



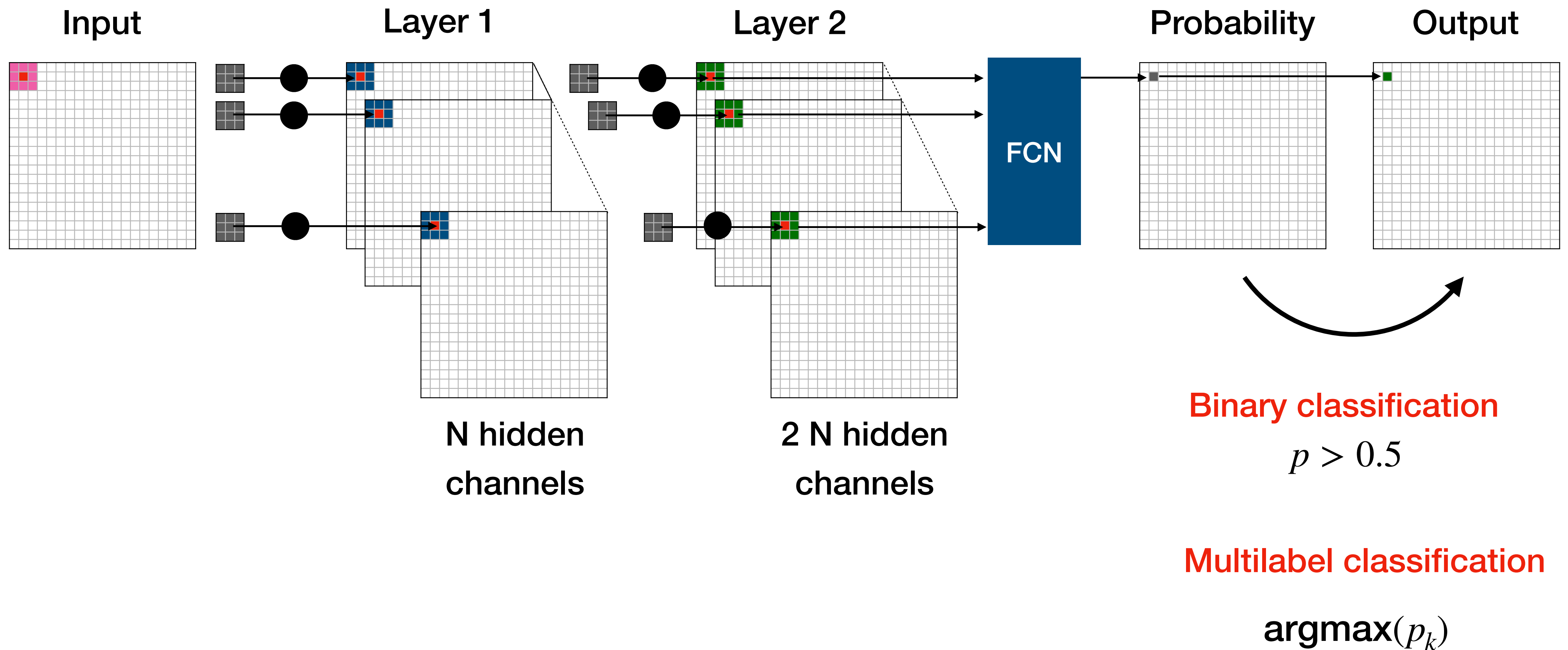
Bioimage Informatics

Daniel Sage & Arne Seitz

Workshop

Training U-Net

👁 Deep Learning Segmentation



👁 Deep Learning Segmentation



512x512x1
Graylevel image

256x256x64

256x256x64

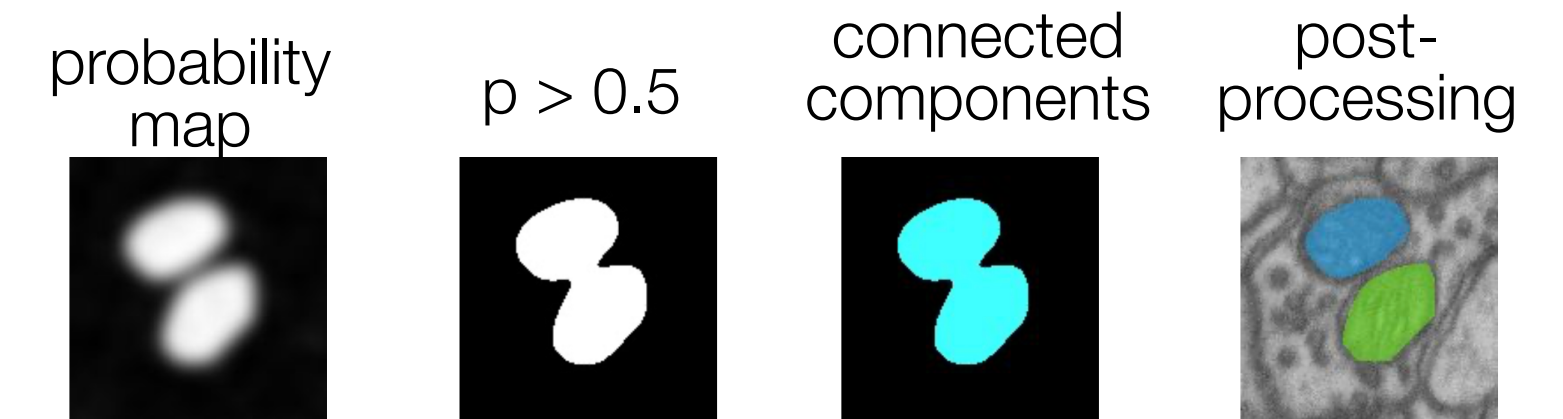
128x128x128

128x128x128

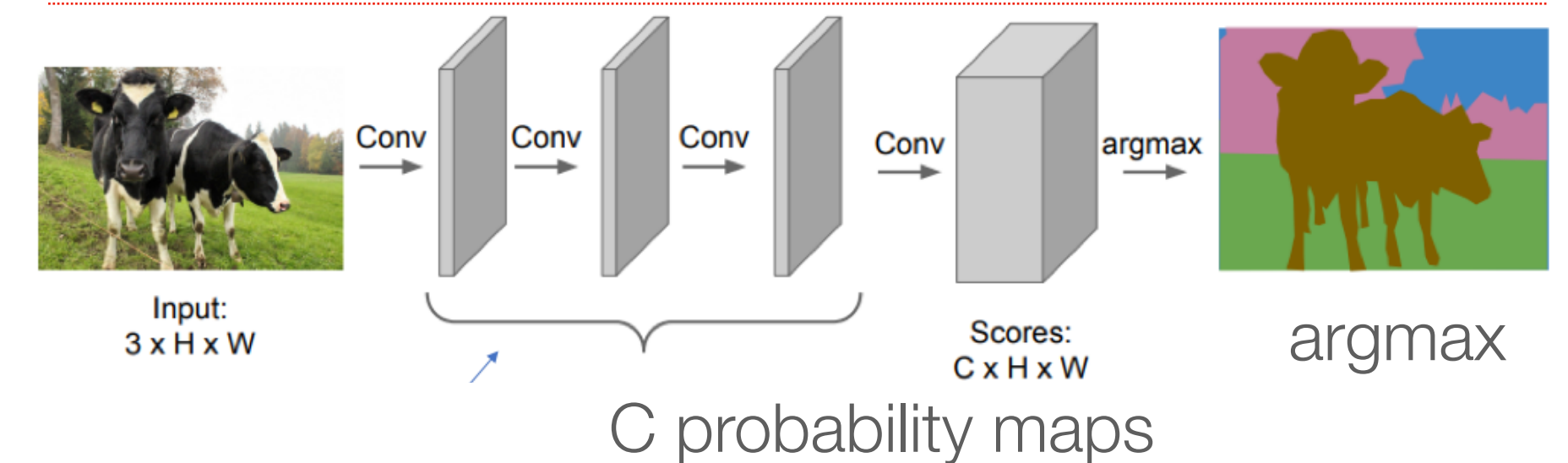
64x64x256

64x64x256

Pixel Binary Classification



Segmentation - Multiple label classification



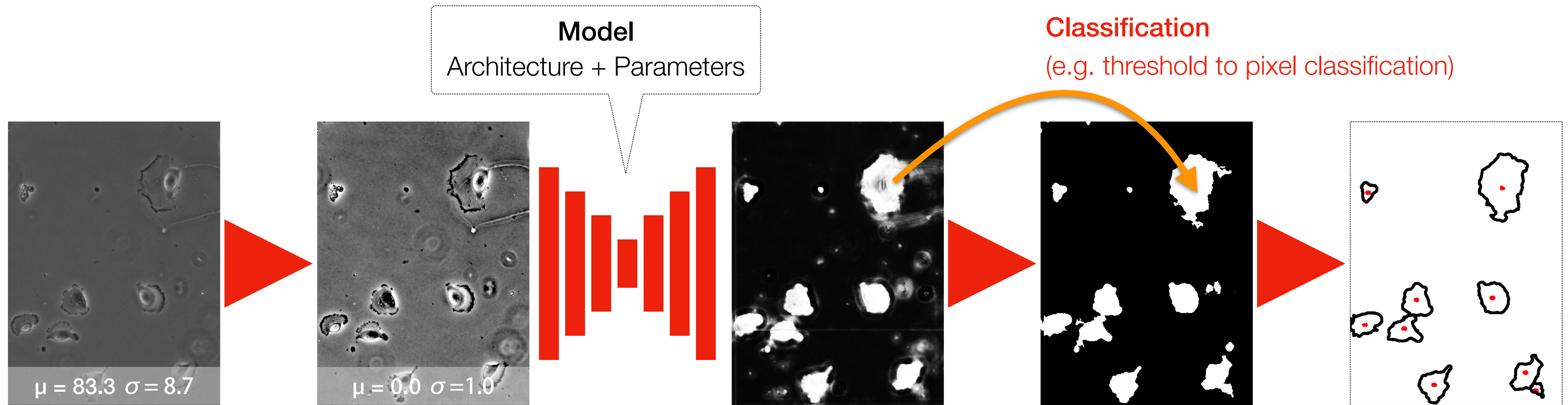
Large datasets of images

~2'000'000 parameters

U-Net
Pixel classification

Ronneberger et al., U-Net:, MICCAI, 2015

👁 Deep Learning Segmentation



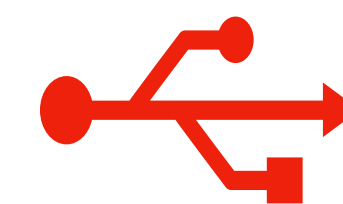
Preprocessing
(e.g. Normalization)

Prediction
(e.g. map of probability)

Postprocessing
(e.g. Analyze Particles)



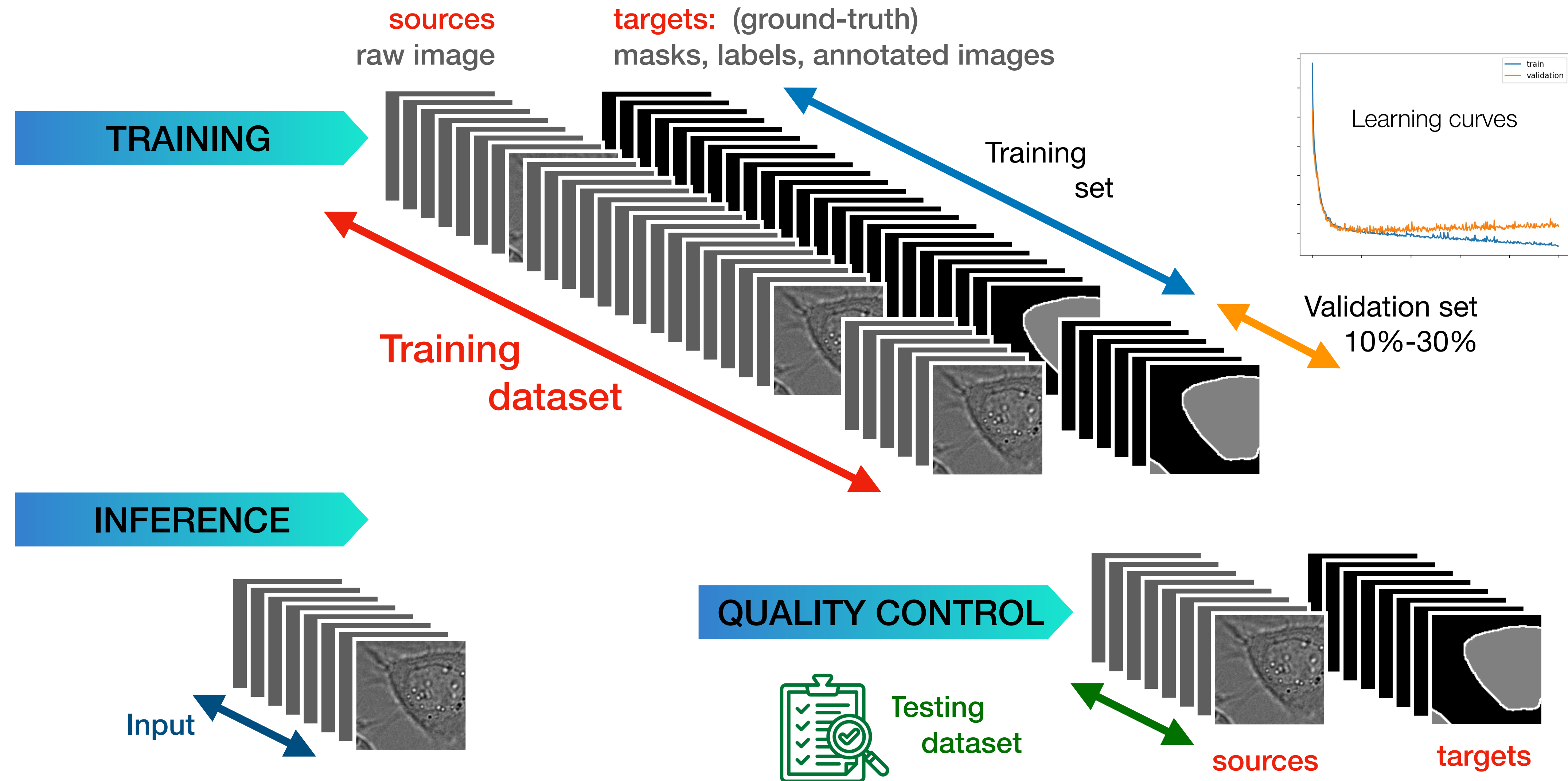
- Dynamic range
- Scale
- Noise level



- Object detection
- Watershed
- Measurement



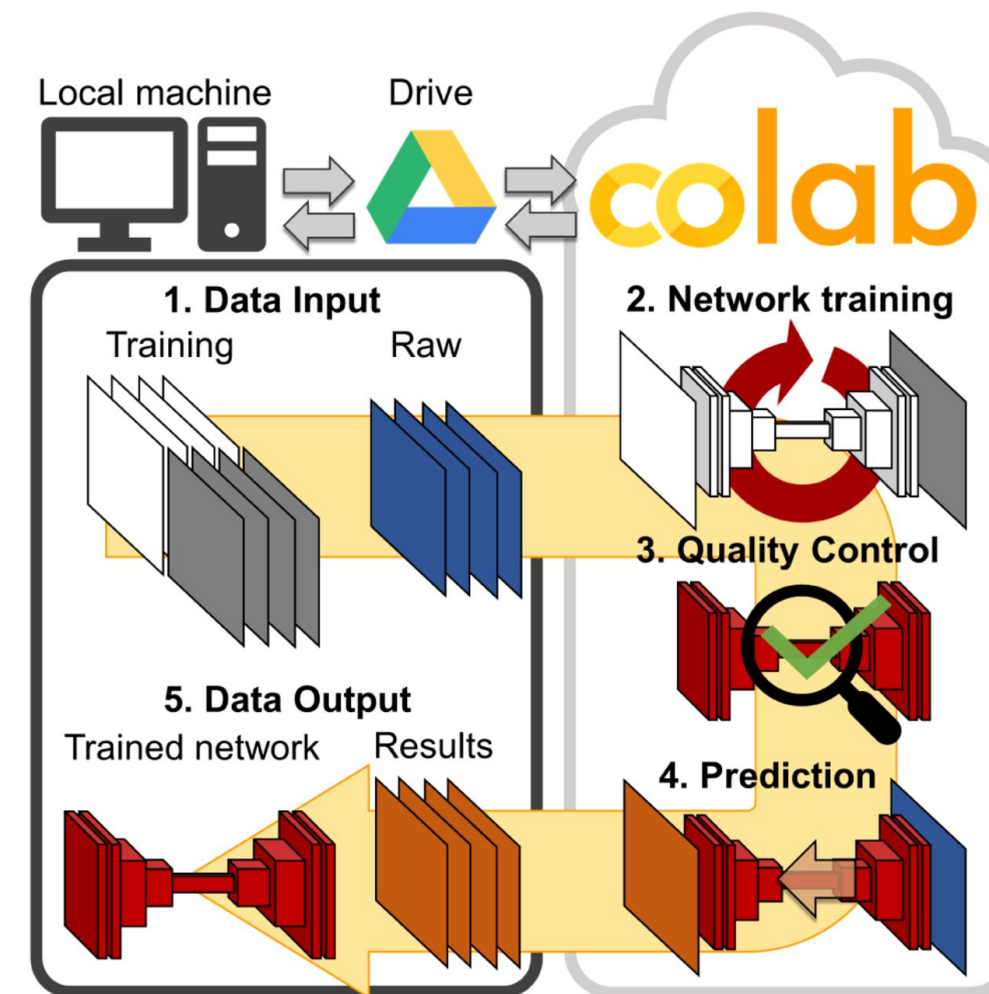
Training Datasets



ZeroCostDL4Mic

- Self-explanatory Notebooks
- Running on **Google Colab** (free)
- Export to the bioimage zoo (beta)
- U-net 2D, 3D, Stardist, noise2void, ...

L. von Chamier. Nature Methods, 2021



1. Data preparation
2. Data augmentation
3. Build network
4. Training
5. Quality Control
6. Assessment
7. Save the model

Multilabel 2D Unet Segmentation Colab Notebook

deepimagej.github.io

- Macro recordable (pipeline)
- One-click installation
- Pre & post-processing
- Models from the **Bioimage Zoo**

E. Gómez-de-Mariscal, Nature Methods, 2021.



Google Colab

- Jupyter Notebook
- Free GPU
- TensorFlow compatible
- Data on Google Drive



Architecture

U-Net

ResNet

MobileNet

GAN

DenseNets

...

Loss function

Mean Squared Error

Cross-entropy

Dice Loss

Focal Loss

Mean Absolute Error

...

Optimisation

Gradient descent

Stochastic GD

ADAM

...

Hyper-parameters

Data curation

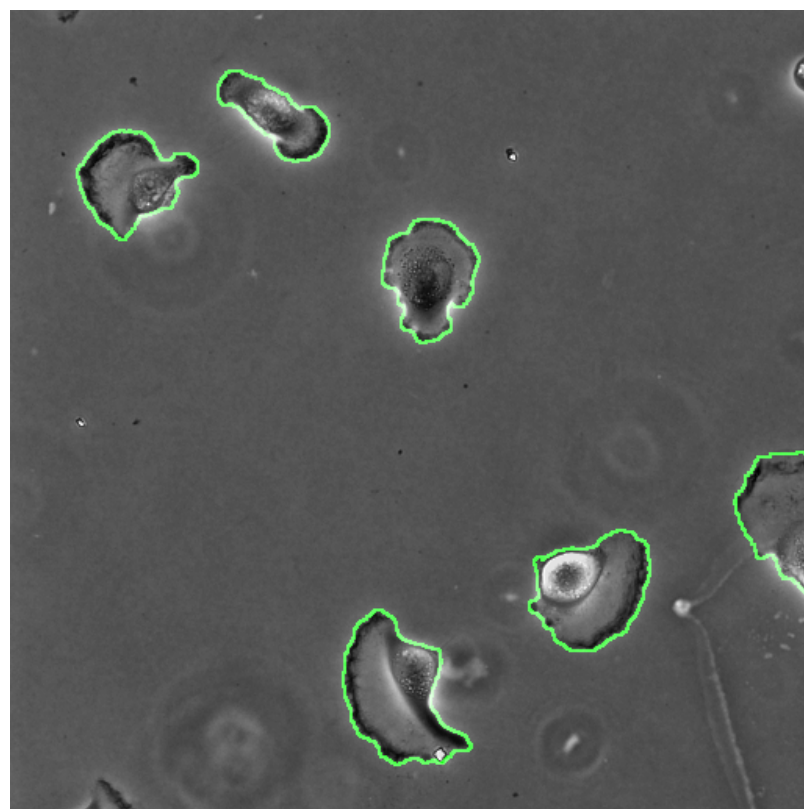
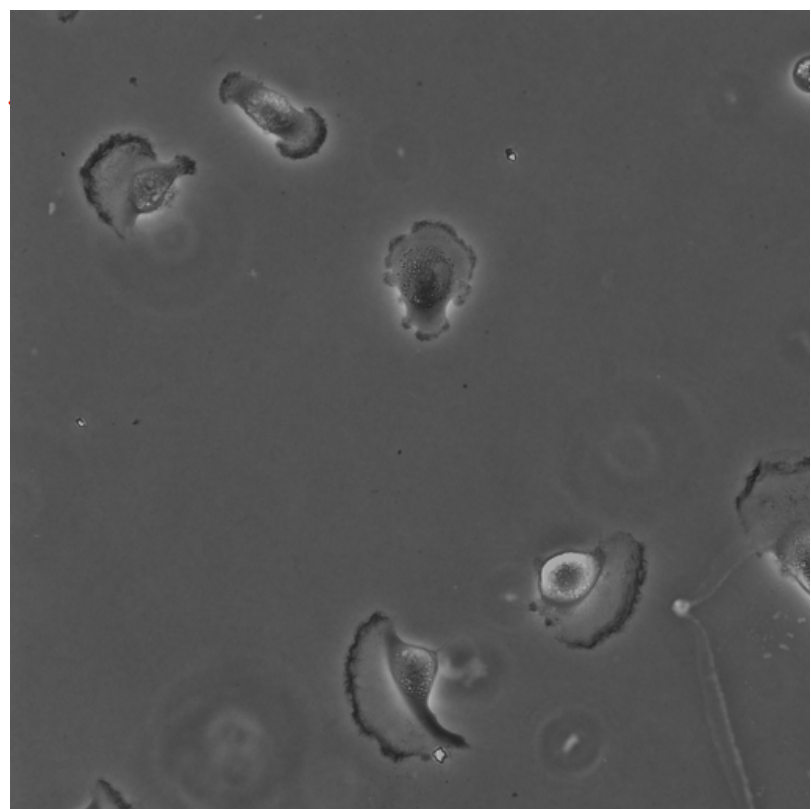
Good ground-truth

Masks / Labels

Keypoints / Boxes

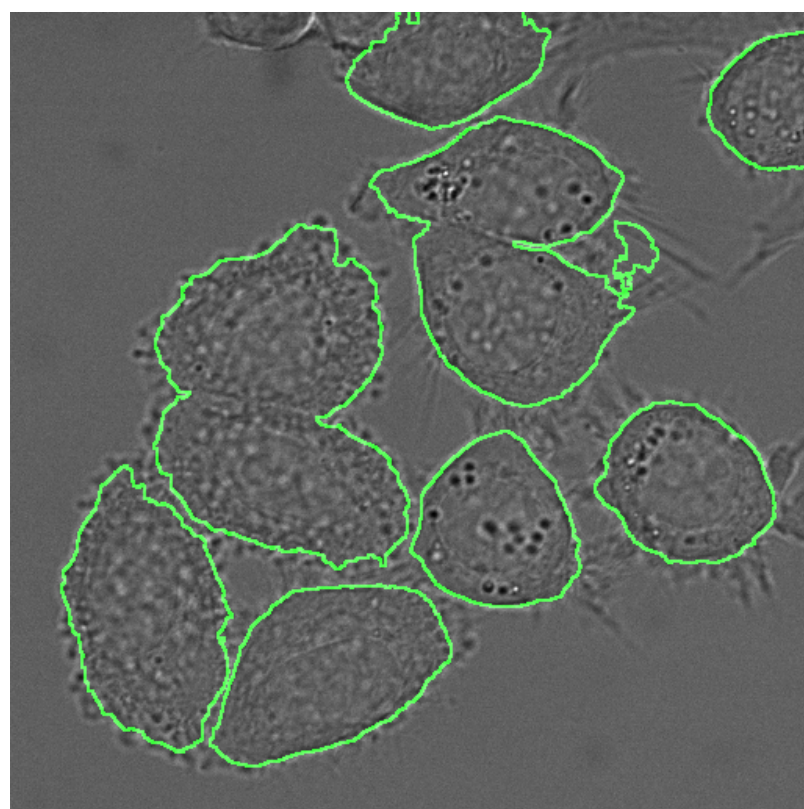
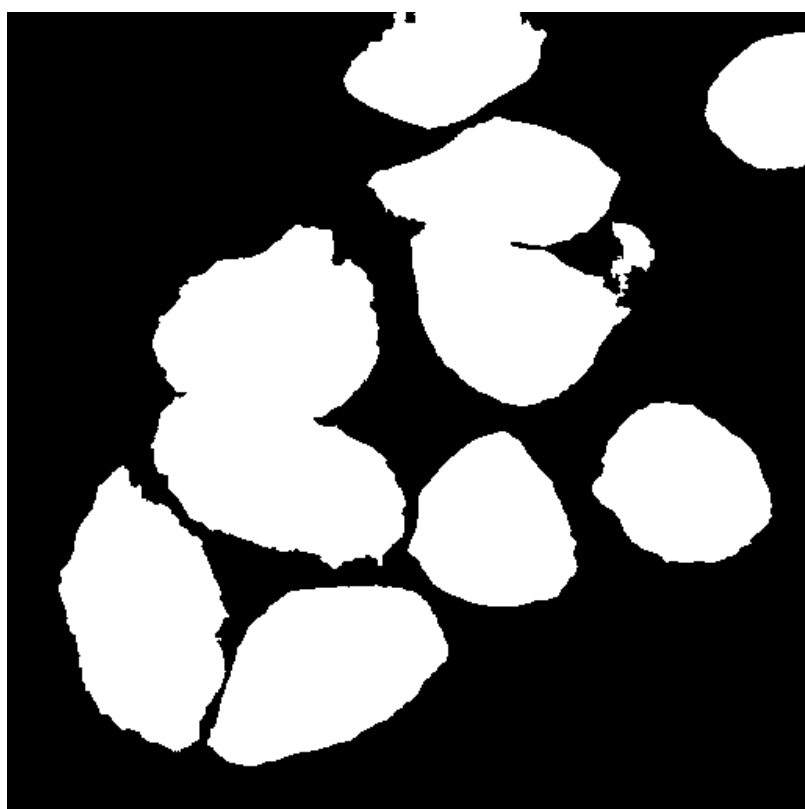
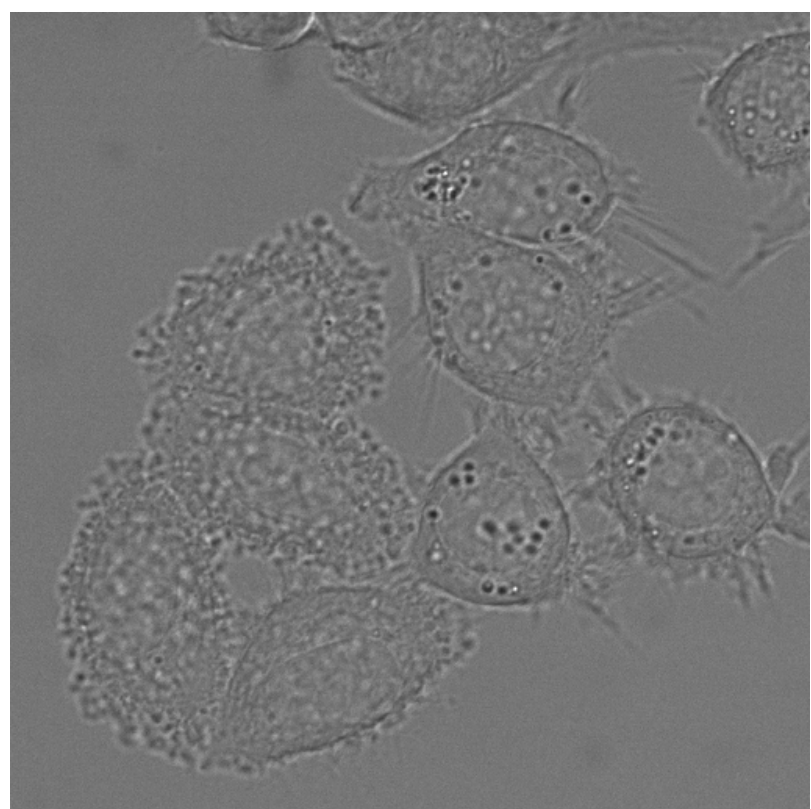
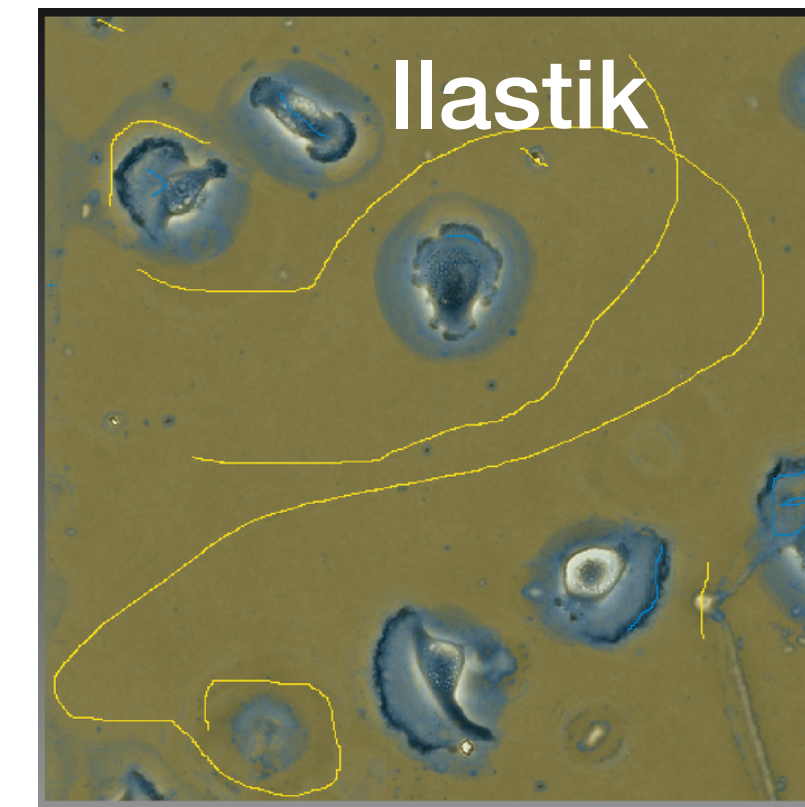
Normalisation

Protocol of acq.



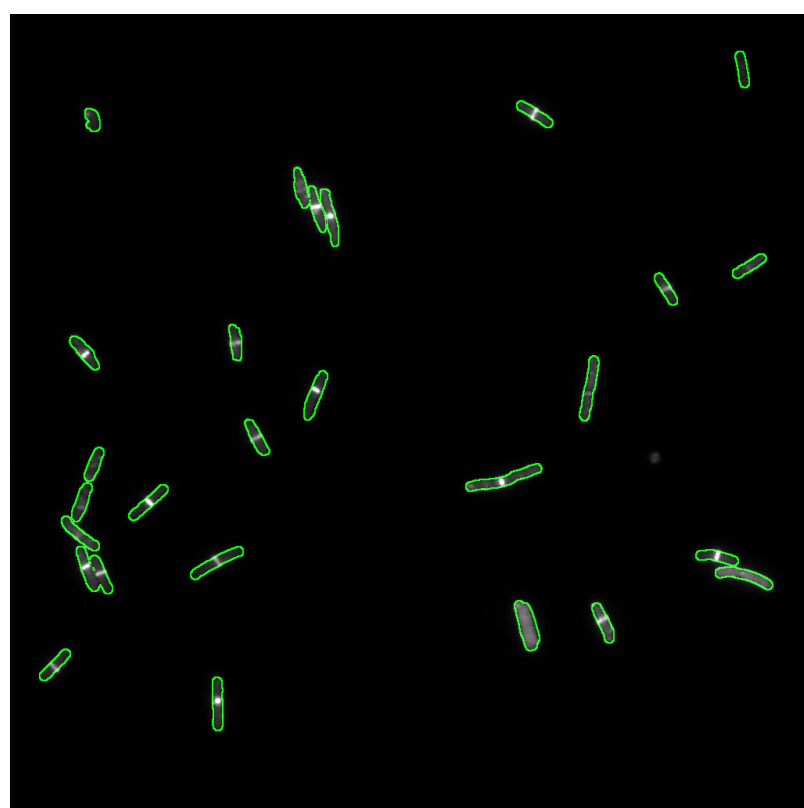
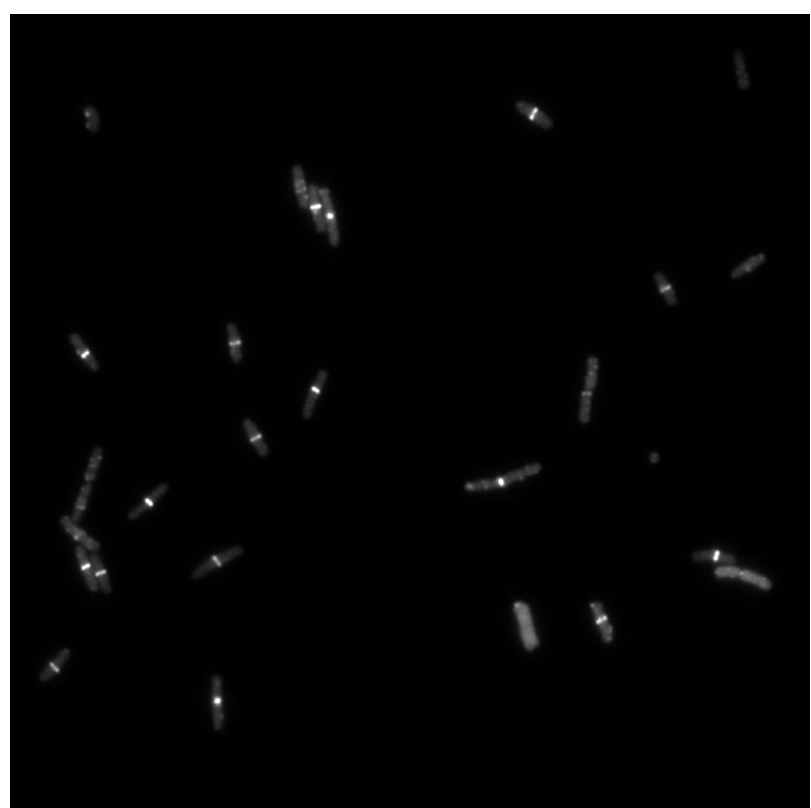
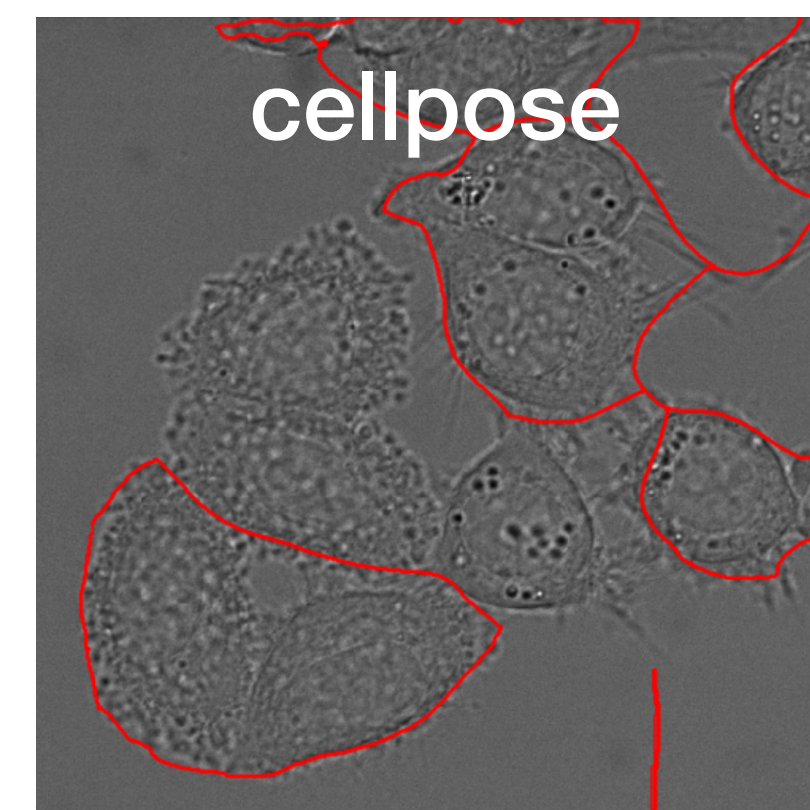
Glioblastoma

- Cell tracking chall.
- 512 x 512
- 66 + 23 images
- Mask 2K (0/1)



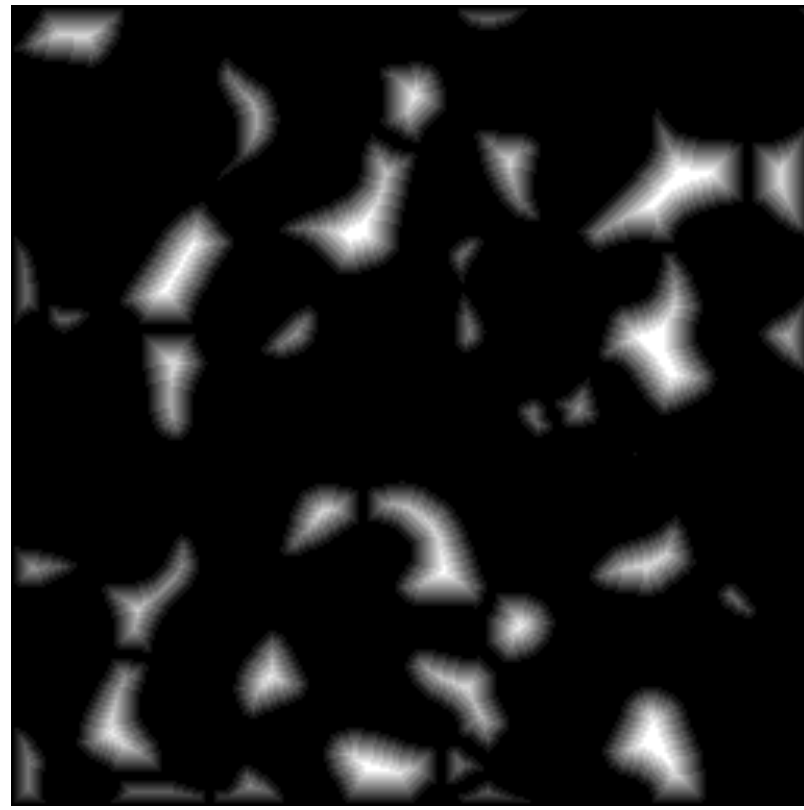
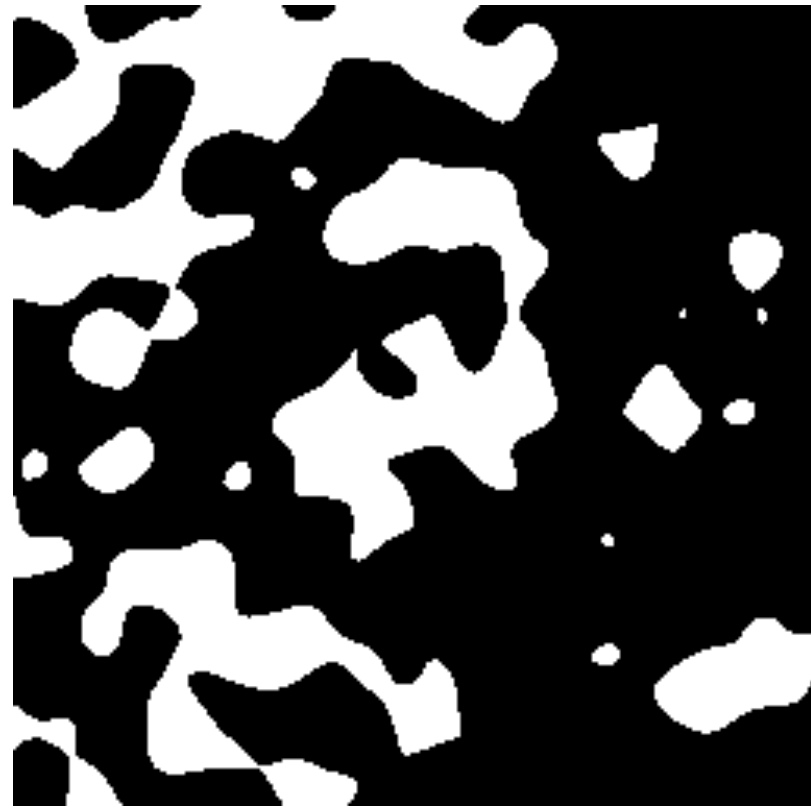
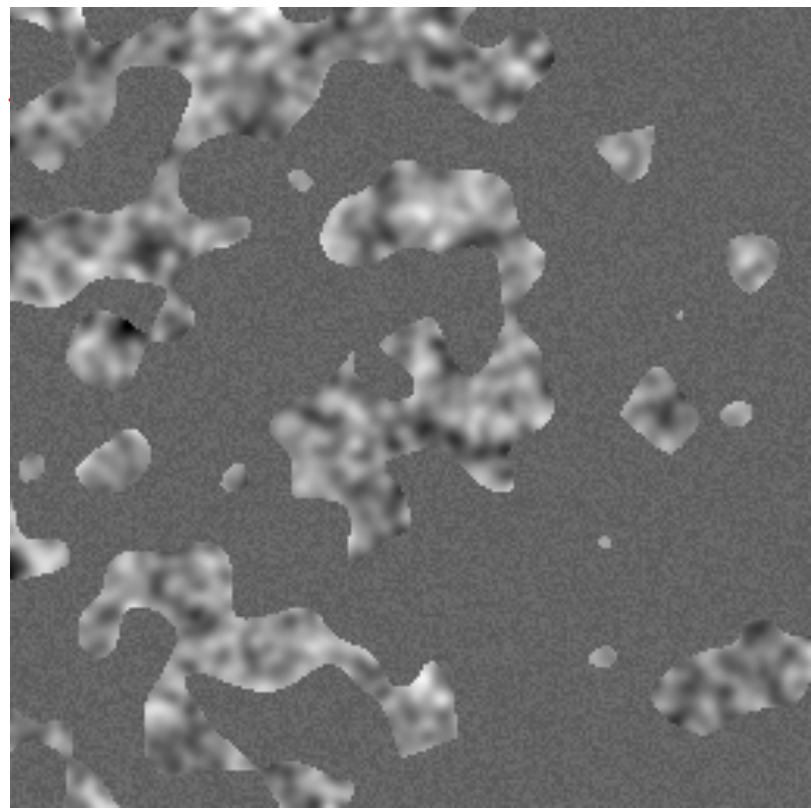
Hela

- Cell tracking chall.
- 72 + 27 images
- Mask 2K (0/1)



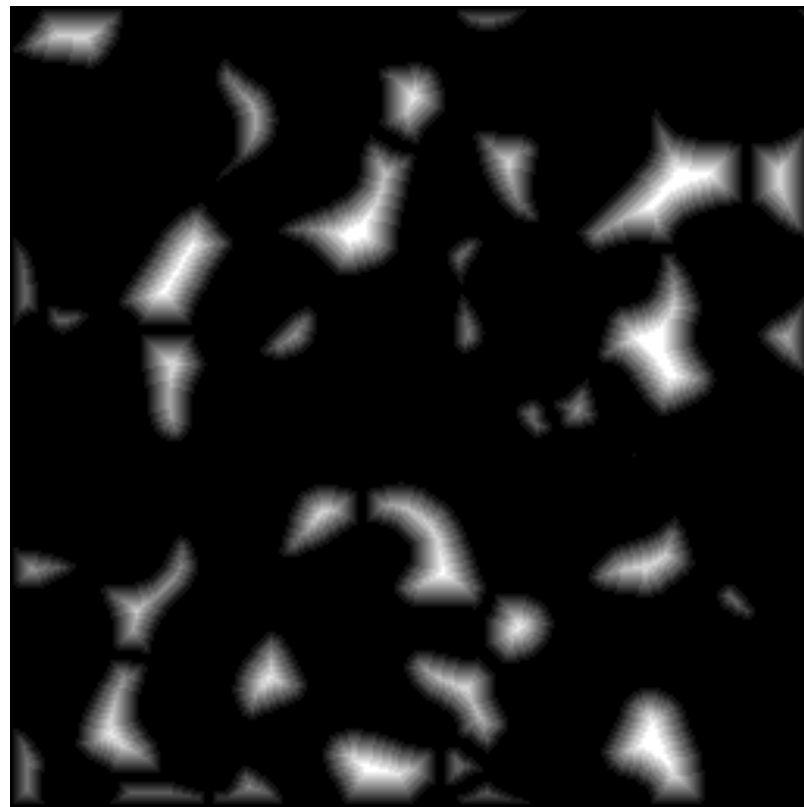
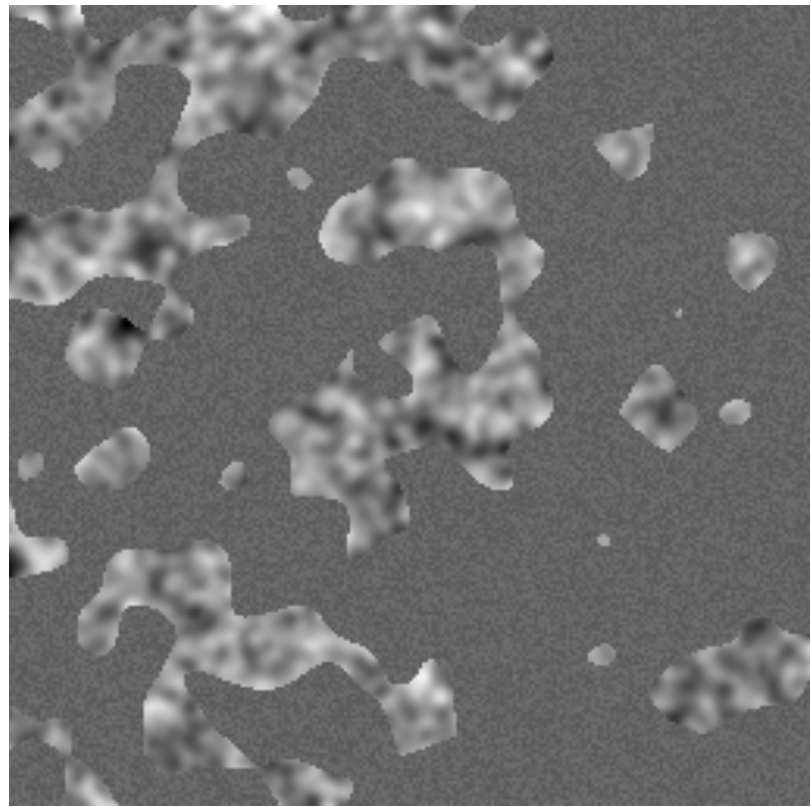
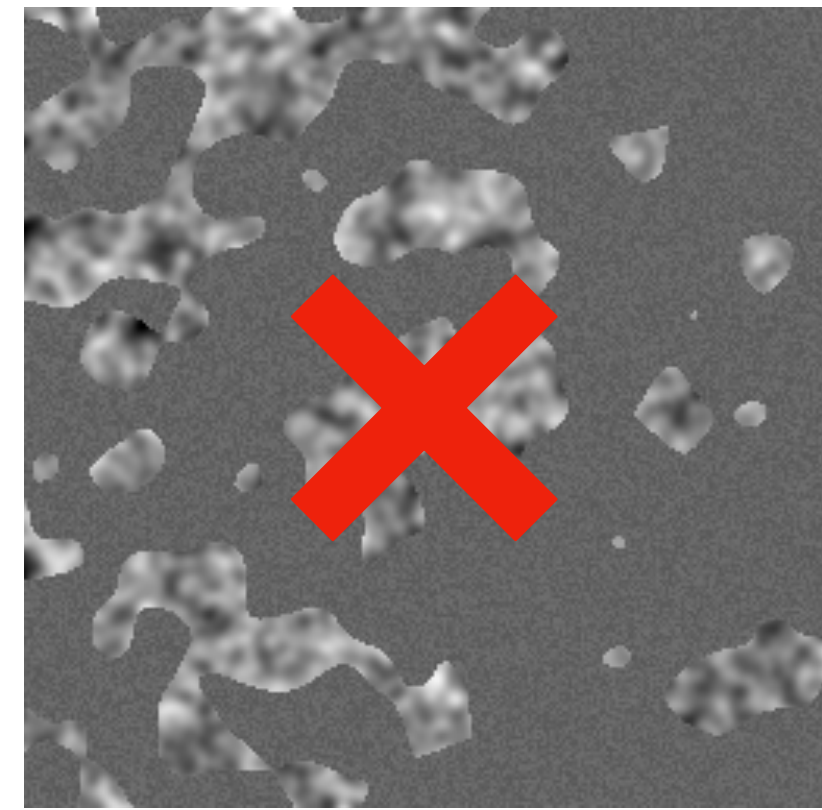
Deepbacs

- Zenodo
- 1024x1024
- 240 + 30 images
- Mask 2 K (0/1)



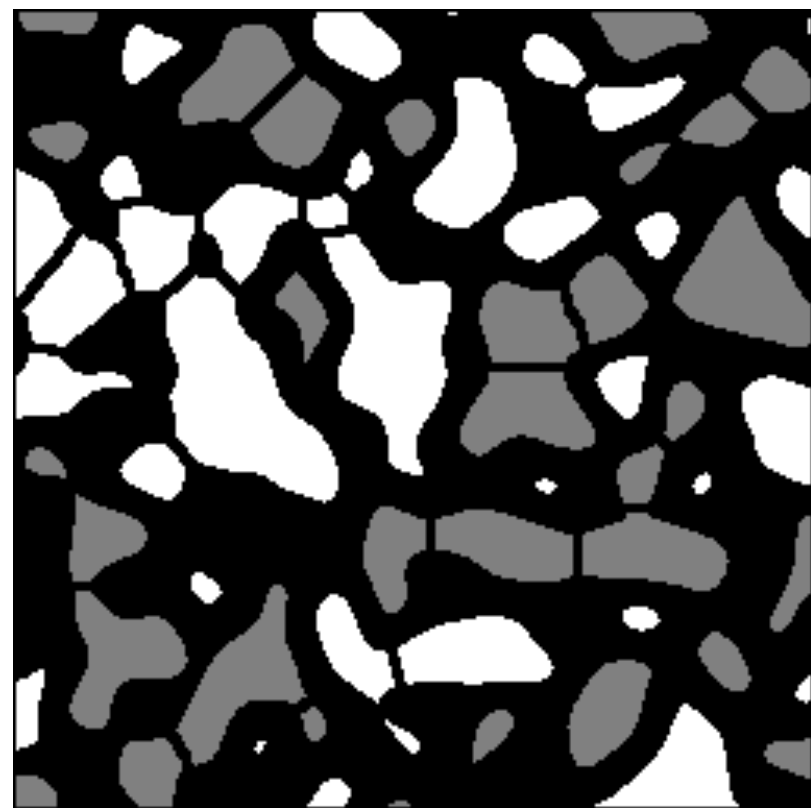
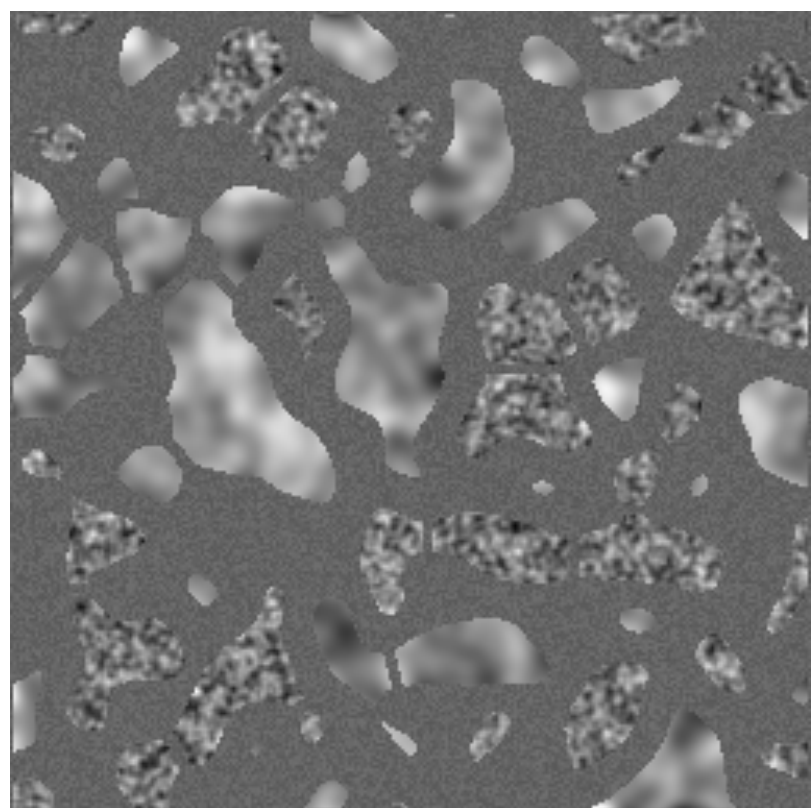
Simulation 2K 10 im

- 256 x 256
- 10 + 10 images
- Mask 2K (0/1)
- Dmaps 12K



Simulation 2K 100im

- 256 x 256
- 100 + 40 images
- Mask 2K (0/1)
- Dmaps 12K



Simulation 3K 100im

- 256 x 256
- Mask 3K (0/1/2)