Biological Image Data Analysis with OMERO

University of Cambridge, 2016

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The OME Consortium

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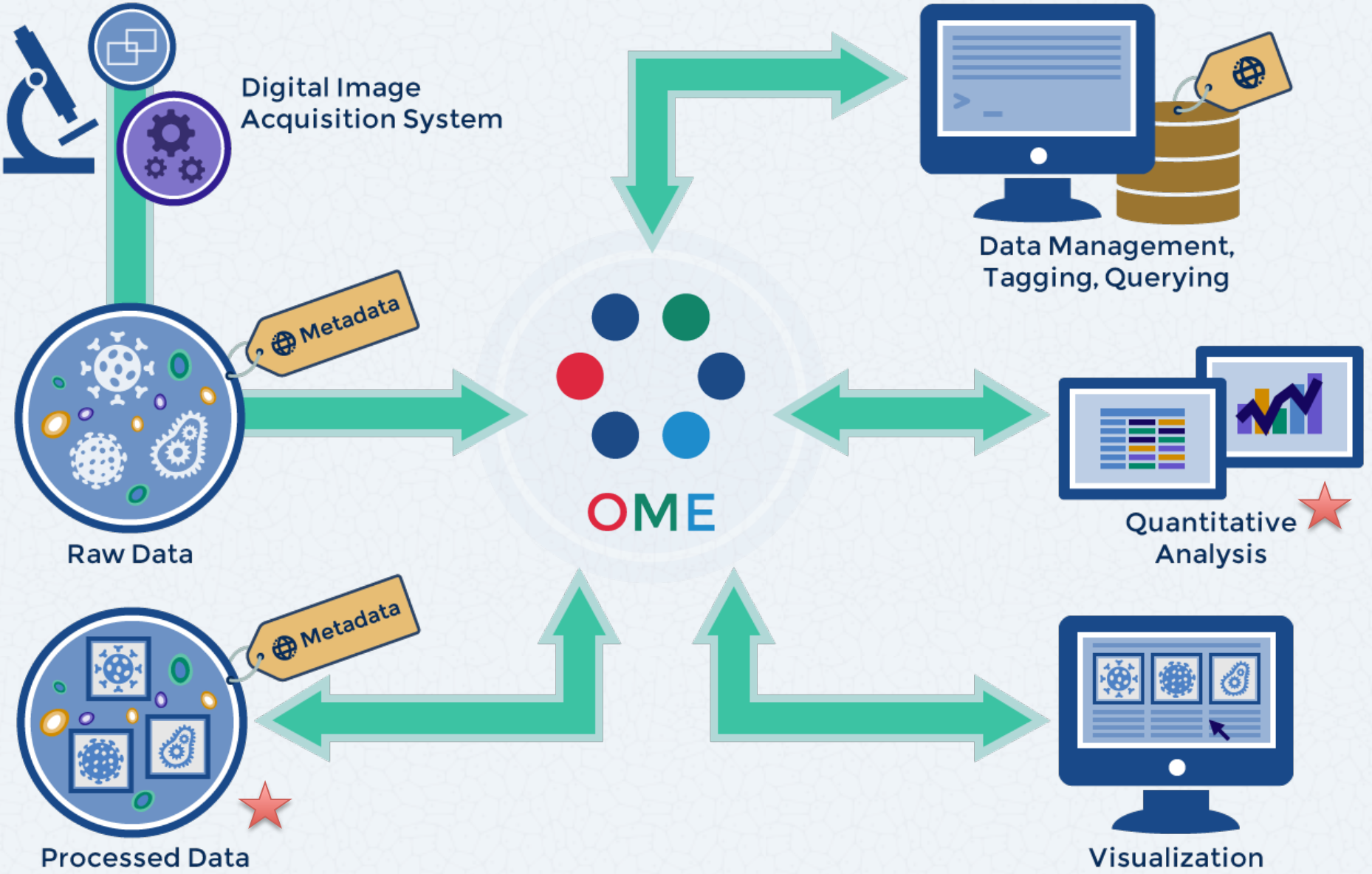
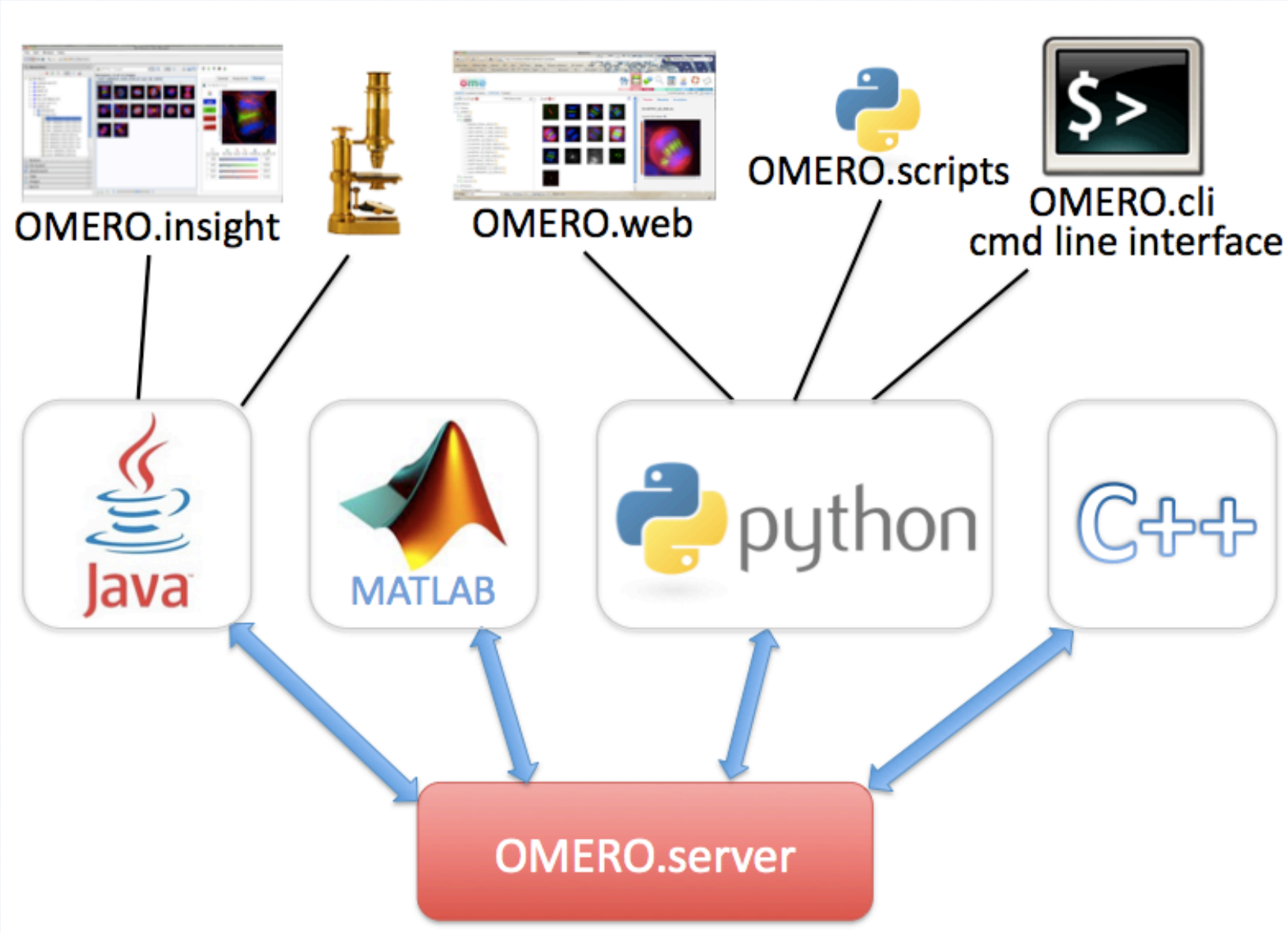
Outline

- 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

Java

Data Processing

Java

Image and Data Processing

Java

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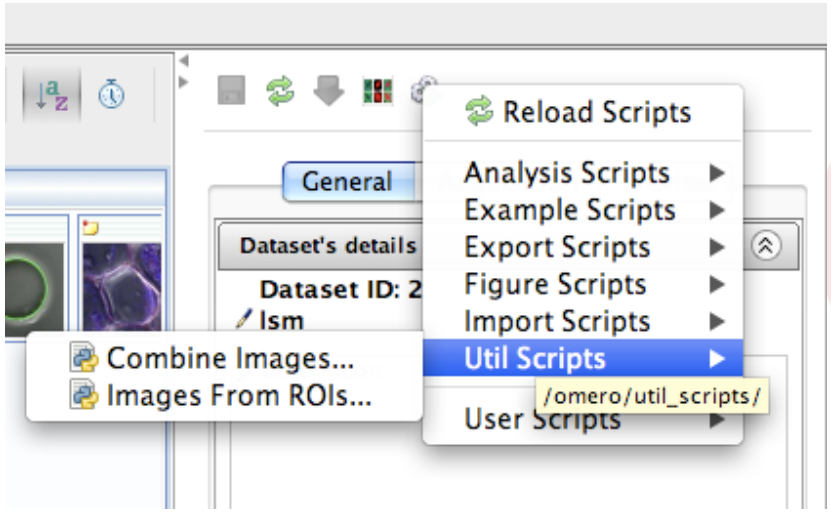
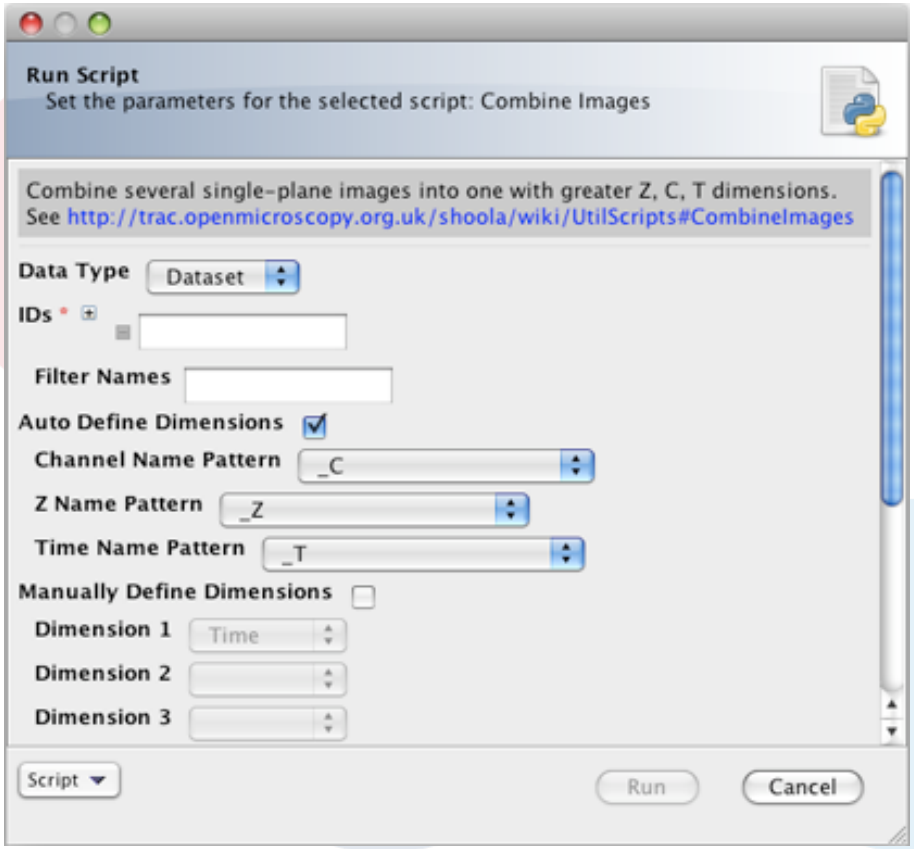
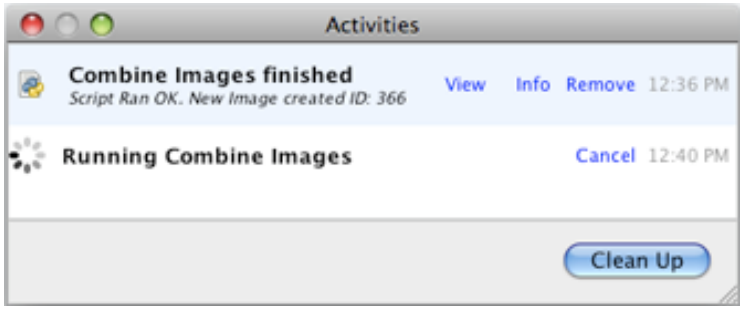
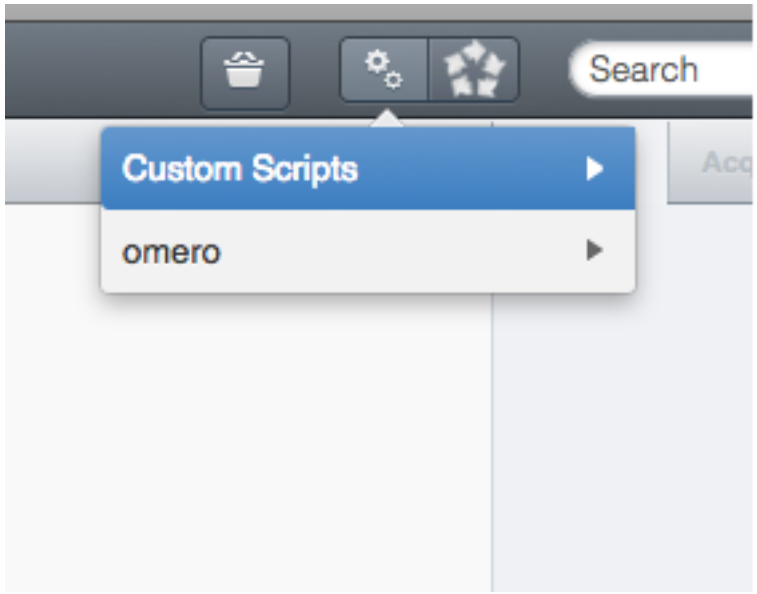
OMERO.Scripts

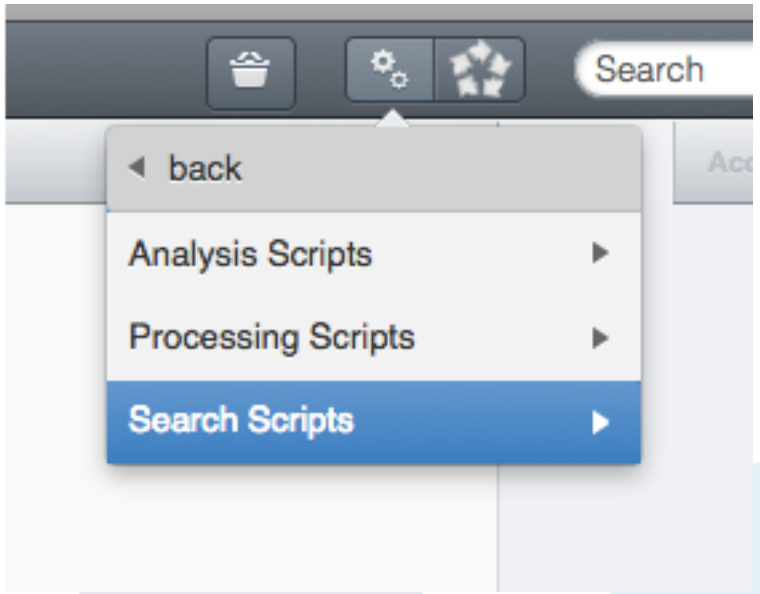






Custom OMERO.Scripts





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:

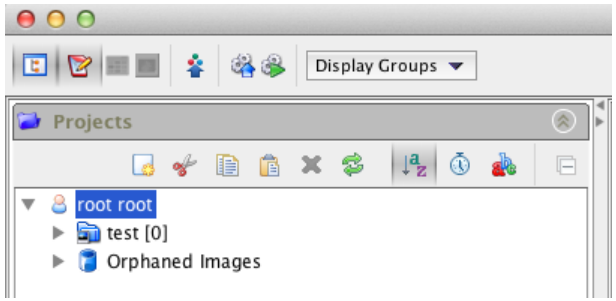
```
$ omero script replace 301 examples/Edit_Descriptions.py
```

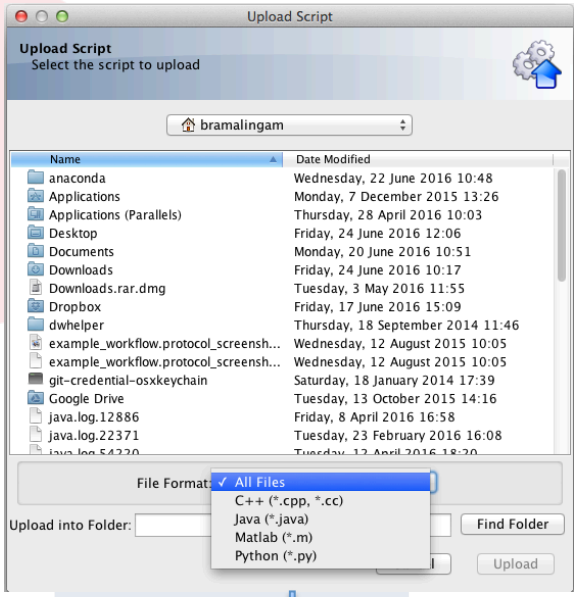
Run Script:

```
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
```

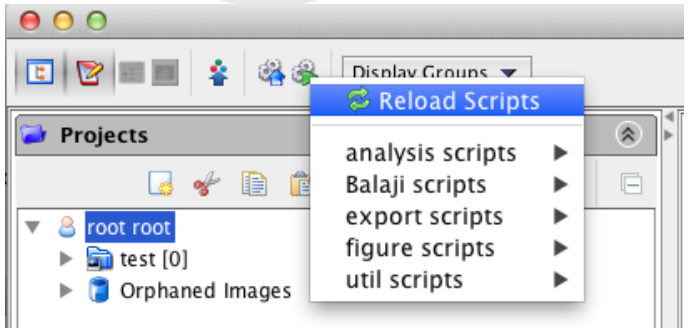
OMERO.Scripts Setup : Insight

Upload Scripts:

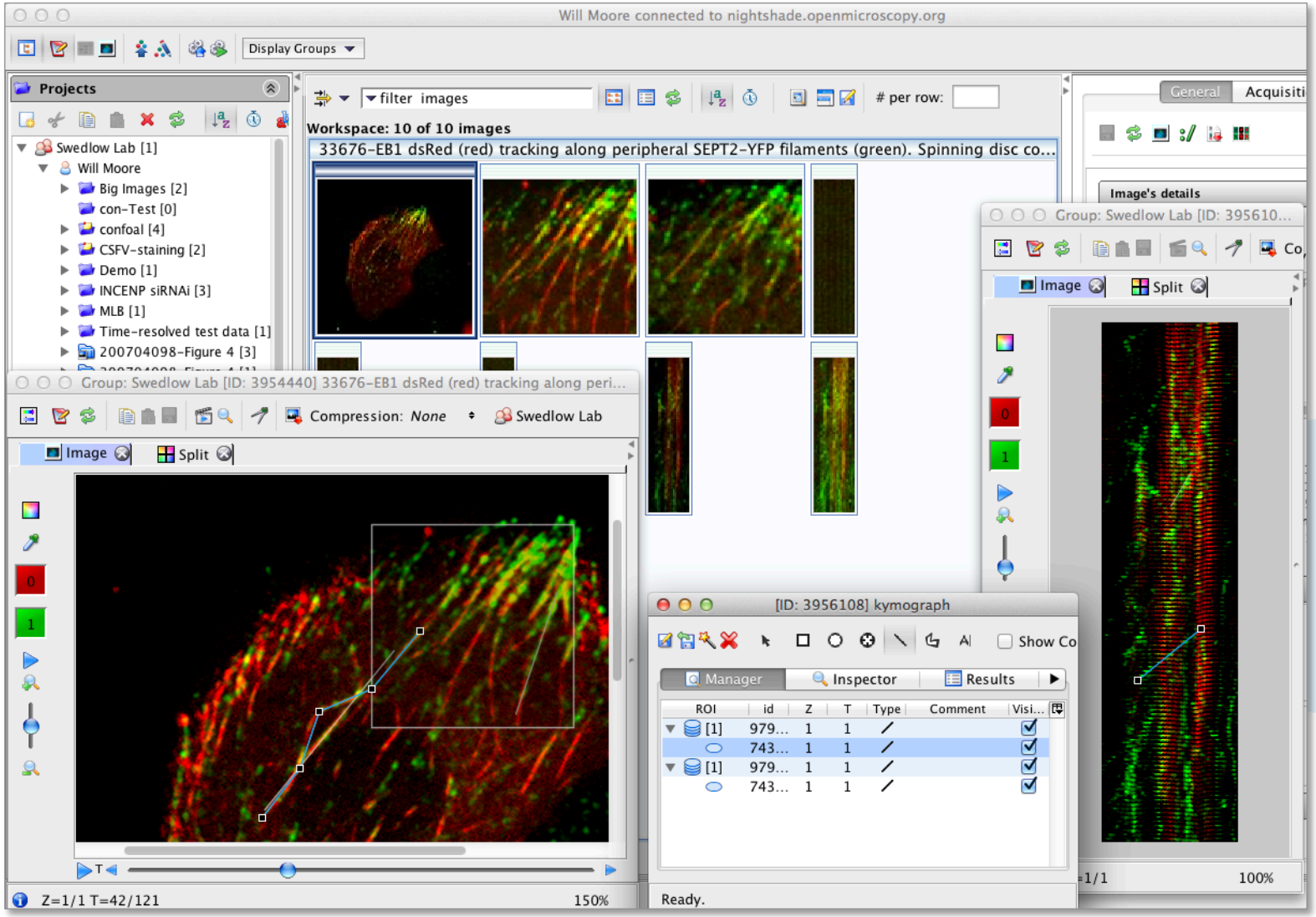




Reload Scripts Menu:



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!!**

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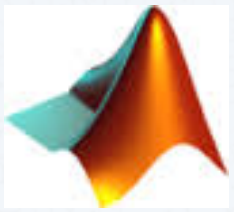
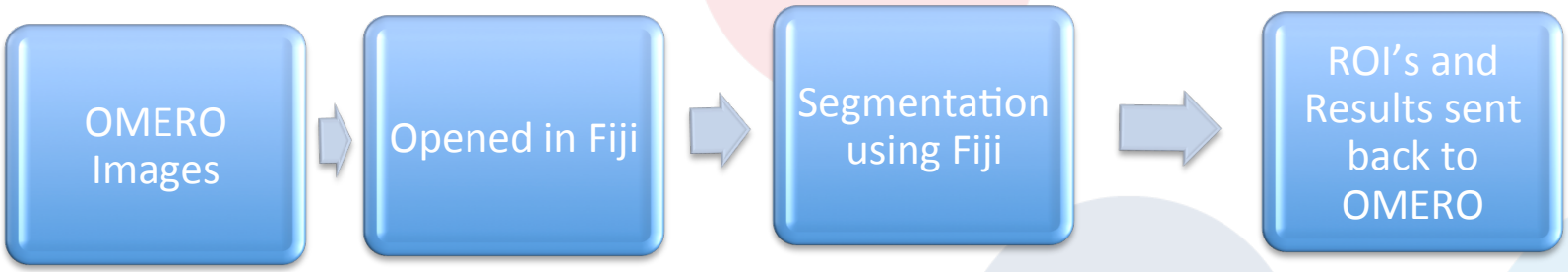


Image and Data Processing

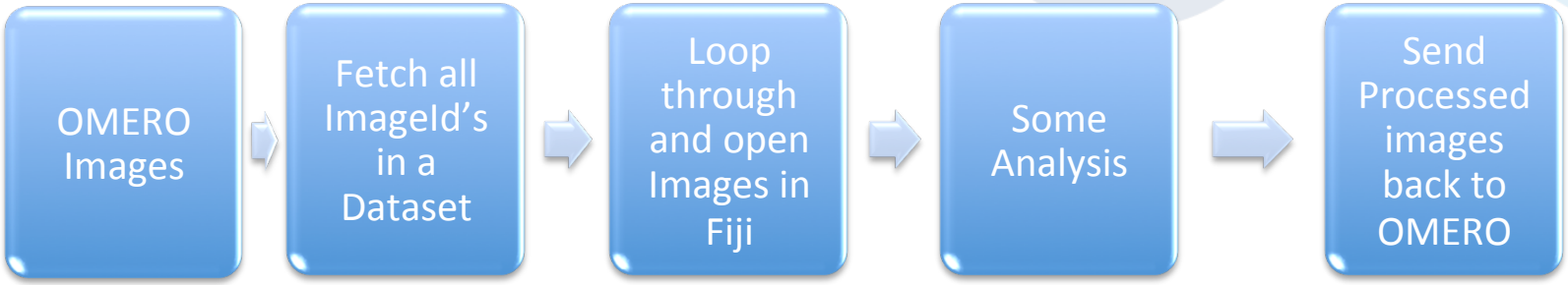
Java

Fiji-OMERO Workflow Outline

- Setup OMEROIJ Plugin
- Manual Workflow:

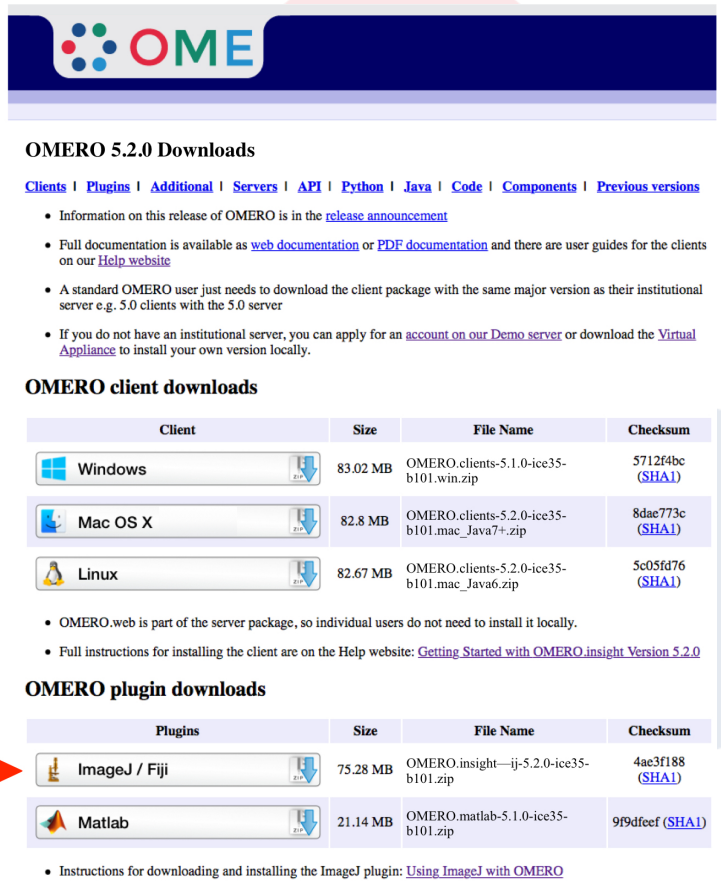


- Batch Analysis using Fiji scripts:



OMEROIJ Plugin : Setup

Dependency : OMERO IJ Plugin



OME

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	5c05fd76 (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

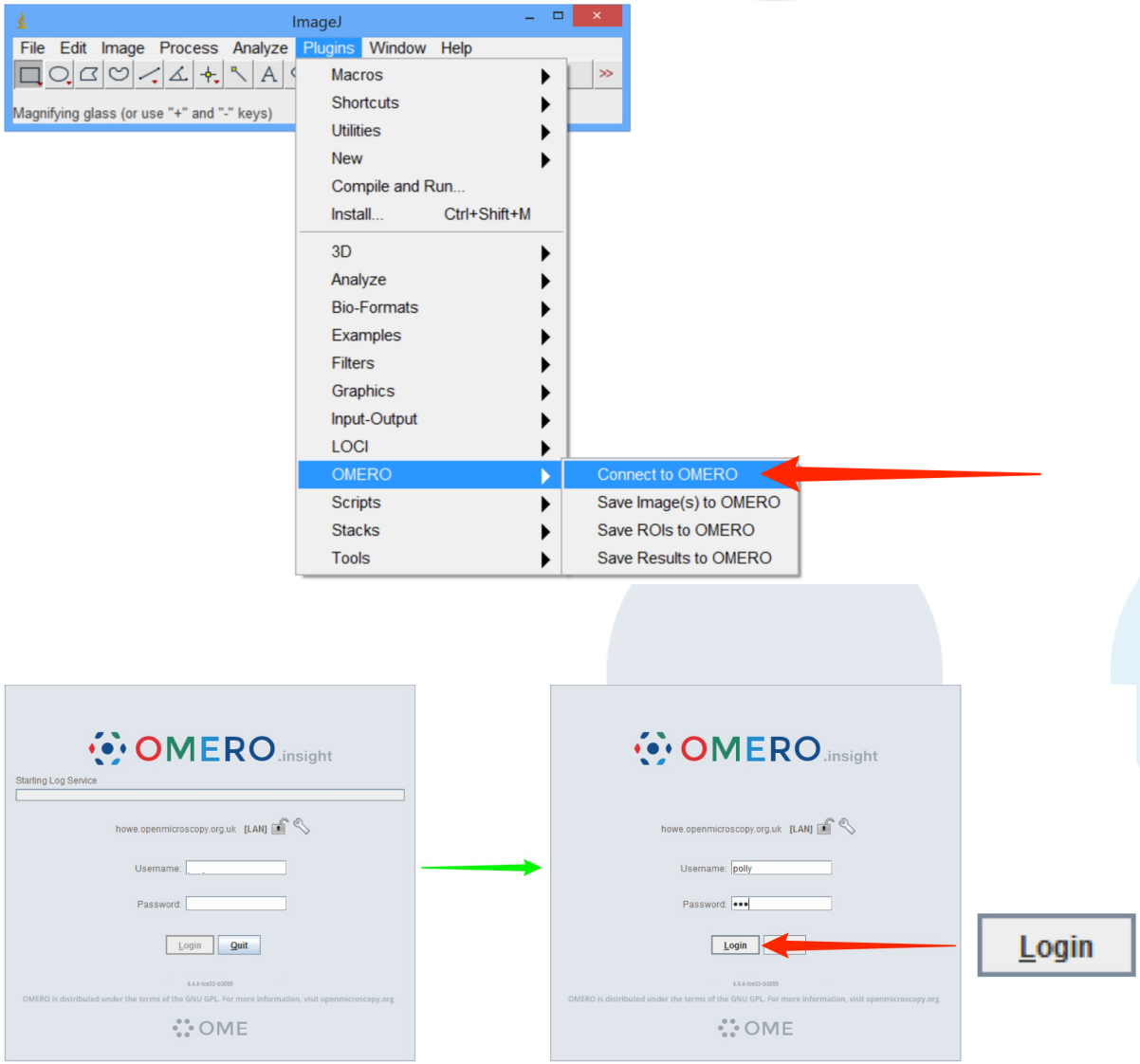
Plugins	Size	File Name	Checksum
ImageJ / Fiji	75.28 MB	OMERO.insight—ij-5.2.0-ice35-b101.zip	4ae3f188 (SHA1)
Matlab	21.14 MB	OMERO.matlab-5.1.0-ice35-b101.zip	9f9dfeef (SHA1)

- Instructions for downloading and installing the ImageJ plugin: Using ImageJ with OMERO

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

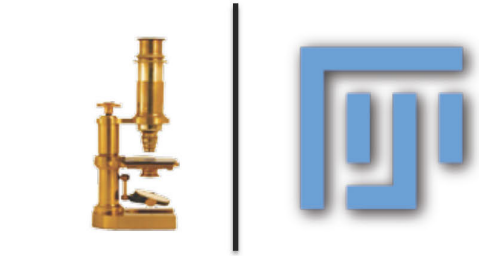
http://help.openmicroscopy.org/imagej.html

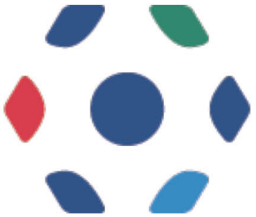
Accessing OMERO using ImageJ and Fiji

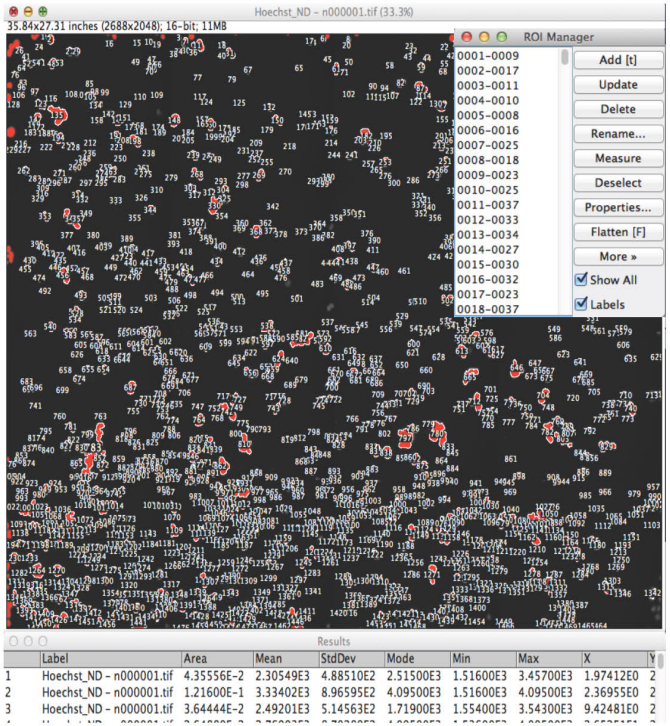


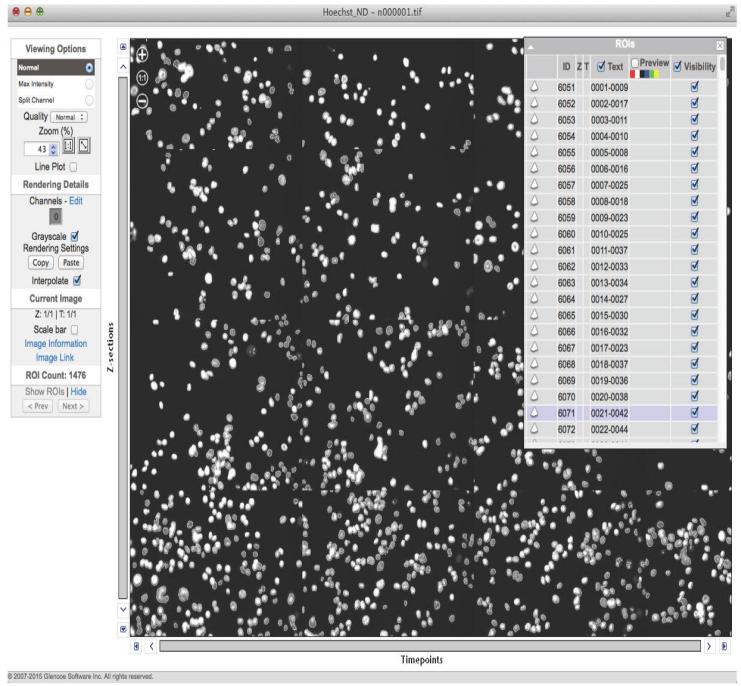
http://help.openmicroscopy.org/imagej.html

ImageJ/Fiji and OMERO





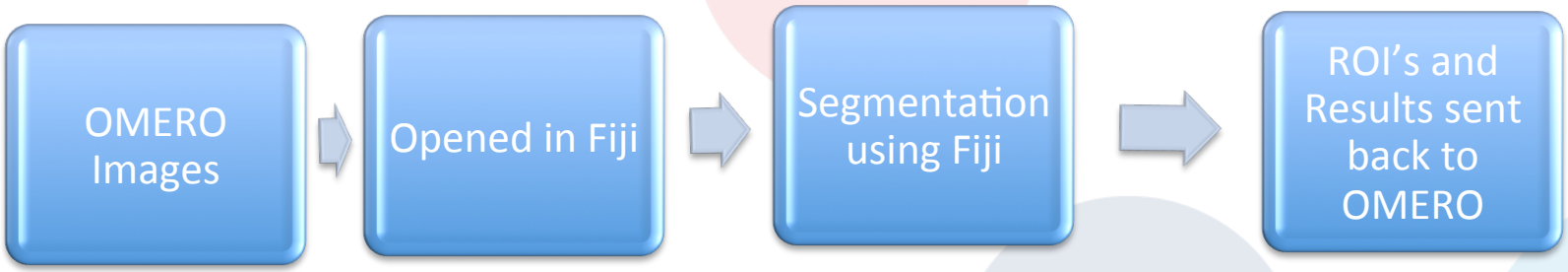




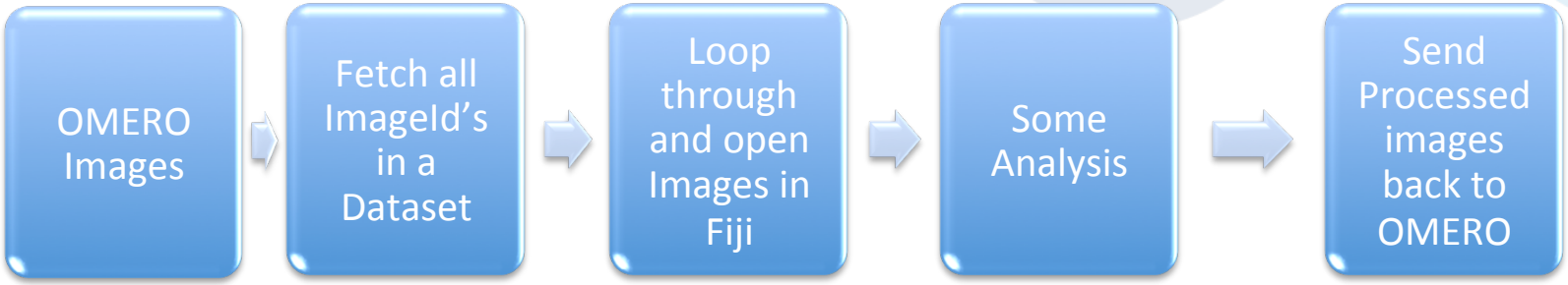
http://help.openmicroscopy.org/imagej.html

Fiji-OMERO Workflow Outline

- Setup OMEROIJ Plugin
- Manual Workflow:

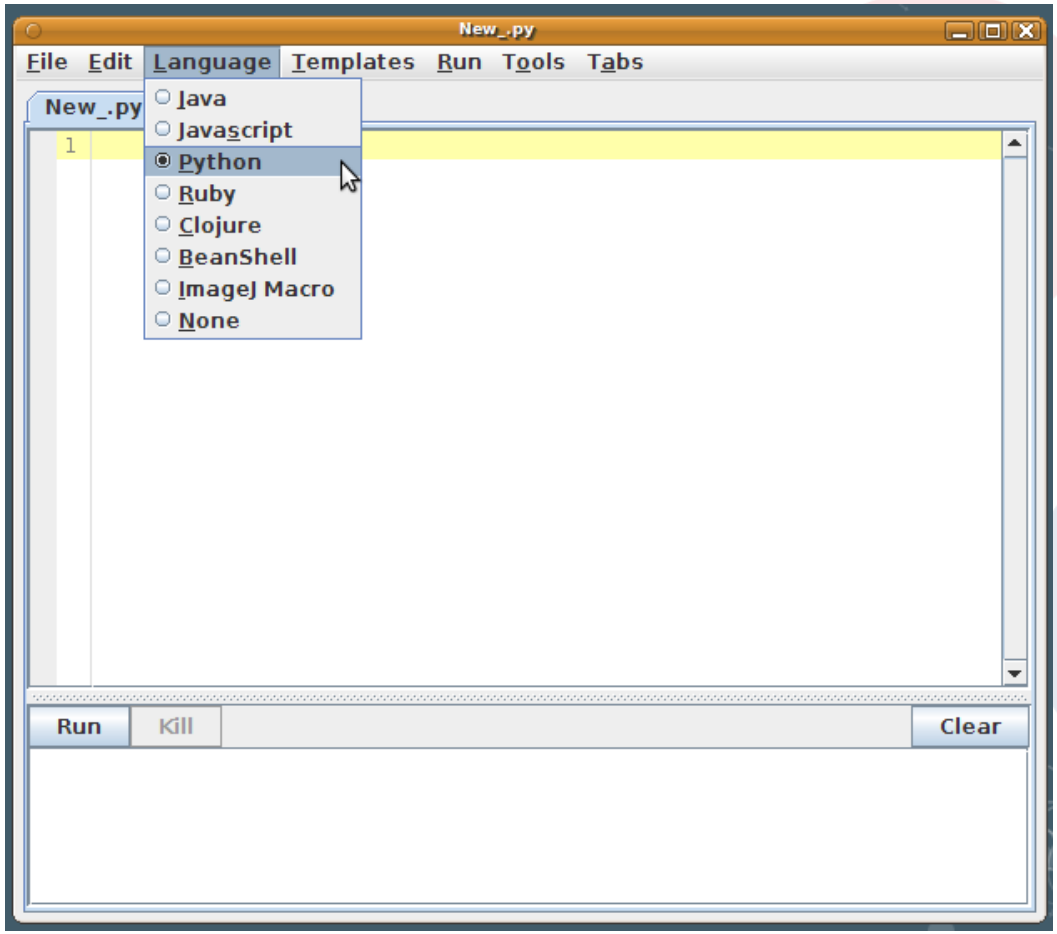


- Batch Analysis using Fiji scripts:

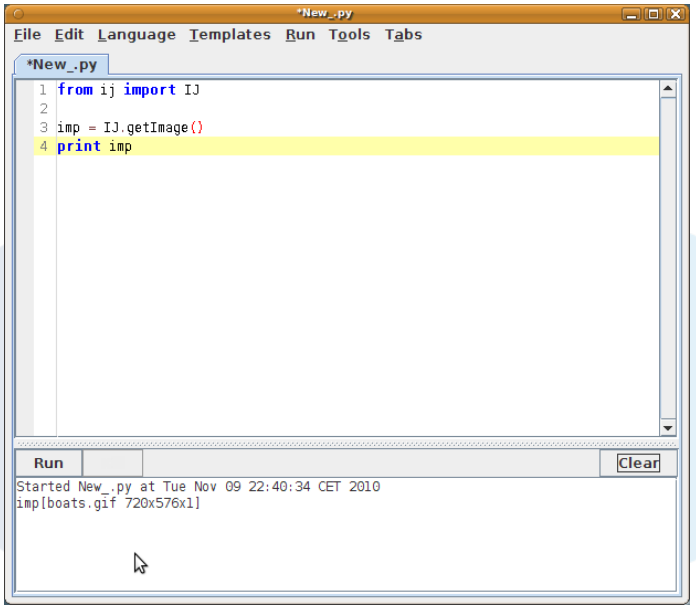


Fiji Scripts

Fiji : Script Editor



Fiji : Grabbing an open Image



https://www.ini.uzh.ch/~acardona/Fiji-tutorial/

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
```

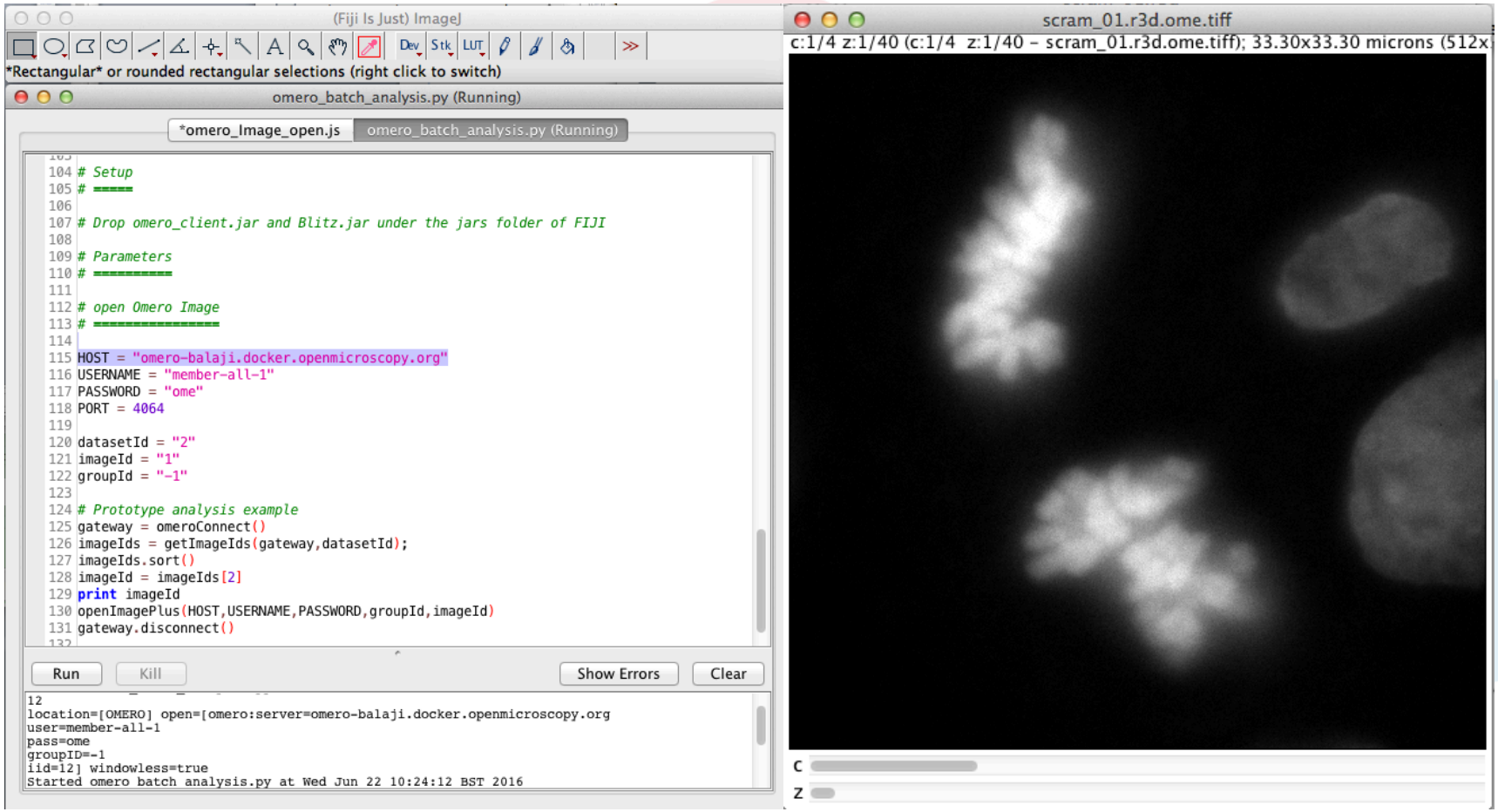
```
# List all ImageId's under a Project/Dataset
def getImageIds(gateway, datasetId):

    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)
```

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

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3rd Party Integrations

OMERO.insight

Image Processing

Java

Data Processing

Java

Image and Data Processing

Java

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

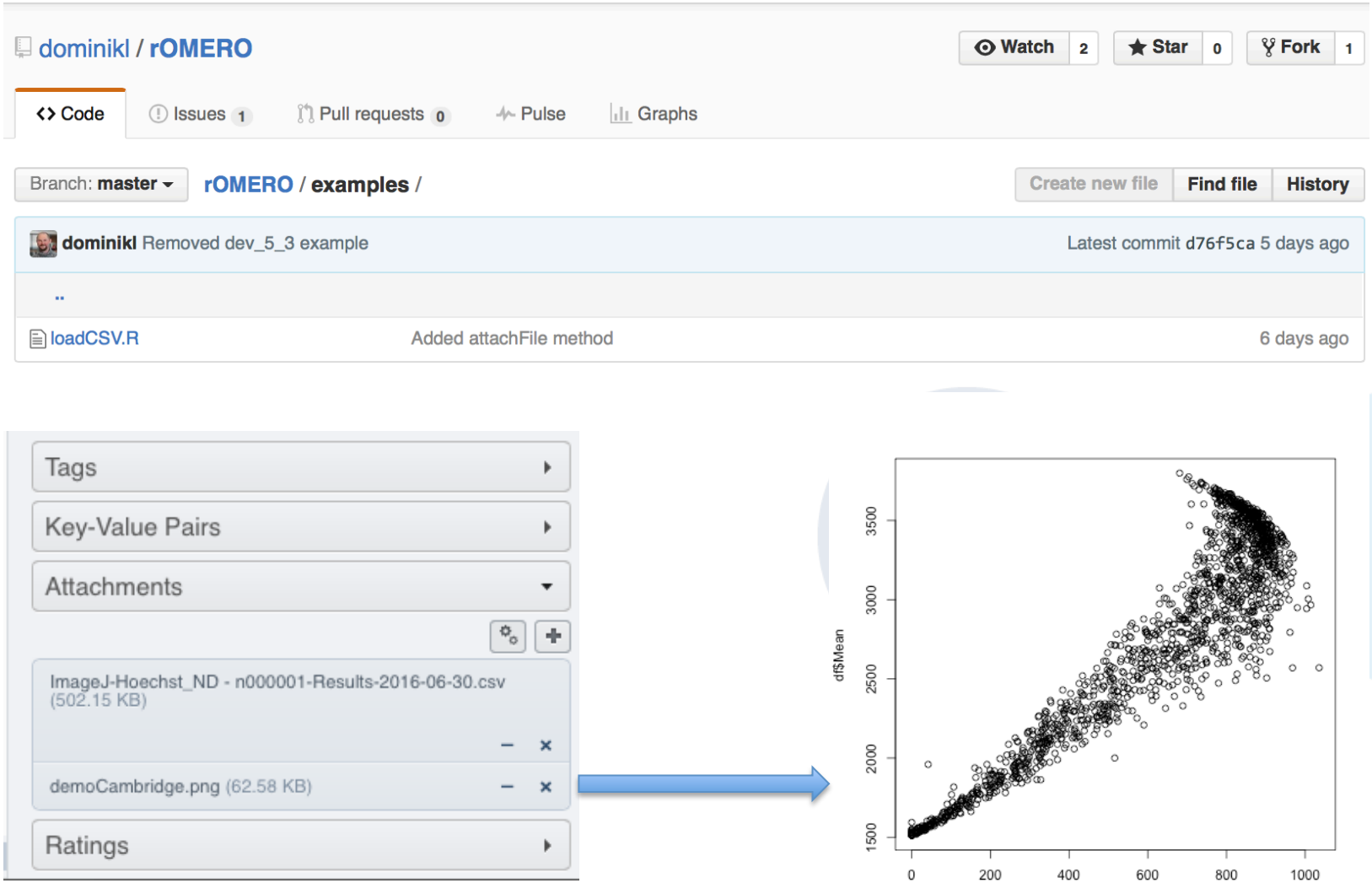
https://github.com/dominikl/rOMERO/tree/master

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 ***
```

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

rOMERO-Example



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

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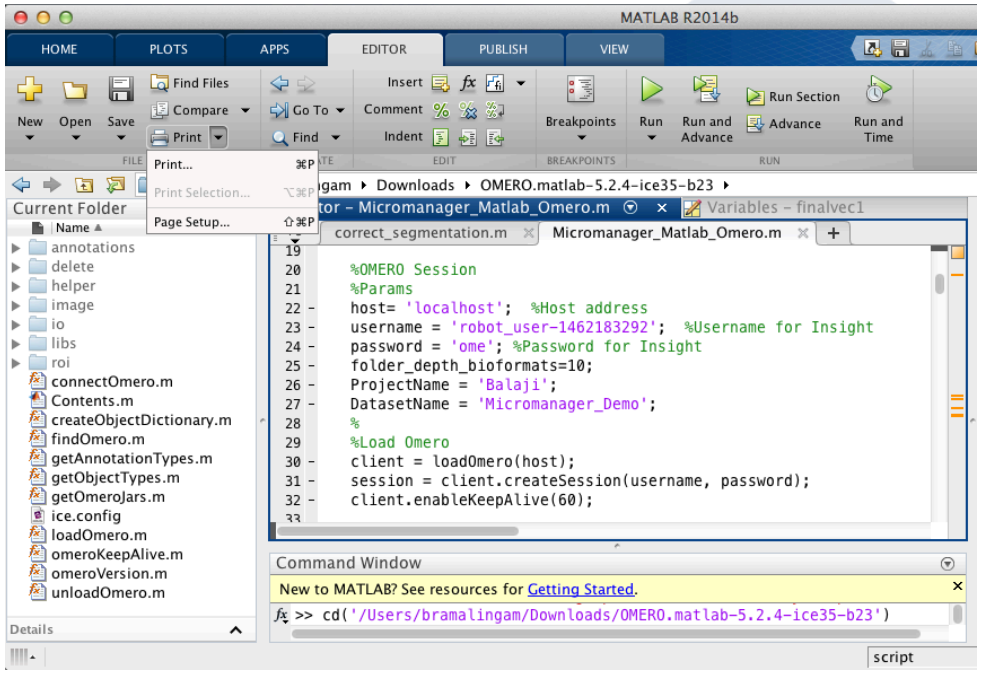
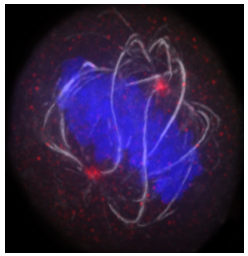
OMERO Matlab Toolbox

OMERO plugin downloads

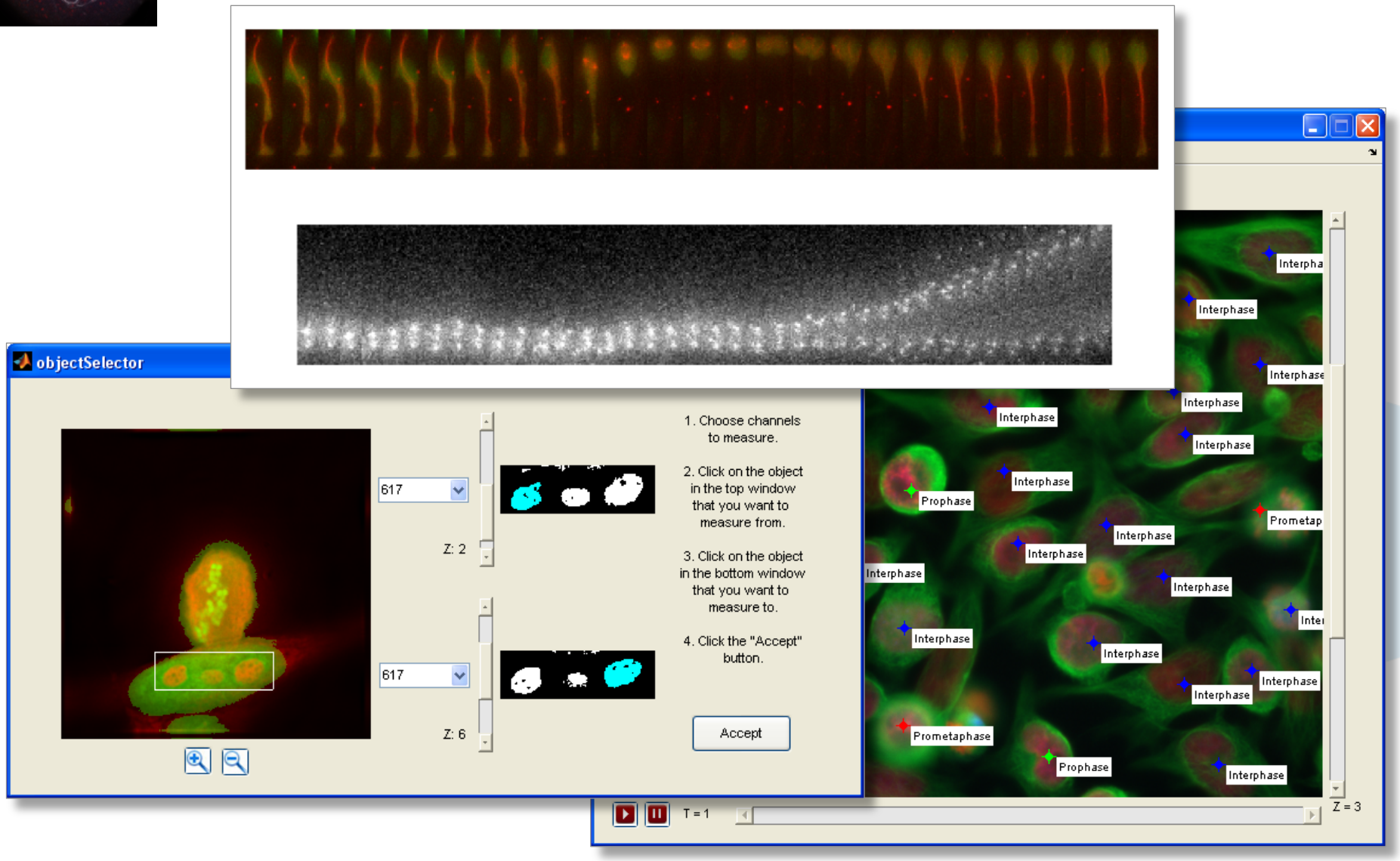
Plugin	Size	File Name	Checksum
ImageJ / Fiji	76.55 MB	OMERO.insight-ij-5.2.4-ice35-b23.zip	f4d64020 (SHA1)
Matlab	21.21 MB	OMERO.matlab-5.2.4-ice35-b23.zip	0035cbc2 (SHA1)

- 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

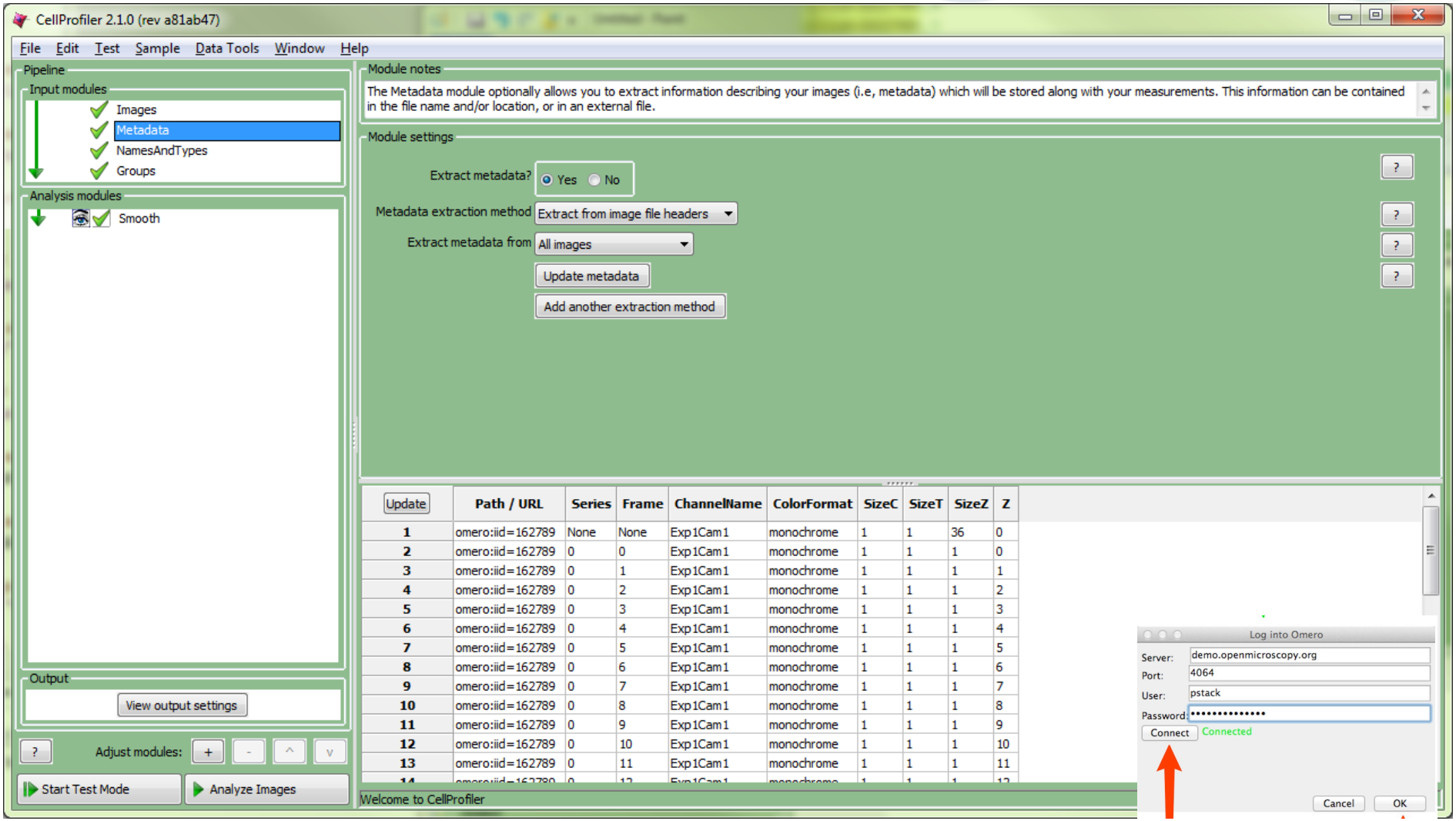


Nature Methods 9, 245–253.

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…

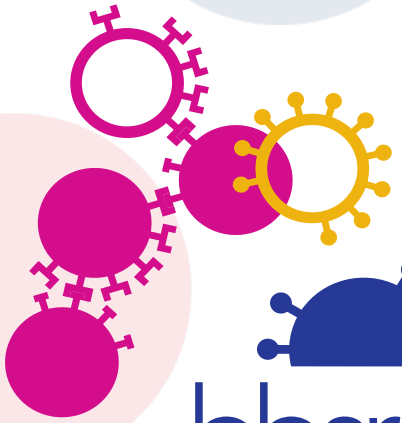
OMERO and Cell Profiler



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

Thank to Funders



bbsrc
biotechnology and biological sciences research council

MULTI MOT

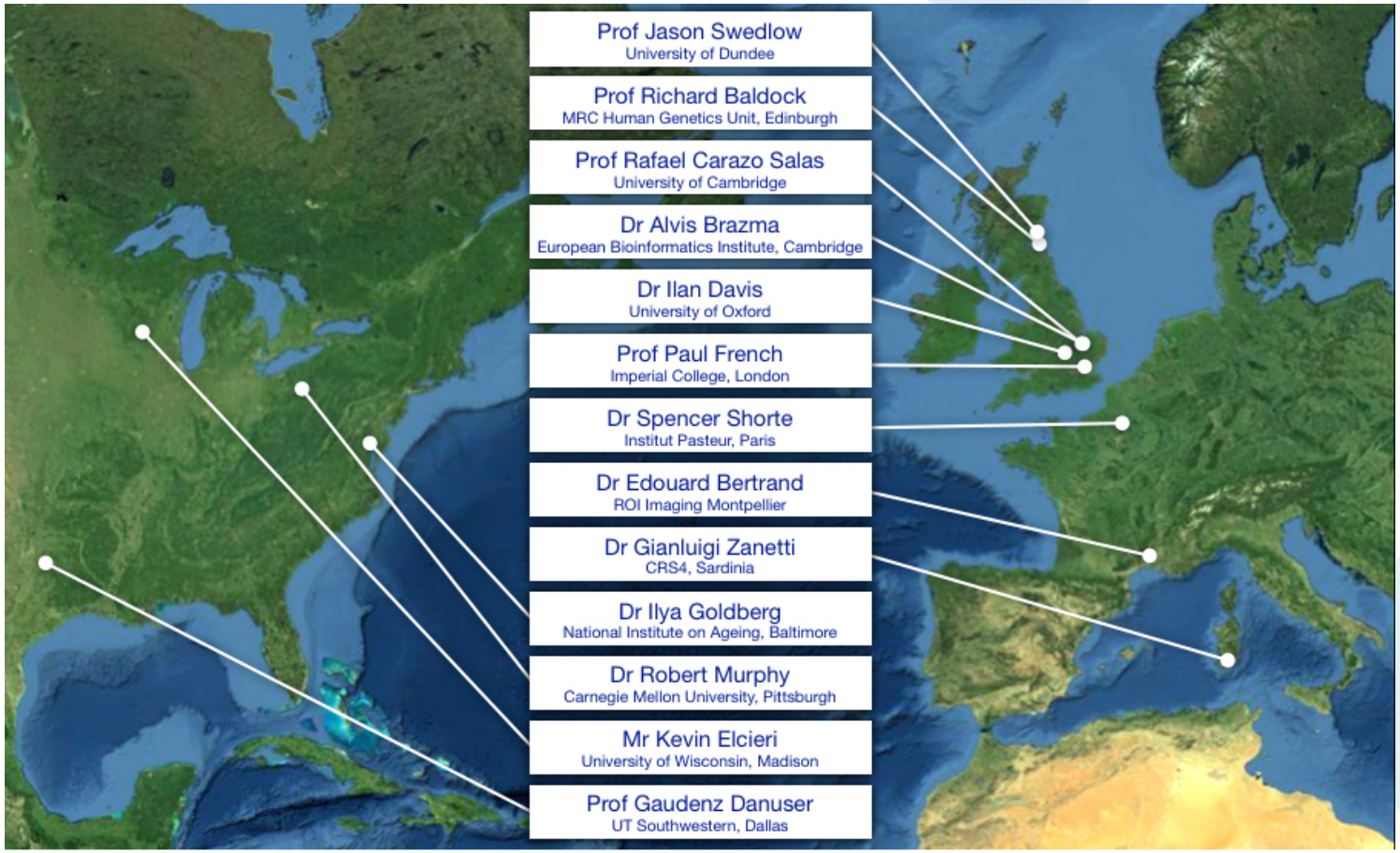
CORBEL

GLOBAL BIOIMAGING
growing collaboration

EURO-BIOIMAGING

wellcome

OME Consortium



Dundee, UW Madison, UT Southwestern, Oxford, CRS4, Montpellier, Edinburgh, CMU, Imperial, NIA, Institut Pasteur, EMBL-EBI, Glencoe Software