



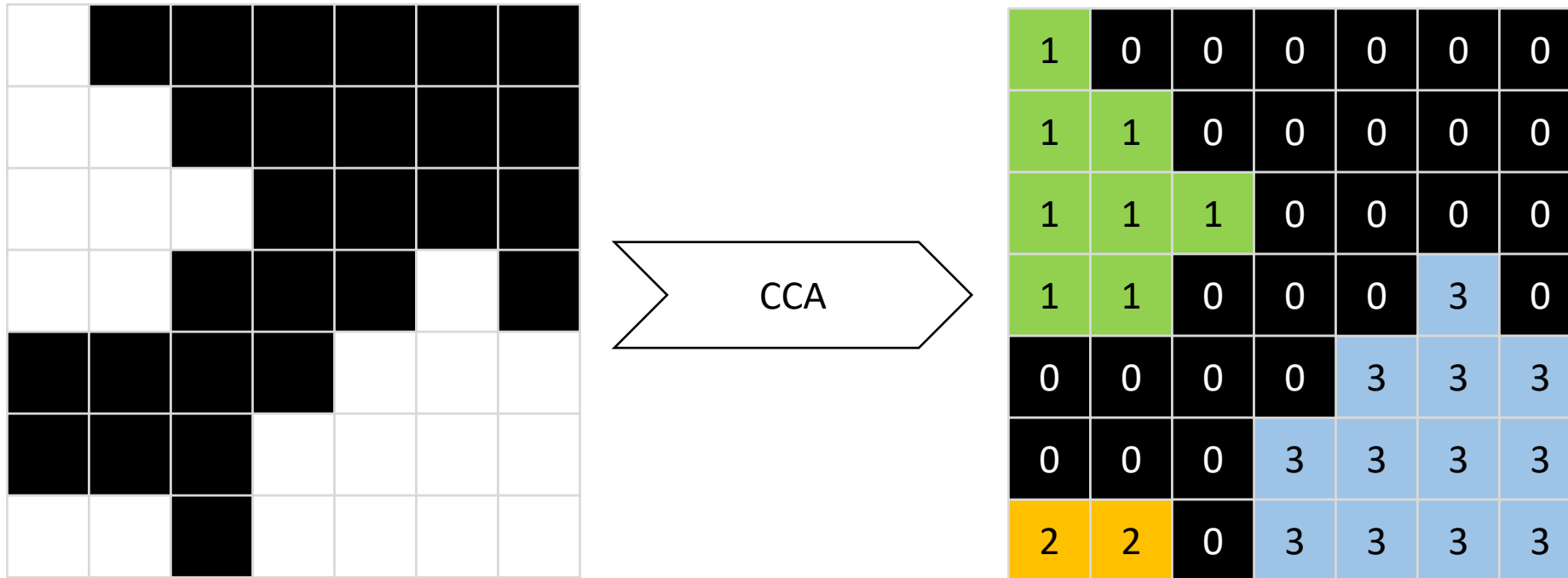
Instance segmentation

Robert Haase

With material from
Benoit Lombardot, Scientific Computing Facility, MPI CBG

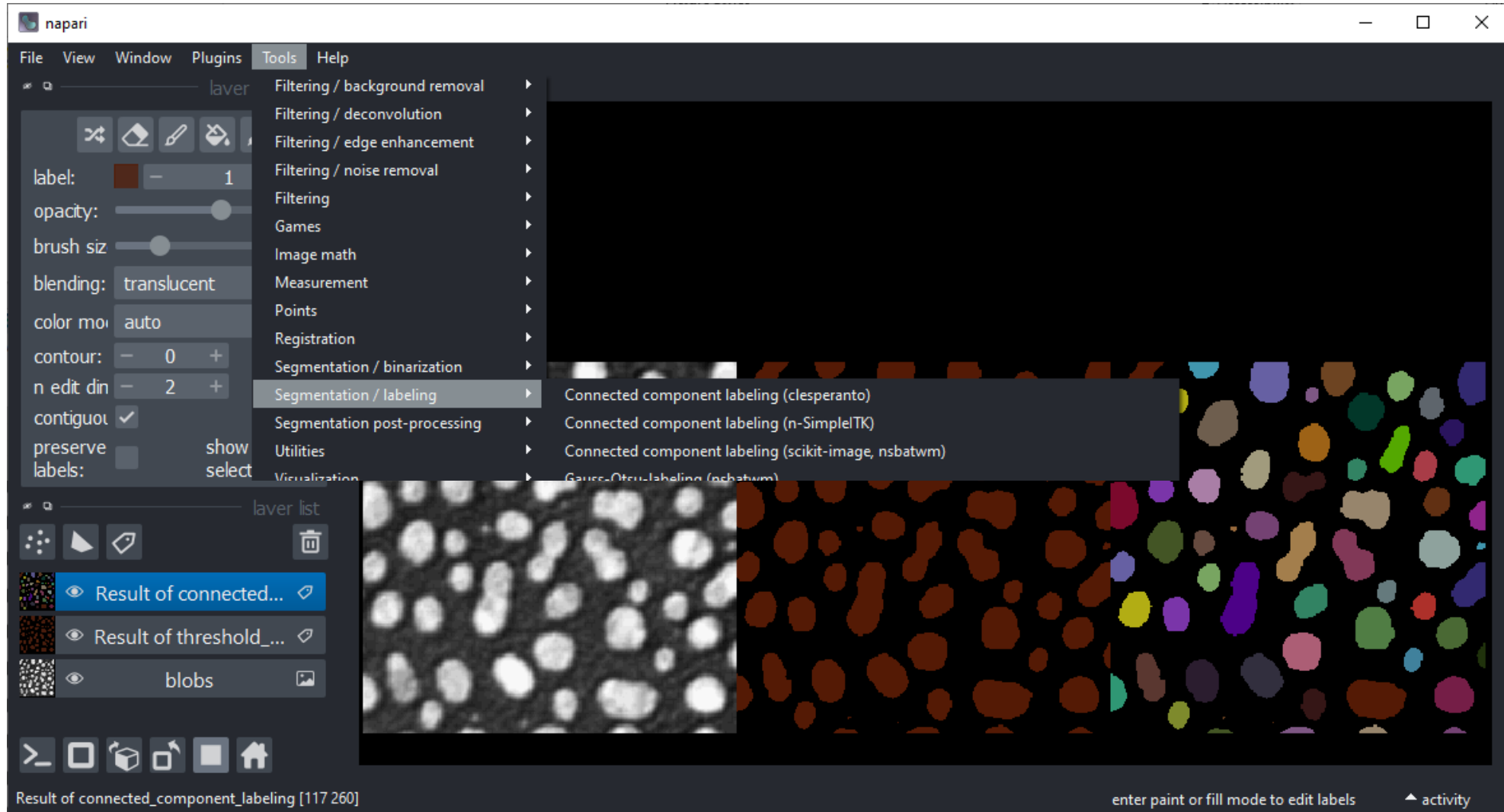
October 2022

- In order to allow the computer differentiating objects, connected component analysis (CCA) is used to mark pixels belonging to different objects with different numbers
- Background pixels are marked with 0.
- The maximum intensity of a labelled map corresponds to the number of objects.



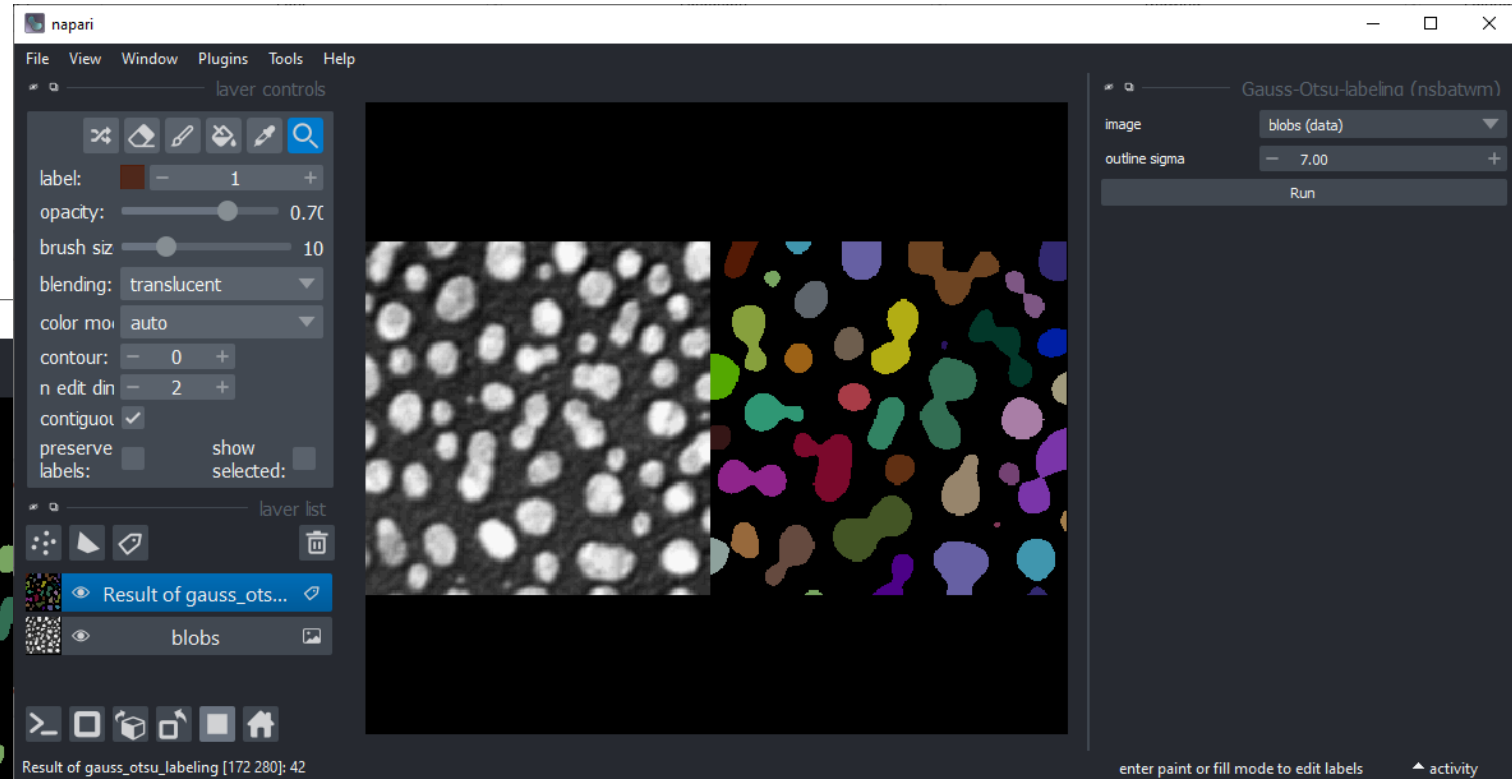
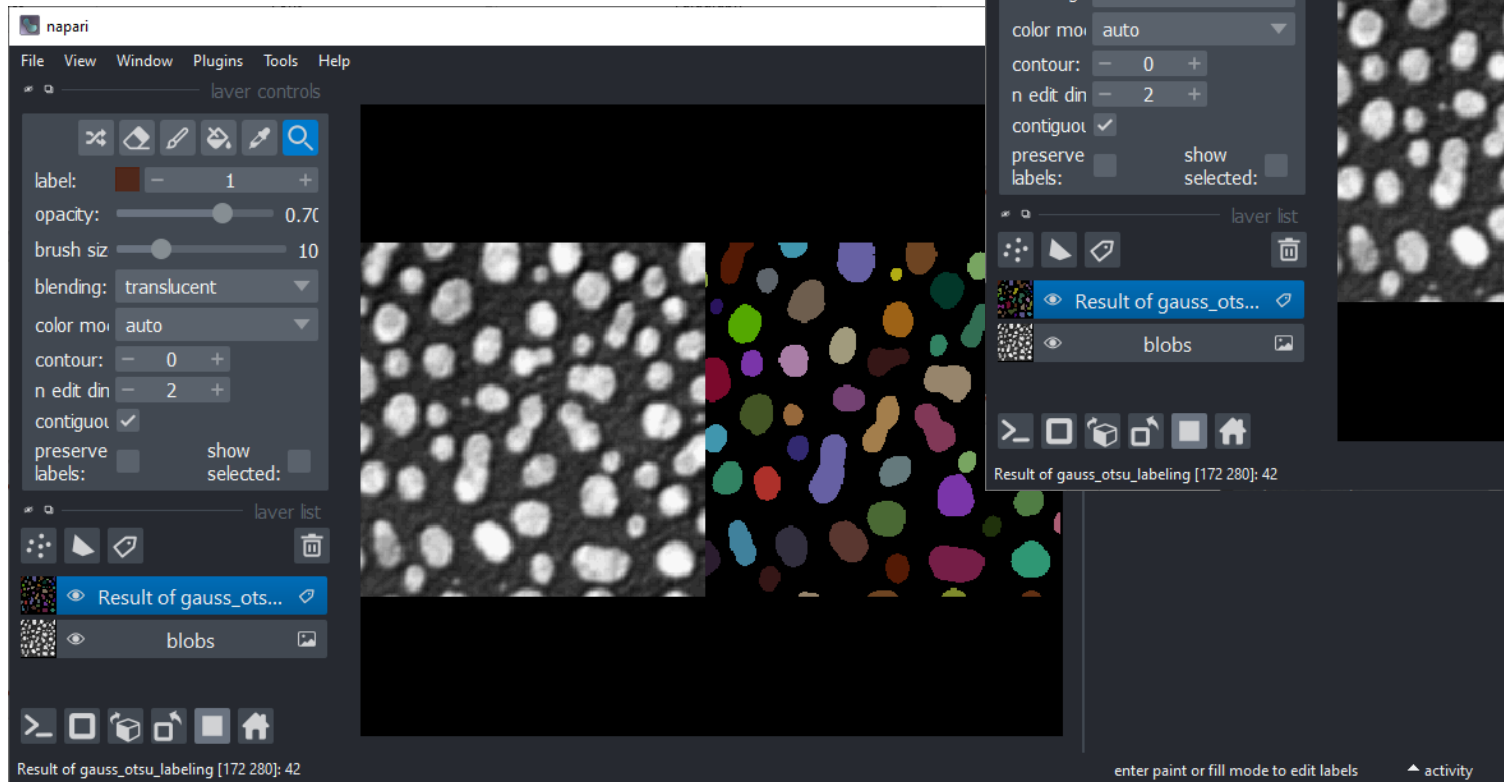
Connected component labelling

- In napari: Tools > Segmentation / labeling menu

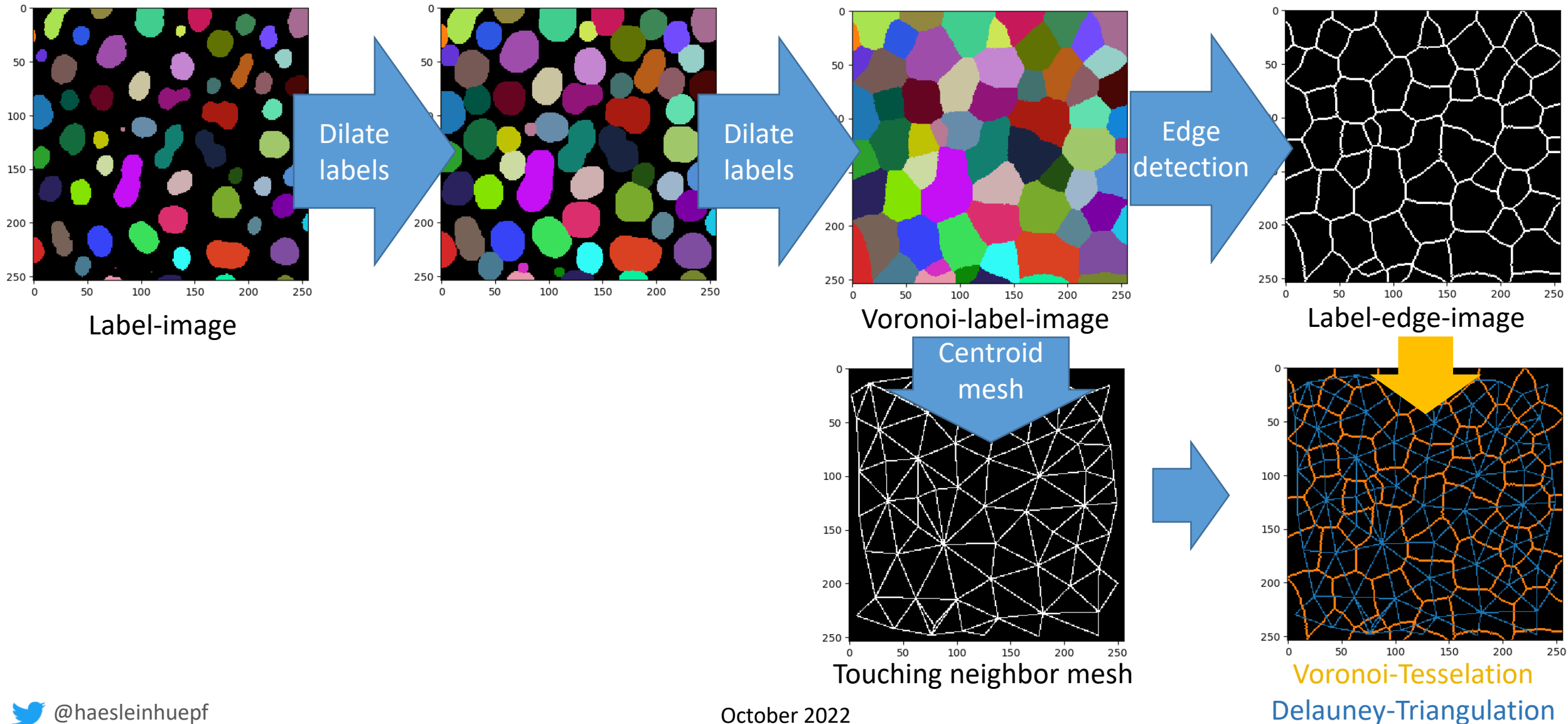


Short-cuts: Gauss-Otsu-Labeling

- In napari: Tools > Segmentation / labeling menu
- Gaussian-blur + Threshold Otsu + Connected component labeling

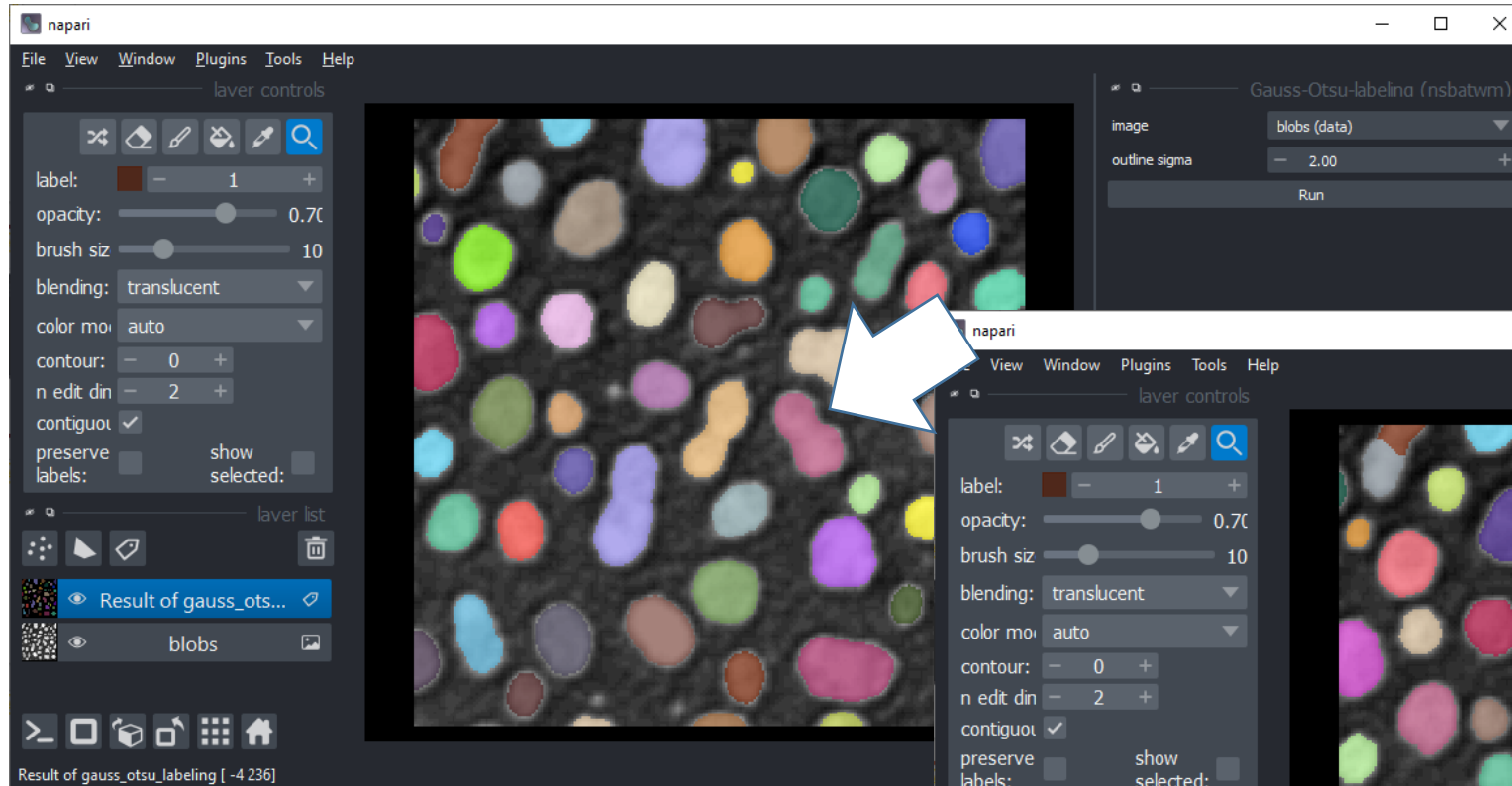


- In napari-menu: Tools > Segmentation post-processing



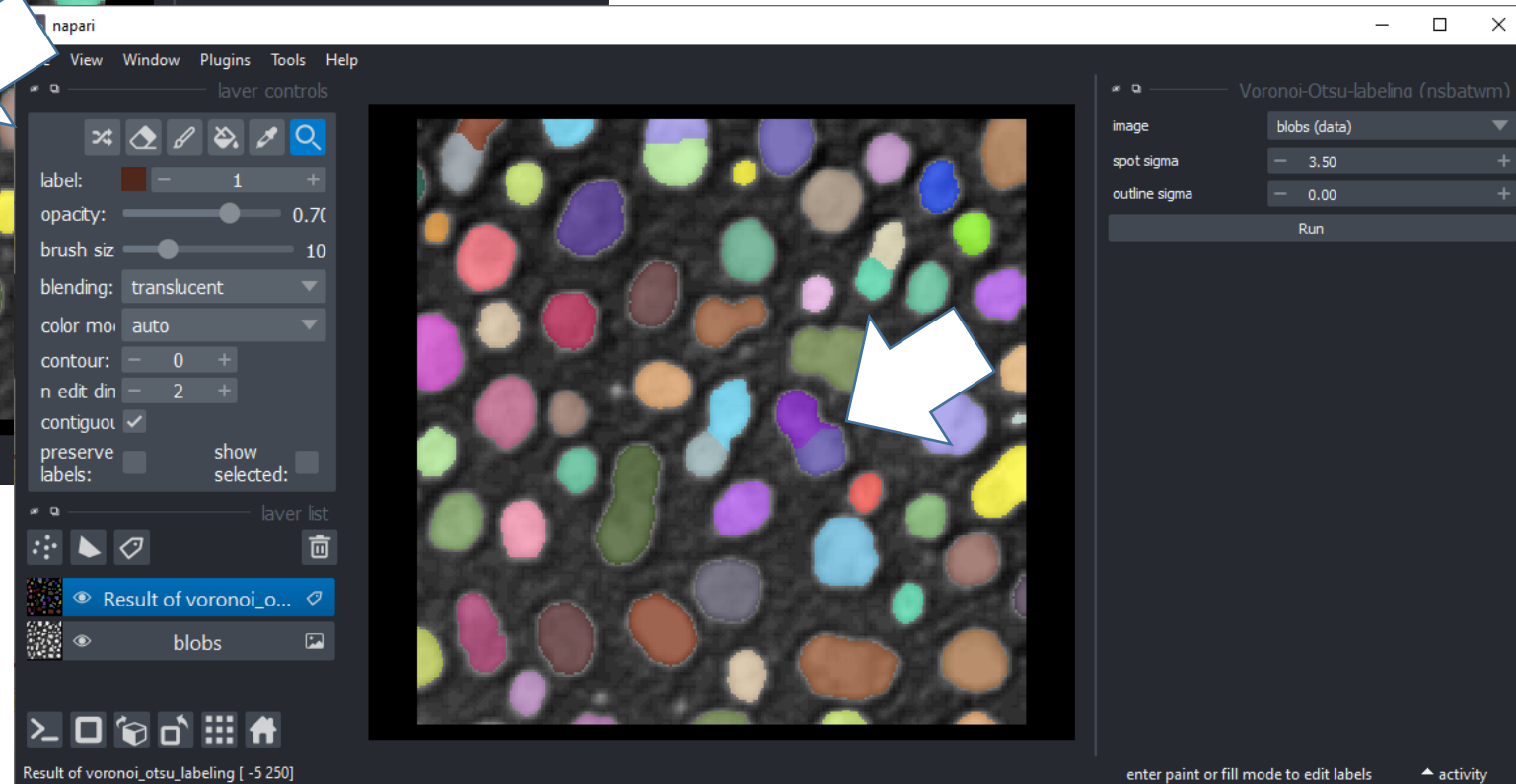
Short-cuts: Voronoi-Otsu-Labeling

- In napari: Tools > Segmentation / labeling menu

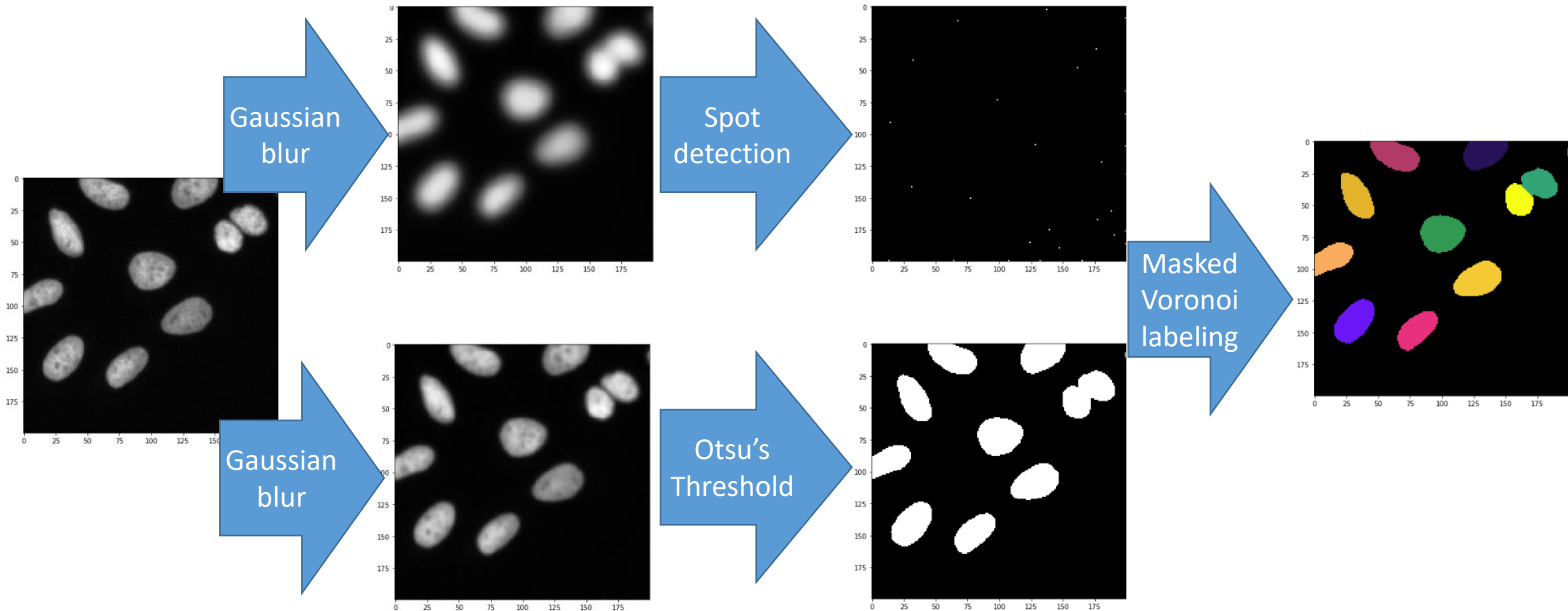


Gauss-Otsu-Labeling

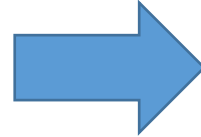
Voronoi-Otsu-Labeling



- Combination of Gaussian blur, Otsu's Threshold and Voronoi-labeling

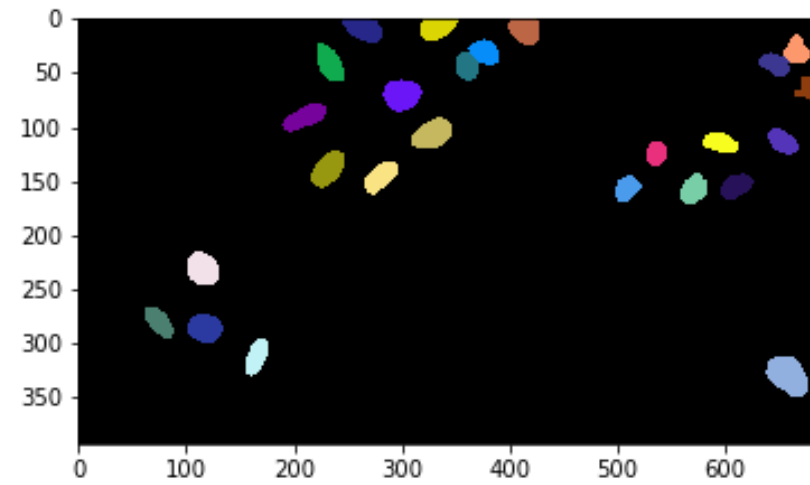
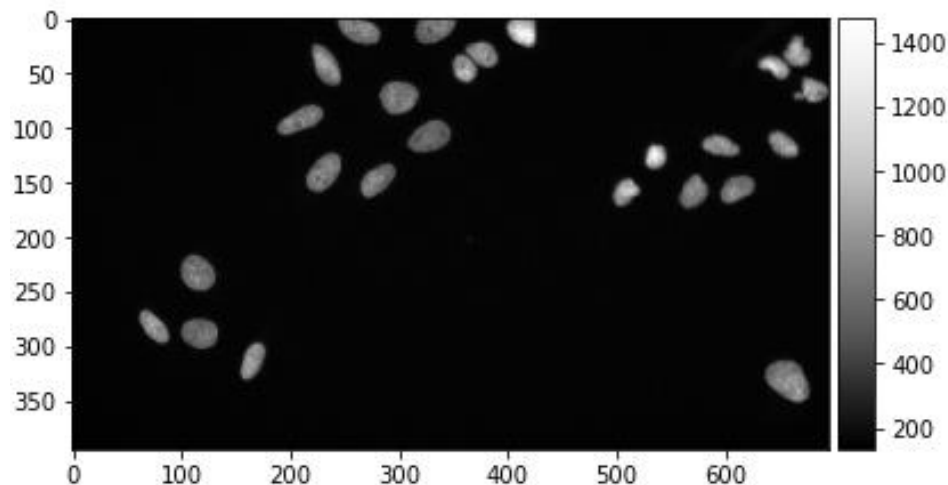


- Gaussian-Blur
- Otsu-Thresholding
- Spot-detection
- Watershed on the binary image



... in a single line of code:

```
segmented = nsbatwm.voronoi_otсу_labeling(input_image,  
                                           spot_sigma=5,  
                                           outline_sigma=1  
                                           )  
segmented
```



nsbatwm made image

shape (395, 695)

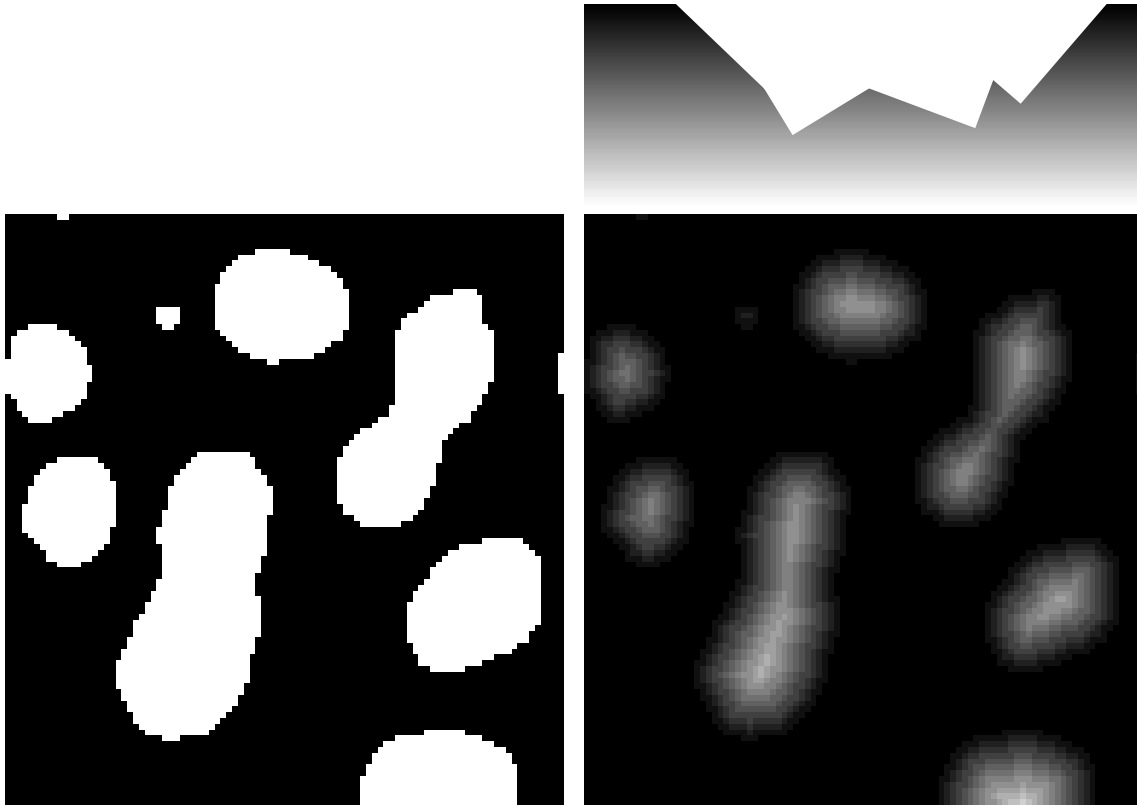
dtype int32

size 1.0 MB

min 0

max 25

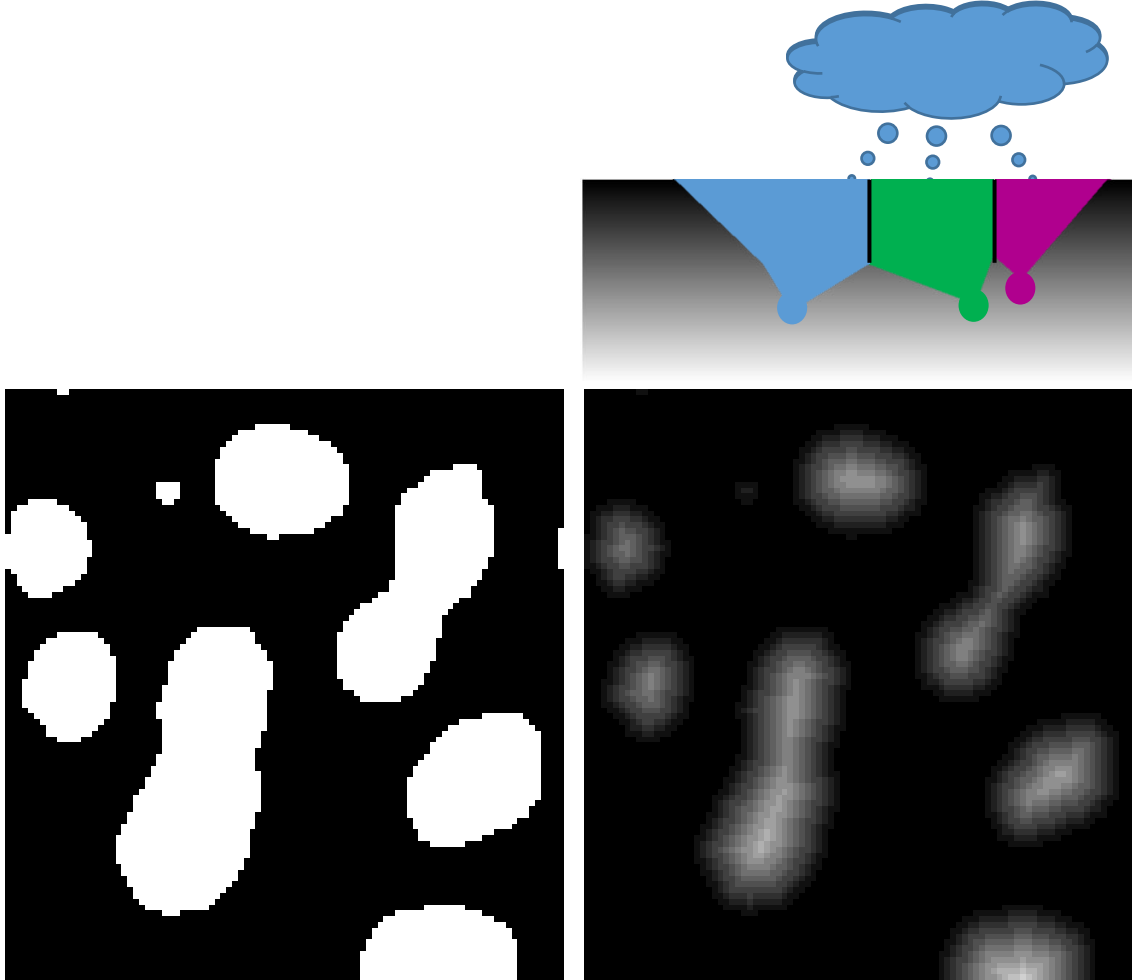
- The watershed algorithm for binary images allows cutting one object into two where it's reasonable.



Binary segmentation

Distance map

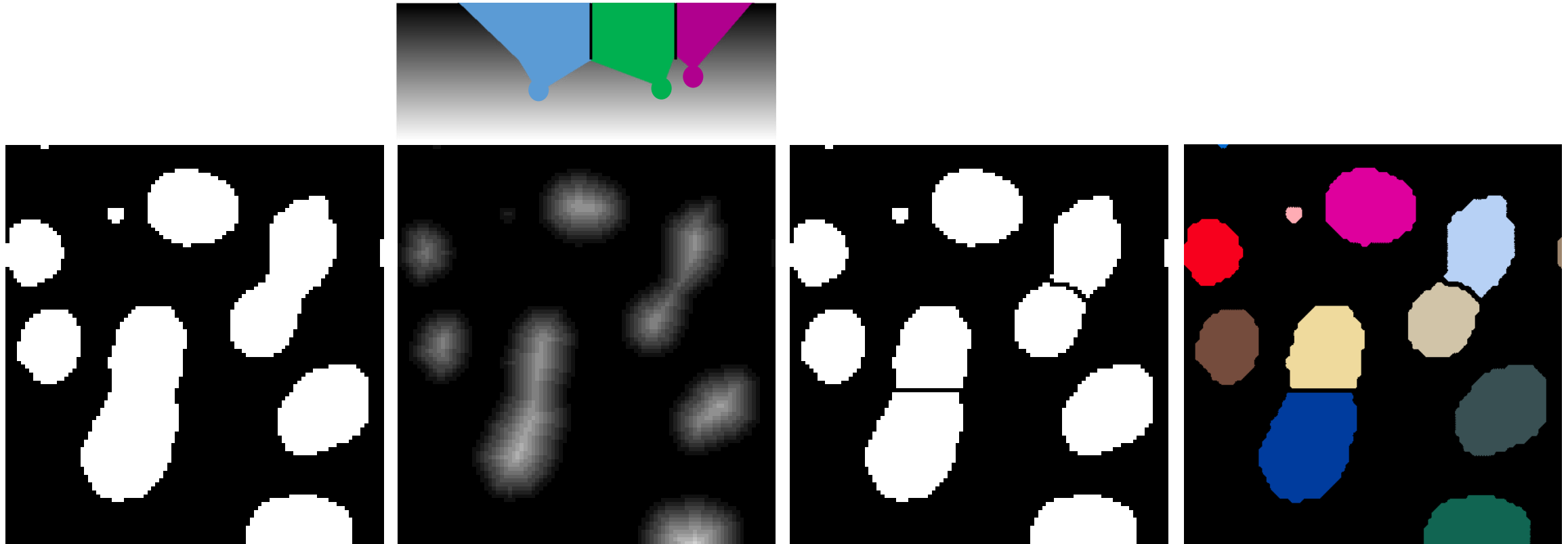
- The watershed algorithm for binary images allows cutting one object into two where it's reasonable.



Binary segmentation

Distance map

- The watershed algorithm for binary images allows cutting one object into two where it's reasonable.
- The watersheds are made from binary images. The algorithm does not take the original image into account!



Binary segmentation

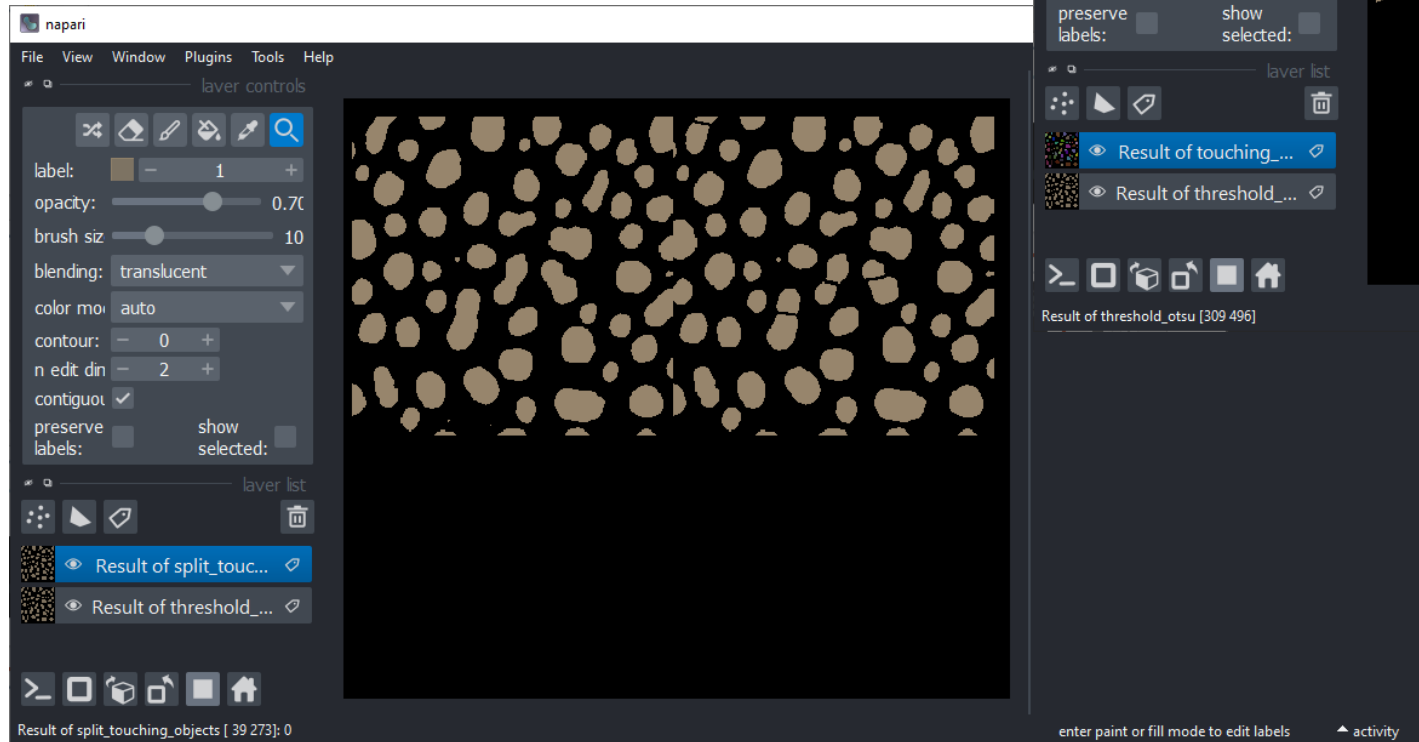
Distance map

Binary watershed

Labeled watershed

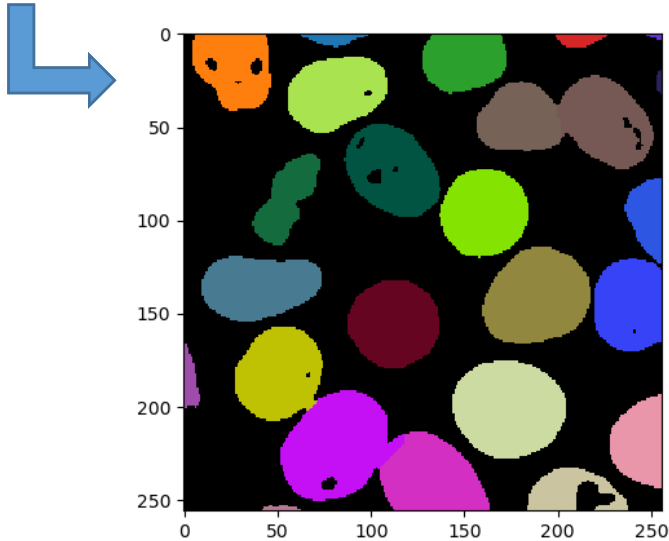
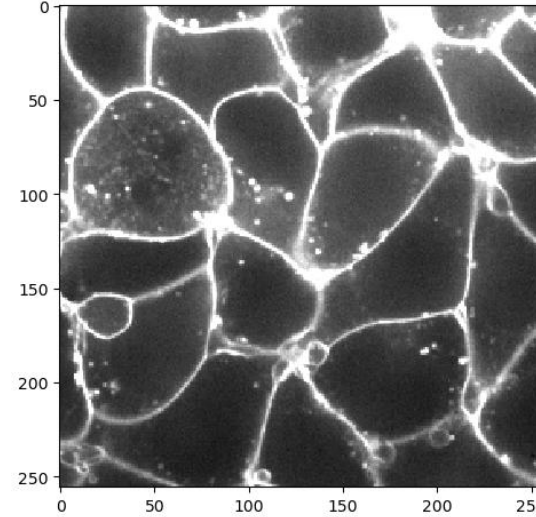
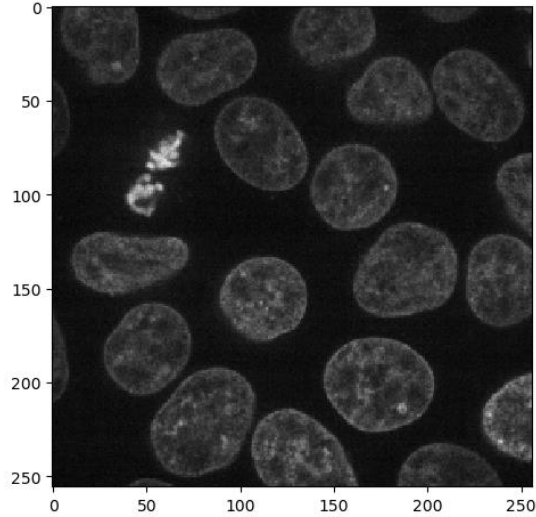
- In Napari

Similar to ImageJ's Watershed:
Tools > Segmentation post-processing >
Split touching objects

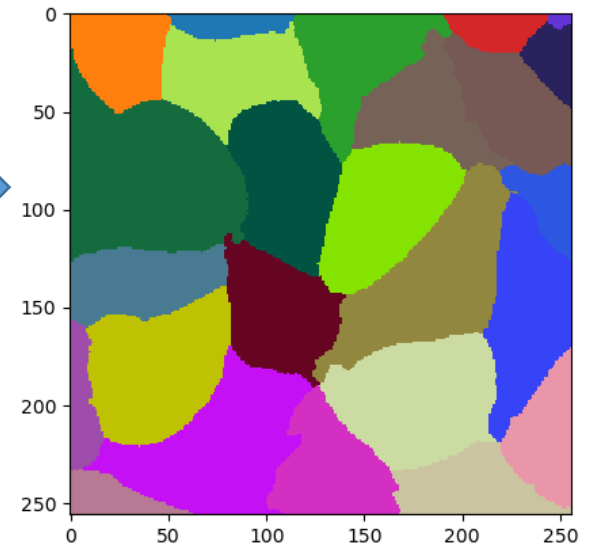


Results directly in a label image:
Tools > Segmentation / labeling >
Label touching objects

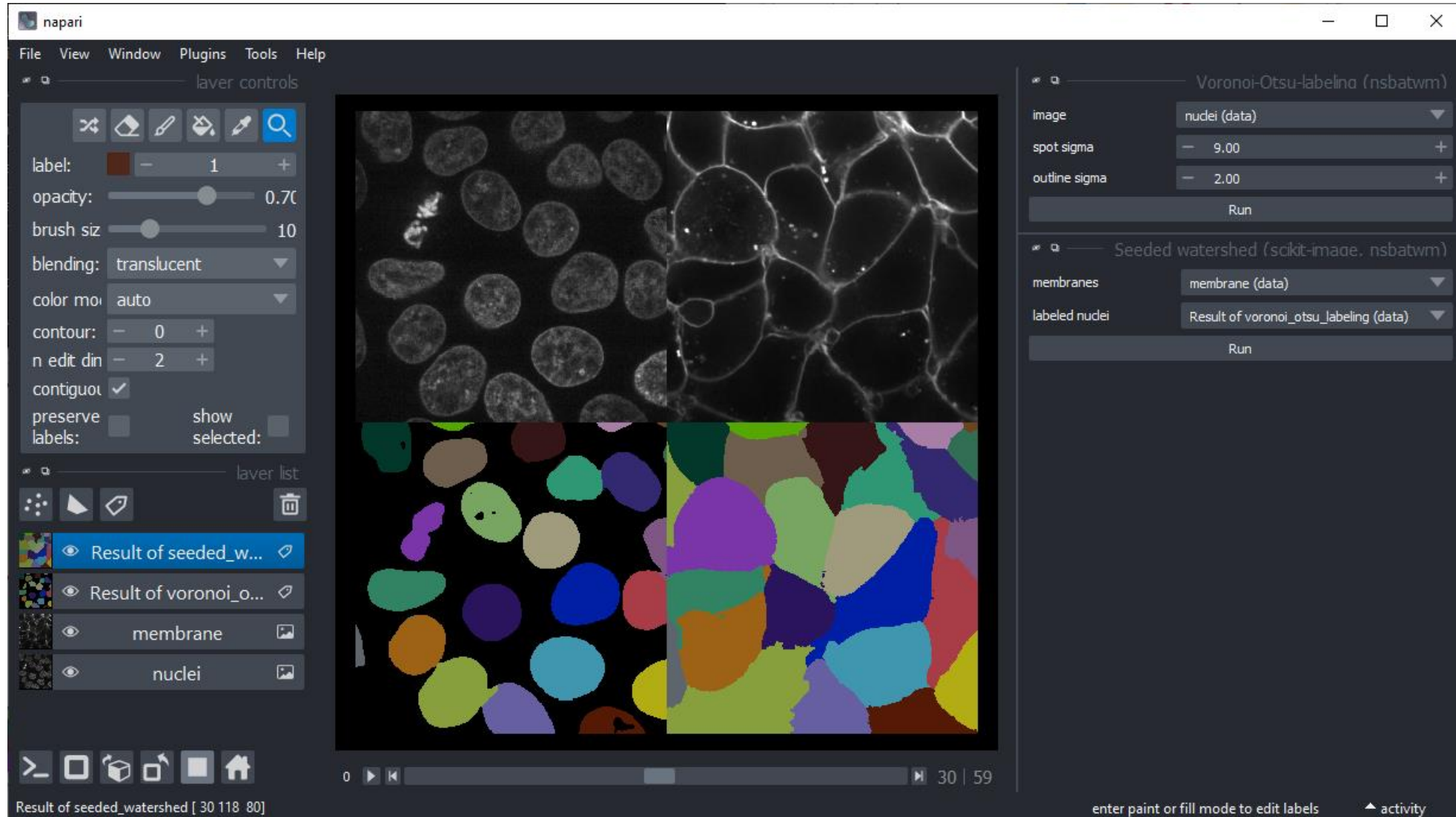
- ... in Python practice



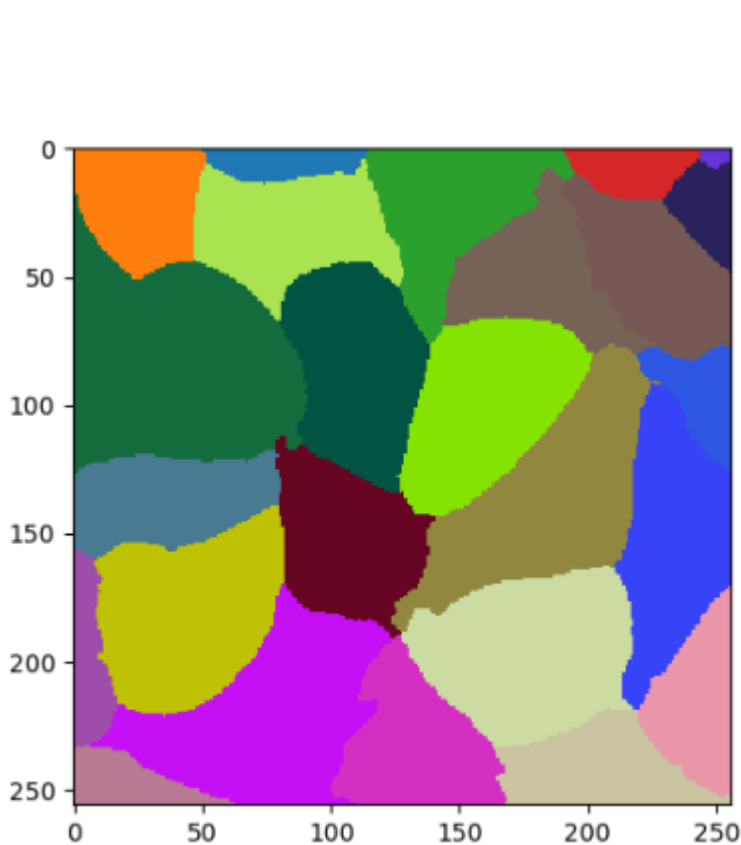
```
labeled_cells = seeded_watershed(membrane_channel, labeled_nuclei)  
labeled_cells
```



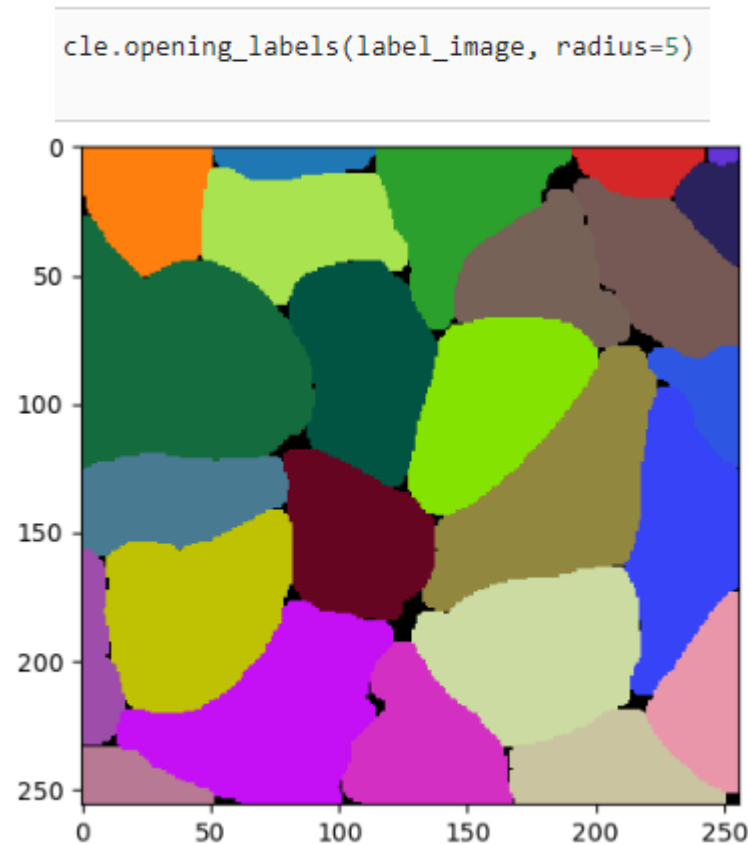
- ... in Napari practice: Tools > Segmentation / Labeling menu



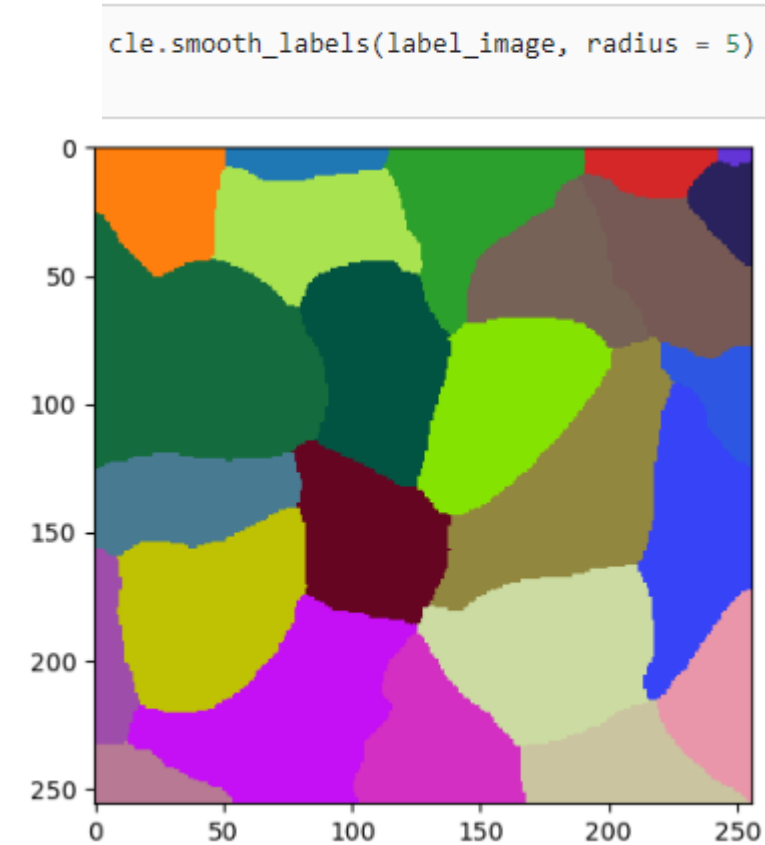
- ... similar to morphological operations on binary images



Original



Opening Labels



Smoothing Labels

Label post-processing / morphological operations

- In Napari menu Tools > Segmentation post-processing > Smooth labels (clEsperanto)

