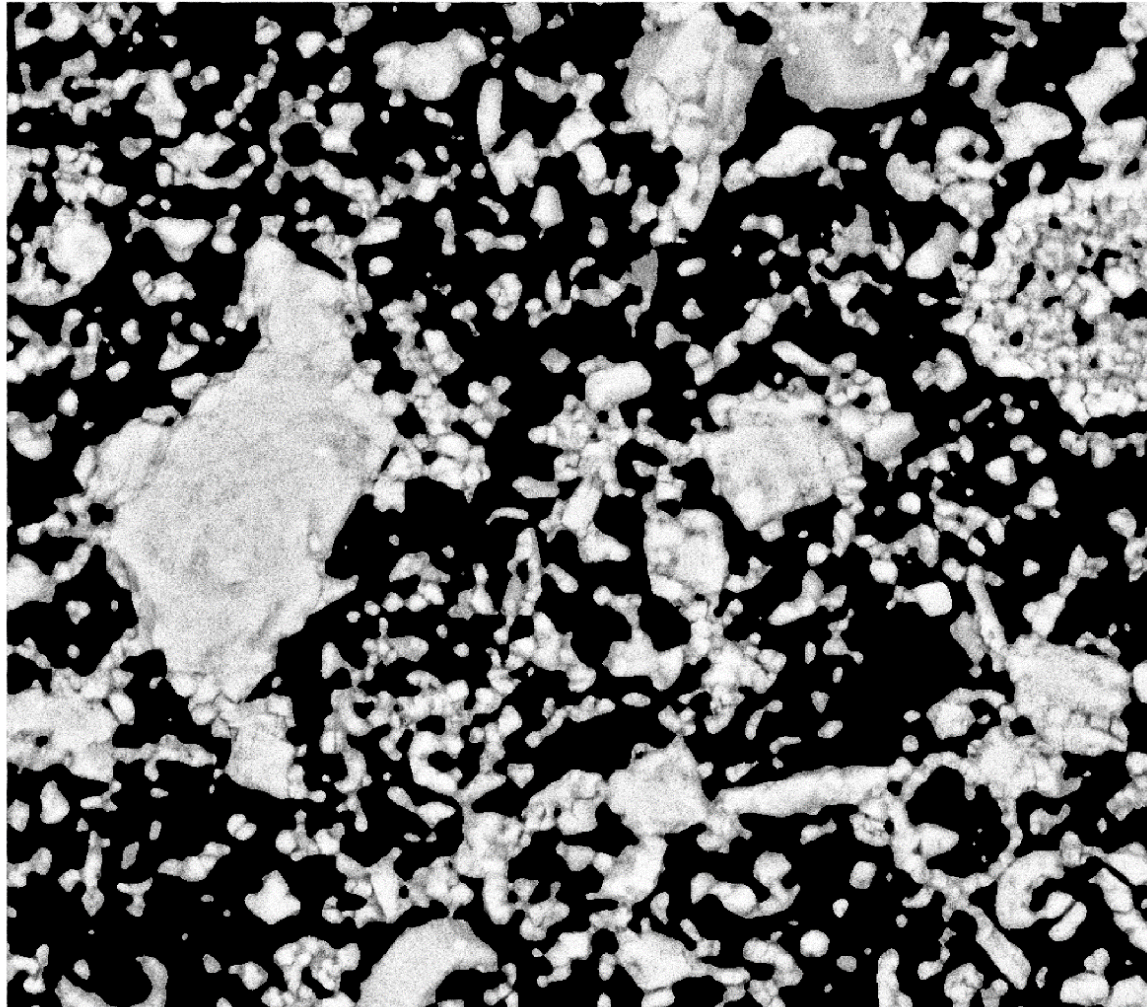
- The Neural Network is gone
- The Postdoc is gone
- There is no documentation to reproduce
- The training data was external

Postdoc Syndrome

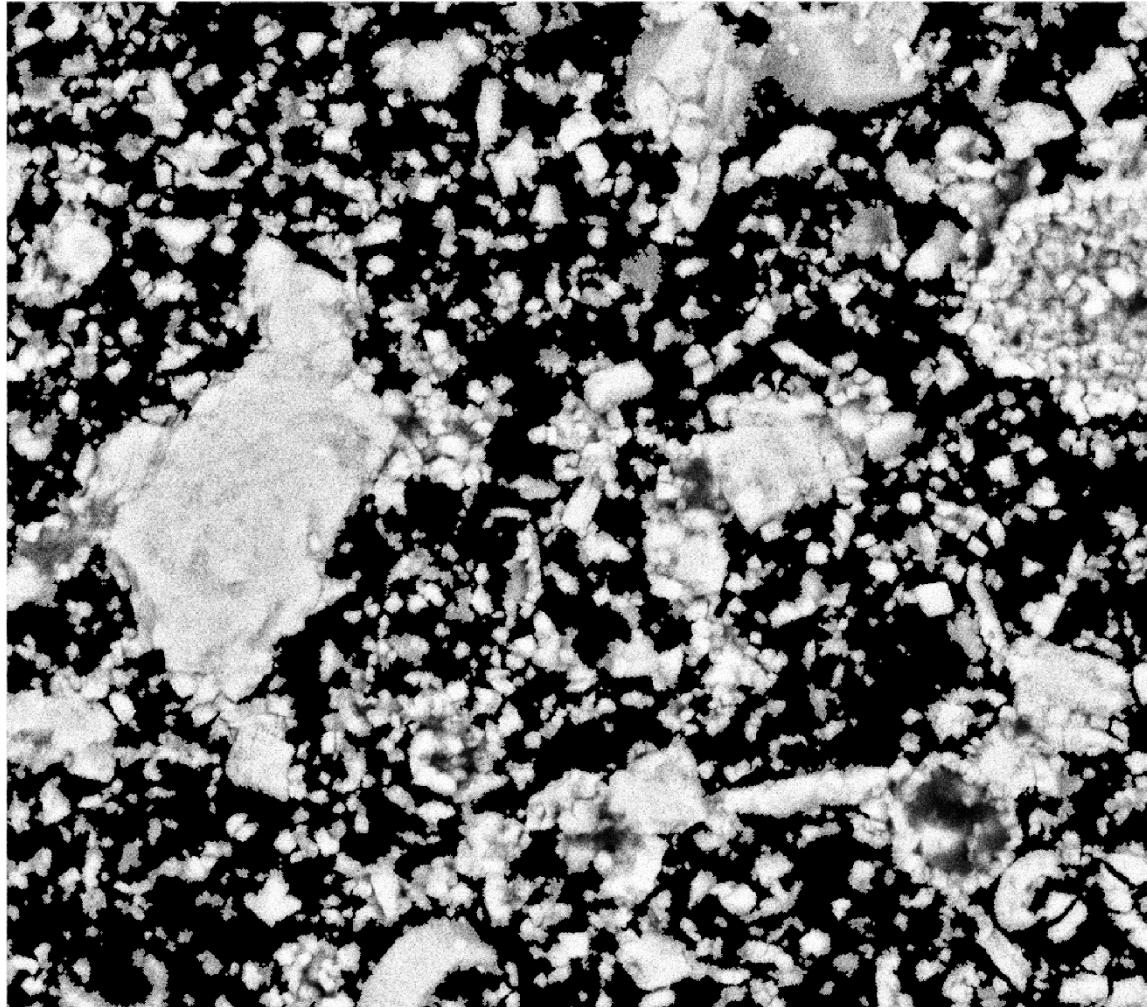
SEM of North Sea Chalk



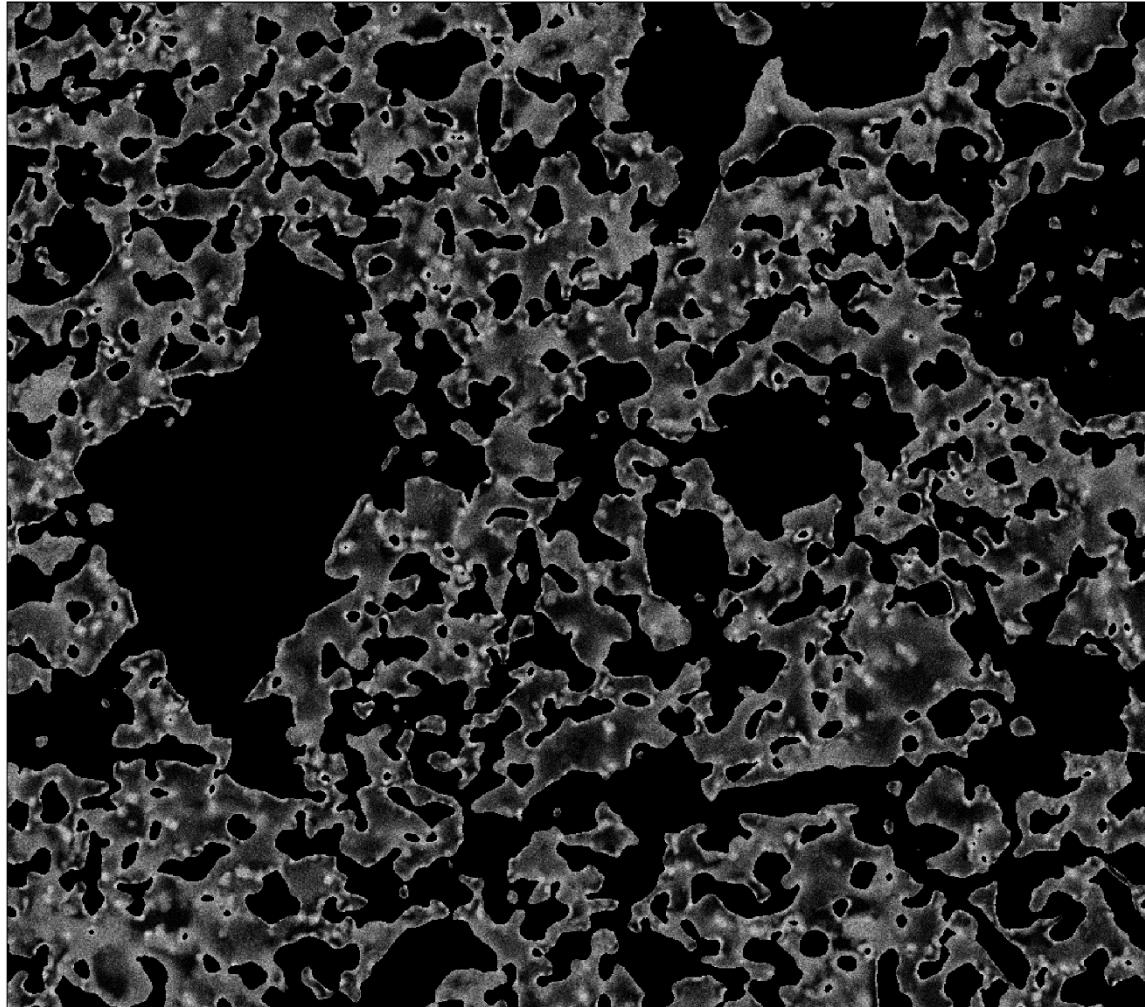
Histogram with Otsu Threshold



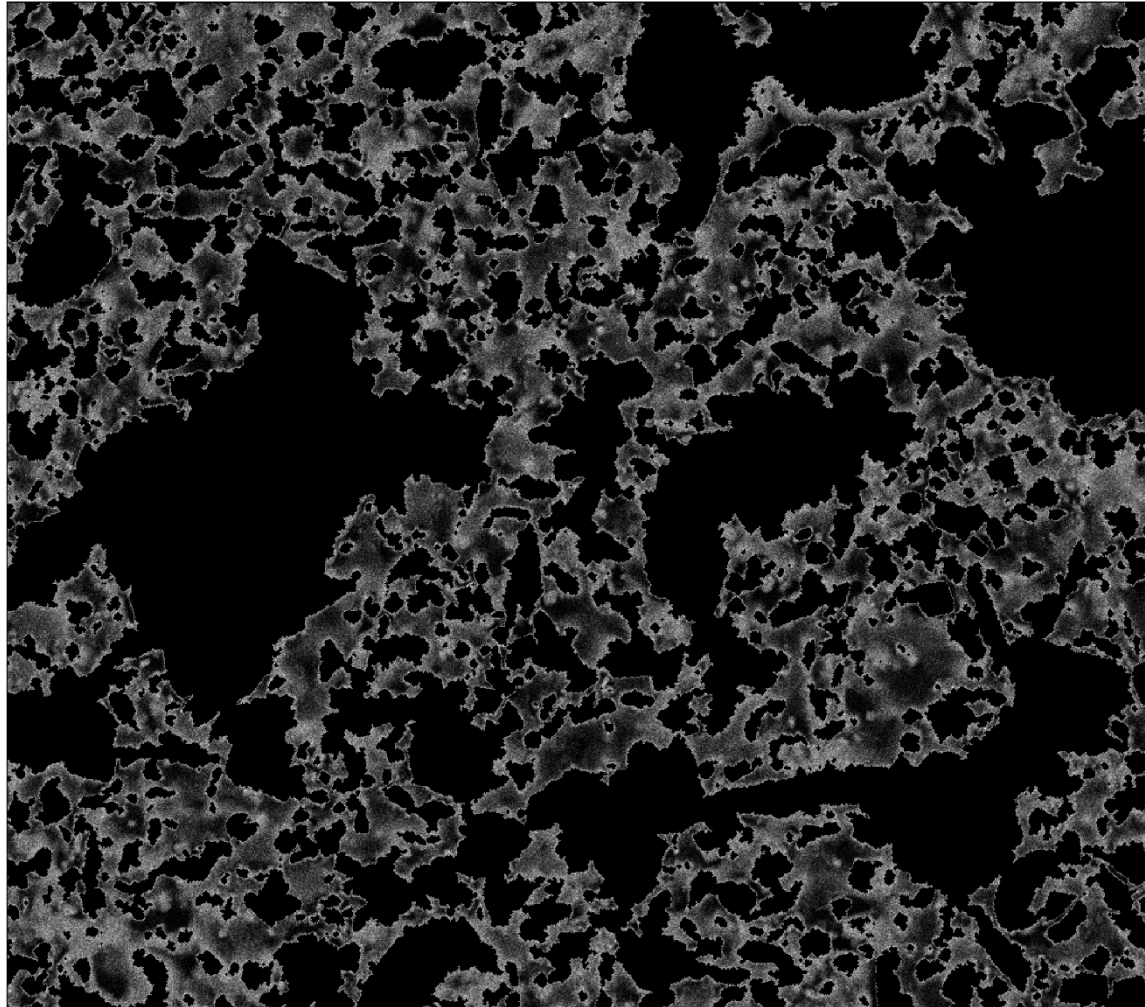
Gaussian Mixture Model



Histogram with Otsu Threshold

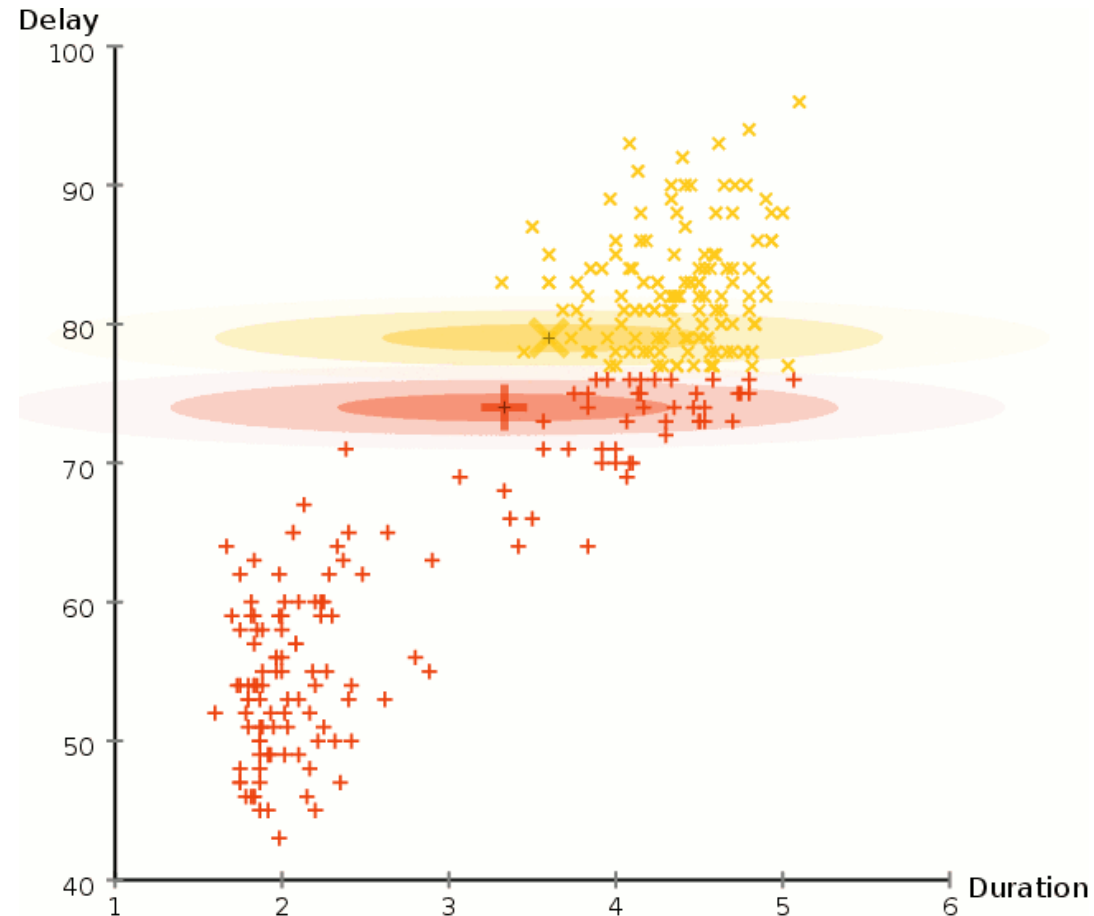


Gaussian Mixture Model



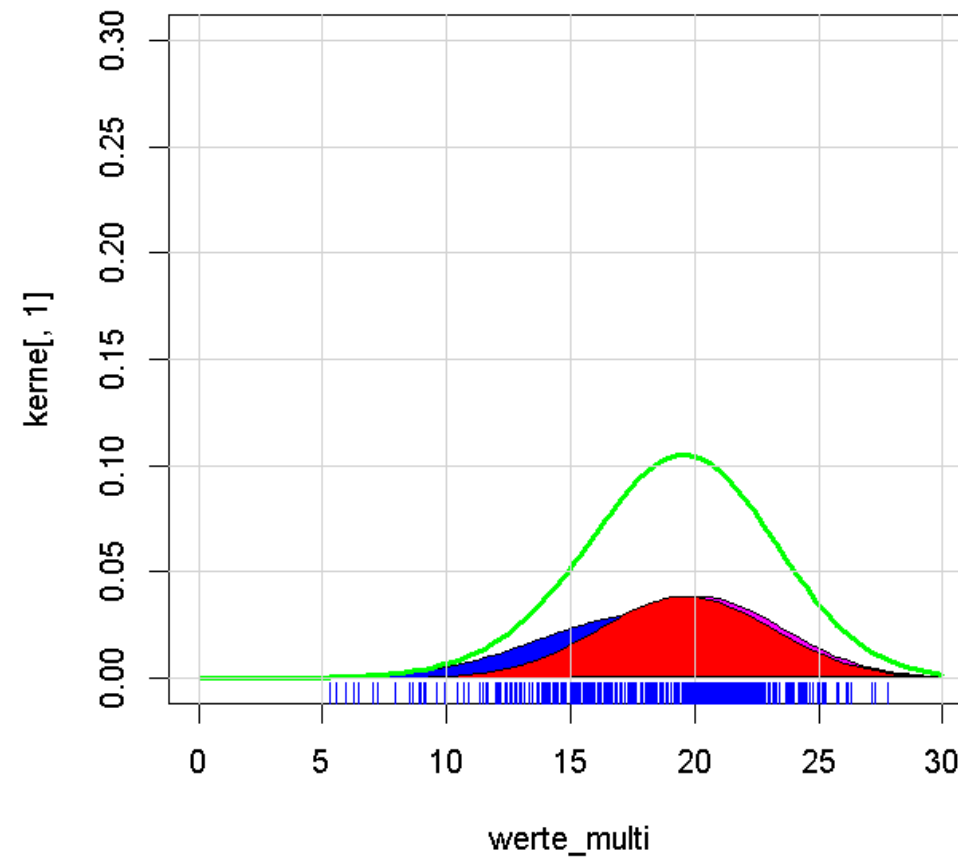
How does it actually work?

Expectation Maximization



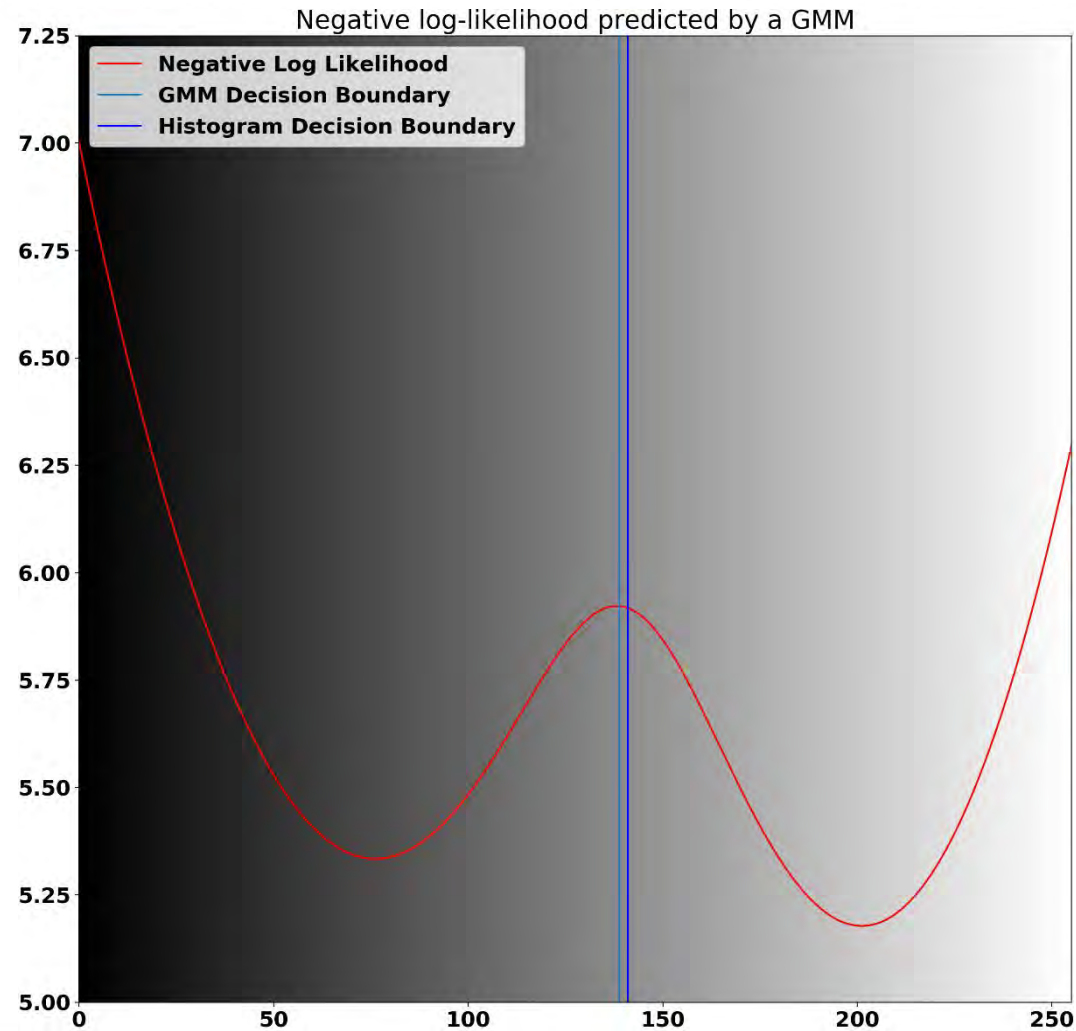
CC-BY Chire

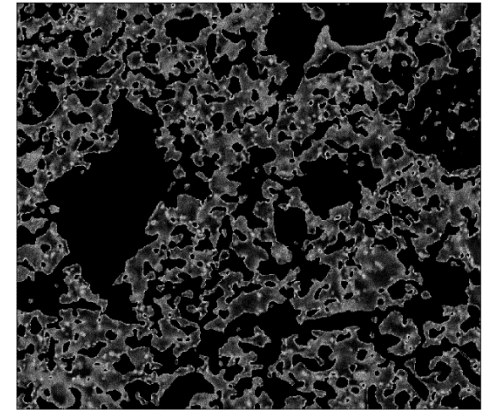
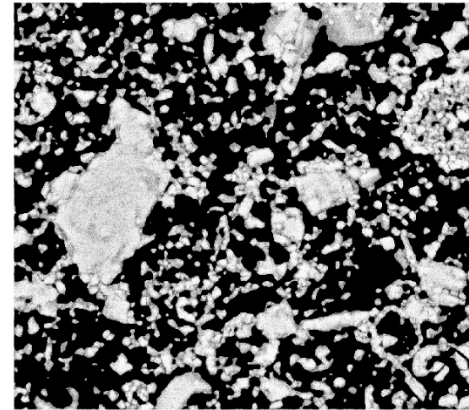
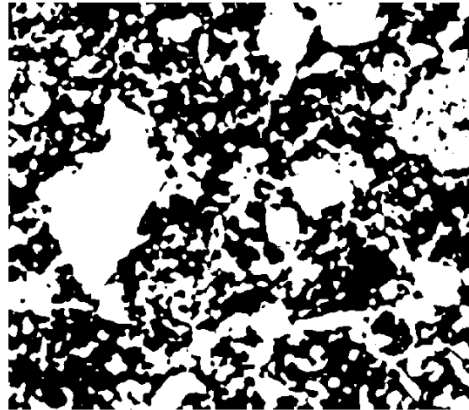
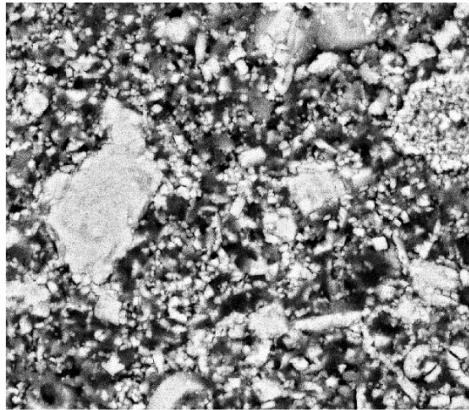
Mixture of Gaussians

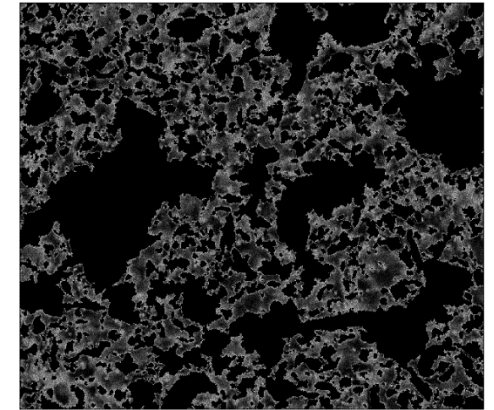
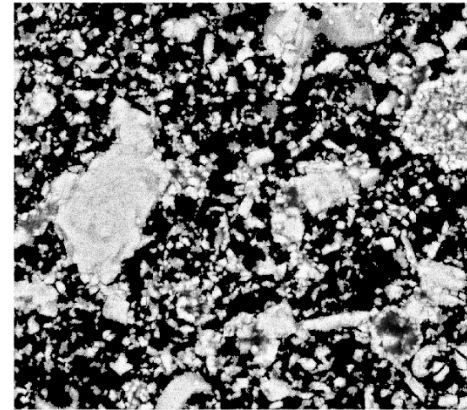
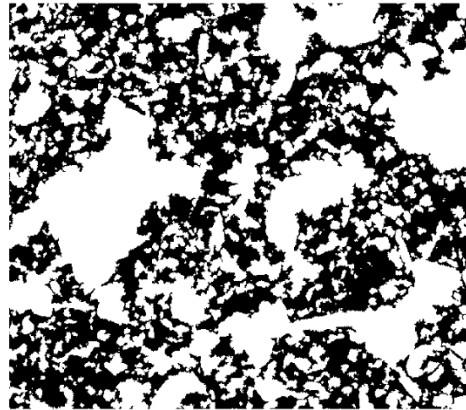
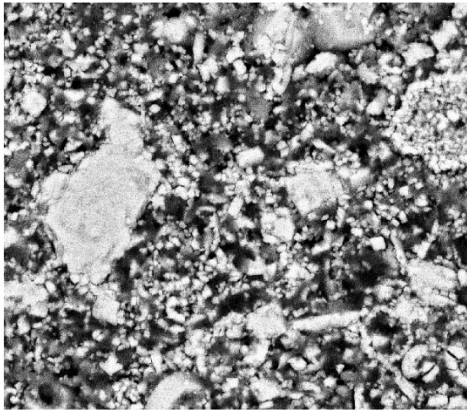


CC-BY Muehlenberg

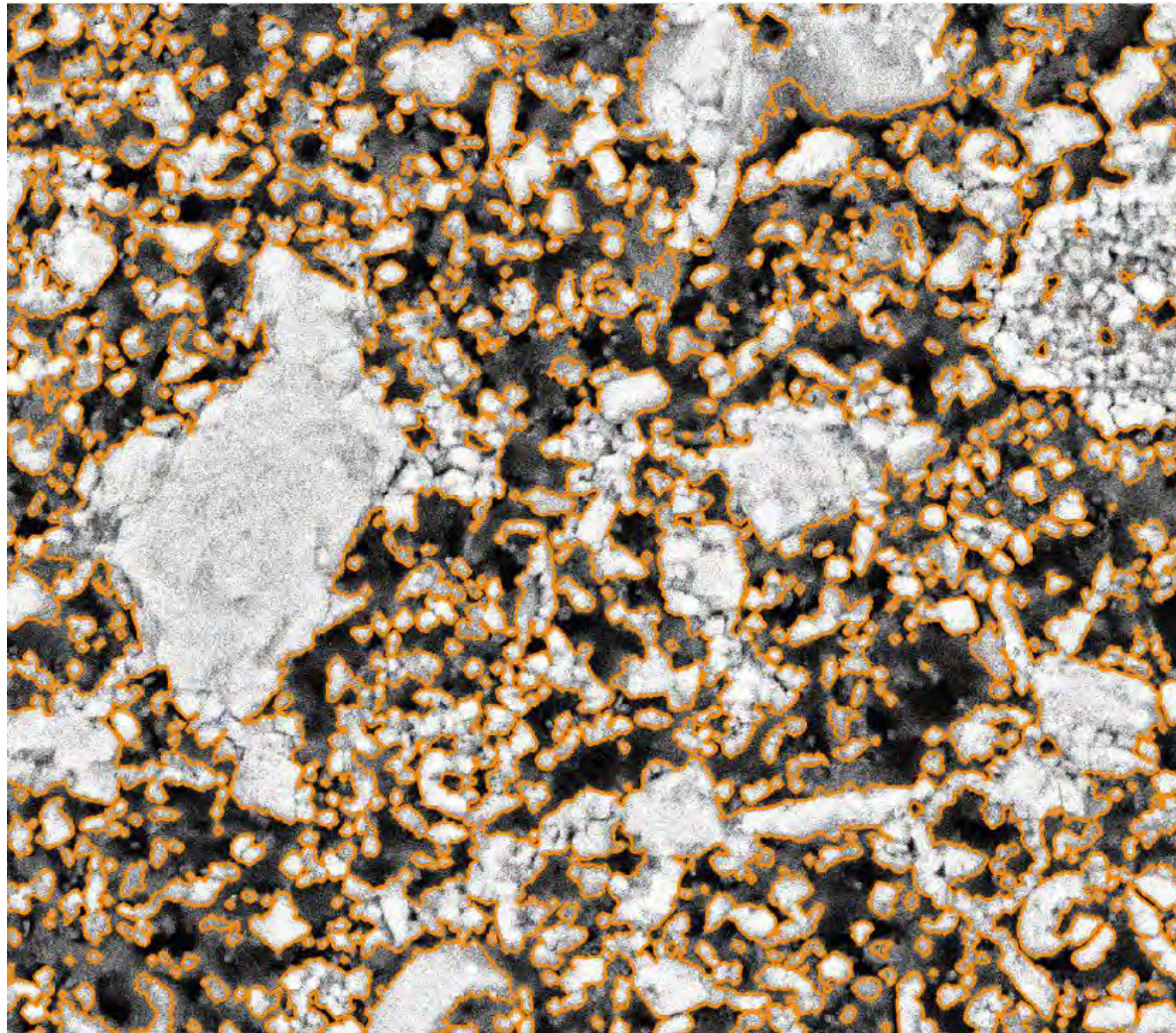
Decision Boundaries

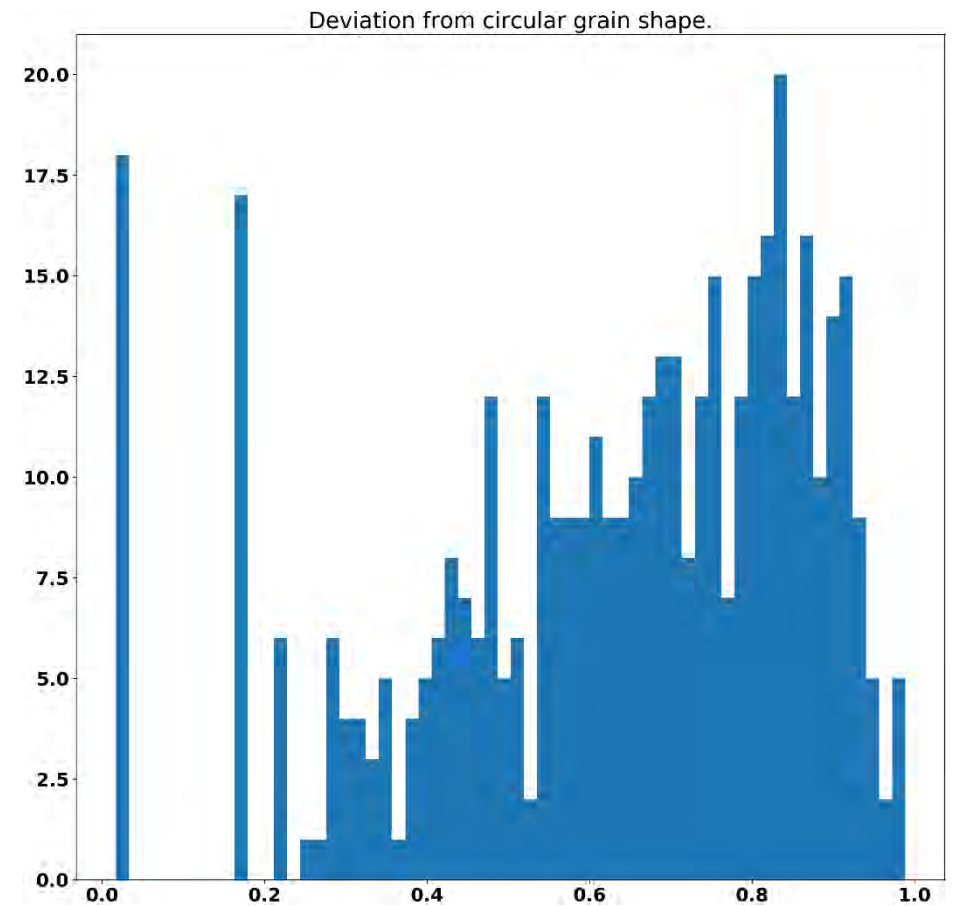
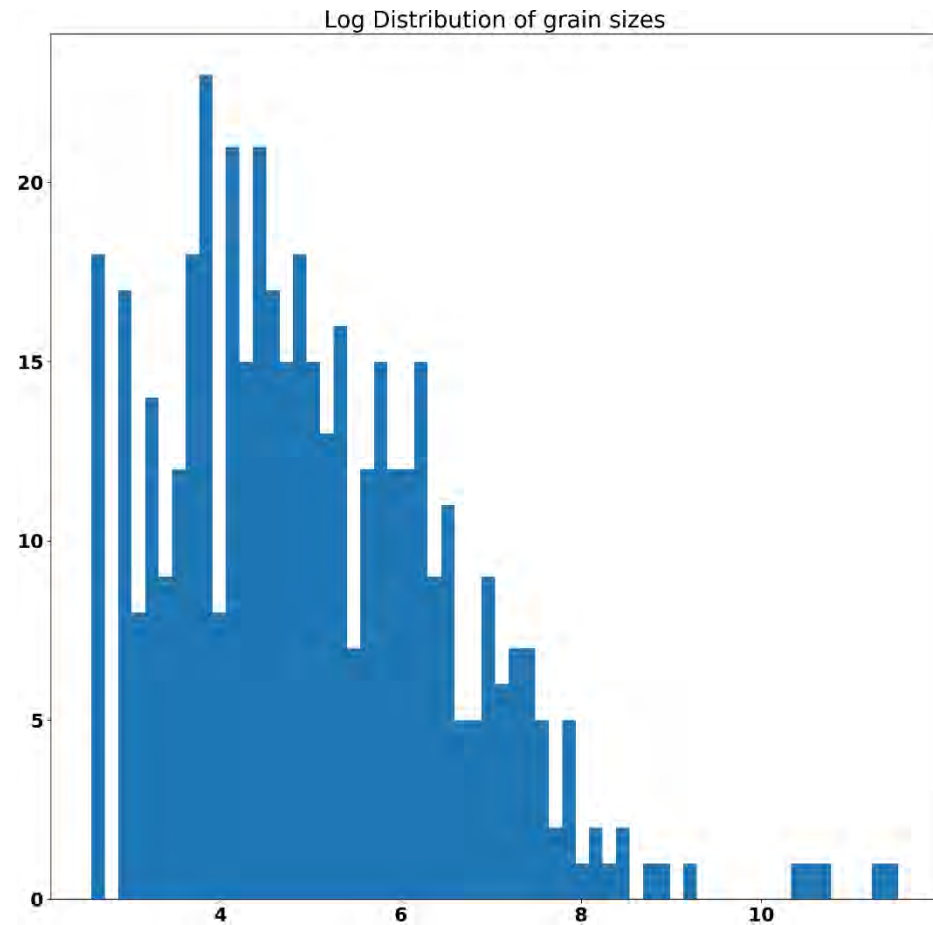






Segmentation with GMM





- GMM is
 - Fast, cheap and noise robust
 - Accurate
 - Automatable
 - Unsupervised
- Morphological Filtering cleans up Segmentation
- Calculate Grain Properties easily



scikit-image
image processing in python



- Dramsch, Jesper Soeren; Amour, Frédéric; Lüthje, Mikael (2018): Gaussian Mixture Models for Robust Unsupervised Scanning-Electron Microscopy Image Segmentation of North Sea Chalk. Presentation.
- <https://doi.org/10.6084/m9.figshare.7421489.v1>
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