

ITKWidgets

**Interactive widgets to visualize images, point sets,
and 3D geometry on the web.**

Matt McCormick @ Kitware

March 2nd, 2023

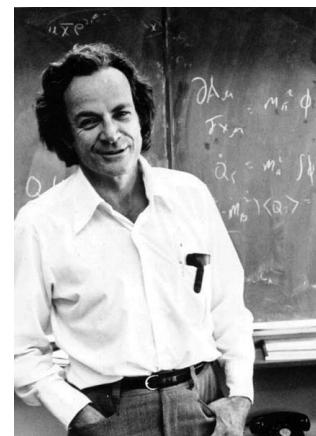
Software Development Panel: Web Visualization Frameworks

Scientific Computing and Imaging Institute, University of Utah

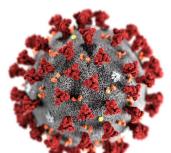
Thank You

- Scientific Computing and Imaging Institute
University of Utah
- National Institute of General Medical Sciences of the
National Institutes of Health: R24 GM136986

Where are our research components located?



Researcher



1



6



2

Image Acquisition System



4

High Performance Computing Cluster



3

Laboratory Workstation

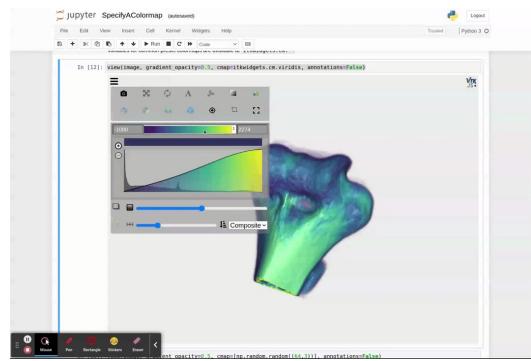
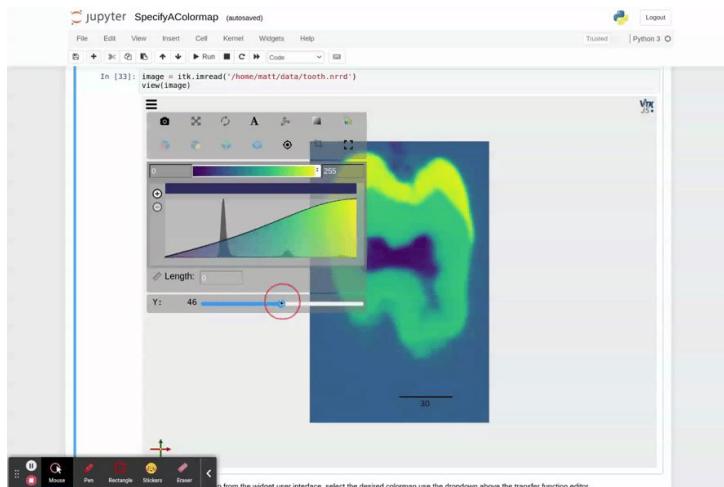
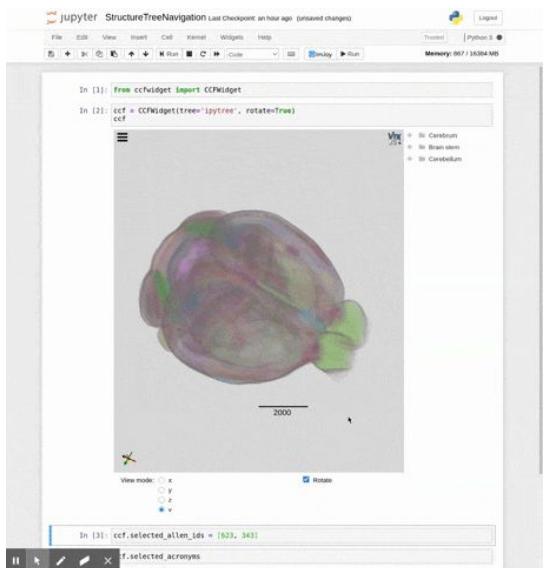


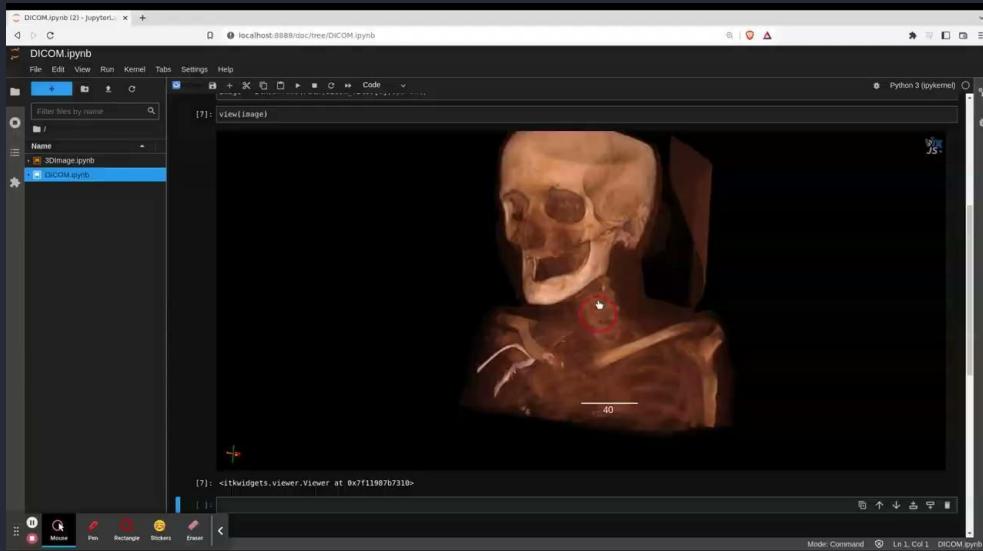
5

Cloud Computing Cluster

What is itkwidgets? (<https://itkwidgets.readthedocs.io/>)

Interactive widgets to visualize images, point sets, and 3D geometry on the web.





itkwidgets

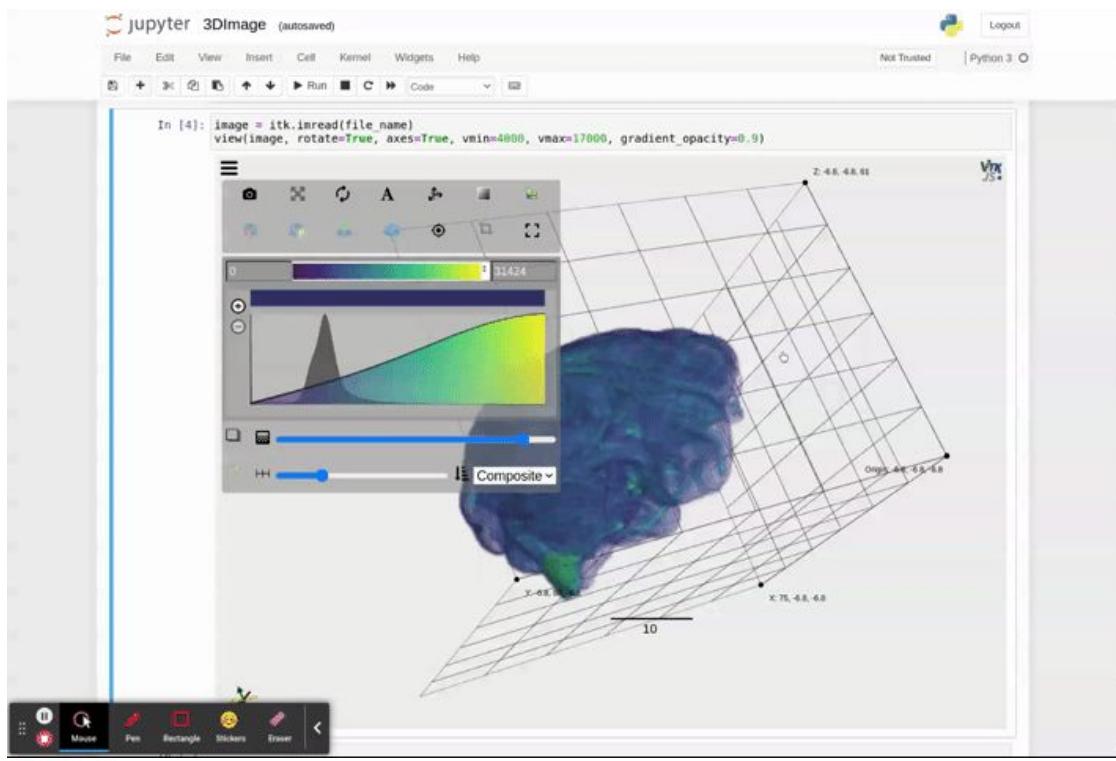
Cinematic Volume Rendering Integrated with your AI Research and Applications

- ◆ Runs in Jupyter, JupyterLab, JupyterLite, Google CoLab, AWS Sagemaker, and Python standalone (WIP)
- ◆ Works with MONAI, PyTorch, TensorFlow, etc.
- ◆ Advanced cinematic volume rendering of medical data
- ◆ Integrated overlay of AI results
- ◆ Open and reproducible

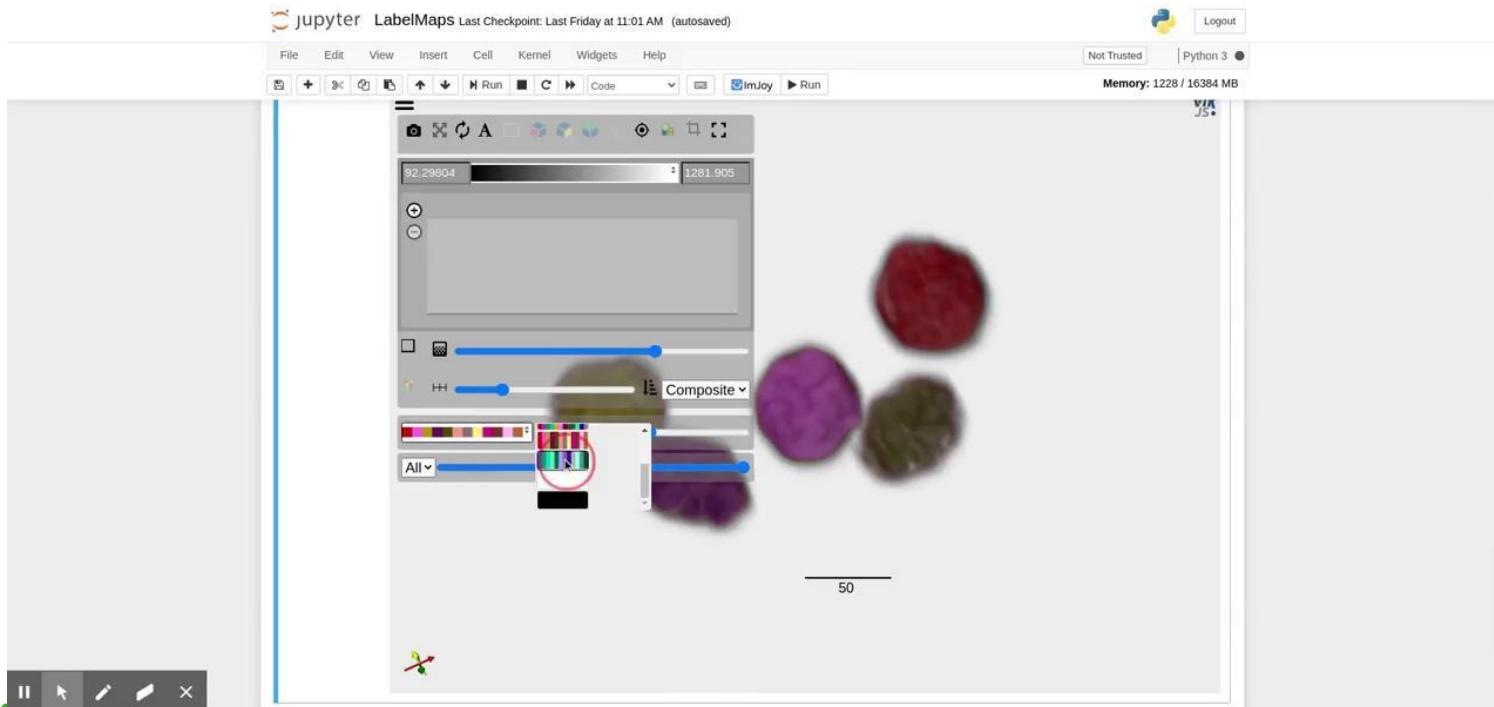
For more information:

<https://itkwidgets.readthedocs.io>

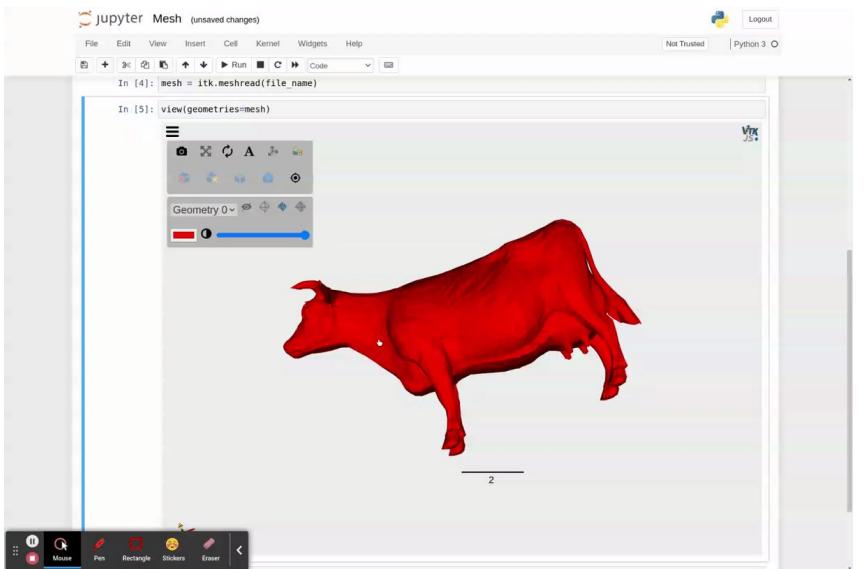
2D and 3D images



Label images



Meshes, geometry



A screenshot of a Jupyter Notebook cell titled "SegmentationSkeleton". The code in the cell is:

```
skelton_csr = skan.csr.Skeleton(skeleton)
```

The output of the cell is a visualization of a white horse silhouette on a black background, with a red skeleton structure overlaid on it, showing the internal bone structure of the animal's body.

Point sets

jupyter NumPyPointSet (unsaved changes)

File Edit View Insert Cell Kernel Widgets Help Trusted Python 2 Logout

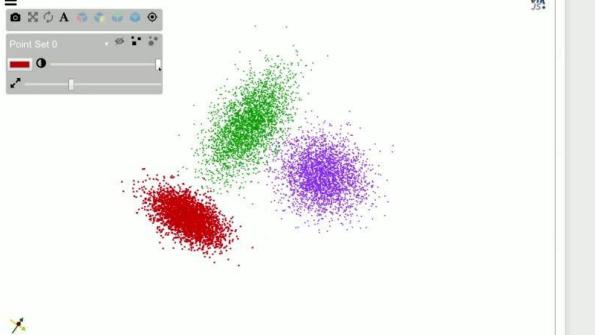
```
In [1]: %import numpy as np
from ipywidgets import view

In [2]: % number_of_points = 3000
gaussian_1_mean = [0.0, 0.0, 0.0]
gaussian_1_cov = [[1.0, 0.0, 0.0], [0.0, 2.0, 0.0], [0.0, 0.0, 0.5]]
point_set_1 = np.random.multivariate_normal(gaussian_1_mean, gaussian_1_cov,
                                            number_of_points)

gaussian_2_mean = [4.0, 0.0, 7.0]
gaussian_2_cov = [[1.0, 0.0, 0.0], [0.0, 2.0, 0.0], [0.0, 0.0, 1.5]]
point_set_2 = np.random.multivariate_normal(gaussian_2_mean, gaussian_2_cov,
                                            number_of_points)

gaussian_3_mean = [4.0, 0.0, 7.0]
gaussian_3_cov = [[1.0, 0.0, 0.0], [0.0, 1.0, 0.0], [0.0, 0.0, 3.5]]
point_set_3 = np.random.multivariate_normal(gaussian_3_mean, gaussian_3_cov,
                                            number_of_points)

In [3]: view(point_sets=[point_set_1, point_set_2, point_set_3])
```



jupyter pvistaLiDAR (autosaved)

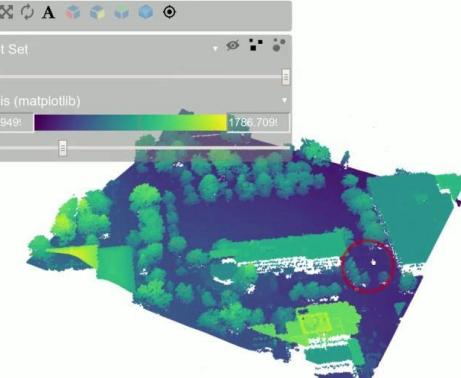
File Edit View Insert Cell Kernel Widgets Help Trusted Python 2 Logout

```
In [2]: % from itkwidgets import view
        point_set = examples.download_lidar()
        point_set
```

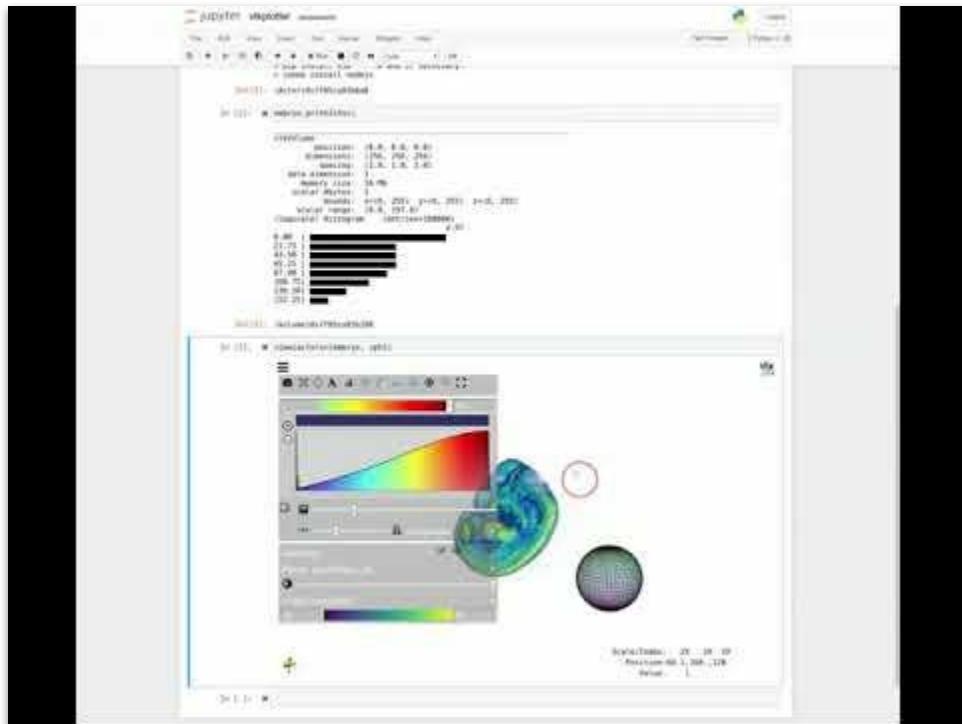
Out[2]:

PolyData	Information
N Cells	3392091
N Points	3392091
X Bounds	4.809e+05, 4.811e+05
Y Bounds	4.400e+06, 4.400e+06
Z Bounds	1.754e+03, 1.787e+03
N Arrays	1

```
In [3]: view(point_sets=point_set)
```



Combine data



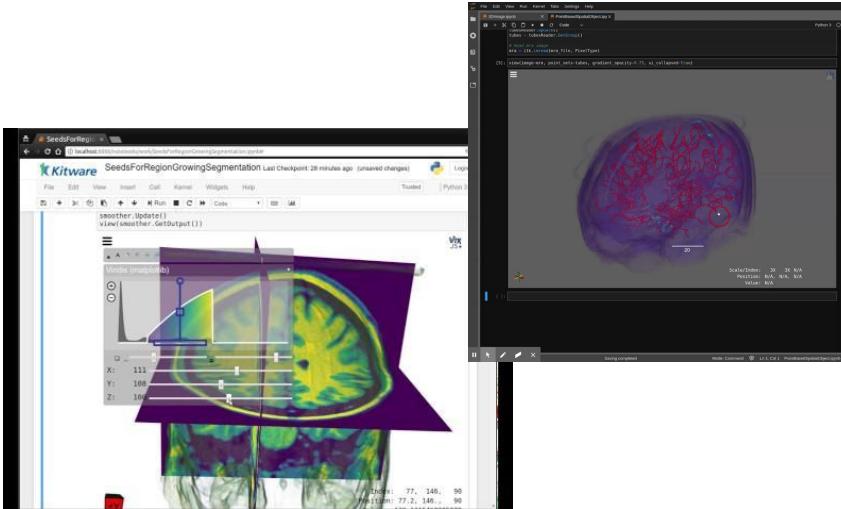
Jupyter Notebook interface showing Python code for reading an MRI file and visualizing it with point-based spatial objects. The code uses `itk.imread` to read the MRI file and `view` to display the image with point sets and tubes. A red circle highlights a point set in the visualization.

```
# Read era image
mra = itk.imread(mra_file, PixelType)

# View image mra, point_sets=tubes, gradient_opacity: 0.75, ui_collapsed:True)
view(image=mra, point_sets=tubes, gradient_opacity: 0.75, ui_collapsed:True)
```

How does it work?

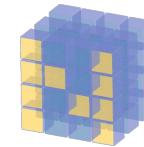
Built on:



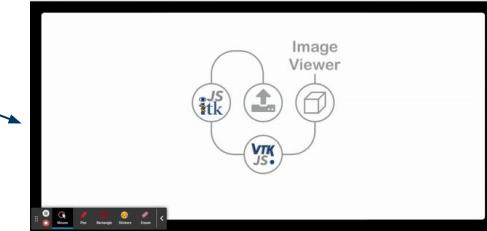
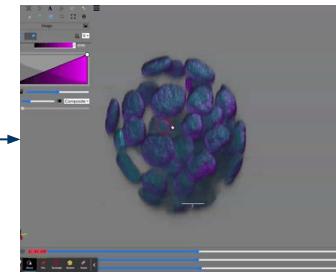
Supports:



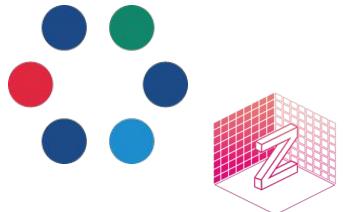
NumPy



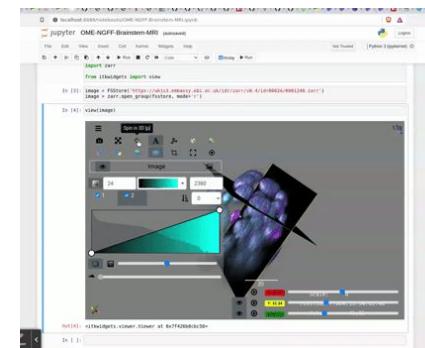
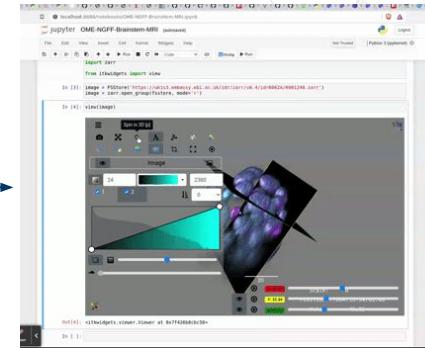
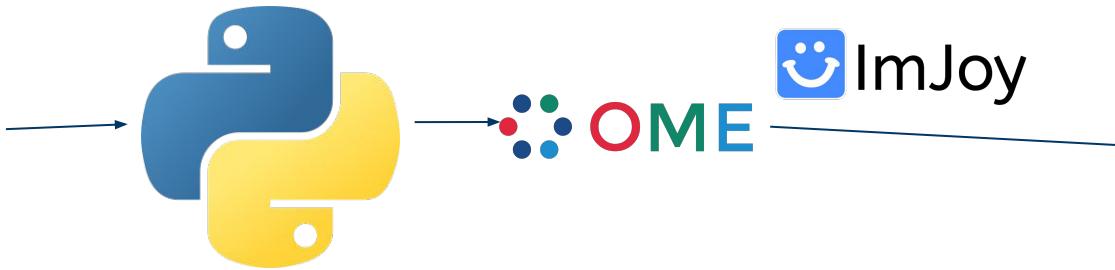
Client-side: Use directly or generate with WebAssembly



Server-side: Use directly or generate with Python

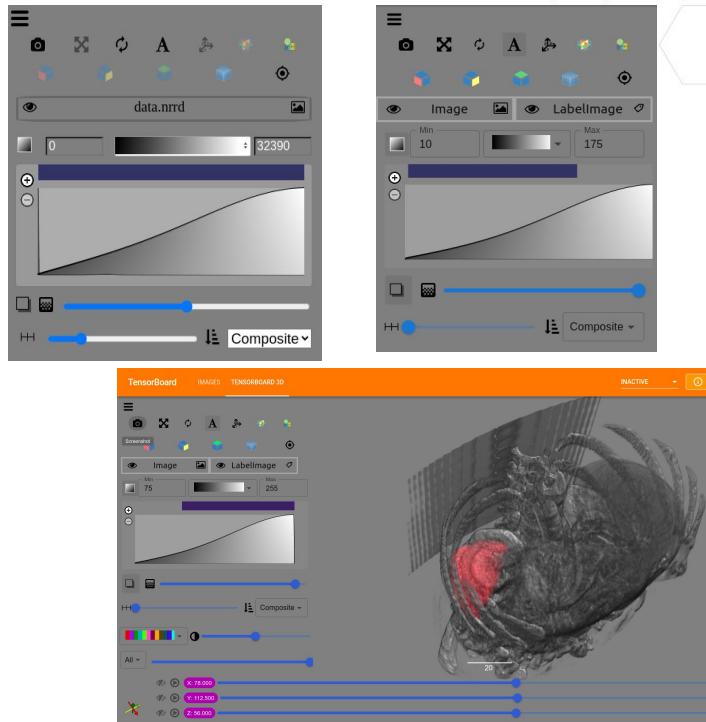


Zarr



A meta-viewer component for custom research applications (alpha)

- Customizable frontends
 - Vanilla HTML, Vue, React, etc.
 - Complete custom UI or only relevant features from examples
- Customizable renderers (WIP)
 - Editor overlays
 - Server side, e.g. 3D Slicer



Open source

- ➊ <https://github.com/InsightSoftwareConsortium/itkwidgets>
- ➋ <https://github.com/InsightSoftwareConsortium/itk-wasm>
- ➌ <https://github.com/Kitware/itk-vtk-viewer>
- ➍ <https://github.com/Kitware/vtk-js>

Reproduce these slides!

- [Brainstem serverless](#)
- [Brainstem Jupyter](#)
- [Load local images](#)

Questions?

Matt McCormick

Thank You

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University of Utah
- National Institute of General Medical Sciences of the
National Institutes of Health: R24 GM136986