



Ilastik

Interactive Machine Learning for Image Analysis



Berg, S., Kutra, D., Kroeger, T. et al. ilastik: interactive machine learning for (bio)image analysis. *Nat Methods* 16, 1226–1232 (2019).

<https://doi.org/10.1038/s41592-019-0582-9>

Ilastik ?!?

User-friendly tool for **interactive image classification, segmentation and analysis**. It is built as a modular software framework, which currently has workflows for automated (supervised) pixel and object-level classification, automated and semi-automated object tracking, semi-automated segmentation and object counting without detection. **Most analysis operations are performed lazily**, which enables targeted interactive processing of data subvolumes, followed by complete volume analysis in offline batch mode. **Using Ilastik requires no experience in image processing.**

Motivation

& what to learn

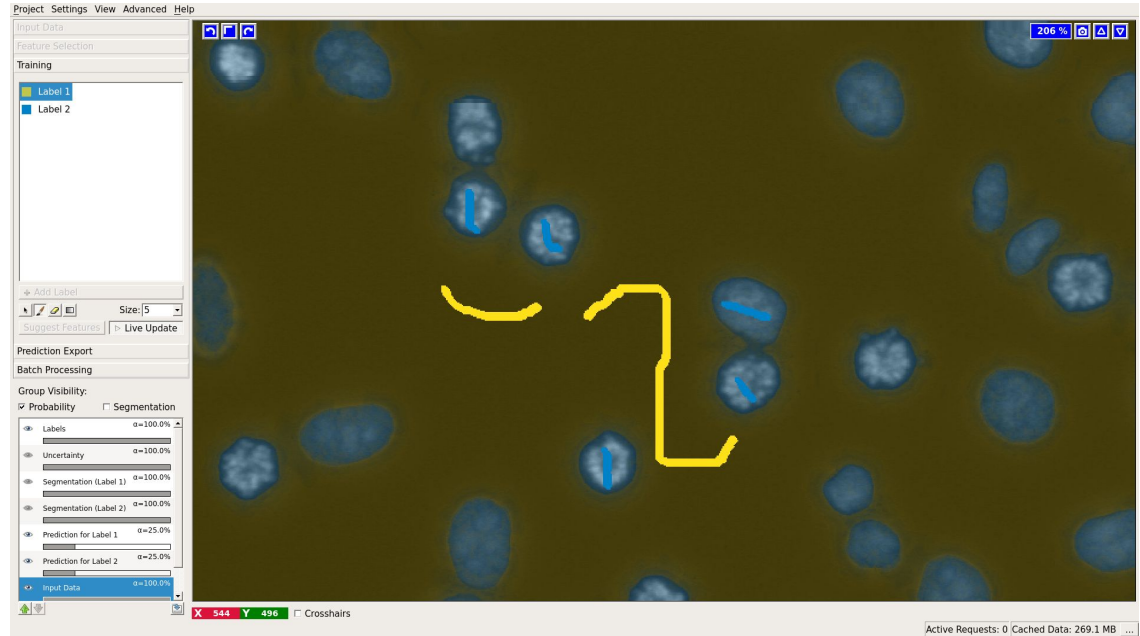
- What is Ilastik?
- What Ilastik can be used for
- How it works
- How to use it (lazily)
- Pixel classification example
- Object classification example

What Ilastik can be used for

- Neural Network Classification
- **Pixel Classification**
- Voxel Segmentation Workflow (beta)
- Autocontext
- **Object Classification**
- Boundary-based Segmentation with Multicut
- Tracking
- Density Counting
- Carving

Why to use Ilastik

1. It is a free software.
2. Easy to learn, with good documentation and tutorials.
3. Fast and interactive setup with visualization.
4. Batch processing.
5. Image.sc forum.
6. ImageJ integration.



ImageJ Plugin

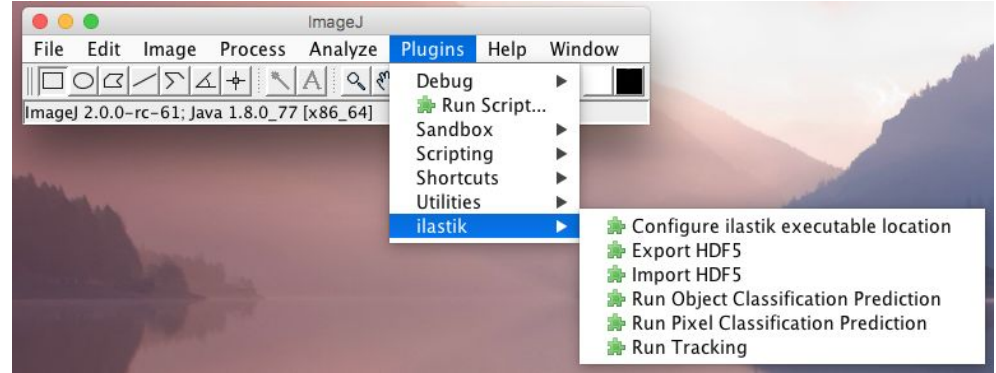
Import Export plugin in FIJI

- Data through HDF5

Pretrain Ilastik model usage

- Pixel Classification
- Object Classification
- Tracking

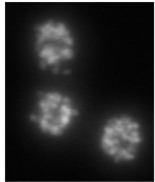
Possibility to use in macro.



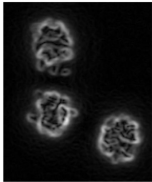
Pixel Classification Background

User input:

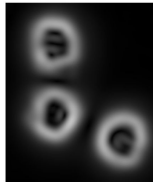
- Image
- Features setting
- Sparse annotation



Raw data



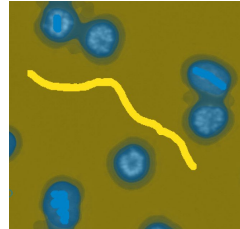
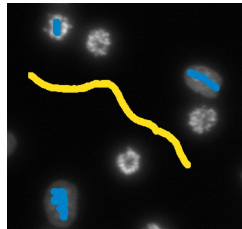
Sigma = 0.7



Sigma = 5

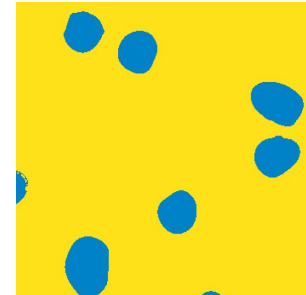


Sigma = 10



Ilastik output:

- Predicted labels based on selected features.
- Prediction probability.



Pixel Classification Background

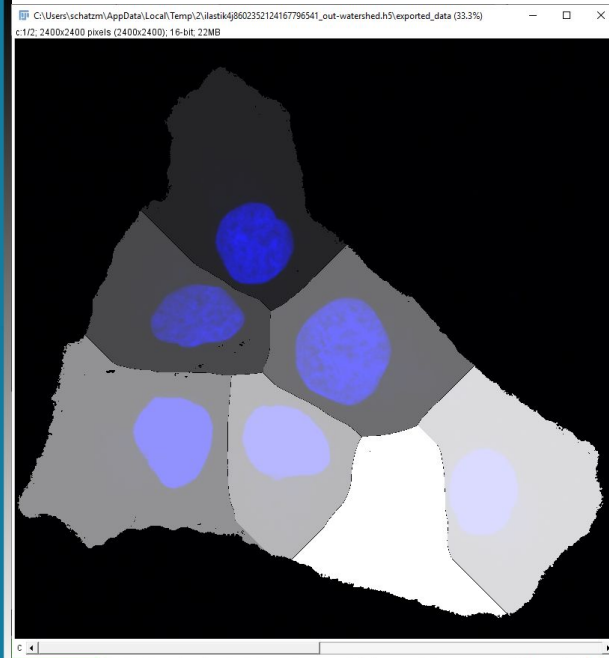
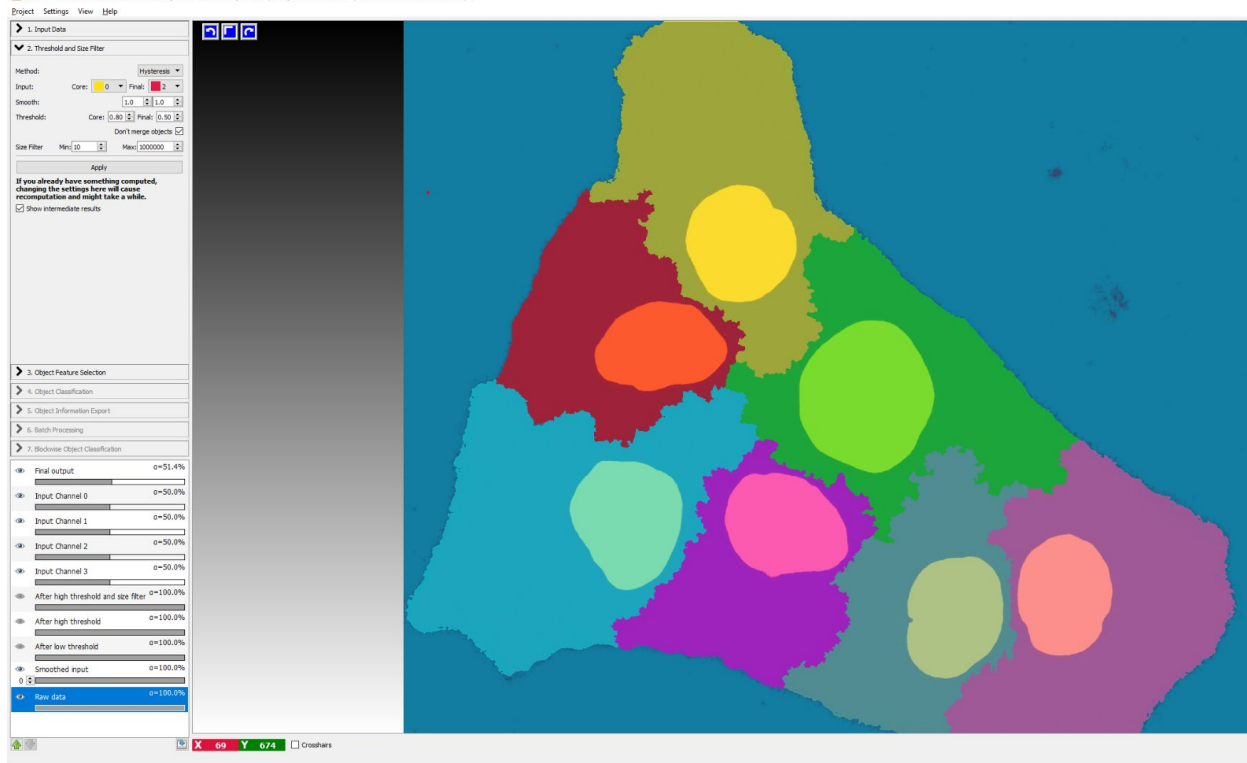
Feature types:

- Color/Intensity: if color or brightness can be used to discern objects
- Edge: if brightness or color gradients can be used to discern objects.
- Texture: if the objects in the image have a special textural appearance.

	σ_0	σ_1	σ_2	σ_3	σ_4	σ_5	σ_6	σ_7
Sigma	0.30	0.70	1.00	1.60	3.50	5.00	10.00	add
► Color/Intensity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
► Edge		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
► Texture		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Pixel Classification Example

File - E:\DATA\SCHATZM\laskb\ch1_ch2_object_hist\ch1_ch2_object_hist.lp - Object Classification [Inputs: Raw Data, Pixel Prediction Map]



Object Classification Background

Goal: From labels and probabilities to object classification.

User input:

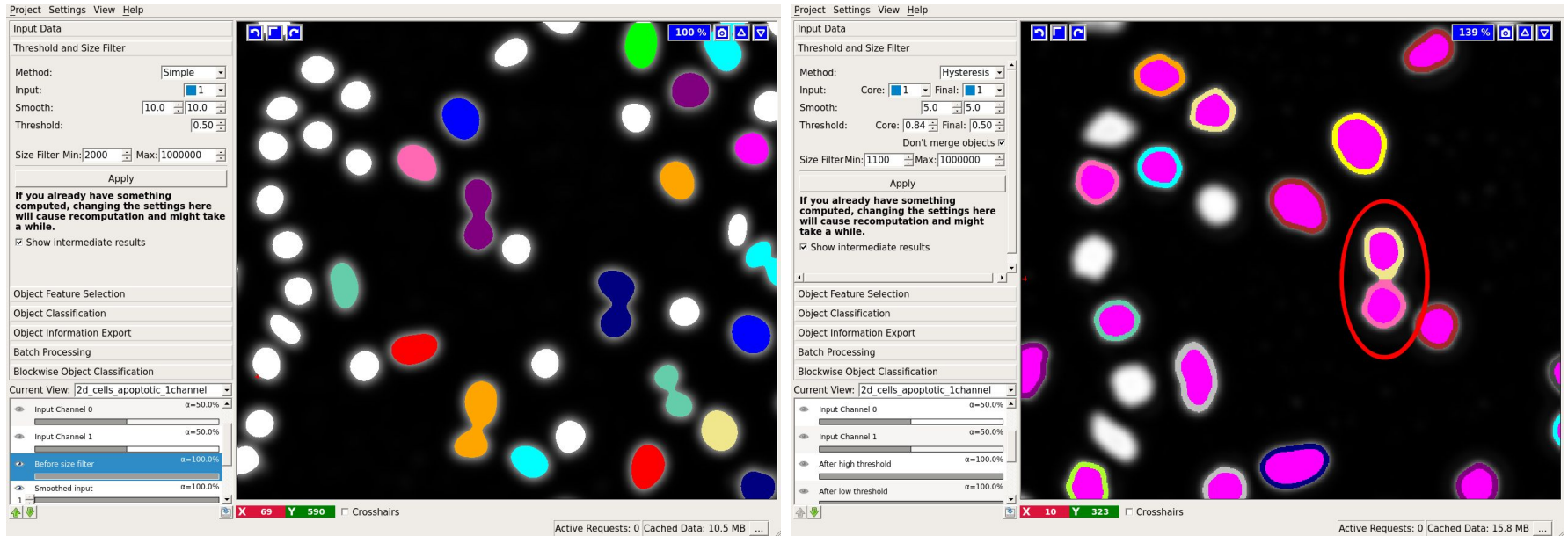
- Trained pixel classification
- Threshold and/or Hysteresis settings
- Object features selection
- Object labels

Ilastik output:

- Object features (values)
- Object classification (labels)
- Object classification and probabilities (images)

Object Classification Background

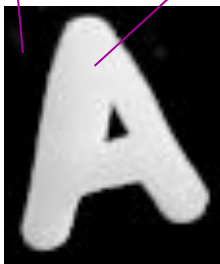
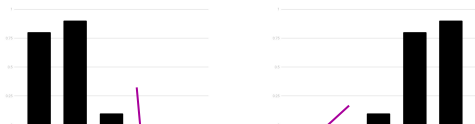
Threshold and Hysteresis



Object Classification Background

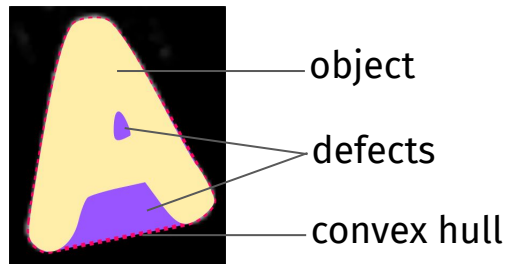
Standard

- Basic shape
- Intensity characteristics
- Location



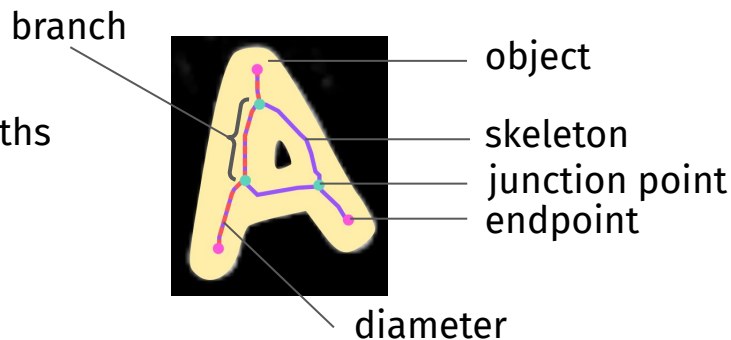
Convex hull

- Areas of hull, object
- Defect characteristics
- Location



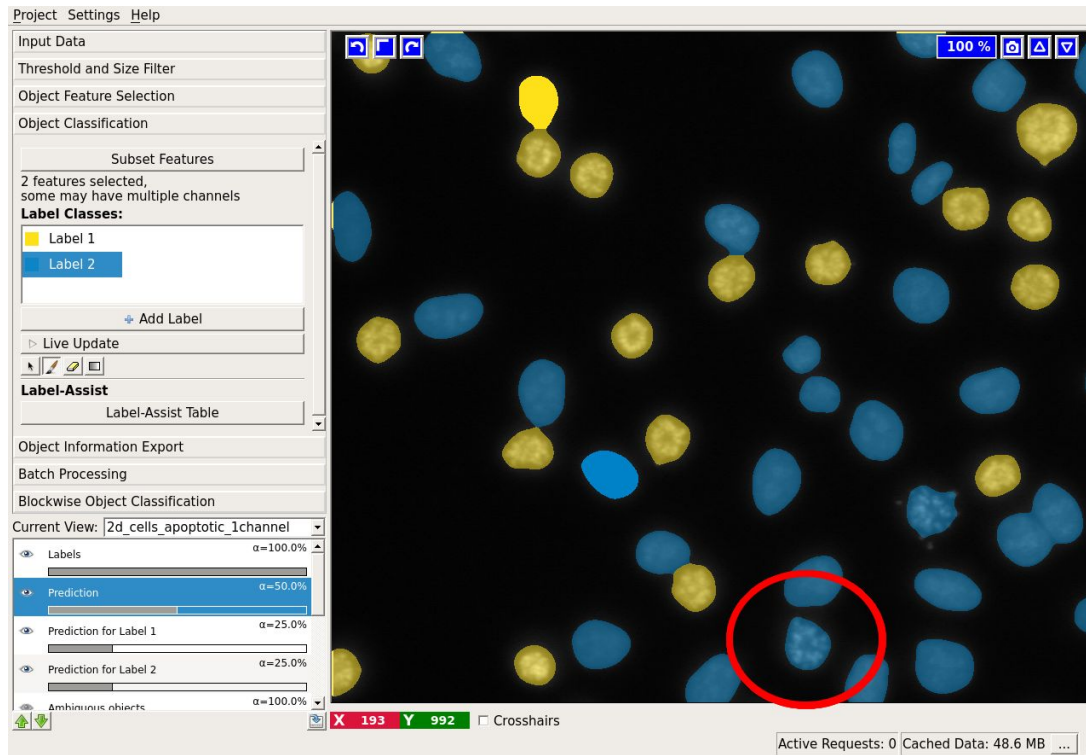
Skeleton

- Branches, lengths
- Cycles
- Location



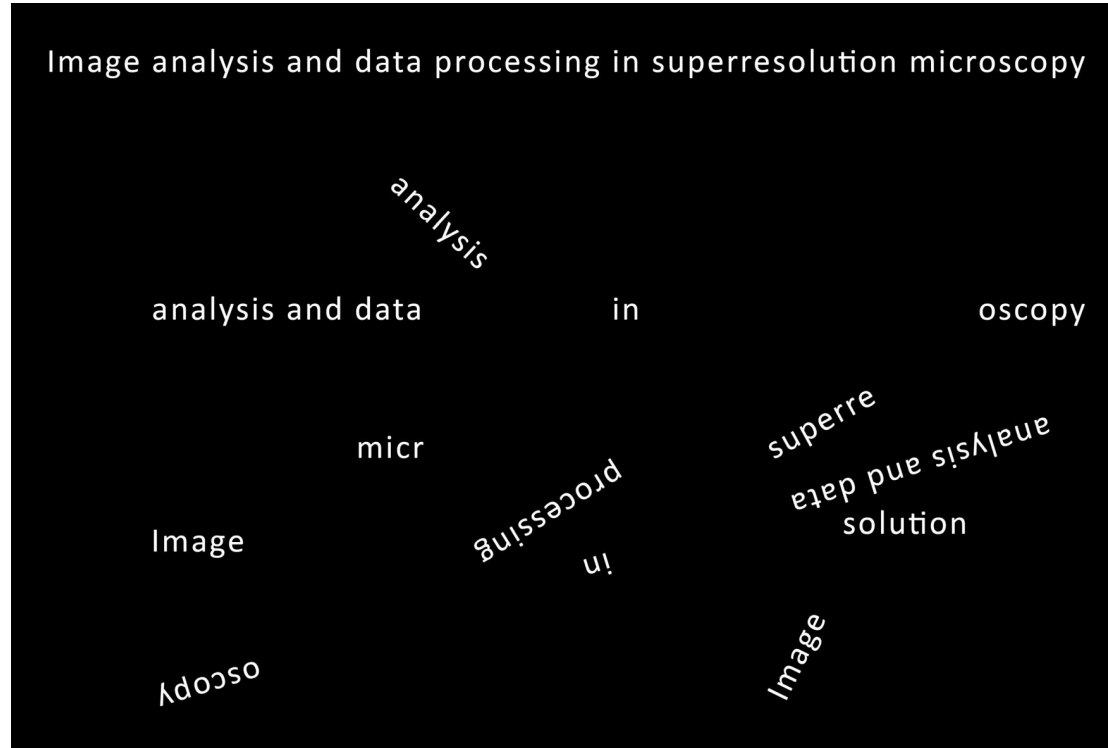
Object Classification Background

- Prediction based on features and user annotation.
- Works with just a few annotated objects.
- Measured object features can be exported to .csv or .h5 file.



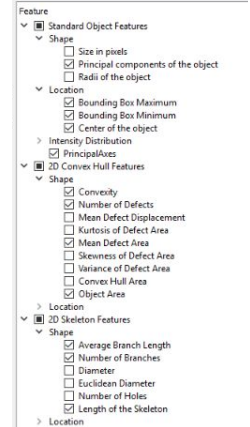
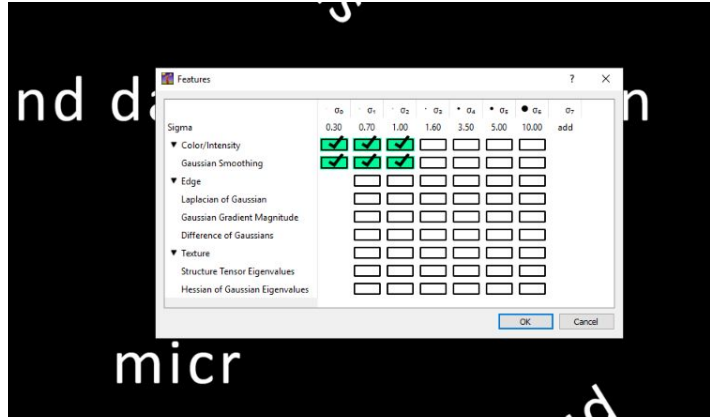
Object Classification Example

Letter classification



Object Classification Example

Letter classification



Hands on

- Getting familiar with Ilastik.
- Try pixel and object classification.
 - Pixel classification on prepared or your own data.
 - Object classification on letters (and downfalls of features).
- Learn about other workflow, documentation and tutorials.

References

- *ilastik: interactive machine learning for (bio)image analysis*, Stuart Berg, Dominik Kutra, Thorben Kroeger, Christoph N. Straehle, Bernhard X. Kausler, Carsten Haubold, Martin Schiegg, Janez Ales, Thorsten Beier, Markus Rudy, Kemal Eren, Jaime I Cervantes, Buote Xu, Fynn Beuttenmueller, Adrian Wolny, Chong Zhang, Ullrich Koethe, Fred A. Hamprecht & Anna Kreshuk in: **Nature Methods**, (2019), DOI: <https://doi.org/10.1038/s41592-019-0582-9>
- Ilastik documentation: <https://www.ilastik.org/documentation/index.html>
- NEUBIAS Academy, Ilastik: <https://www.youtube.com/watch?v= ValtSLeAr0>