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Python accessing SPECCHIO

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OPTIMISE SPECCHIO Programming Course

SPECCHIO

Agenda

- Configuring your machine for SPECCHIO access from Python
- Connecting to SPECCHIO
- Selecting data
- Load spectral data from database
- Load metadata from database

Java – Python Bridge

Two bridging packages have been tested, but only JPype is currently supported:

- Py4J: https://www.py4j.org
- JPype: https://jpype.readthedocs.io/en/latest/#

Install JPype packages on your operating system.

Based on tests, **JPype is currently the preferred option**, as transfers of Java arrays (i.e. spectral matrices) to Python arrays are much faster.

* Py4J is partly supported from client build 160 onwards

Connecting to SPECCHIO – Python – JPype

- Create a new Python script, test each of the lines below as you enter them.
- Import jpype, start JVM with clas path pointing to specchio client jar file, get specchio client package:

```
from jpype import *
startJVM('/Library/Java/JavaVirtualMachines/jdk1.7.0_79.jdk/Contents/MacOS/libjli.dylib', "-ea",
"-Djava.class.path=/Applications/SPECCHIO/SPECCHIO.app/Contents/Java/specchio-client.jar")

SPECCHIO = JPackage('ch').specchio.client
```

- Create a client factory instance and get a list of all connection details:

```
cf = SPECCHIO.SPECCHIOClientFactory.getInstance();
db_descriptor_list = cf.getAllServerDescriptors();
```

- Create client for the first entry in the database connection list:

```
specchio_client = cf.createClient(db_descriptor_list.get(0)) # zero indexed
```

- If no error appears then you are connected successfully to the SPECCHIO database running in your SPECCHIO VM

Connecting to SPECCHIO – Python – JPype

- If you want to see what server you just connected to, type:

```
db_descriptor = db_descriptor_list.get(0)
db_descriptor.getDataSourceName()
```

Selecting data – Python – JPype

The SPECCHIO tutorial dataset contains some spectra that have a spatial position.
We are now going to select spectra based on their altitude above sea level. Our condition is that the altitude must be 50m or higher.

•Create a query object:

```
QUERIES = JPackage('ch').specchio.queries
query = QUERIES.Query();
```

•Create query condition for the altitude attribute and configure it:

```
attr = specchio_client.getAttributesNameHash().get('Altitude')
cond =QUERIES.EAVQueryConditionObject(attr)
cond.setValue('50.0');
cond.setOperator('>=');
query.add_condition(cond);
```

•Get spectrum ids that match the query:

```
ids = specchio_client.getSpectrumIdsMatchingQuery(query);
```

Selecting data – Python – JPype

- Check how many spectra we found

```
ids.size()
```

- Add another condition to restrict the maximum altitude:

```
cond = QUERIES.EAVQueryConditionObject(attr);
cond.setValue('55.0');
cond.setOperator('<');
query.add_condition(cond);
```

- Get spectrum ids that match the query

```
ids = specchio_client.getSpectrumIdsMatchingQuery(query);
```

- Check the size of the ids variable again – there should be less spectra selected than before

Load spectral data from database – Python – JPype

Refer to the general presentation on SPECCHIO explaining the Spectral Space concept and the Space Factory; the following statements are using the implementation of these concepts.

•Create spectral spaces and order the spectra by their acquisition time (note: this does not load the spectral vectors yet but only prepares the 'containers') :

```
spaces = specchio_client.getSpaces(ids, 'Acquisition Time');
```

•Find out how many space we have received:

```
len(spaces)
```

•Get the first space:

```
space = spaces[0]
```

•The order of the ids may have changed because the vectors in the space are ordered by their Acquisition Time; therefore get the ids in their correct sequence to match the vector sequence:

```
ids = space.getSpectrumIds(); # get them sorted by 'Acquisition Time'
```

•Load the spectral data from the database into the space:

```
space = specchio_client.loadSpace(space);
```

Load spectral data from database – Python – JPype

- Get the spectral vectors, wavelengths and measurement unit, the plot using matplotlib.

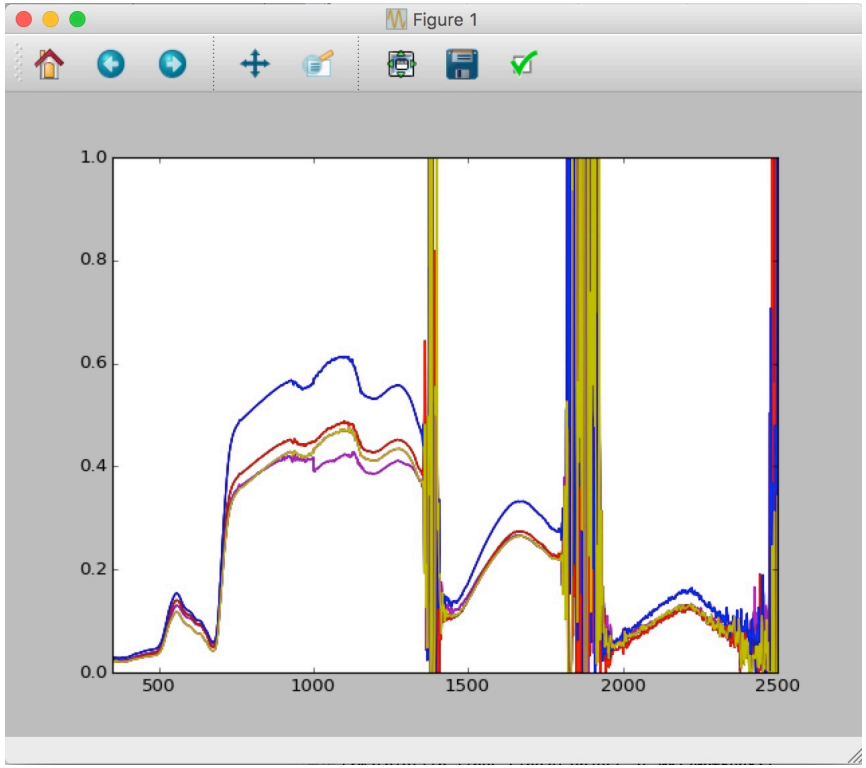
```
vectors = space.getVectorsAsArray();
wvl = space.getAverageWavelengths();
unit = space.getMeasurementUnit().getUnitName();


import numpy


import matplotlib.pyplot as mp
axes = mp.gca()
axes.set_xlim([350,2500])
axes.set_ylim([0,1])
y = numpy.rot90(vectors,3)
mp.plot(wvl, y)



   # end connection to Java
shutdownJVM()
```



Thank you for your attention!

For more information on the current version of SPECCHIO see: www.specchio.ch

https://twitter.com/SPECCHIO_DB

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SPECCHIO

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Appendix: Py4J Documentation

Note: support for Py4J is currently disabled!

Connecting to SPECCHIO – Python – Py4J

- Create a new Python script, test each of the lines below as you enter them.
- Start the SPECCHIO java client. This starts the Java Py4J Gateway. (If you start the SPECCHIO client from the terminal, you will see a message similar to:

```
Welcome to 3.2.1.3 Alpha
Specchio - Python Gateway Server Started
```

- Import the PyJ4 Gateway and get the gateway object:

```
from py4j.java_gateway import JavaGateway
gateway = JavaGateway()
```

- Create a client factory instance and get a list of all connection details:

```
cf=gateway.entry_point.getClientFactory()
db_descriptor_list = cf.getAllServerDescriptors()
```

- Create client for the first entry in the database connection list:

```
specchio_client = cf.createClient(db_descriptor_list.get(0)) # zero indexed
```

- If no error appears then you are connected successfully to the SPECCHIO database running in your SPECCHIO VM

Connecting to SPECCHIO – Python – Py4J

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Selecting data – Python – Py4J

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We are now going to select spectra based on their altitude above sea level. Our condition is that the altitude must be 50m or higher.

•Create a query object:

```
query = specchio_client.getQueryObject()
```

•Create query condition for the altitude attribute and configure it:

```
attr = specchio_client.getAttributesNameHash().get('Altitude')
cond =specchio_client.getEAVQueryConditionObject(attr)
cond.setValue('50.0');
cond.setOperator('>=');
query.add_condition(cond);
```

•Get spectrum ids that match the query:

```
ids = specchio_client.getSpectrumIdsMatchingQuery(query);
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Selecting data – Python – Py4J

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Load spectral data from database – Python – Py4J

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•Find out how many space we have received:

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•Get the first space:

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```
ids = space.getSpectrumIds(); # get them sorted by 'Acquisition Time'
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•Load the spectral data from the database into the space:

```
space = specchio_client.loadSpace(space);
```

Load spectral data from database – Python – Py4J

- Get the spectral vectors, wavelengths and measurement unit, the plot using matplotlib. Note: conversion of the vectors to the list data format is time consuming.

```
vectors = space.getVectorsAsArray();
wvl = space.getAverageWavelengths();
unit = space.getMeasurementUnit().getUnitName();

wavelengths = list(wvl)

import matplotlib.pyplot as mp
mp.hold
axes = mp.gca()
axes.set_xlim([350,2500])
axes.set_ylim([0,1])
for i, dataset in enumerate(vectors):
mp.plot(wavelengths, list(dataset))

    # further option using numpy, but also not faster …
import numpy
from numpy import array
x = array(wavelengths)
v=array(list(vectors))
mp.plot(x, numpy.rot90(v))
a = numpy.asarray(list(vectors))
```