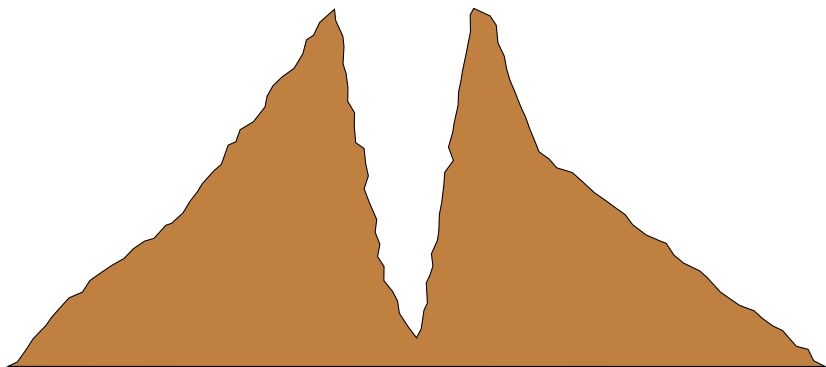
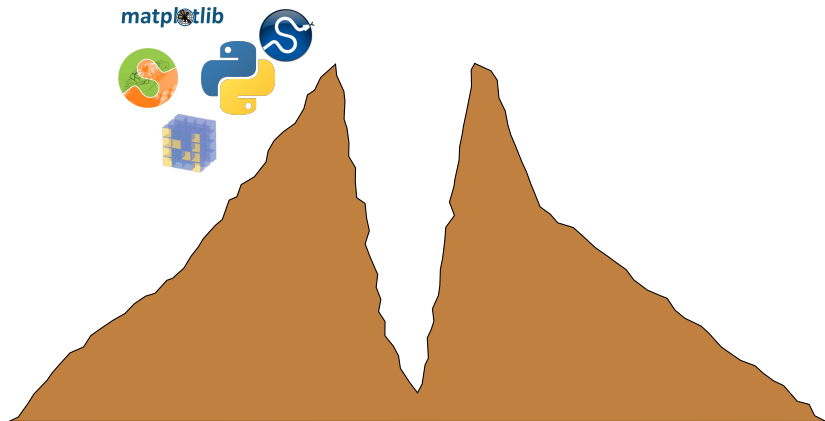


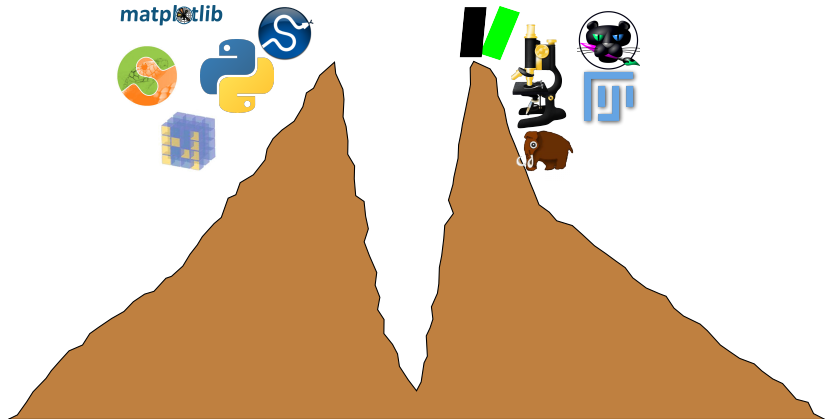
Philipp Hanslovsky

**imglyb**

# Bridging The Chasm Between ImageJ and NumPy







# What is Python?

- ▶ Interpreted language with dynamic typing.
- ▶ Access to native memory.
- ▶ Efficient software through C/C++ extensions.
- ▶ Interactive shell and notebooks.

# What is Java?

- ▶ Statically typed language that compiles into byte code.
- ▶ Byte code is executed within a virtual machine (JVM).
- ▶ No access to native memory through Java language API, but:
  - ▶ Java Native Interface (JNI)
  - ▶ Internal methods of the Java Runtime Environment

# Why are they hard to combine?

- ▶ Native vs JVM
- ▶ Java Array  $\neq$  C-Array

# Ways out of the dilemma

- ▶ Inter-process communication:



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► Python and JVM in the same process:

- ✓ Shared memory possible.
- ✓ Avoids unnecessary copies of data.

# Two options

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- ▶ Java implementation of Python: Jython
  - ✓ Access native CPython extensions through Jython Native Interface
  - ✗ Only Jython 2.7 is available
- ▶ Start Java within a CPython process

# Way out!

- ✓ Start JVM from Python process.  
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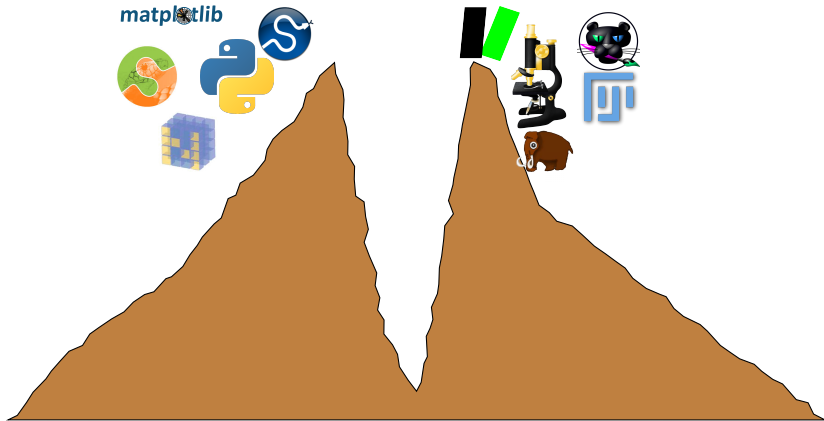
<https://github.com/imglib/imglib2-unsafe>

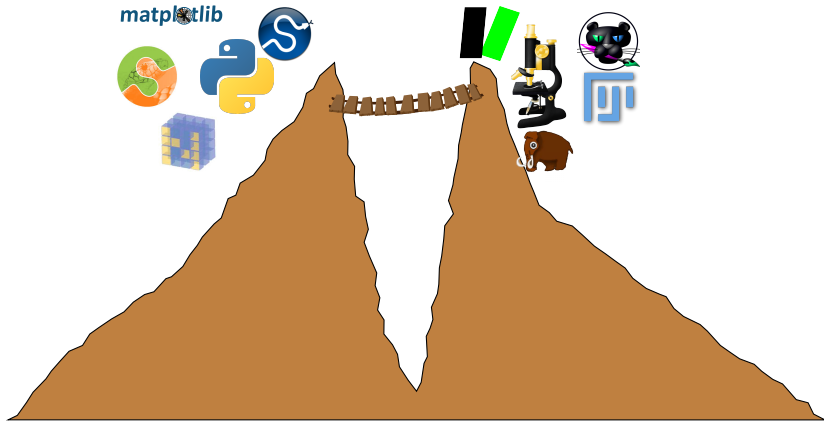
<https://github.com/imglib/imglib2-imglyb>

<https://github.com/imglib/imglyb>

My contribution







# Installation & Usage

- ▶ Install imglyb from conda

```
conda install -c conda-forge imglyb
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- ▶ Notebooks available on

<https://github.com/hanslovsky/imglyb-learnathon>

# How to use?

## Import imglyb

```
# import imglyb before jnius
import imglyb
from imglyb import util
# import from jnius what you need
from jnius import autoclass, cast, PythonJavaClass, java_method
```

# Wrap NumPy arrays in ImgLib2

```
import imglyb
from imglyb import util

import numpy as np

img = np.random.rand( 300, 200, 100 ) * 2**16
wrapped = util.to_imglib( img )
util.BdvFunctions.show( wrapped, "wrapped image" )

rgba = np.random.randint(
    2**32, size = ( 300, 200, 100 ),
    dtype=np.uint32 )
wrapped_rgba = util.to_imglib_argb( rgba )
util.BdvFunctions.show( wrapped_rgba, "wrapped rgba image" )
```

# Examples

Available in the imglyb-examples package:

```
imglyb-examples.bdv-hello-world  
imglyb-examples.bdv-painter  
imglyb-examples.butterfly  
imglyb-examples.qt-awt  
imglyb-examples.views-stack
```

# Known Issues

- ▶ Java awt and Swing require wrapper script on macOS
- ▶ Dask Arrays cannot be wrapped as ImgLib2 data structures yet

# Example 1 — BigDataViewer



T. Pietzsch

BigDataViewer (BDV) is a Java viewer for arbitrarily large multi-view 3D images and 3D image sequences developed by Tobias Pietzsch.

<https://imagej.net/BigDataViewer>

<https://github.com/hanslovsky/imglyb-learnathon/blob/master/notebooks/bdv/show-numpy-array-in-bdv.ipynb>

# Example 2 — BigDataViewer



T. Pietzsch

BigDataViewer (BDV) is a Java viewer for arbitrarily large multi-view 3D images and 3D image sequences developed by Tobias Pietzsch.

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<https://github.com/hanslovsky/imglyb-learnathon/blob/master/notebooks/bdv/write-into-numpy-array-in-bdv.ipynb>

# Example 3 — BigWarp



J. Bogovic

BigWarp is a tool for interactive manual alignment of 2D or 3D images developed by John Bogovic.

<https://imagej.net/BigWarp>

<https://github.com/hanslovsky/imglyb-learnathon/blob/master/notebooks/bigwarp/bigwarp.ipynb>



## Example 4 — Paintera

Paintera is a tool for the efficient generation of dense ground truth annotations and proof-reading 3D EM connectomics with 3D visualization and mesh generation on the fly.

<https://github.com/saalfeldlab/paintera>

<https://github.com/hanslovsky/imglyb-learnathon/blob/master/notebooks/paintera/paintera-mesh-generation-on-the-fly.ipynb>

# Resources



<https://www.python.org>



<https://www.numpy.org>



<https://scipy.org>



<https://scikit-image.org>



<https://matplotlib.org>



<https://imagej.net/ImageJ2>



<https://imagej.net/ImgLib2>



<https://github.com/saalfeldlab/paintera>



<https://fiji.sc/>



<https://imagej.net/MaMuT>



<https://openclipart.org/detail/209218/firebog-bridge>

# Thank You!



Link to Slides

<https://github.com/hanslovsky/scipy-2019>

```
conda install -c conda-forge imglyb  
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```

<https://github.com/imglib/imglib2-unsafe>

<https://github.com/imglib/imglib2-imglyb>

<https://github.com/imglib/imglyb>

<https://github.com/hanslovsky/imglyb-examples>

<https://github.com/hanslovsky/imglyb-learnathon>

<https://github.com/imagej/pyimagej>

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