

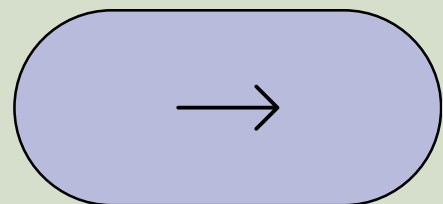
ZUZANNA SMEKTAŁA

# The ImageJ ecosystem

Alexandra B. Schroeder | Ellen T. A. Dobson | Curtis T.  
Rueden | Pavel Tomancak | Florian Jug | Kevin W. Eliceiri

# What is ImageJ?

ImageJ is a widely-used open-source software that allows users to visualize, inspect, quantify, and validate scientific image data



Novel imaging modalities offer enhanced resolution, specificity, and coverage and have contributed to many of the tremendous biological advancements over the past several decades

# Biological studies

- quantifying the proximity of fluorescent-labeled proteins
- tracking cell fates over time

- automating cell counting
- tracking invading cancer cells
- collecting whole-slide information

- quantifying and characterizing cells, such as microglia, within the brain
- registering multiview light sheet fluorescence microscopy datasets to study development

The ImageJ ecosystem lends utility to a **wide range of users** with varying programming expertise

ImageJ ecosystem can be found in freely-accessible GitHub repositories

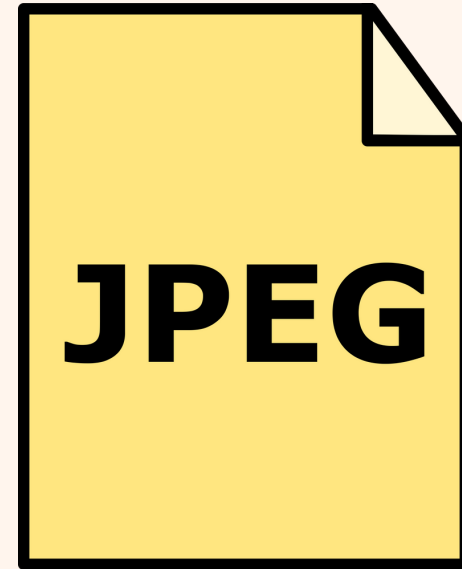
Individuals may modify any particular component of the ImageJ ecosystem

# ImageJ's capabilities

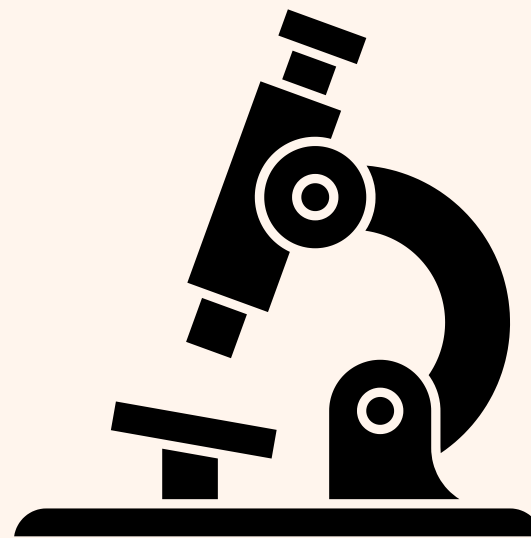
from common tasks such as opening images of various formats, annotating and processing images, and executing simple workflows on images, to advanced projects involving visualizing and analyzing large image data and implementing machine learning algorithms

- Opening and annotating images
- Common image analysis techniques: Segmentation, tracking, and registration
- Scripting and plugins
- Handling big data and specialized plugins for analysis
- Machine learning

# Opening and annotating images



opening images saved in  
a broad variety of file  
formats



images generated by a  
microscope

# Common image analysis techniques

01

## Segmentation

object detection/delineation

02

## Tracking

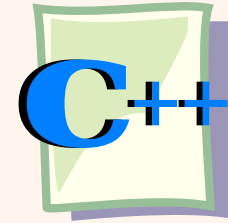
objects or structures of interest are separated from the background signal and tracked frame-to-frame

03

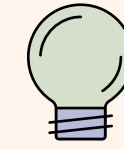
## Registration

data mining images based on morphological features and perform 3D modeling, stitching, registration, and annotation

# Scripting and plugins



JavaScript, Clojure,  
BeanShell, Groovy,  
Python/Jython,  
Ruby/ JRuby, R,  
and Scala



Macro Recorder

The screenshot displays the Fiji software interface with several windows open:

- (a) Recorder:** A window for recording macros. It shows a list of recorded actions for a macro named "Macro.ijm".
- (b) mask (75%):** A window showing a binary mask of the original image, with white regions representing the segmented cells.
- (d) Results:** A table showing the results of the macro execution.
- (e) \*Macro.ijm.ijm:** A window showing the source code of the recorded macro.
- (c) ROI Manager:** A window showing a list of ROIs with their labels and coordinates.

Label	Area	Mean	StdDev	Min	Max	X	Y	Perim.	
1	mask	35.085	255	0	255	255	23.732	9.203	23.081
2	mask	36.456	255	0	255	255	15.346	8.903	23.091
3	mask	34.123	255	0	255	255	7.244	14.475	22.382
4	mask	32.442	255	0	255	255	17.134	21.112	22.066

```
1 run("HeLa Cells (48-bit RGB)");run("Split Channels");
2 run("Gaussian Blur...", "sigma=2");
3 setAutoThreshold("Minimum dark");
4 //run("Threshold...");
5 run("Create Mask");
6 run("Scale Bar...", "width=10 height=5 font=18 color=white background=None location=[Lower Left] bold overlay");
7 run("Fill Holes");
8 run("Analyze Particles...", "size=20-Infinity display exclude clear add");
9
```



# Machine learning in ImageJ

ImageJOpenCV

TensorFlow and ImageJTensorFlow

# Handling big data and specialized plugins for analysis

Fiji's BigDataViewer (BDV)

# CONCLUSIONS

ImageJ has grown from a simple tool to analyze two dimensional images, into a widely utilized platform for modern biological image analysis.

- Adaptable by the users, for the users
- The ImageJ wiki
- Scientific Community Image Forum
- GitHub repositories
- The challenge for the ImageJ ecosystem is to remain relevant
- The way forward will be to continue building bridges to emerging platforms for the benefit of the larger scientific community