Open-source tools development for geospatial analysis

Introduction to QGIS plugin

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What is a plugin?

A QGIS plugin refers to a software component that extends the functionality of QGIS. A plugin adds specific features, tools, or capabilities to QGIS, allowing users to customize and enhance their GIS workflows according to their specific needs.
A QGIS plugin is written in Python.
Users can browse and install plugins directly from within QGIS using the built-in plugin manager.

We consider two different type of plugin:

- QGIS processing toolbox plugin
- QGIS plugin

When do you need a plugin?

- To **simplify** a process that must be repeated several times with different dataset
- To give a contribution to the community and develop something that miss and it could be useful to a number of people (**citations**)

pyQGIS

PyQGIS is the Python API (Application Programming Interface) for QGIS.
PyQGIS allows users to write scripts and create plugins in Python to interact with and automate various aspects of QGIS.
PyQGIS provides a comprehensive set of modules and classes that enable users to access and manipulate geospatial data, perform geoprocessing tasks, create and manage map layouts, interact with the QGIS interface, and more. With PyQGIS, you can harness the power of QGIS functionality and extend it using Python scripting.

Documentation

PyQGIS: docs: https://docs.qgis.org/3.28/en/docs/pyqgis_developer_cookbook/index.html

PyQGIS tutorial: https://courses.spatialthoughts.com/pyqgis-in-a-day.html

PyQGIS tutorial:

https://anitagraser.com/pyqgis-101-introduction-to-qgis-python-programming-for-non-programmers/

Processing toolbox plugin

The Processing Toolbox in QGIS is a powerful framework that provides a wide range of geospatial analysis and processing tools. It offers a comprehensive collection of algorithms and models which can be used by a pre-compiled plugin.
The algorithms in the Processing Toolbox are not limited to QGIS functionality alone but also include algorithms from other providers, such as GRASS GIS, SAGA GIS, and GDAL/OGR. This integration allows users to access a broad set of geospatial processing capabilities from within QGIS.

Documentation

QGIS docs: https://docs.qgis.org/3.28/en/docs/user_manual/index.html

QGIS processing: https://docs.qgis.org/3.28/en/docs/user_manual/processing/index.html

QGIS alternative tutorial: https://www.qgistutorials.com/en/docs/3/processing_python_scripts.html

QGIS plugin components

- *metadata.txt* - required - Contains general info, version, name and some other metadata used by plugins website and plugin infrastructure.
- *__init__.py* - required - The starting point of the plugin. It has to have the classFactory() method and may have any other initialisation code.
- *mainPlugin.py* - core code - The main working code of the plugin. Contains all the information about the actions of the plugin and the main code.
- *form.ui* - for plugins with custom GUI - The GUI created by Qt Designer.
- *form.py* - compiled GUI - The translation of the form.ui described above to Python.
- *resources.qrc* - optional - An .xml document created by Qt Designer. Contains relative paths to resources used in the GUI forms.
- *resources.py* - compiled resources, optional - The translation of the .qrc file described above to Python.

Documentation

QGIS docs: https://docs.qgis.org/3.28/en/docs/user_manual/index.html

QGIS plugin: https://docs.qgis.org/3.28/en/docs/pyqgis_developer_cookbook/plugins/plugins.html

create-qgis-plugin: https://create-qgis-plugin.readthedocs.io/en/latest/index.html

code in bitbucket: https://bitbucket.org/kul-reseco/create-qgis-plugin/src/master/

Case studies

Easy:

NDVI calculation and relative date difference (raster)

Statistical distribution plot (raster)

Medium:

Index calculation NDVI, NDMI, EVI, SAVI

Statistical distribution plot (vector)

Hard:

Neural Network Algorithm bivariate application (vector)

Convolutional Neural Network for object detection (raster)