

Biological Image Data Analysis with OMERO

University of Cambridge, 2016

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The OME Consortium



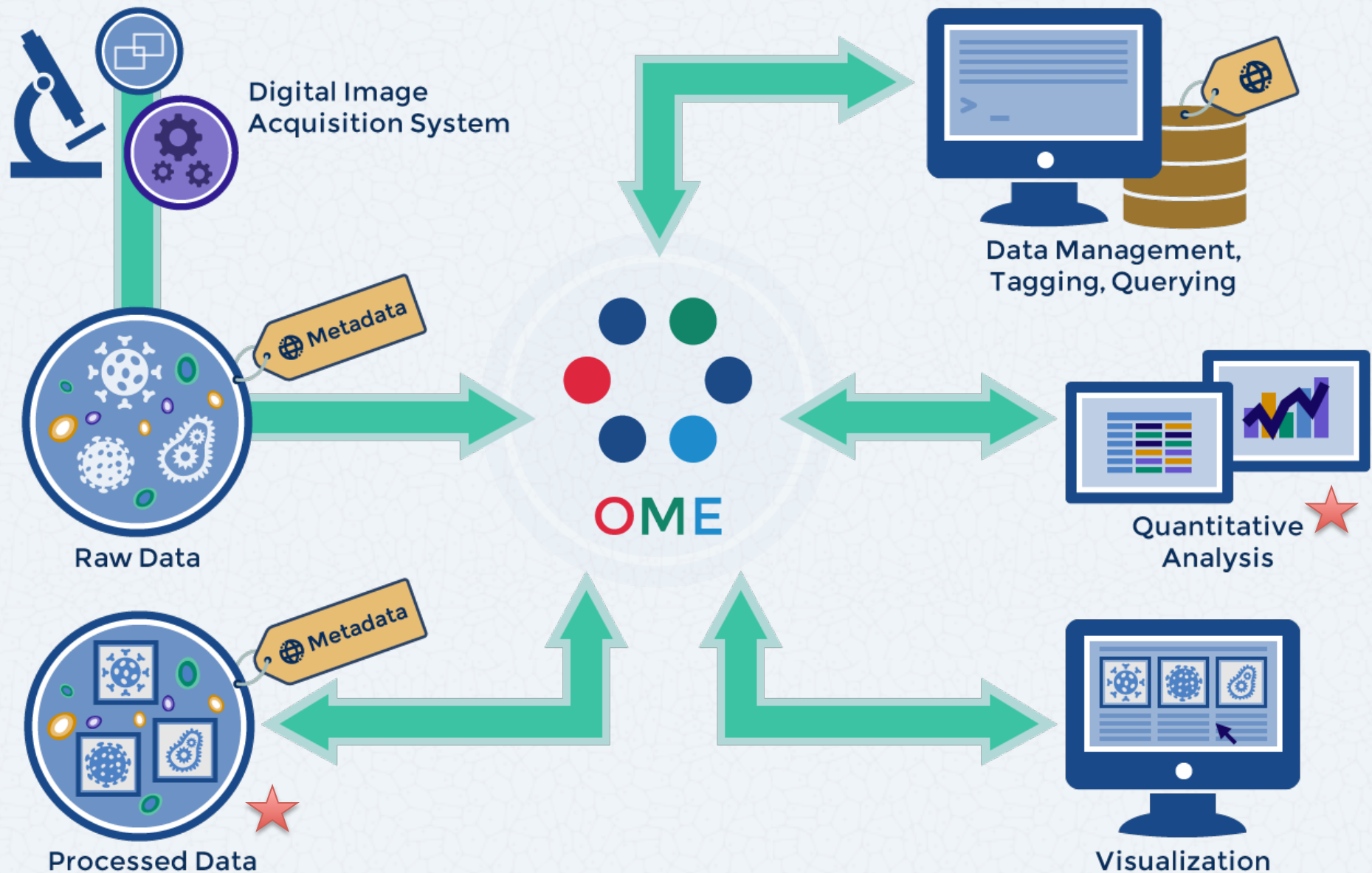
Open Microscopy Environment
Centre for Gene Regulation & Expression
School of Life Sciences, University of Dundee
Dundee, Scotland, UK

Outline

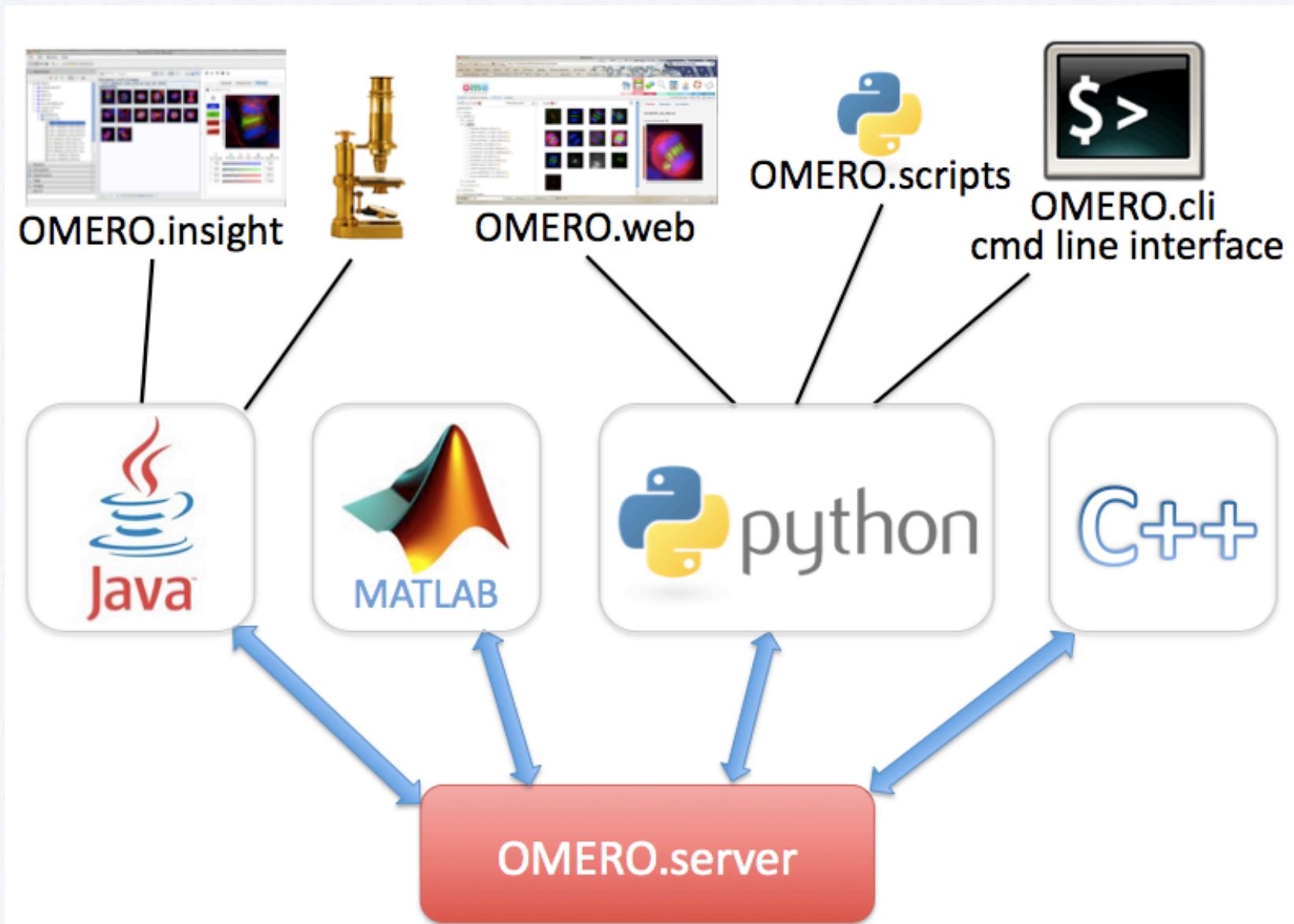


- Towards Image Informatics
- OMERO: Java Server with an open API
- Analysis Integrations To Be Discussed
 - OMERO Scripts
 - OMERO and its open source integrations
 - OMERO and Matlab
- Other Analysis Integrations

...Towards Image Informatics




OMERO : JAVA Server with an open API




Workshop Outline


Analysis Within OMERO



OMERO.scripts



OMERO.Web



python

3rd Party Integrations



Image Processing



Data Processing

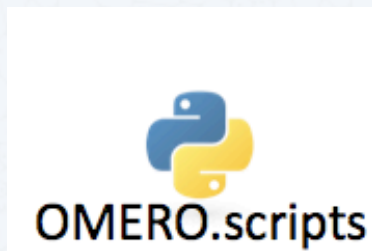


Image and Data Processing



Workshop Outline

Analysis Within OMERO



3rd Party Integrations

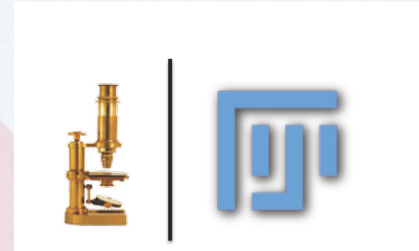


Image Processing



The R logo, a large blue letter 'R' with a grey circular arrow around it.

Data Processing

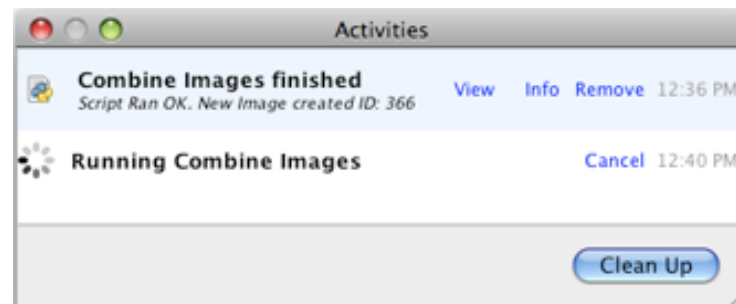
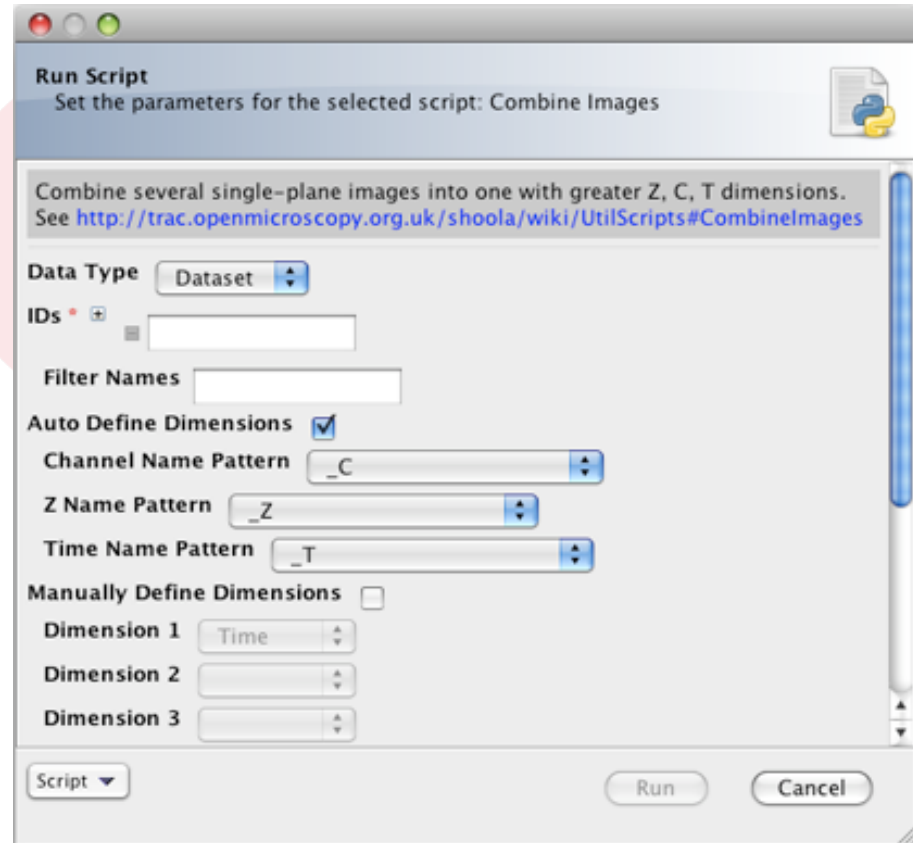
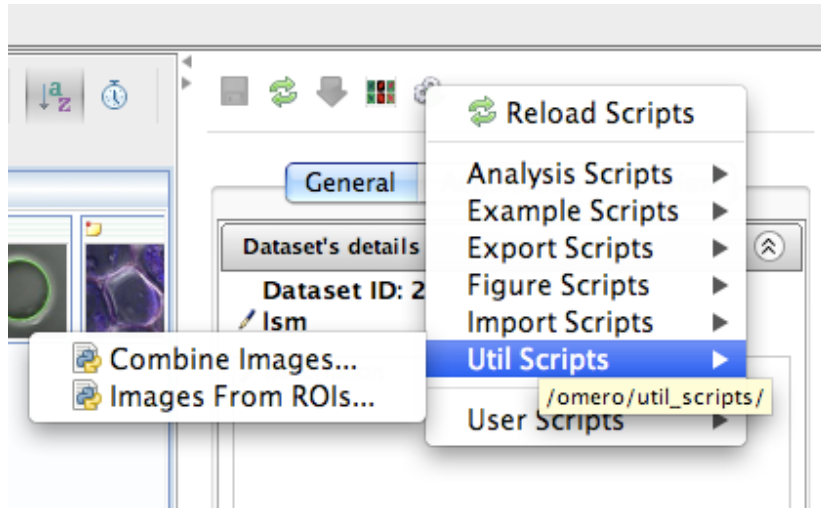


A 3D surface plot with a color gradient from blue to red, showing a peak and a valley.

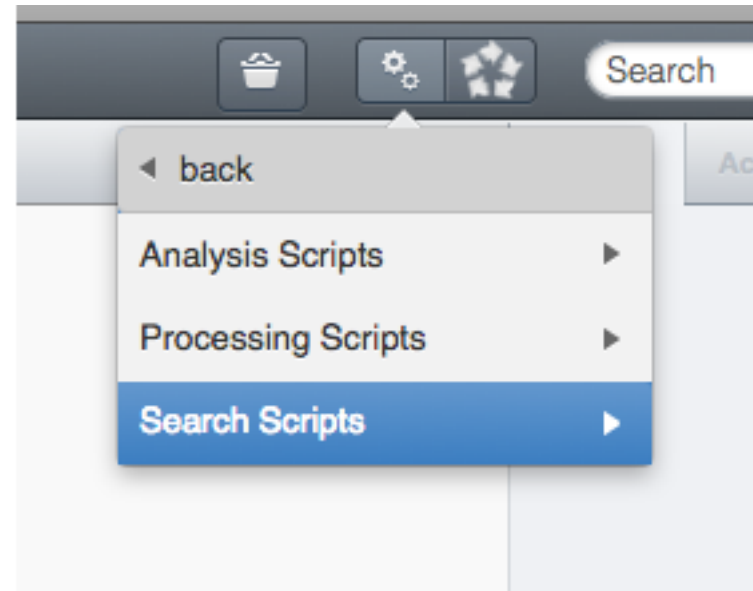
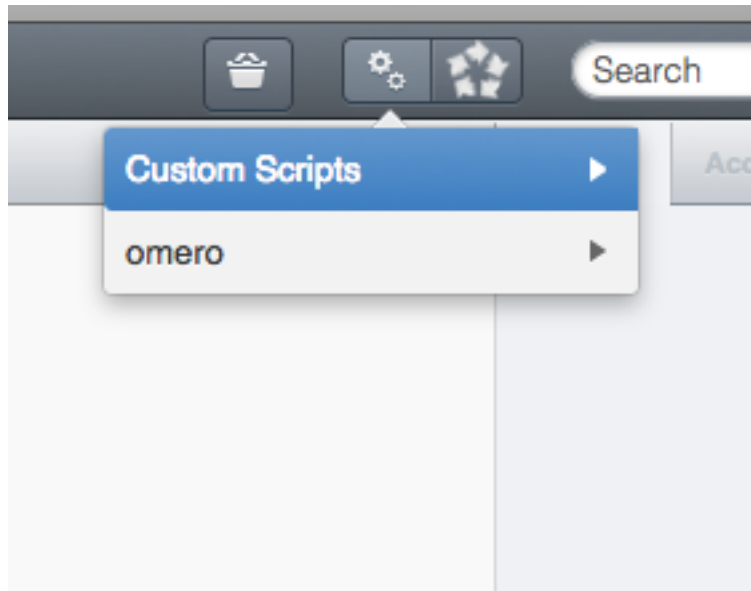
Image and Data Processing



OMERO.Scripts



Custom OMERO.Scripts



<http://www.openmicroscopy.org/site/support/omero5.2/developers/scripts/user-guide.html>

<http://www.openmicroscopy.org/site/support/omero5.2/developers/scripts/style-guide.html>

OMERO.Scripts : Setup

Command-line upload of scripts:

```
$ cd Desktop/scripts/  
$ omero script upload demo_tutorial/Edit_Descriptions.py --official
```

Edit and Replace:

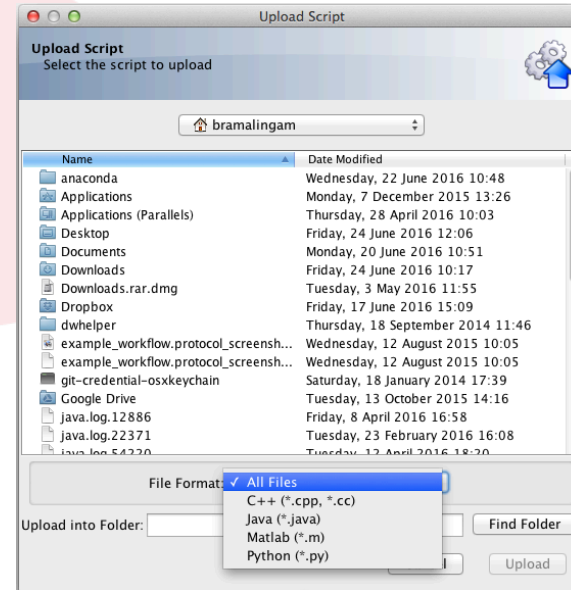
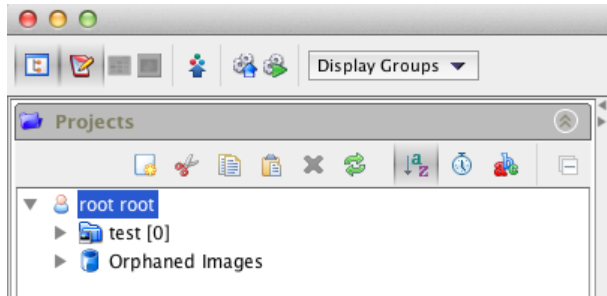
```
$ omero script replace 301 examples/Edit_Descriptions.py
```

Run Script:

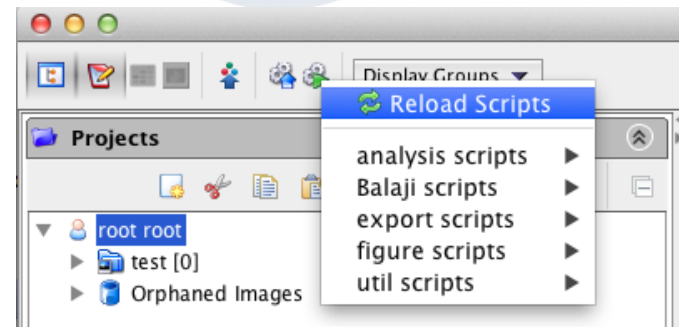
```
wjm:examples will$ omero script launch 301 # script ID  
Using session 1202acc0-4424-4fa2-84fe-7c9e069d3563 (root@localhost:4064). Idle timeout: 10.0 min. Current group: system
```


OMERO.Scripts Setup : Insight

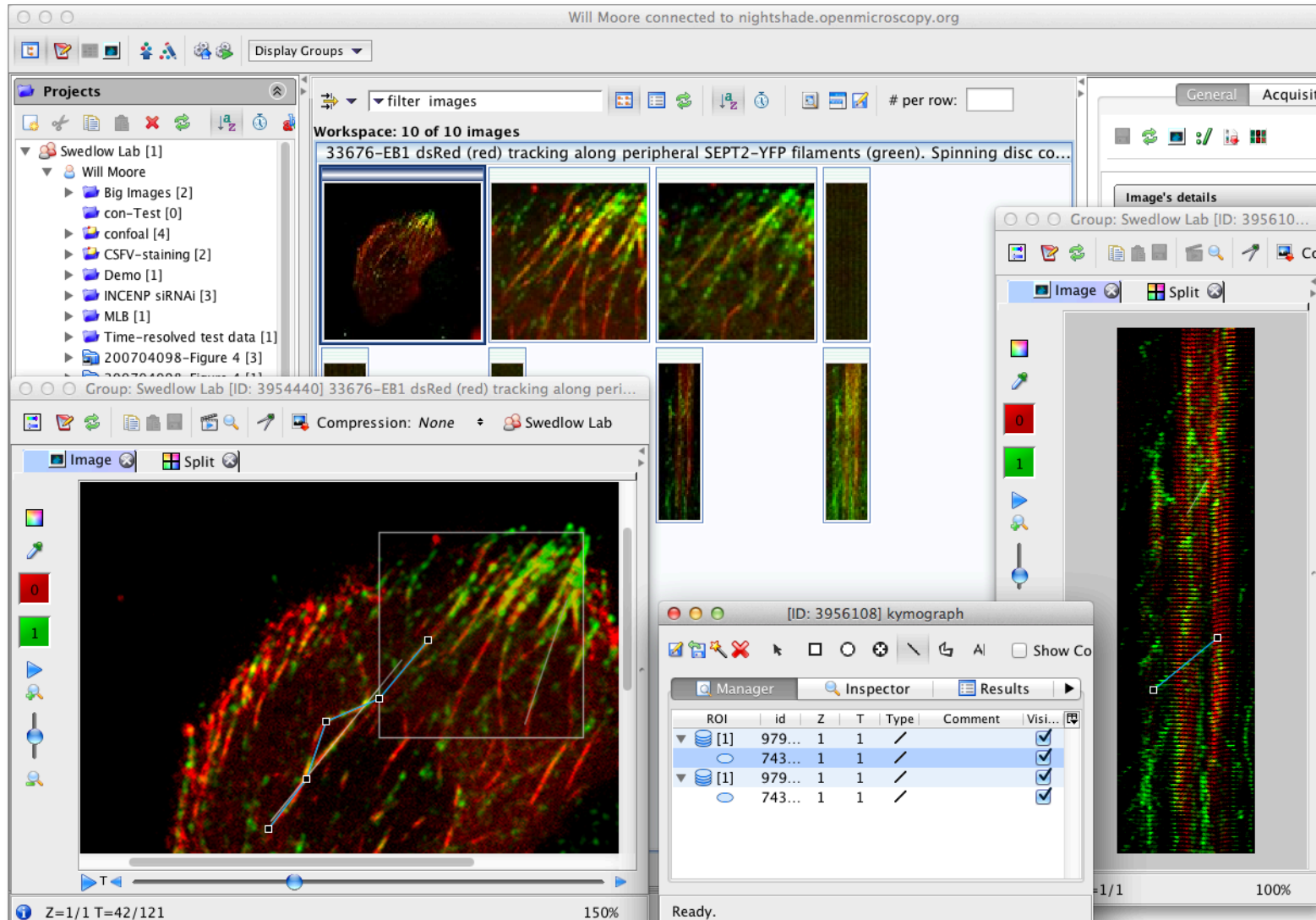
Upload Scripts:



Reload Scripts Menu:



OMERO.scripts: Kymographs example





Lets Try:

- **Plot Profile** : This script processes Images, which have Line or PolyLine ROIs and outputs the data as CSV files, for plotting in e.g. Excel.
- **Batch Image Export** Save multiple images as JPEG, PNG, TIFF or OME-TIFF in a zip file available for download as a batch export. See <http://help.openmicroscopy.org/export.html#batch>
- **Thumbnail Figure: Secret Scripts Menu!!**

Workshop Outline

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python

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Data Processing

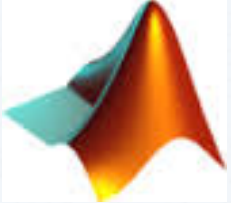

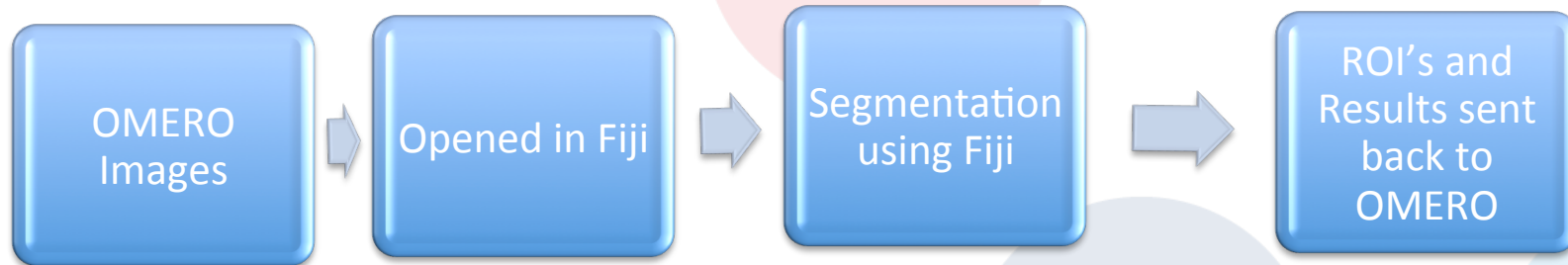


Image and Data Processing

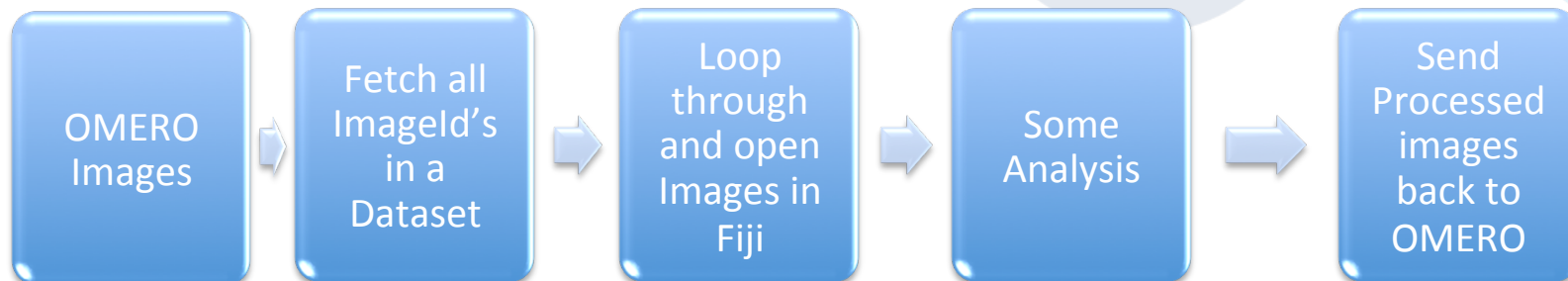


Fiji-OMERO Workflow Outline

- Setup OMEROIJ Plugin
- Manual Workflow:



- Batch Analysis using Fiji scripts:



OMERO IJ Plugin : Setup

Dependency : OMERO IJ Plugin

OMERO 5.2.0 Downloads

[Clients](#) | [Plugins](#) | [Additional](#) | [Servers](#) | [API](#) | [Python](#) | [Java](#) | [Code](#) | [Components](#) | [Previous versions](#)

- Information on this release of OMERO is in the [release announcement](#)
- Full documentation is available as [web documentation](#) or [PDF documentation](#) and there are user guides for the clients on our [Help website](#)
- A standard OMERO user just needs to download the client package with the same major version as their institutional server e.g. 5.0 clients with the 5.0 server
- If you do not have an institutional server, you can apply for an [account on our Demo server](#) or download the [Virtual Appliance](#) to install your own version locally.

OMERO client downloads

Client	Size	File Name	Checksum
Windows	83.02 MB	OMERO.clients-5.1.0-ice35-b101.win.zip	5712f4bc (SHA1)
Mac OS X	82.8 MB	OMERO.clients-5.2.0-ice35-b101.mac_Java7+.zip	8dae773c (SHA1)
Linux	82.67 MB	OMERO.clients-5.2.0-ice35-b101.mac_Java6.zip	5e05fd76 (SHA1)

- OMERO.web is part of the server package, so individual users do not need to install it locally.
- Full instructions for installing the client are on the Help website: [Getting Started with OMERO.insight Version 5.2.0](#)

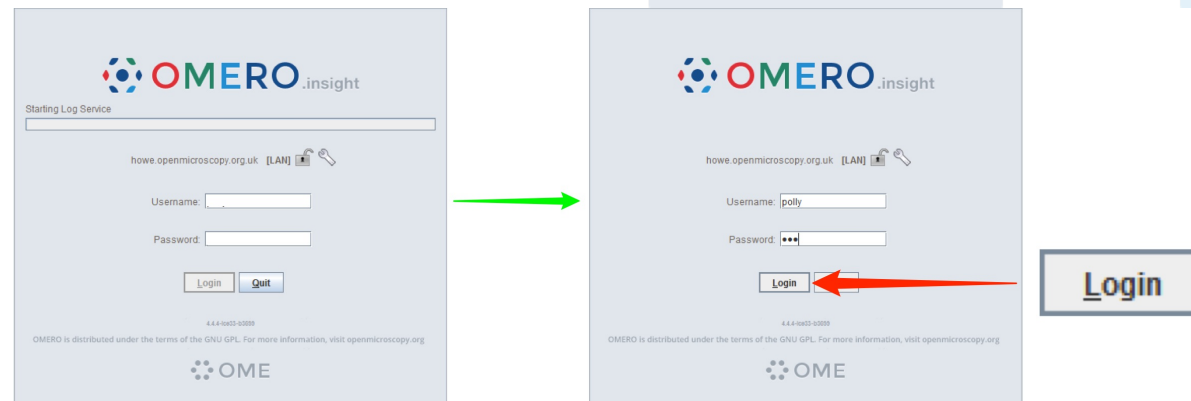
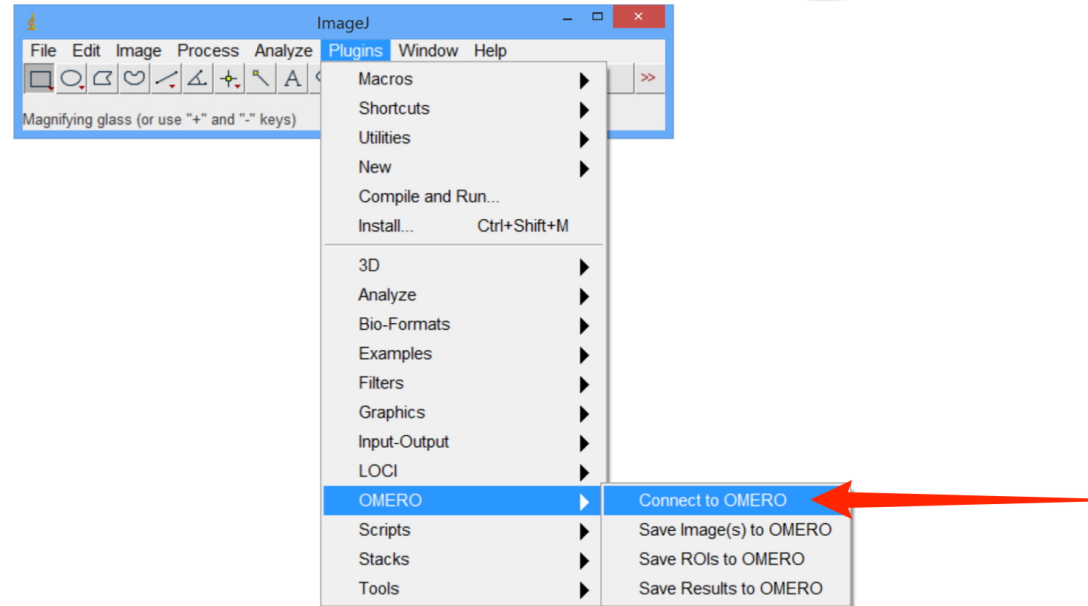
OMERO plugin downloads

Plugins	Size	File Name	Checksum
ImageJ / Fiji	75.28 MB	OMERO.insight—ij-5.2.0-ice35-b101.zip	4ae3f188 (SHA1)
Matlab	21.14 MB	OMERO.matlab-5.1.0-ice35-b101.zip	9f9dfeef (SHA1)

- Instructions for downloading and installing the ImageJ plugin: [Using ImageJ with OMERO](#)

Save or move the .zip archive to the Fiji > plugins folder.

Accessing OMERO using ImageJ and Fiji



ImageJ/Fiji and OMERO



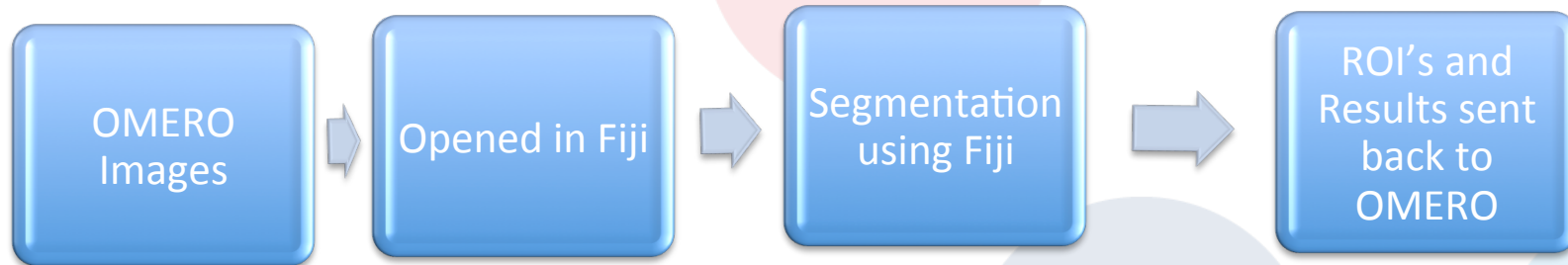
Label	Area	Mean	StdDev	Mode	Min	Max	X	Y
Hoechst_ND - n000001.tif	4.35556E-2	2.30549E3	4.88510E2	2.51500E3	1.51600E3	3.45700E3	1.97412E0	2
Hoechst_ND - n000001.tif	1.21600E-1	3.33402E3	8.96595E2	4.09500E3	1.51600E3	4.09500E3	2.36955E0	2
Hoechst_ND - n000001.tif	3.64444E-2	2.49201E3	5.14563E2	1.71900E3	1.55400E3	3.54300E3	9.42481E0	2



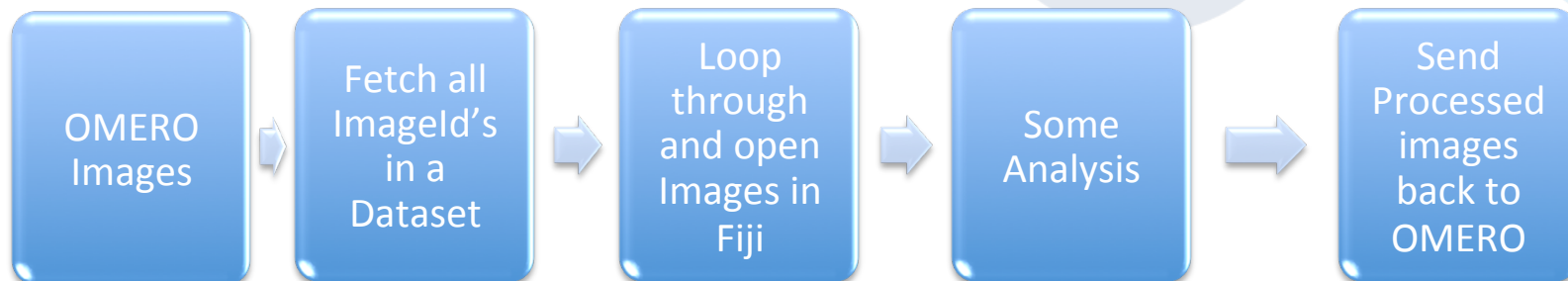
ID	Z	T	Text	Preview	Visibility
6051	0001-0009			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6052	0002-0017			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6053	0003-0011			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6054	0004-0010			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6055	0005-0008			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6056	0006-0016			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6057	0007-0025			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6058	0008-0018			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6059	0009-0023			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6060	0010-0025			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6061	0011-0037			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6062	0012-0033			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6063	0013-0034			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6064	0014-0027			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6065	0015-0030			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6066	0016-0032			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6067	0017-0023			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6068	0018-0037			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6069	0019-0036			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6070	0020-0038			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6071	0021-0042			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6072	0022-0044			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Fiji-OMERO Workflow Outline

- Setup OMEROIJ Plugin
- Manual Workflow:

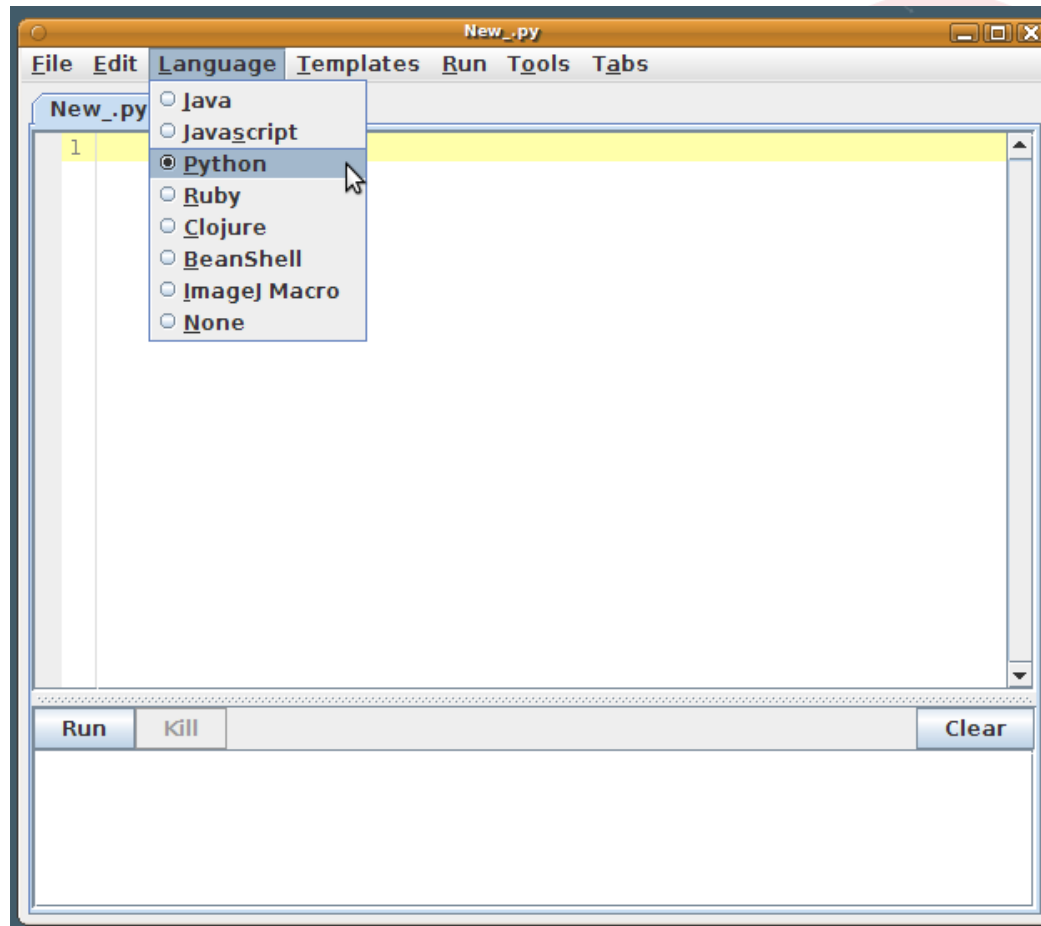


- Batch Analysis using Fiji scripts:

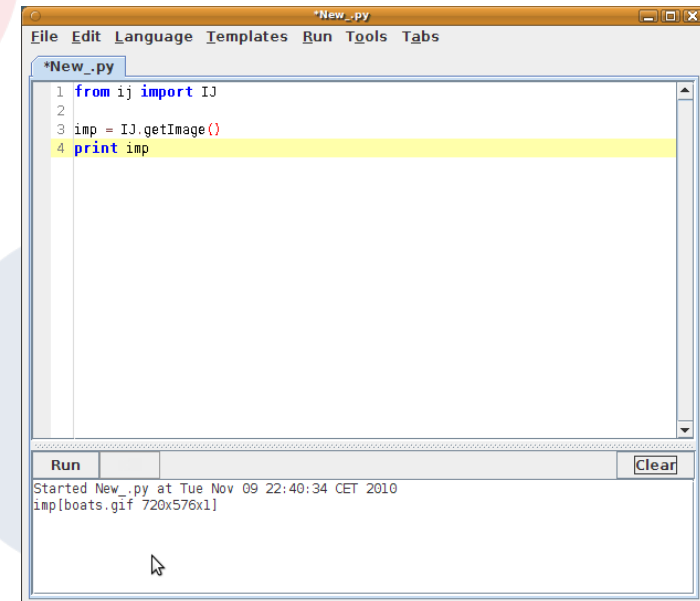


Fiji Scripts

Fiji : Script Editor



Fiji : Grabbing an open Image



OMERO-Fiji Scripts : Accessory Methods

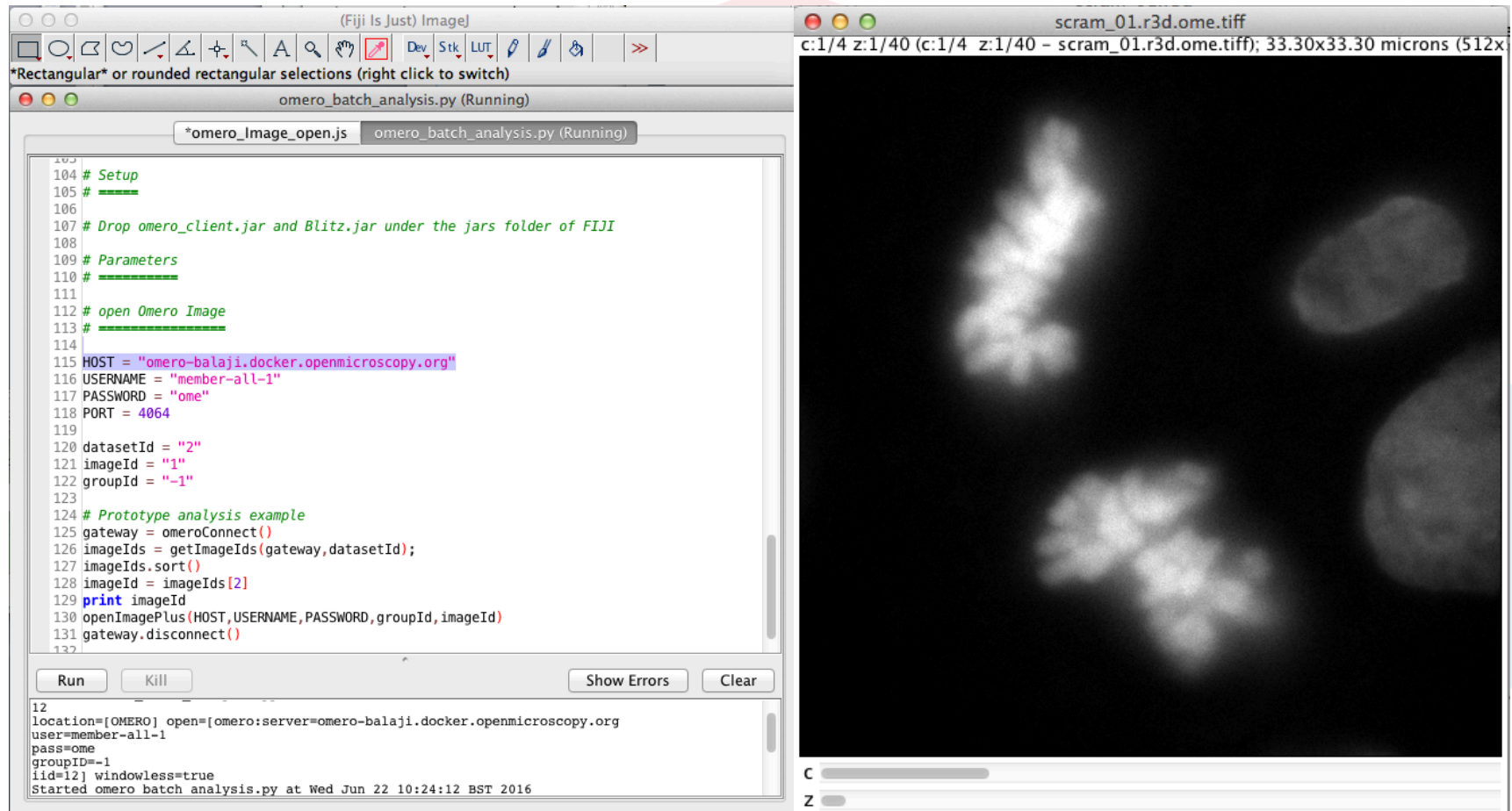
```
def omeroConnect():  
  
    # Omero Connect with credentials and simpleLogger  
    cred = LoginCredentials()  
    cred.getServer().setHostname(HOST)  
    cred.getServer().setPort(PORT)  
    cred.getUser().setUsername(USERNAME)  
    cred.getUser().setPassword(PASSWORD)  
    simpleLogger = SimpleLogger()  
    gateway = Gateway(simpleLogger)  
    gateway.connect(cred)  
    return gateway
```

```
# List all ImageId's under a Project/Dataset  
def getImageIds(gateway, datasetId):  
  
    browse = gateway.getFacility(BrowseFacility)  
    user = gateway.getLoggedInUser()  
    ctx = SecurityContext(user.getGroupId())  
    ids = ArrayList(1)  
    val = Long(datasetId)  
    ids.add(val)  
    images = browse.getImagesForDatasets(ctx, ids)  
    j = images.iterator()  
    imageIds = []  
    while j.hasNext():  
        image = j.next()  
        imageIds.append(String.valueOf(image.getId()))  
    return imageIds
```

https://github.com/bramalingam/Omero-Imagej-Scripts/blob/master/omero_batch_analysis.py

```
def openImagePlus(HOST, USERNAME, PASSWORD, groupId, imageId):  
  
    options = ""  
    options += "location=[OMERO] open=[omero:server=" +  
    options += HOST  
    options += "\nuser=" +  
    options += USERNAME  
    options += "\npass=" +  
    options += PASSWORD  
    options += "\ngroupID=" +  
    options += groupId  
    options += "\niid=" +  
    options += imageId  
    options += "]"  
    options += " windowless=true "  
  
    print options  
    from ij import IJ  
  
    IJ.runPlugIn("loci.plugins.LociImporter", options);  
  
def uploadImage(path, gateway):  
  
    user = gateway.getLoggedInUser()  
    ctx = SecurityContext(user.getGroupId())  
    sessionKey = gateway.getSessionId(user)  
  
    config = ImportConfig()  
  
    config.email.set("")  
    config.sendFiles.set('true')  
    config.sendReport.set('false')  
    config.contOnError.set('false')  
    config.debug.set('false')  
    config.hostname.set(HOST)  
    config.sessionKey.set(sessionKey)  
    config.targetClass.set("omero.model.Dataset")  
    config.targetId.set(datasetId)  
  
    loci.common.DebugTools.enableLogging("DEBUG")  
  
    store = config.createStore()  
    reader = OMEROWrapper(config)  
  
    library = ImportLibrary(store, reader)  
    errorHandler = ErrorHandler(config)  
  
    library.addObserver(LoggingImportMonitor())  
    candidates = ImportCandidates (reader, path, errorHandler)  
    reader.setMetadataOptions(DefaultMetadataOptions(MetadataLevel.ALL))  
    success = library.importCandidates(config, candidates)  
    return success
```

Fiji Scripts : Client Side (DEMO)



https://github.com/bramalingam/Omero-Imagej-Scripts/blob/master/omero_batch_analysis.py

Lets Try

- Run a Macro on the Image
- Export Image using Bio-Formats (locally)
- Upload Image back to OMERO

- Cheat Code:

https://github.com/bramalingam/Omero-Imagej-Scripts/blob/master/omero_batch_analysis.py

Run a Macro and Save Image Locally

Run a Macro File:

```
#Plug Your analysis here#  
macroFilePath = "/Users/bramalingam/Desktop/bg_subtract.ijm"  
IJ.runMacroFile(macroFilePath)
```

Save Processed Image (Locally):

```
# Save resultant image using Bio-Formats  
paths= "/Users/bramalingam/Desktop/"  
imp = IJ.getImage();  
path = paths + imp.getTitle() + ".ome.tiff";  
print(path)  
options = "save=" + path + " export compression=Uncompressed"  
IJ.run(imp, "Bio-Formats Exporter", options);  
imp.changes = False  
imp.close()
```


https://github.com/bramalingam/Omero-Imagej-Scripts/blob/master/omero_batch_analysis.py

Upload Image (Back) to OMERO


```
# Upload image to OMERO
str2d = java.lang.reflect.Array.newInstance(java.lang.String, [1])
str2d [0] = path
success = uploadImage(str2d, gateway)
```


Workshop Outline


Analysis Within OMERO



OMERO.scripts



OMERO.web



python

3rd Party Integrations

OMERO.insight



Image Processing



Data Processing

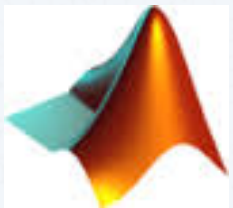



Image and Data Processing



rOMERO-Setup

README.md

rOMERO

This repository provides some examples for how to connect to OMERO in R (using rJava and the OMERO Java Gateway)

Prerequisites

- [R](#)
- [Java](#)
- [rJava](#)
- [Apache Maven](#) (recommended)
- [Git](#) (recommended)

Setup

- Install/Setup the software mentioned above
- Download this repository:
 - Using Git: `git clone https://github.com/dominikl/rOMERO.git`
 - *Alternative:* Download as Zip and extract.
- `cd` into the `rOMERO` directory
- Download the dependencies
 - Using Maven: Run `mvn install`
 - *Alternative:* Create `lib` directory. Download [OMERO.Insight client](#). Extract the zip file. Copy all files within `libs` directory into the previously created `rOMERO/lib` directory

<https://github.com/dominikl/rOMERO/tree/master>

rOMERO

```
ls29010:CellProfiler bramalingam$ cd ..  
ls29010:OME bramalingam$ cd rOMERO/  
ls29010:rOMERO bramalingam$ sudo R  
Password:
```



```
R version 3.3.1 (2016-06-21) -- "Bug in Your Hair"  
Copyright (C) 2016 The R Foundation for Statistical Computing  
Platform: x86_64-apple-darwin13.4.0 (64-bit)
```

```
R is free software and comes with ABSOLUTELY NO WARRANTY.  
You are welcome to redistribute it under certain conditions.  
Type 'license()' or 'licence()' for distribution details.
```

```
  Natural language support but running in an English locale
```

```
R is a collaborative project with many contributors.  
Type 'contributors()' for more information and  
'citation()' on how to cite R or R packages in publications.
```

```
Type 'demo()' for some demos, 'help()' for on-line help, or  
'help.start()' for an HTML browser interface to help.  
Type 'q()' to quit R.
```

```
*** Welcome to rOMERO ***
```

rOMERO-Example

dominikl / rOMERO

Watch 2 Star 0 Fork 1

Code Issues 1 Pull requests 0 Pulse Graphs

Branch: master rOMERO / examples / Create new file Find file History

dominikl Removed dev_5_3 example Latest commit d76f5ca 5 days ago

..

loadCSV.R Added attachFile method 6 days ago

Tags

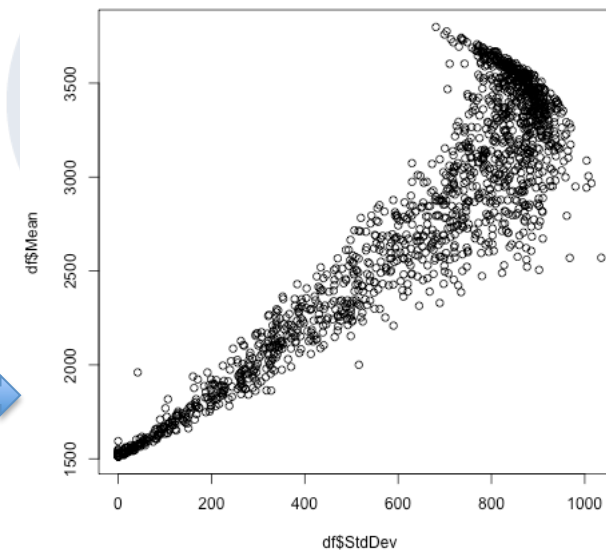
Key-Value Pairs

Attachments

ImageJ-Hoechst_ND - n000001-Results-2016-06-30.csv (502.15 KB)

demoCambridge.png (62.58 KB)


Ratings




<https://github.com/dominikl/rOMERO/tree/master>

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python

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OMERO.insight



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Data Processing







Image and Data Processing

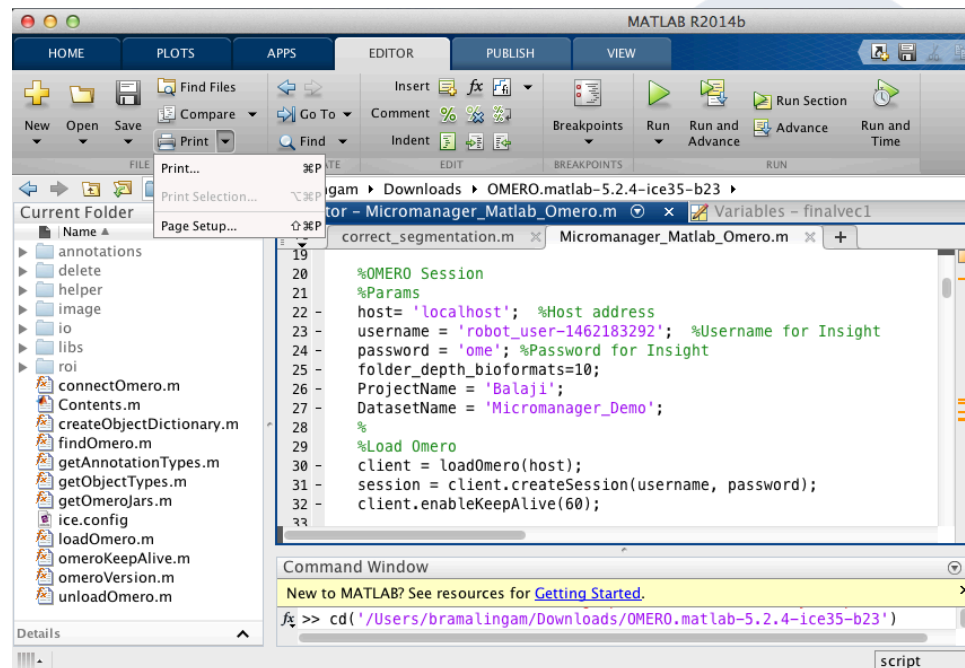


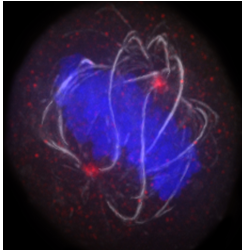
OMERO Matlab Toolbox

OMERO plugin downloads

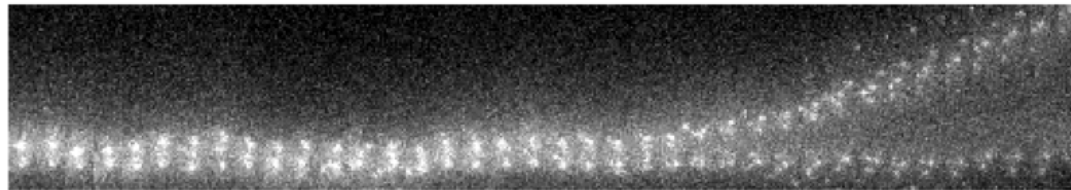
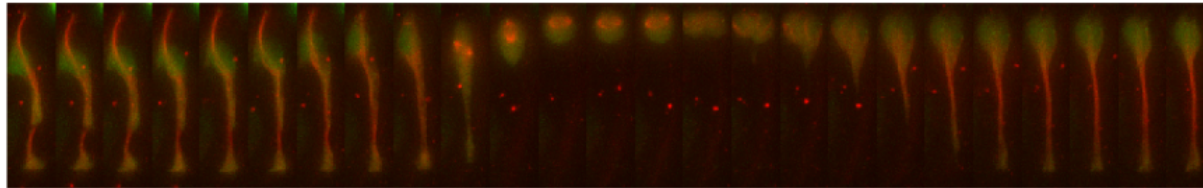
Plugin	Size	File Name	Checksum
 ImageJ / Fiji 	76.55 MB	OMERO.insight-ij-5.2.4-ice35-b23.zip	f4d64020 (SHA1)
 Matlab 	21.21 MB	OMERO.matlab-5.2.4-ice35-b23.zip	0035cbc2 (SHA1)

- Instructions for downloading and installing the ImageJ plugin: [Using ImageJ with OMERO](#)
- Instructions for using the Matlab plugin are at: [OMERO Matlab language bindings](#)





OMERO.mtools: Matlab-based analysis



objectSelector

617 Z: 2

617 Z: 6

1. Choose channels to measure.
2. Click on the object in the top window that you want to measure from.
3. Click on the object in the bottom window that you want to measure to.
4. Click the "Accept" button.

Accept

T = 1

Z = 3

Interphase, Prophase, Prometaphase

Analysis Integrations (Not Discussed here):

- FLIMfit– fluorescence lifetime fitting (Matlab)
- uTrack– Globally optimised object tracking (Matlab)
- ThunderSTORM and PALMSiever– Localisation SRM (ImageJ, Matlab)
- OMERO-ICY plugin. (Java)
- **OMERO-CellProfiler (Python)**
- WND-CHRM-- weighted nearest neighbor machine learning (Python)
- OMERO2CV– LSFM Multi-View Reconstruction (C++, OpenCV, ITK)
- Coumbus Acapella®-- commercial Big Data processing...

OMERO and Cell Profiler

The screenshot displays the CellProfiler 2.1.0 (rev a81ab47) software interface. The main window is divided into several sections:

- Pipeline:** Shows a list of modules. Under "Input modules", "Images", "Metadata", "NamesAndTypes", and "Groups" are listed with checkmarks. "Metadata" is currently selected. Under "Analysis modules", "Smooth" is listed with a checkmark.
- Module notes:** A text area containing information about the Metadata module: "The Metadata module optionally allows you to extract information describing your images (i.e, metadata) which will be stored along with your measurements. This information can be contained in the file name and/or location, or in an external file."
- Module settings:** Configuration options for the Metadata module:
 - Extract metadata?: Yes No
 - Metadata extraction method: Extract from image file headers
 - Extract metadata from: All images
 - Buttons: Update metadata, Add another extraction method
- Table:** A table with 11 columns: Update, Path / URL, Series, Frame, ChannelName, ColorFormat, SizeC, SizeT, SizeZ, Z. It contains 14 rows of data for image analysis.
- Output:** A section with a "View output settings" button.
- Bottom Panel:** Includes "Adjust modules" controls (+, -, ^, v), "Start Test Mode", and "Analyze Images" buttons.

An inset window titled "Log into Omero" is shown in the bottom right corner, with an orange arrow pointing to the "Connect" button. The window contains the following fields:

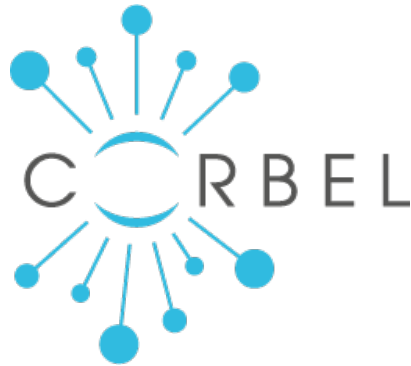
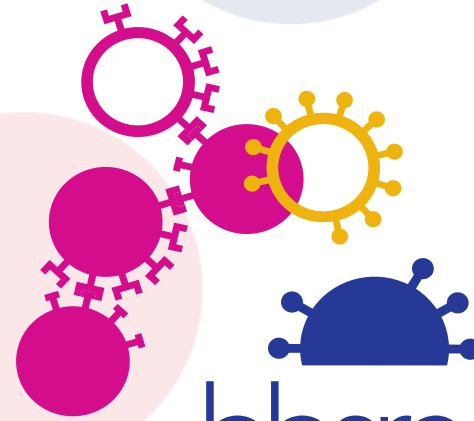
- Server: demo.openmicroscopy.org
- Port: 4064
- User: pstack
- Password: [masked]
- Buttons: Connect (highlighted with an orange arrow), Connected, Cancel, OK

Update	Path / URL	Series	Frame	ChannelName	ColorFormat	SizeC	SizeT	SizeZ	Z
1	omero:iid=162789	None	None	Exp1Cam1	monochrome	1	1	36	0
2	omero:iid=162789	0	0	Exp1Cam1	monochrome	1	1	1	0
3	omero:iid=162789	0	1	Exp1Cam1	monochrome	1	1	1	1
4	omero:iid=162789	0	2	Exp1Cam1	monochrome	1	1	1	2
5	omero:iid=162789	0	3	Exp1Cam1	monochrome	1	1	1	3
6	omero:iid=162789	0	4	Exp1Cam1	monochrome	1	1	1	4
7	omero:iid=162789	0	5	Exp1Cam1	monochrome	1	1	1	5
8	omero:iid=162789	0	6	Exp1Cam1	monochrome	1	1	1	6
9	omero:iid=162789	0	7	Exp1Cam1	monochrome	1	1	1	7
10	omero:iid=162789	0	8	Exp1Cam1	monochrome	1	1	1	8
11	omero:iid=162789	0	9	Exp1Cam1	monochrome	1	1	1	9
12	omero:iid=162789	0	10	Exp1Cam1	monochrome	1	1	1	10
13	omero:iid=162789	0	11	Exp1Cam1	monochrome	1	1	1	11
14	omero:iid=162789	0	12	Exp1Cam1	monochrome	1	1	1	12

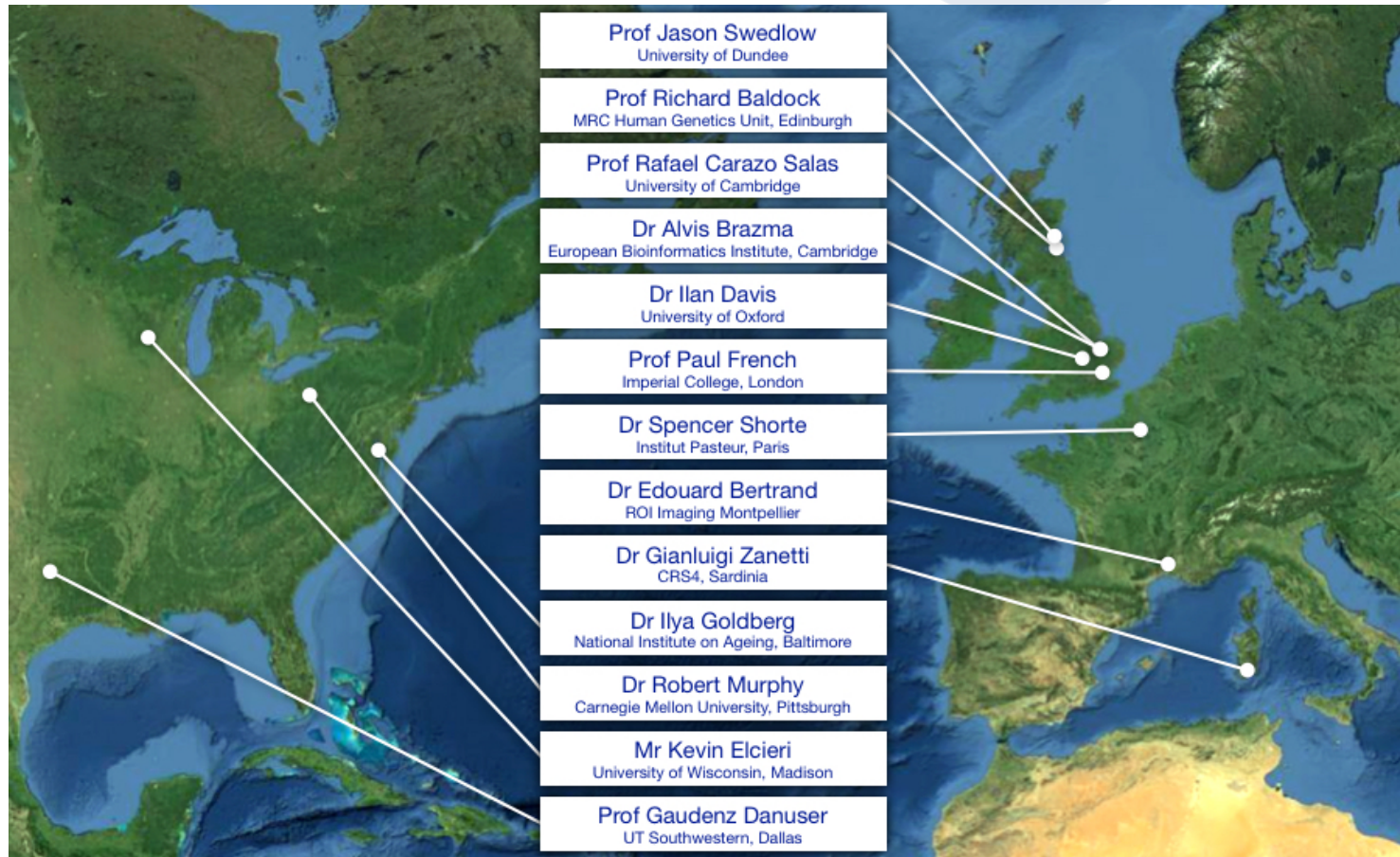
Some useful links

- OMERO Downloads:
 - <http://downloads.openmicroscopy.org/omero/>
- OMERO Help Pages:
 - <http://help.openmicroscopy.org/>
- OMERO Forums:
 - <https://www.openmicroscopy.org/community/>
- OMERO demo server:
 - <http://help.openmicroscopy.org/demo-server.html>

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OME Consortium



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