# Python and (Q)GIS

A very brief overview of the possibilities of using python scripting in GIS:

**QGIS/Python ecosystem**

- Written in C++
- In 2007 work began to add python as scripting language
- QGIS have 400 core C++ classes of which 75% are python enabled through SIP
- QGIS use Qt (C++) for windows and buttons etc. PyQt binds this with python

# Python and (Q)GIS

cont.

Recommend reading (in course literature list):

- The PyQGIS Programmers Guide, Gary Sherman (QGIS founder)
- PyQGIS developer cookbook

https://docs.qgis.org/3.16/en/docs/pyqgis_developer_cookbook/index.html

**recent transition period between QGIS2 (deprecated) and QGIS3**

# Package management

pip – a install program for python packages

pip list

pip install your_favorite_module

pip uninstall your_not_so_favorite_module

Windows users:

Use the setup file in the start menu

# Python and (Q)GIS

There are four main modules that has most of all the python classes for QGIS

```
from PyQt4.QtCore import *  (qgis.PyQt.QtCore)

from PyQt4.QtGui import *  (qgis.PyQt.QtGui)

from qgis.core import *

from qgis.gui import *
```

(Not good coding practice to use *)

In parentheses used in QGIS3. qgis.analysis is still available in QGIS3

# Python and (Q)GIS

Let us try to open a vector layer with only code

Open python console in QGIS

```
>>>vlayer = QgsVectorLayer('c:/temp/drone_pos.gml',
'point', 'ogr')
```

```
>>>vlayer.isValid()
```

```
>>>QgsProject.instance().addMapLayer(vlayer)
```

Zoom in to one point

```
>>>iface.zoomFull()
```

All GUI functionalities are accessible through code

https://docs.qgis.org/3.16/en/docs/pyqgis_developer_cookbook/loadlayer.html

# Python and (Q)GIS

Let us try to open a raster layer with only code

```
>>>fileName = 'c:/temp/DSM_LondonCity_1m.tif'

>>>fileInfo = QFileInfo(fileName)

>>>from qgis.PyQt.QtCore import *

>>>baseName = fileInfo.baseName()

>>>print(baseName)

>>>rlayer = QgsRasterLayer(fileName, baseName)

>>>QgsProject.instance().addMapLayer(rlayer)
```

https://docs.qgis.org/3.16/en/docs/pyqgis_developer_cookbook/loadlayer.html

An alternative way to open raster in order to get matrix and make into a numpy array

```
>>>import numpy as np

>>>from osgeo import gdal

>>>data = gdal.Open(fileName)

>>>mat = np.array(data.ReadAsArray())

>>>mat
```

The numpy array variable mat has many methods that could be used now

```
>>>mat.shape

>>>mat.mean()
```

# qgis.core – qgis.gui

The CORE library contains all basic GIS functionality

The GUI library is build on top of the CORE library and adds reusable GUI widgets

```
>>>iface.messageBar().pushMessage("Ops", "Lots of red
here", level=Qgis.Critical)
```

# qgis.pyqt

Bindings between Qt and Python

```
>>>from qgis.PyQt.QtWidgets import QMessageBox
```

```
>>>QMessageBox.about(None, "About MyPlugin" ,"No animals
were harmed in the development of this Plugin")
```

# Access attributes by a loop

Try to find out how to access vector attributes and write a loop that prints an attribute column from the drone vector file.

```
>>>idx = vlayer.dataProvider().fieldNameIndex('Id')

>>>for f in vlayer.getFeatures():

>>>  print(f.attributes()[idx])
```

See **PyQGIS Developer Cookbook** on how to edit attribute by code

# Accessing other tools

The PyQGIS libraries also have access to external tools

One solution is to use a system call to e.g. access a C++ function:

```
>>>import subprocess

>>>rSquare = 100

>>>x = 283935

>>>y = 5711504

>>>gdalclipdsm = 'gdalwarp -dstnodata -9999 -q -overwrite -
te ' + str(x - rSquare) + ' ' + str(y - rSquare) + ' ' +
str(x + rSquare) + ' ' + str(y + rSquare) + ' -of GTiff ' +
'c:/temp/DSM_LondonCity_1m.tif c:/temp/clipdsm.tif'

>>>subprocess.call(gdalclipdsm)
```

Best way is to use the processing framework (upcoming slides)

# Accessing other tools

gdal now also part of core functionality in QGIS via Python:

```
>>>from osgeo import gdal
>>>r = 200
>>>x = 283935
>>>y = 5711504
>>>filepath_tempdsm = 'C:/temp/clipdsm.tif'
>>>bigraster = gdal.Open(fileName)
>>>bbox = (x - r, y + r, x + r, y - r)
>>>gdal.Translate(filepath_tempdsm, bigraster, projWin=bbox)
>>>bigraster = None
```

# Accessing other tools

One other solution is to access the tools in the processing toolbox (VSCode). Here you can access function from GRASS, SAGA etc.:

```
# Prepare processing framework
sys.path.append('C:/OSGeo4W64/apps/qgis/python/plugins')
import processing
from processing.core.Processing import Processing
Processing.initialize()

for alg in QgsApplication.processingRegistry().algorithms():
    print(alg.id(), "->", alg.displayName())

processing.algorithmHelp("native:buffer")
```

# Accessing other tools

One other solution is to access the tools in the processing toolbox. Here you can access function from GRASS, SAGA etc.:

```
processing.run("native:buffer", {'INPUT':
'c:/temp/DroneExercise/dronephotos.shp', 'DISTANCE':
100.0,'SEGMENTS': 10,'DISSOLVE': True,'END_CAP_STYLE': 0,
'JOIN_STYLE': 0,'MITER_LIMIT': 10,'OUTPUT':
'c:/temp/DroneExercise/dronephotos_buff.shp'})
```

# Making a python script

- A drone path is planned over the central area on London and we would like to retrieve height information for an area around each point
- Now we will examine the mean and (maximum height) for a 200 meter square around all points based on the DSM
- This will be accomplished by making a loop through each vector point
- To make is easier and also to easy change the settings, we will produce a script

Let’s continue in VSCode…

# Getting stared with an IDE (VSCode)

To use QGIS outside you need to add the following lines:

```
# Starting a QGIS application
qgishome = 'C:/OSGeo4W64/apps/qgis/'
QgsApplication.setPrefixPath(qgishome, True)
app = QgsApplication([], False)
app.initQgis()
[
code
]
app.exitQgis()
```

# Task 1

- Write out the result from previous script to a text file. The text file should consist of a header, and three column (ID, mean height and max height)

**Hints:**

- Use **numpy.zeros()** function to create an empty matrix to fill in your numbers
- Use **numpy.savetxt()** function to save to file

# Task 2

**Perform a moving 3x3 kernel filtering (both smoothing and edge detecting) on a raster by using a nested looping process and saving the raster to disk.**

Use a cutout (500 x 500 pixels) from the raster data used in first task.

np.array() can be used to create a kernel

Beware of the raster edges!!!

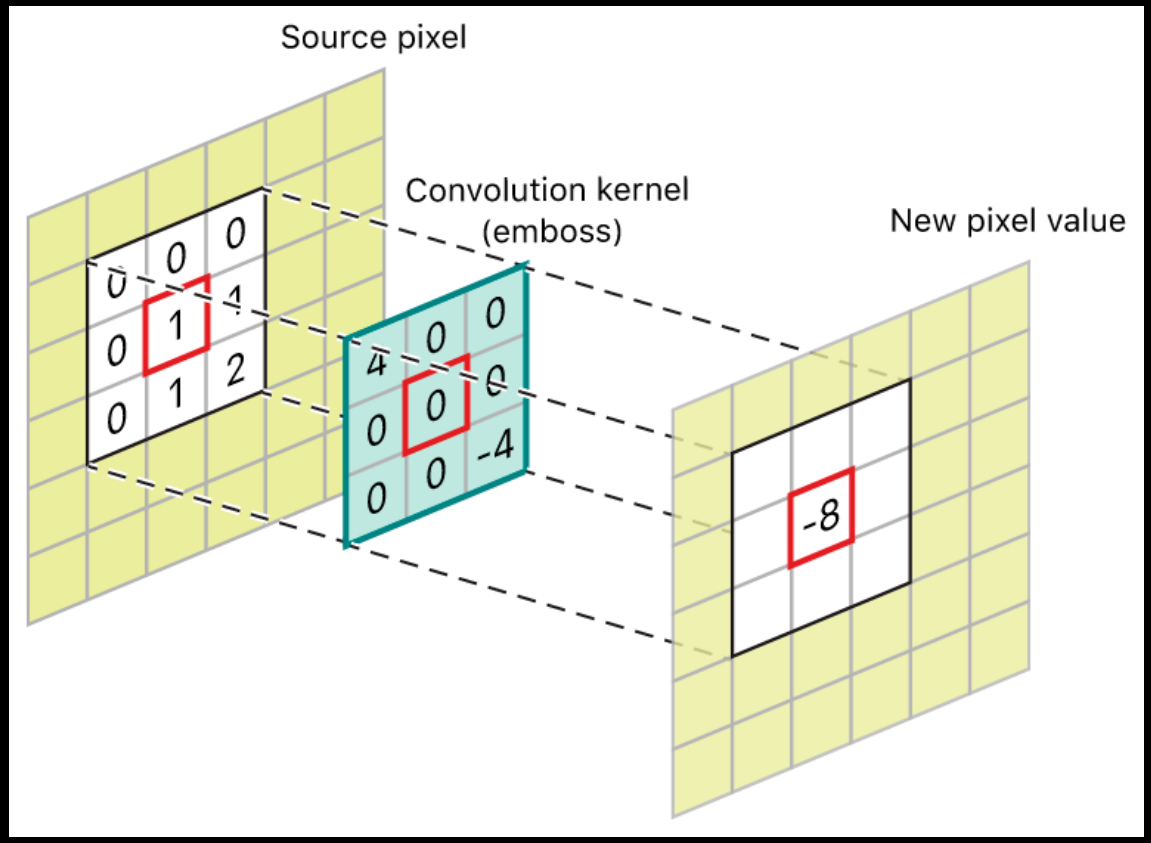
np.where() can be used to extract values from the raster using the kernel

Make use of the **saveraster** function in **misc.py** found on Canvas to save your filtered raster.

**No hand in**

# Task 2

A kernel filter, convolution matrix, or mask is a small matrix. It is used for blurring, sharpening, embossing, edge detection, and more. This is accomplished by doing a convolution between a kernel and an image.



# Task 3 (extra)

**Extend your first script from task 1 to include a new column in your text file including average sky view factor calculated using a processing algorithm, either from UMEP (a QGIS third party plugin) or SAGA GIS**

Make use of instructions given earlier. For third party plugins, talk to teachers for more help

No hand in