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# **PyQGIS developer cookbook**

*Versão 2.18*

**QGIS Project**

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## Introdução

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- Run Python code when QGIS starts
  - PYQGIS\_STARTUP environment variable
  - The `startup.py` file
- Python Console
- Complementos Python
- Aplicações Python
  - Using PyQGIS in standalone scripts
  - Using PyQGIS in custom applications
  - Executando aplicativos personalizados

This document is intended to work both as a tutorial and a reference guide. While it does not list all possible use cases, it should give a good overview of the principal functionality.

Starting from 0.9 release, QGIS has optional scripting support using Python language. We've decided for Python as it's one of the most favourite languages for scripting. PyQGIS bindings depend on SIP and PyQt4. The reason for using SIP instead of more widely used SWIG is that the whole QGIS code depends on Qt libraries. Python bindings for Qt (PyQt) are done also using SIP and this allows seamless integration of PyQGIS with PyQt.

There are several ways how to use Python bindings in QGIS desktop, they are covered in detail in the following sections:

- automatically run Python code when QGIS starts
- issue commands in Python console within QGIS
- create and use plugins in Python
- create custom applications based on QGIS API

Python bindings are also available for QGIS Server:

- starting from 2.8 release, Python plugins are also available on QGIS Server (see *Server Python Plugins*)
- starting from 2.11 version (Master at 2015-08-11), QGIS Server library has Python bindings that can be used to embed QGIS Server into a Python application.

There is a [complete QGIS API](#) reference that documents the classes from the QGIS libraries. Pythonic QGIS API is nearly identical to the API in C++.

A good resource when dealing with plugins is to download some plugins from [plugin repository](#) and examine their code. Also, the `python/plugins/` folder in your QGIS installation contains some plugin that you can use to learn how to develop such plugin and how to perform some of the most common tasks.

### 1.1 Run Python code when QGIS starts

Existem dois métodos distintos de executar o código em Python toda vez que o QGIS é iniciado.

### 1.1.1 PYQGIS\_STARTUP environment variable

You can run Python code just before QGIS initialization completes by setting the `PYQGIS_STARTUP` environment variable to the path of an existing Python file.

This method is something you will probably rarely need, but worth mentioning here because it is one of the several ways to run Python code within QGIS and because this code will run before QGIS initialization is complete. This method is very useful for cleaning `sys.path`, which may have undesirable paths, or for isolating/loading the initial environ without requiring a virt env, e.g. homebrew or MacPorts installs on Mac.

### 1.1.2 The `startup.py` file

Every time QGIS starts, the user's Python home directory (usually: `.qgis2/python`) is searched for a file named `startup.py`, if that file exists, it is executed by the embedded Python interpreter.

## 1.2 Python Console

For scripting, it is possible to take advantage of integrated Python console. It can be opened from menu: *Plugins* → *Python Console*. The console opens as a non-modal utility window:



```
Python Console
1 Python 2.7.6 (default, Mar 22 2014, 23:03:41)
2 [GCC 4.8.2] on alex-portatil
3 ## Type help(iface) for more info and list of methods.
4 >>> layer = qgis.utils.iface.activeLayer()
5 >>> layer.id()
6 u'agueda_linhas_agua20141003093657531'
7 >>> layer.featureCount()
8 14L
9
>>> |
```

Figure 1.1: Terminal Python QGIS

The screenshot above illustrates how to get the layer currently selected in the layer list, show its ID and optionally, if it is a vector layer, show the feature count. For interaction with QGIS environment, there is a `iface` variable, which is an instance of `QgsInterface`. This interface allows access to the map canvas, menus, toolbars and other parts of the QGIS application.

For convenience of the user, the following statements are executed when the console is started (in future it will be possible to set further initial commands)

```
from qgis.core import *
import qgis.utils
```

For those which use the console often, it may be useful to set a shortcut for triggering the console (within menu *Settings* → *Configure shortcuts...*)



## 1.3 Complementos Python

QGIS allows enhancement of its functionality using plugins. This was originally possible only with C++ language. With the addition of Python support to QGIS, it is also possible to use plugins written in Python. The main advantage over C++ plugins is its simplicity of distribution (no compiling for each platform needed) and easier development.

Many plugins covering various functionality have been written since the introduction of Python support. The plugin installer allows users to easily fetch, upgrade and remove Python plugins. See the [Python Plugin Repositories](#) page for various sources of plugins.

Creating plugins in Python is simple, see *Desenvolvimento de Complementos Python* for detailed instructions.

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**Nota:** Python plugins are also available in QGIS server (*label\_qgisserver*), see *Complementos de servidores Python do QGIS* for further details.

---

## 1.4 Aplicações Python

Often when processing some GIS data, it is handy to create some scripts for automating the process instead of doing the same task again and again. With PyQGIS, this is perfectly possible — import the `qgis.core` module, initialize it and you are ready for the processing.

Or you may want to create an interactive application that uses some GIS functionality — measure some data, export a map in PDF or any other functionality. The `qgis.gui` module additionally brings various GUI components, most notably the map canvas widget that can be very easily incorporated into the application with support for zooming, panning and/or any further custom map tools.

PyQGIS custom applications or standalone scripts must be configured to locate the QGIS resources such as projection information, providers for reading vector and raster layers, etc. QGIS Resources are initialized by adding a few lines to the beginning of your application or script. The code to initialize QGIS for custom applications and standalone scripts is similar, but examples of each are provided below.

Note: do *not* use `qgis.py` as a name for your test script — Python will not be able to import the bindings as the script's name will shadow them.

### 1.4.1 Using PyQGIS in standalone scripts

To start a standalone script, initialize the QGIS resources at the beginning of the script similar to the following code:

```
from qgis.core import *

# supply path to qgis install location
QgsApplication.setPrefixPath("/path/to/qgis/installation", True)

# create a reference to the QgsApplication, setting the
# second argument to False disables the GUI
qgs = QgsApplication([], False)

# load providers
qgs.initQgis()

# Write your code here to load some layers, use processing algorithms, etc.

# When your script is complete, call exitQgis() to remove the provider and
# layer registries from memory
qgs.exitQgis()
```

We begin by importing the `qgis.core` module and then configuring the prefix path. The prefix path is the location where QGIS is installed on your system. It is configured in the script by calling the `setPrefixPath` method. The second argument of `setPrefixPath` is set to `True`, which controls whether the default paths are used.

The QGIS install path varies by platform; the easiest way to find it for your your system is to use the *Python Console* from within QGIS and look at the output from running `QgsApplication.prefixPath()`.

After the prefix path is configured, we save a reference to `QgsApplication` in the variable `qgs`. The second argument is set to `False`, which indicates that we do not plan to use the GUI since we are writing a standalone script. With the `QgsApplication` configured, we load the QGIS data providers and layer registry by calling the `qgs.initQgis()` method. With QGIS initialized, we are ready to write the rest of the script. Finally, we wrap up by calling `qgs.exitQgis()` to remove the data providers and layer registry from memory.

### 1.4.2 Using PyQGIS in custom applications

The only difference between *Using PyQGIS in standalone scripts* and a custom PyQGIS application is the second argument when instantiating the `QgsApplication`. Pass `True` instead of `False` to indicate that we plan to use a GUI.

```
from qgis.core import *

# supply path to qgis install location
QgsApplication.setPrefixPath("/path/to/qgis/installation", True)

# create a reference to the QgsApplication
# setting the second argument to True enables the GUI, which we need to do
# since this is a custom application
qgs = QgsApplication([], True)

# load providers
qgs.initQgis()

# Write your code here to load some layers, use processing algorithms, etc.

# When your script is complete, call exitQgis() to remove the provider and
# layer registries from memory
qgs.exitQgis()
```

Now you can work with QGIS API — load layers and do some processing or fire up a GUI with a map canvas. The possibilities are endless :-)

### 1.4.3 Executando aplicativos personalizados

You will need to tell your system where to search for QGIS libraries and appropriate Python modules if they are not in a well-known location — otherwise Python will complain:

```
>>> import qgis.core
ImportError: No module named qgis.core
```

This can be fixed by setting the `PYTHONPATH` environment variable. In the following commands, `qgispath` should be replaced with your actual QGIS installation path:

- on Linux: **export PYTHONPATH=/qgispath/share/qgis/python**
- on Windows: **set PYTHONPATH=c:\qgispath\python**

The path to the PyQGIS modules is now known, however they depend on `qgis_core` and `qgis_gui` libraries (the Python modules serve only as wrappers). Path to these libraries is typically unknown for the operating system, so you get an import error again (the message might vary depending on the system):

```
>>> import qgis.core
```

```
ImportError: libqgis_core.so.1.5.0: cannot open shared object file: No such file or directory
```

Fix this by adding the directories where the QGIS libraries reside to search path of the dynamic linker:

- on Linux: **export LD\_LIBRARY\_PATH=/qgispath/lib**
- on Windows: **set PATH=C:\qgispath;%PATH%**

These commands can be put into a bootstrap script that will take care of the startup. When deploying custom applications using PyQGIS, there are usually two possibilities:

- require user to install QGIS on his platform prior to installing your application. The application installer should look for default locations of QGIS libraries and allow user to set the path if not found. This approach has the advantage of being simpler, however it requires user to do more steps.
- package QGIS together with your application. Releasing the application may be more challenging and the package will be larger, but the user will be saved from the burden of downloading and installing additional pieces of software.

The two deployment models can be mixed - deploy standalone application on Windows and macOS, for Linux leave the installation of QGIS up to user and his package manager.



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## Carregando projetos

---

Sometimes you need to load an existing project from a plugin or (more often) when developing a stand-alone QGIS Python application (see: *Aplicações Python*).

To load a project into the current QGIS application you need a `QgsProject` instance() object and call its `read()` method passing to it a `QFileInfo` object that contains the path from where the project will be loaded:

```
# If you are not inside a QGIS console you first need to import
# qgis and PyQt4 classes you will use in this script as shown below:
from qgis.core import QgsProject
from PyQt4.QtCore import QFileInfo
# Get the project instance
project = QgsProject.instance()
# Print the current project file name (might be empty in case no projects have been loaded)
print project.fileName()
u'/home/user/projects/my_qgis_project.qgs'
# Load another project
project.read(QFileInfo('/home/user/projects/my_other_qgis_project.qgs'))
print project.fileName()
u'/home/user/projects/my_other_qgis_project.qgs'
```

In case you need to make some modifications to the project (for example add or remove some layers) and save your changes, you can call the `write()` method of your project instance. The `write()` method also accepts an optional `QFileInfo` that allows you to specify a path where the project will be saved:

```
# Save the project to the same
project.write()
# ... or to a new file
project.write(QFileInfo('/home/user/projects/my_new_qgis_project.qgs'))
```

Both `read()` and `write()` functions return a boolean value that you can use to check if the operation was successful.

---

**Nota:** If you are writing a QGIS standalone application, in order to synchronise the loaded project with the canvas you need to instantiate a `QgsLayerTreeMapCanvasBridge` as in the example below:

```
bridge = QgsLayerTreeMapCanvasBridge( \
    QgsProject.instance().layerTreeRoot(), canvas)
# Now you can safely load your project and see it in the canvas
project.read(QFileInfo('/home/user/projects/my_other_qgis_project.qgs'))
```

---



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## Carregando Camadas

---

- Camadas Vetoriais
- Camadas Matriciais
- Map Layer Registry

Vamos abrir algumas camadas com dados. QGIS reconhece camadas vetoriais e matriciais. Adicionalmente, camadas personalizadas estão disponíveis, mas não discutiremos este tipo de camadas aqui.

### 3.1 Camadas Vetoriais

To load a vector layer, specify layer's data source identifier, name for the layer and provider's name:

```
layer = QgsVectorLayer(data_source, layer_name, provider_name)
if not layer.isValid():
    print "Layer failed to load!"
```

O identificador da fonte de dados é uma string e é específico para cada provedor de dados vetoriais. O nome da camada é usado no painel de lista de camadas. É importante verificar se a camada foi carregada com sucesso. Se não for, uma instância de camada inválida é retornada.

The quickest way to open and display a vector layer in QGIS is the `addVectorLayer` function of the `QgisInterface`:

```
layer = iface.addVectorLayer("/path/to/shapefile/file.shp", "layer name you like", "ogr")
if not layer:
    print "Layer failed to load!"
```

This creates a new layer and adds it to the map layer registry (making it appear in the layer list) in one step. The function returns the layer instance or *None* if the layer couldn't be loaded.

A lista a seguir mostra como acessar várias fontes de dados usando provedores de dados vetoriais:

- OGR library (shapefiles and many other file formats) — data source is the path to the file:

- for shapefile:

```
vlayer = QgsVectorLayer("/path/to/shapefile/file.shp", "layer_name_you_like", "ogr")
```

- for dxf (note the internal options in data source uri):

```
uri = "/path/to/dxffile/file.dxf|layername=entities|geometrytype=Point"
vlayer = QgsVectorLayer(uri, "layer_name_you_like", "ogr")
```

- PostGIS database — data source is a string with all information needed to create a connection to PostgreSQL database. `QgsDataSourceURI` class can generate this string for you. Note that QGIS has to be compiled with Postgres support, otherwise this provider isn't available:

```
uri = QgsDataSourceURI()
# set host name, port, database name, username and password
uri.setConnection("localhost", "5432", "dbname", "johny", "xxx")
# set database schema, table name, geometry column and optionally
# subset (WHERE clause)
uri.setDataSource("public", "roads", "the_geom", "cityid = 2643")

vlayer = QgsVectorLayer(uri.uri(False), "layer name you like", "postgres")
```

---

**Nota:** The `False` argument passed to `uri.uri(False)` prevents the expansion of the authentication configuration parameters, if you are not using any authentication configuration this argument does not make any difference.

---

- CSV or other delimited text files — to open a file with a semicolon as a delimiter, with field “x” for x-coordinate and field “y” for y-coordinate you would use something like this:

```
uri = "/some/path/file.csv?delimiter=%s&xField=%s&yField=%s" % (";", "x", "y")
vlayer = QgsVectorLayer(uri, "layer name you like", "delimitedtext")
```

---

**Nota:** The provider string is structured as a URL, so the path must be prefixed with `file://`. Also it allows WKT (well known text) formatted geometries as an alternative to x and y fields, and allows the coordinate reference system to be specified. For example:

---

```
uri = "file:///some/path/file.csv?delimiter=%s&crs=epsg:4723&wktField=%s" % (";", "shape")
```

- GPX files — the “gpx” data provider reads tracks, routes and waypoints from gpx files. To open a file, the type (track/route/waypoint) needs to be specified as part of the url:

```
uri = "path/to/gpx/file.gpx?type=track"
vlayer = QgsVectorLayer(uri, "layer name you like", "gpx")
```

- Spatialite database — Similarly to PostGIS databases, `QgsDataSourceURI` can be used for generation of data source identifier:

```
uri = QgsDataSourceURI()
uri.setDatabase('/home/martin/test-2.3.sqlite')
schema = ''
table = 'Towns'
geom_column = 'Geometry'
uri.setDataSource(schema, table, geom_column)

display_name = 'Towns'
vlayer = QgsVectorLayer(uri.uri(), display_name, 'spatialite')
```

- MySQL WKB-based geometries, through OGR — data source is the connection string to the table:

```
uri = "MySQL:dbname,host=localhost,port=3306,user=root,password=xxx|layername=my_table"
vlayer = QgsVectorLayer(uri, "my table", "ogr")
```

- WFS connection: the connection is defined with a URI and using the WFS provider:

```
uri = "http://localhost:8080/geoserver/wfs?srsname=EPSG:23030&typename=union&version=1.0.0&re"
vlayer = QgsVectorLayer(uri, "my wfs layer", "WFS")
```

The uri can be created using the standard `urllib` library:

```
params = {
    'service': 'WFS',
    'version': '1.0.0',
    'request': 'GetFeature',
    'typename': 'union',
    'srsname': "EPSG:23030"
```



```

}
uri = 'http://localhost:8080/geoserver/wfs?' + urllib.unquote(urllib.urlencode(params))

```

**Nota:** You can change the data source of an existing layer by calling `setDataSource()` on a `QgsVectorLayer` instance, as in the following example:

```

# layer is a vector layer, uri is a QgsDataSourceURI instance
layer.setDataSource(uri.uri(), "layer name you like", "postgres")

```

## 3.2 Camadas Matriciais

For accessing raster files, GDAL library is used. It supports a wide range of file formats. In case you have troubles with opening some files, check whether your GDAL has support for the particular format (not all formats are available by default). To load a raster from a file, specify its file name and base name:

```

fileName = "/path/to/raster/file.tif"
fileInfo = QFileInfo(fileName)
baseName = fileInfo.baseName()
rlayer = QgsRasterLayer(fileName, baseName)
if not rlayer.isValid():
    print "Layer failed to load!"

```

Similarly to vector layers, raster layers can be loaded using the `addRasterLayer` function of the `QgisInterface`:

```

iface.addRasterLayer("/path/to/raster/file.tif", "layer name you like")

```

This creates a new layer and adds it to the map layer registry (making it appear in the layer list) in one step.

Raster layers can also be created from a WCS service:

```

layer_name = 'modis'
uri = QgsDataSourceURI()
uri.setParam('url', 'http://demo.mapserver.org/cgi-bin/wcs')
uri.setParam("identifier", layer_name)
rlayer = QgsRasterLayer(str(uri.encodedUri()), 'my wcs layer', 'wcs')

```

detailed URI settings can be found in [provider documentation](#)

Alternatively you can load a raster layer from WMS server. However currently it's not possible to access `GetCapabilities` response from API — you have to know what layers you want:

```

urlWithParams = 'url=http://irs.gis-lab.info/?layers=landsat&styles=&format=image/jpeg&crs=EPSG:4
rlayer = QgsRasterLayer(urlWithParams, 'some layer name', 'wms')
if not rlayer.isValid():
    print "Layer failed to load!"

```

## 3.3 Map Layer Registry

If you would like to use the opened layers for rendering, do not forget to add them to map layer registry. The map layer registry takes ownership of layers and they can be later accessed from any part of the application by their unique ID. When the layer is removed from map layer registry, it gets deleted, too.

Adding a layer to the registry:

```

QgsMapLayerRegistry.instance().addMapLayer(layer)

```

Layers are destroyed automatically on exit, however if you want to delete the layer explicitly, use:

```
QgsMapLayerRegistry.instance().removeMapLayer(layer_id)
```

For a list of loaded layers and layer ids, use:

```
QgsMapLayerRegistry.instance().mapLayers()
```

---

## Usando Camadas Raster

---

- Detalhes da Camada
- Renderer
  - Rasters única banda
  - Rasters Multi Banda
- Refreshing Layers
- Query Values

This sections lists various operations you can do with raster layers.

### 4.1 Detalhes da Camada

A raster layer consists of one or more raster bands — it is referred to as either single band or multi band raster. One band represents a matrix of values. Usual color image (e.g. aerial photo) is a raster consisting of red, blue and green band. Single band layers typically represent either continuous variables (e.g. elevation) or discrete variables (e.g. land use). In some cases, a raster layer comes with a palette and raster values refer to colors stored in the palette:

```
rlayer.width(), rlayer.height()
(812, 301)
rlayer.extent()
<qgis._core.QgsRectangle object at 0x00000000F8A2048>
rlayer.extent().toString()
u'12.095833,48.552777 : 18.863888,51.056944'
rlayer.rasterType()
2 # 0 = GrayOrUndefined (single band), 1 = Palette (single band), 2 = Multiband
rlayer.bandCount()
3
rlayer.metadata()
u'<p class="glossy">Driver:</p>...'
rlayer.hasPyramids()
False
```

### 4.2 Renderer

When a raster layer is loaded, it gets a default renderer based on its type. It can be altered either in raster layer properties or programmatically.

To query the current renderer:

```
>>> rlayer.renderer()
<qgis._core.QgsSingleBandPseudoColorRenderer object at 0x7f471c1da8a0>
>>> rlayer.renderer().type()
u'singlebandpseudocolor'
```

To set a renderer use `setRenderer()` method of `QgsRasterLayer`. There are several available renderer classes (derived from `QgsRasterRenderer`):

- `QgsMultiBandColorRenderer`
- `QgsPalettedRasterRenderer`
- `QgsSingleBandColorDataRenderer`
- `QgsSingleBandGrayRenderer`
- `QgsSingleBandPseudoColorRenderer`

Single band raster layers can be drawn either in gray colors (low values = black, high values = white) or with a pseudocolor algorithm that assigns colors for values from the single band. Single band rasters with a palette can be additionally drawn using their palette. Multiband layers are typically drawn by mapping the bands to RGB colors. Other possibility is to use just one band for gray or pseudocolor drawing.

The following sections explain how to query and modify the layer drawing style. After doing the changes, you might want to force update of map canvas, see [Refreshing Layers](#).

**TODO:** contrast enhancements, transparency (no data), user defined min/max, band statistics

### 4.2.1 Rasters única banda

Let's say we want to render our raster layer (assuming one band only) with colors ranging from green to yellow (for pixel values from 0 to 255). In the first stage we will prepare `QgsRasterShader` object and configure its shader function:

```
>>> fcn = QgsColorRampShader()
>>> fcn.setColorRampType(QgsColorRampShader.INTERPOLATED)
>>> lst = [ QgsColorRampShader.ColorRampItem(0, QColor(0,255,0)), \
          QgsColorRampShader.ColorRampItem(255, QColor(255,255,0)) ]
>>> fcn.setColorRampItemList(lst)
>>> shader = QgsRasterShader()
>>> shader.setRasterShaderFunction(fcn)
```

The shader maps the colors as specified by its color map. The color map is provided as a list of items with pixel value and its associated color. There are three modes of interpolation of values:

- linear (INTERPOLATED): resulting color is linearly interpolated from the color map entries above and below the actual pixel value
- discrete (DISCRETE): color is used from the color map entry with equal or higher value
- exact (EXACT): color is not interpolated, only the pixels with value equal to color map entries are drawn

In the second step we will associate this shader with the raster layer:

```
>>> renderer = QgsSingleBandPseudoColorRenderer(layer.dataProvider(), 1, shader)
>>> layer.setRenderer(renderer)
```

The number 1 in the code above is band number (raster bands are indexed from one).

### 4.2.2 Rasters Multi Banda

By default, QGIS maps the first three bands to red, green and blue values to create a color image (this is the `MultiBandColor` drawing style). In some cases you might want to override these setting. The following code interchanges red band (1) and green band (2):

```
rlayer.renderer().setGreenBand(1)
rlayer.renderer().setRedBand(2)
```

In case only one band is necessary for visualization of the raster, single band drawing can be chosen — either gray levels or pseudocolor.

## 4.3 Refreshing Layers

If you do change layer symbology and would like ensure that the changes are immediately visible to the user, call these methods

```
if hasattr(layer, "setCacheImage"):
    layer.setCacheImage(None)
layer.triggerRepaint()
```

The first call will ensure that the cached image of rendered layer is erased in case render caching is turned on. This functionality is available from QGIS 1.4, in previous versions this function does not exist — to make sure that the code works with all versions of QGIS, we first check whether the method exists.

---

**Nota:** This method is deprecated as of QGIS 2.18.0 and will produce a warning. Simply calling `triggerRepaint()` is sufficient.

---

The second call emits signal that will force any map canvas containing the layer to issue a refresh.

With WMS raster layers, these commands do not work. In this case, you have to do it explicitly

```
layer.dataProvider().reloadData()
layer.triggerRepaint()
```

In case you have changed layer symbology (see sections about raster and vector layers on how to do that), you might want to force QGIS to update the layer symbology in the layer list (legend) widget. This can be done as follows (iface is an instance of `QgisInterface`)

```
iface.legendInterface().refreshLayerSymbology(layer)
```

## 4.4 Query Values

To do a query on value of bands of raster layer at some specified point

```
ident = rlayer.dataProvider().identify(QgsPoint(15.30, 40.98), \
    QgsRaster.IdentifyFormatValue)
if ident.isValid():
    print ident.results()
```

The `results` method in this case returns a dictionary, with band indices as keys, and band values as values.

```
{1: 17, 2: 220}
```



---

## Usando Camadas Vetor

---

- Retrieving information about attributes
- Selecionando características
- Interagindo sobre camada vetor
  - Acessando atributos
  - Iteração sobre os feições selecionadas
  - Iterando sobre um subconjunto de feições
- Modificando Camadas Vetoriais
  - Adicionar feições
  - Excluir feições
  - Modificar Feições
  - Adicionando e Removendo Campos
- Modificando Camadas Vetoriais com um Buffer
- Utilizando Índices Espaciais
- Writing Vector Layers
- Memory Provider
- Aparência (Simbologia) de Camadas de Vetor
  - Single Symbol Renderer
  - Categorized Symbol Renderer
  - Graduated Symbol Renderer
  - Trabalhando com Símbolos
    - \* Trabalhando com Camadas de Símbolos
    - \* Creating Custom Symbol Layer Types
  - Creating Custom Renderers
- Outros Tópicos

Esta seção lista várias operações que podem ser realizadas com camadas vetoriais.

### 5.1 Retrieving information about attributes

You can retrieve information about the fields associated with a vector layer by calling `pendingFields()` on a `QgsVectorLayer` instance:

```
# "layer" is a QgsVectorLayer instance
for field in layer.pendingFields():
    print field.name(), field.typeName()
```

---

**Nota:** Starting from QGIS 2.12 there is also a `fields()` in `QgsVectorLayer` which is an alias to `pendingFields()`.

---

## 5.2 Selecionando características

In QGIS desktop, features can be selected in different ways, the user can click on a feature, draw a rectangle on the map canvas or use an expression filter. Selected features are normally highlighted in a different color (default is yellow) to draw user's attention on the selection. Sometimes can be useful to programmatically select features or to change the default color.

To change the selection color you can use `setSelectionColor()` method of `QgsMapCanvas` as shown in the following example:

```
iface.mapCanvas().setSelectionColor( QColor("red") )
```

To add features to the selected features list for a given layer, you can call `setSelectedFeatures()` passing to it the list of features IDs:

```
# Get the active layer (must be a vector layer)
layer = iface.activeLayer()
# Get the first feature from the layer
feature = layer.getFeatures().next()
# Add this features to the selected list
layer.setSelectedFeatures([feature.id()])
```

To clear the selection, just pass an empty list:

```
layer.setSelectedFeatures([])
```

## 5.3 Interagindo sobre camada vetor

Iterating over the features in a vector layer is one of the most common tasks. Below is an example of the simple basic code to perform this task and showing some information about each feature. the `layer` variable is assumed to have a `QgsVectorLayer` object

```
iter = layer.getFeatures()
for feature in iter:
    # retrieve every feature with its geometry and attributes
    # fetch geometry
    geom = feature.geometry()
    print "Feature ID %d: " % feature.id()

    # show some information about the feature
    if geom.type() == Qgs.Point:
        x = geom.asPoint()
        print "Point: " + str(x)
    elif geom.type() == Qgs.Line:
        x = geom.asPolyline()
        print "Line: %d points" % len(x)
    elif geom.type() == Qgs.Polygon:
        x = geom.asPolygon()
        numPts = 0
        for ring in x:
            numPts += len(ring)
        print "Polygon: %d rings with %d points" % (len(x), numPts)
    else:
        print "Unknown"

    # fetch attributes
    attrs = feature.attributes()

    # attrs is a list. It contains all the attribute values of this feature
    print attrs
```



### 5.3.1 Acessando atributos

Attributes can be referred to by their name.

```
print feature['name']
```

Alternatively, attributes can be referred to by index. This will be a bit faster than using the name. For example, to get the first attribute:

```
print feature[0]
```

### 5.3.2 Iteração sobre os feições selecionadas

if you only need selected features, you can use the `selectedFeatures()` method from vector layer:

```
selection = layer.selectedFeatures()
print len(selection)
for feature in selection:
    # do whatever you need with the feature
```

Another option is the `Processing features()` method:

```
import processing
features = processing.features(layer)
for feature in features:
    # do whatever you need with the feature
```

By default, this will iterate over all the features in the layer, in case there is no selection, or over the selected features otherwise. Note that this behavior can be changed in the `Processing options` to ignore selections.

### 5.3.3 Iterando sobre um subconjunto de feições

If you want to iterate over a given subset of features in a layer, such as those within a given area, you have to add a `QgsFeatureRequest` object to the `getFeatures()` call. Here's an example

```
request = QgsFeatureRequest()
request.setFilterRect(areaOfInterest)
for feature in layer.getFeatures(request):
    # do whatever you need with the feature
```

With `setLimit()` you can limit the number of requested features. Here's an example

```
request = QgsFeatureRequest()
request.setLimit(2)
for feature in layer.getFeatures(request):
    # loop through only 2 features
```

If you need an attribute-based filter instead (or in addition) of a spatial one like shown in the examples above, you can build an `QgsExpression` object and pass it to the `QgsFeatureRequest` constructor. Here's an example

```
# The expression will filter the features where the field "location_name"
# contains the word "Lake" (case insensitive)
exp = QgsExpression('location_name ILIKE \'%Lake%\'')
request = QgsFeatureRequest(exp)
```

See *Expressões, filtragem e cálculo dos valores* for the details about the syntax supported by `QgsExpression`.

The request can be used to define the data retrieved for each feature, so the iterator returns all features, but returns partial data for each of them.

```
# Only return selected fields
request.setSubsetOfAttributes([0,2])
# More user friendly version
request.setSubsetOfAttributes(['name','id'],layer.pendingFields())
# Don't return geometry objects
request.setFlags(QgsFeatureRequest.NoGeometry)
```

---

**Dica: Speed features request**

If you only need a subset of the attributes or you don't need the geometry information, you can significantly increase the **speed** of the features request by using `QgsFeatureRequest.NoGeometry` flag or specifying a subset of attributes (possibly empty) like shown in the example above.

---

## 5.4 Modificando Camadas Vetoriais

Most vector data providers support editing of layer data. Sometimes they support just a subset of possible editing actions. Use the `capabilities()` function to find out what set of functionality is supported

```
caps = layer.dataProvider().capabilities()
# Check if a particular capability is supported:
caps & QgsVectorDataProvider.DeleteFeatures
# Print 2 if DeleteFeatures is supported
```

For a list of all available capabilities, please refer to the [API Documentation of QgsVectorDataProvider](#)

To print layer's capabilities textual description in a comma separated list you can use `capabilitiesString()` as in the following example:

```
caps_string = layer.dataProvider().capabilitiesString()
# Print:
# u'Add Features, Delete Features, Change Attribute Values,
# Add Attributes, Delete Attributes, Create Spatial Index,
# Fast Access to Features at ID, Change Geometries,
# Simplify Geometries with topological validation'
```

By using any of the following methods for vector layer editing, the changes are directly committed to the underlying data store (a file, database etc). In case you would like to do only temporary changes, skip to the next section that explains how to do *modifications with editing buffer*.

---

**Nota:** If you are working inside QGIS (either from the console or from a plugin), it might be necessary to force a redraw of the map canvas in order to see the changes you've done to the geometry, to the style or to the attributes:

```
# If caching is enabled, a simple canvas refresh might not be sufficient
# to trigger a redraw and you must clear the cached image for the layer
if iface.mapCanvas().isCachingEnabled():
    layer.setCacheImage(None)
else:
    iface.mapCanvas().refresh()
```

---

### 5.4.1 Adicionar feições

Create some `QgsFeature` instances and pass a list of them to provider's `addFeatures()` method. It will return two values: `result` (true/false) and list of added features (their ID is set by the data store).

To set up the attributes you can either initialize the feature passing a `QgsFields` instance or call `initAttributes()` passing the number of fields you want to be added.

```

if caps & QgsVectorDataProvider.AddFeatures:
    feat = QgsFeature(layer.pendingFields())
    feat.setAttributes([0, 'hello'])
    # Or set a single attribute by key or by index:
    feat.setAttribute('name', 'hello')
    feat.setAttribute(0, 'hello')
    feat.setGeometry(QgsGeometry.fromPoint(QgsPoint(123, 456)))
    (res, outFeats) = layer.dataProvider().addFeatures([feat])

```

## 5.4.2 Excluir feições

To delete some features, just provide a list of their feature IDs

```

if caps & QgsVectorDataProvider.DeleteFeatures:
    res = layer.dataProvider().deleteFeatures([5, 10])

```

## 5.4.3 Modificar Feições

It is possible to either change feature's geometry or to change some attributes. The following example first changes values of attributes with index 0 and 1, then it changes the feature's geometry

```

fid = 100 # ID of the feature we will modify

if caps & QgsVectorDataProvider.ChangeAttributeValues:
    attrs = { 0 : "hello", 1 : 123 }
    layer.dataProvider().changeAttributeValues({ fid : attrs })

if caps & QgsVectorDataProvider.ChangeGeometries:
    geom = QgsGeometry.fromPoint(QgsPoint(111,222))
    layer.dataProvider().changeGeometryValues({ fid : geom })

```

---

### Dica: Favor QgsVectorLayerEditUtils class for geometry-only edits

If you only need to change geometries, you might consider using the `QgsVectorLayerEditUtils` which provides some of useful methods to edit geometries (translate, insert or move vertex etc.).

---

### Dica: Directly save changes using `with` based command

Using `with edit(layer)`: the changes will be committed automatically calling `commitChanges()` at the end. If any exception occurs, it will `rollback()` all the changes. See *Modificando Camadas Vetoriais com um Buffer*.

---

## 5.4.4 Adicionando e Removendo Campos

To add fields (attributes), you need to specify a list of field definitions. For deletion of fields just provide a list of field indexes.

```

from PyQt4.QtCore import QVariant

if caps & QgsVectorDataProvider.AddAttributes:
    res = layer.dataProvider().addAttributes(
        [QgsField("mytext", QVariant.String),
         QgsField("myint", QVariant.Int)])

if caps & QgsVectorDataProvider.DeleteAttributes:
    res = layer.dataProvider().deleteAttributes([0])

```

After adding or removing fields in the data provider the layer's fields need to be updated because the changes are not automatically propagated.

```
layer.updateFields()
```

## 5.5 Modificando Camadas Vetoriais com um Buffer

When editing vectors within QGIS application, you have to first start editing mode for a particular layer, then do some modifications and finally commit (or rollback) the changes. All the changes you do are not written until you commit them — they stay in layer's in-memory editing buffer. It is possible to use this functionality also programmatically — it is just another method for vector layer editing that complements the direct usage of data providers. Use this option when providing some GUI tools for vector layer editing, since this will allow user to decide whether to commit/rollback and allows the usage of undo/redo. When committing changes, all changes from the editing buffer are saved to data provider.

To find out whether a layer is in editing mode, use `isEditable()` — the editing functions work only when the editing mode is turned on. Usage of editing functions

```
from PyQt4.QtCore import QVariant

# add two features (QgsFeature instances)
layer.addFeatures([feat1, feat2])
# delete a feature with specified ID
layer.deleteFeature(fid)

# set new geometry (QgsGeometry instance) for a feature
layer.changeGeometry(fid, geometry)
# update an attribute with given field index (int) to given value (QVariant)
layer.changeAttributeValue(fid, fieldIndex, value)

# add new field
layer.addAttribute(QgsField("mytext", QVariant.String))
# remove a field
layer.deleteAttribute(fieldIndex)
```

In order to make undo/redo work properly, the above mentioned calls have to be wrapped into undo commands. (If you do not care about undo/redo and want to have the changes stored immediately, then you will have easier work by *editing with data provider*.) How to use the undo functionality

```
layer.beginEditCommand("Feature triangulation")

# ... call layer's editing methods ...

if problem_occurred:
    layer.destroyEditCommand()
    return

# ... more editing ...

layer.endEditCommand()
```

The `beginEditCommand()` will create an internal “active” command and will record subsequent changes in vector layer. With the call to `endEditCommand()` the command is pushed onto the undo stack and the user will be able to undo/redo it from GUI. In case something went wrong while doing the changes, the `destroyEditCommand()` method will remove the command and rollback all changes done while this command was active.

To start editing mode, there is `startEditing()` method, to stop editing there are `commitChanges()` and `rollback()` — however normally you should not need these methods and leave this functionality to be triggered by the user.

You can also use the `with edit(layer)`-statement to wrap `commit` and `rollback` into a more semantic code block as shown in the example below:

```
with edit(layer):
    feat = layer.getFeatures().next()
    feat[0] = 5
    layer.updateFeature(feat)
```

This will automatically call `commitChanges()` in the end. If any exception occurs, it will `rollback()` all the changes. In case a problem is encountered within `commitChanges()` (when the method returns `False`) a `QgsEditError` exception will be raised.

## 5.6 Utilizando Índices Espaciais

Spatial indexes can dramatically improve the performance of your code if you need to do frequent queries to a vector layer. Imagine, for instance, that you are writing an interpolation algorithm, and that for a given location you need to know the 10 closest points from a points layer, in order to use those point for calculating the interpolated value. Without a spatial index, the only way for QGIS to find those 10 points is to compute the distance from each and every point to the specified location and then compare those distances. This can be a very time consuming task, especially if it needs to be repeated for several locations. If a spatial index exists for the layer, the operation is much more effective.

Think of a layer without a spatial index as a telephone book in which telephone numbers are not ordered or indexed. The only way to find the telephone number of a given person is to read from the beginning until you find it.

Spatial indexes are not created by default for a QGIS vector layer, but you can create them easily. This is what you have to do:

- create spatial index — the following code creates an empty index

```
index = QgsSpatialIndex()
```

- add features to index — index takes `QgsFeature` object and adds it to the internal data structure. You can create the object manually or use one from previous call to provider's `nextFeature()`

```
index.insertFeature(feat)
```

- alternatively, you can load all features of a layer at once using bulk loading

```
index = QgsSpatialIndex(layer.getFeatures())
```

- uma vez que o índice espacial é preenchido com alguns valores, você pode fazer algumas consultas

```
# returns array of feature IDs of five nearest features
nearest = index.nearestNeighbor(QgsPoint(25.4, 12.7), 5)
```

```
# returns array of IDs of features which intersect the rectangle
intersect = index.intersects(QgsRectangle(22.5, 15.3, 23.1, 17.2))
```

## 5.7 Writing Vector Layers

You can write vector layer files using `QgsVectorFileWriter` class. It supports any other kind of vector file that OGR supports (shapefiles, GeoJSON, KML and others).

There are two possibilities how to export a vector layer:

- from an instance of `QgsVectorLayer`

```

error = QgsVectorFileWriter.writeAsVectorFormat(layer, "my_shapes.shp", "CP1250", None, "ESRI SH
if error == QgsVectorFileWriter.NoError:
    print "success!"

error = QgsVectorFileWriter.writeAsVectorFormat(layer, "my_json.json", "utf-8", None, "GeoJSON
if error == QgsVectorFileWriter.NoError:
    print "success again!"

```

The third parameter specifies output text encoding. Only some drivers need this for correct operation - shapefiles are one of those — however in case you are not using international characters you do not have to care much about the encoding. The fourth parameter that we left as `None` may specify destination CRS — if a valid instance of `QgsCoordinateReferenceSystem` is passed, the layer is transformed to that CRS.

For valid driver names please consult the [supported formats by OGR](#) — you should pass the value in the “Code” column as the driver name. Optionally you can set whether to export only selected features, pass further driver-specific options for creation or tell the writer not to create attributes — look into the documentation for full syntax.

- directly from features

```

from PyQt4.QtCore import QVariant

# define fields for feature attributes. A QgsFields object is needed
fields = QgsFields()
fields.append(QgsField("first", QVariant.Int))
fields.append(QgsField("second", QVariant.String))

""" create an instance of vector file writer, which will create the vector file.
Arguments:
1. path to new file (will fail if exists already)
2. encoding of the attributes
3. field map
4. geometry type - from WKBTYP enum
5. layer's spatial reference (instance of
   QgsCoordinateReferenceSystem) - optional
6. driver name for the output file """
writer = QgsVectorFileWriter("my_shapes.shp", "CP1250", fields, QGis.WKBPoint, None, "ESRI SH

if writer.hasError() != QgsVectorFileWriter.NoError:
    print "Error when creating shapefile: ", w.errorMessage()

# add a feature
fet = QgsFeature()
fet.setGeometry(QgsGeometry.fromPoint(QgsPoint(10,10)))
fet.setAttributes([1, "text"])
writer.addFeature(fet)

# delete the writer to flush features to disk
del writer

```

## 5.8 Memory Provider

Memory provider is intended to be used mainly by plugin or 3rd party app developers. It does not store data on disk, allowing developers to use it as a fast backend for some temporary layers.

The provider supports string, int and double fields.

The memory provider also supports spatial indexing, which is enabled by calling the provider’s `createSpatialIndex()` function. Once the spatial index is created you will be able to iterate over fea-

tures within smaller regions faster (since it's not necessary to traverse all the features, only those in specified rectangle).

A memory provider is created by passing "memory" as the provider string to the `QgsVectorLayer` constructor.

The constructor also takes a URI defining the geometry type of the layer, one of: "Point", "LineString", "Polygon", "MultiPoint", "MultiLineString", or "MultiPolygon".

The URI can also specify the coordinate reference system, fields, and indexing of the memory provider in the URI. The syntax is:

**crs=definição** Specifies the coordinate reference system, where definition may be any of the forms accepted by `QgsCoordinateReferenceSystem.createFromString()`

**index=yes** Especifica que o provedor irá usar o index espacial

**field=name:type(tamanho,precisão)** Specifies an attribute of the layer. The attribute has a name, and optionally a type (integer, double, or string), length, and precision. There may be multiple field definitions.

O exemplo seguinte de URL incorpora todas estas opções

```
"Point?crs=epsg:4326&field=id:integer&field=name:string(20)&index=yes"
```

The following example code illustrates creating and populating a memory provider

```
from PyQt4.QtCore import QVariant

# create layer
vl = QgsVectorLayer("Point", "temporary_points", "memory")
pr = vl.dataProvider()

# add fields
pr.addAttributes([QgsField("name", QVariant.String),
                  QgsField("age", QVariant.Int),
                  QgsField("size", QVariant.Double)])
vl.updateFields() # tell the vector layer to fetch changes from the provider

# add a feature
fet = QgsFeature()
fet.setGeometry(QgsGeometry.fromPoint(QgsPoint(10,10)))
fet.setAttributes(["Johny", 2, 0.3])
pr.addFeatures([fet])

# update layer's extent when new features have been added
# because change of extent in provider is not propagated to the layer
vl.updateExtents()
```

Finally, let's check whether everything went well

```
# show some stats
print "fields:", len(pr.fields())
print "features:", pr.featureCount()
e = layer.extent()
print "extent:", e.xMinimum(), e.yMinimum(), e.xMaximum(), e.yMaximum()

# iterate over features
f = QgsFeature()
features = vl.getFeatures()
for f in features:
    print "F:", f.id(), f.attributes(), f.geometry().asPoint()
```

## 5.9 Aparência (Simbologia) de Camadas de Vetor

When a vector layer is being rendered, the appearance of the data is given by **renderer** and **symbols** associated with the layer. Symbols are classes which take care of drawing of visual representation of features, while renderers determine what symbol will be used for a particular feature.

The renderer for a given layer can be obtained as shown below:

```
renderer = layer.rendererV2()
```

And with that reference, let us explore it a bit

```
print "Type:", rendererV2.type()
```

There are several known renderer types available in QGIS core library:

Tipo	Classes	Descrição
singleSymbol	QgsSingleSymbolRenderer	Renderiza todas as características com o mesmo símbolo
categorizedSymbol	QgsCategorizedSymbolRenderer	Renderiza características usando um símbolo diferente para cada categoria
graduatedSymbol	QgsGraduatedSymbolRenderer	Renderiza características usando diferentes símbolos para cada limite de valores

There might be also some custom renderer types, so never make an assumption there are just these types. You can query `QgsRendererV2Registry` singleton to find out currently available renderers:

```
print QgsRendererV2Registry.instance().renderersList()
# Print:
[u' singleSymbol',
u' categorizedSymbol',
u' graduatedSymbol',
u' RuleRenderer',
u' pointDisplacement',
u' invertedPolygonRenderer',
u' heatmapRenderer']
```

It is possible to obtain a dump of a renderer contents in text form — can be useful for debugging

```
print rendererV2.dump()
```

### 5.9.1 Single Symbol Renderer

You can get the symbol used for rendering by calling `symbol()` method and change it with `setSymbol()` method (note for C++ devs: the renderer takes ownership of the symbol.)

You can change the symbol used by a particular vector layer by calling `setSymbol()` passing an instance of the appropriate symbol instance. Symbols for *point*, *line* and *polygon* layers can be created by calling the `createSimple()` function of the corresponding classes `QgsMarkerSymbolV2`, `QgsLineSymbolV2` and `QgsFillSymbolV2`.

The dictionary passed to `createSimple()` sets the style properties of the symbol.

For example you can replace the symbol used by a particular **point** layer by calling `setSymbol()` passing an instance of a `QgsMarkerSymbolV2` as in the following code example:

```
symbol = QgsMarkerSymbolV2.createSimple({'name': 'square', 'color': 'red'})
layer.rendererV2().setSymbol(symbol)
```

`name` indicates the shape of the marker, and can be any of the following:

- circulo
- quadrado



- cross
- *retângulo*
- diamante
- pentágono
- triângulo
- triângulo\_equilateral
- estrela
- regular\_star
- flecha
- filled\_arrowhead
- x

To get the full list of properties for the first symbol layer of a symbol instance you can follow the example code:

```
print layer.rendererV2().symbol().symbolLayers()[0].properties()
# Prints
{u'angle': u'0',
u'color': u'0,128,0,255',
u'horizontal_anchor_point': u'1',
u'name': u'circle',
u'offset': u'0,0',
u'offset_map_unit_scale': u'0,0',
u'offset_unit': u'MM',
u'outline_color': u'0,0,0,255',
u'outline_style': u'solid',
u'outline_width': u'0',
u'outline_width_map_unit_scale': u'0,0',
u'outline_width_unit': u'MM',
u'scale_method': u'area',
u'size': u'2',
u'size_map_unit_scale': u'0,0',
u'size_unit': u'MM',
u'vertical_anchor_point': u'1'}
```

This can be useful if you want to alter some properties:

```
# You can alter a single property...
layer.rendererV2().symbol().symbolLayer(0).setName('square')
# ... but not all properties are accessible from methods,
# you can also replace the symbol completely:
props = layer.rendererV2().symbol().symbolLayer(0).properties()
props['color'] = 'yellow'
props['name'] = 'square'
layer.rendererV2().setSymbol(QgsMarkerSymbolV2.createSimple(props))
```

## 5.9.2 Categorized Symbol Renderer

You can query and set attribute name which is used for classification: use `classAttribute()` and `setClassAttribute()` methods.

To get a list of categories

```
for cat in rendererV2.categories():
    print "%s: %s :: %s" % (cat.value().toString(), cat.label(), str(cat.symbol()))
```

Where `value()` is the value used for discrimination between categories, `label()` is a text used for category description and `symbol()` method returns assigned symbol.

The renderer usually stores also original symbol and color ramp which were used for the classification: `sourceColorRamp()` and `sourceSymbol()` methods.

### 5.9.3 Graduated Symbol Renderer

This renderer is very similar to the categorized symbol renderer described above, but instead of one attribute value per class it works with ranges of values and thus can be used only with numerical attributes.

To find out more about ranges used in the renderer

```
for ran in rendererV2.ranges():
    print "%f - %f: %s %s" % (
        ran.lowerValue(),
        ran.upperValue(),
        ran.label(),
        str(ran.symbol())
    )
```

you can again use `classAttribute()` to find out classification attribute name, `sourceSymbol()` and `sourceColorRamp()` methods. Additionally there is `mode()` method which determines how the ranges were created: using equal intervals, quantiles or some other method.

If you wish to create your own graduated symbol renderer you can do so as illustrated in the example snippet below (which creates a simple two class arrangement)

```
from qgis.core import *

myVectorLayer = QgsVectorLayer(myVectorPath, myName, 'ogr')
myTargetField = 'target_field'
myRangeList = []
myOpacity = 1
# Make our first symbol and range...
myMin = 0.0
myMax = 50.0
myLabel = 'Group 1'
myColour = QtGui.QColor('#ffee00')
mySymbol1 = QgsSymbolV2.defaultSymbol(myVectorLayer.geometryType())
mySymbol1.setColor(myColour)
mySymbol1.setAlpha(myOpacity)
myRange1 = QgsRendererRangeV2(myMin, myMax, mySymbol1, myLabel)
myRangeList.append(myRange1)
#now make another symbol and range...
myMin = 50.1
myMax = 100
myLabel = 'Group 2'
myColour = QtGui.QColor('#00eeff')
mySymbol2 = QgsSymbolV2.defaultSymbol(
    myVectorLayer.geometryType())
mySymbol2.setColor(myColour)
mySymbol2.setAlpha(myOpacity)
myRange2 = QgsRendererRangeV2(myMin, myMax, mySymbol2, myLabel)
myRangeList.append(myRange2)
myRenderer = QgsGraduatedSymbolRendererV2('', myRangeList)
myRenderer.setMode(QgsGraduatedSymbolRendererV2.EqualInterval)
myRenderer.setClassAttribute(myTargetField)

myVectorLayer.setRendererV2(myRenderer)
QgsMapLayerRegistry.instance().addMapLayer(myVectorLayer)
```

## 5.9.4 Trabalhando com Símbolos

For representation of symbols, there is `QgsSymbolV2` base class with three derived classes:

- `QgsMarkerSymbolV2` — for point features
- `QgsLineSymbolV2` — for line features
- `QgsFillSymbolV2` — for polygon features

**Every symbol consists of one or more symbol layers** (classes derived from `QgsSymbolLayerV2`). The symbol layers do the actual rendering, the symbol class itself serves only as a container for the symbol layers.

Having an instance of a symbol (e.g. from a renderer), it is possible to explore it: `type()` method says whether it is a marker, line or fill symbol. There is a `dump()` method which returns a brief description of the symbol. To get a list of symbol layers

```
for i in xrange(symbol.symbolLayerCount()):
    lyr = symbol.symbolLayer(i)
    print "%d: %s" % (i, lyr.layerType())
```

To find out symbol's color use `color()` method and `setColor()` to change its color. With marker symbols additionally you can query for the symbol size and rotation with `size()` and `angle()` methods, for line symbols there is `width()` method returning line width.

Por padrão, tamanho e largura são em milímetros e ângulos em graus.

### Trabalhando com Camadas de Símbolos

As said before, symbol layers (subclasses of `QgsSymbolLayerV2`) determine the appearance of the features. There are several basic symbol layer classes for general use. It is possible to implement new symbol layer types and thus arbitrarily customize how features will be rendered. The `layerType()` method uniquely identifies the symbol layer class — the basic and default ones are `SimpleMarker`, `SimpleLine` and `SimpleFill` symbol layers types.

You can get a complete list of the types of symbol layers you can create for a given symbol layer class like this

```
from qgis.core import QgsSymbolLayerV2Registry
myRegistry = QgsSymbolLayerV2Registry.instance()
myMetadata = myRegistry.symbolLayerMetadata("SimpleFill")
for item in myRegistry.symbolLayersForType(QgsSymbolV2.Marker):
    print item
```

#### Output

```
EllipseMarker
FontMarker
SimpleMarker
SvgMarker
VectorField
```

`QgsSymbolLayerV2Registry` class manages a database of all available symbol layer types.

To access symbol layer data, use its `properties()` method that returns a key-value dictionary of properties which determine the appearance. Each symbol layer type has a specific set of properties that it uses. Additionally, there are generic methods `color()`, `size()`, `angle()`, `width()` with their setter counterparts. Of course size and angle is available only for marker symbol layers and width for line symbol layers.

### Creating Custom Symbol Layer Types

Imagine you would like to customize the way how the data gets rendered. You can create your own symbol layer class that will draw the features exactly as you wish. Here is an example of a marker that draws red circles with specified radius

```
class FooSymbolLayer(QgsMarkerSymbolLayerV2):

    def __init__(self, radius=4.0):
        QgsMarkerSymbolLayerV2.__init__(self)
        self.radius = radius
        self.color = QColor(255,0,0)

    def layerType(self):
        return "FooMarker"

    def properties(self):
        return { "radius" : str(self.radius) }

    def startRender(self, context):
        pass

    def stopRender(self, context):
        pass

    def renderPoint(self, point, context):
        # Rendering depends on whether the symbol is selected (QGIS >= 1.5)
        color = context.selectionColor() if context.selected() else self.color
        p = context.renderContext().painter()
        p.setPen(color)
        p.drawEllipse(point, self.radius, self.radius)

    def clone(self):
        return FooSymbolLayer(self.radius)
```

The `layerType()` method determines the name of the symbol layer, it has to be unique among all symbol layers. Properties are used for persistence of attributes. `clone()` method must return a copy of the symbol layer with all attributes being exactly the same. Finally there are rendering methods: `startRender()` is called before rendering first feature, `stopRender()` when rendering is done. And `renderPoint()` method which does the rendering. The coordinates of the point(s) are already transformed to the output coordinates.

For polylines and polygons the only difference would be in the rendering method: you would use `renderPolyline()` which receives a list of lines, resp. `renderPolygon()` which receives list of points on outer ring as a first parameter and a list of inner rings (or None) as a second parameter.

Usually it is convenient to add a GUI for setting attributes of the symbol layer type to allow users to customize the appearance: in case of our example above we can let user set circle radius. The following code implements such widget

```
class FooSymbolLayerWidget(QgsSymbolLayerV2Widget):

    def __init__(self, parent=None):
        QgsSymbolLayerV2Widget.__init__(self, parent)

        self.layer = None

        # setup a simple UI
        self.label = QLabel("Radius:")
        self.spinRadius = QDoubleSpinBox()
        self.hbox = QHBoxLayout()
        self.hbox.addWidget(self.label)
        self.hbox.addWidget(self.spinRadius)
        self.setLayout(self.hbox)
        self.connect(self.spinRadius, SIGNAL("valueChanged(double)"), \
                    self.radiusChanged)

    def setSymbolLayer(self, layer):
        if layer.layerType() != "FooMarker":
            return
        self.layer = layer
```

```

self.spinRadius.setValue(layer.radius)

def symbolLayer(self):
    return self.layer

def radiusChanged(self, value):
    self.layer.radius = value
    self.emit(SIGNAL("changed()"))

```

This widget can be embedded into the symbol properties dialog. When the symbol layer type is selected in symbol properties dialog, it creates an instance of the symbol layer and an instance of the symbol layer widget. Then it calls `setSymbolLayer()` method to assign the symbol layer to the widget. In that method the widget should update the UI to reflect the attributes of the symbol layer. `symbolLayer()` function is used to retrieve the symbol layer again by the properties dialog to use it for the symbol.

On every change of attributes, the widget should emit `changed()` signal to let the properties dialog update the symbol preview.

Now we are missing only the final glue: to make QGIS aware of these new classes. This is done by adding the symbol layer to registry. It is possible to use the symbol layer also without adding it to the registry, but some functionality will not work: e.g. loading of project files with the custom symbol layers or inability to edit the layer's attributes in GUI.

Você terá que criar metadados para a camada de símbolos

```

class FooSymbolLayerMetadata(QgsSymbolLayerV2AbstractMetadata):

    def __init__(self):
        QgsSymbolLayerV2AbstractMetadata.__init__(self, "FooMarker", QgsSymbolV2.Marker)

    def createSymbolLayer(self, props):
        radius = float(props[QString("radius")]) if QString("radius") in props else 4.0
        return FooSymbolLayer(radius)

    def createSymbolLayerWidget(self):
        return FooSymbolLayerWidget()

```

```
QgsSymbolLayerV2Registry.instance().addSymbolLayerType(FooSymbolLayerMetadata())
```

You should pass layer type (the same as returned by the layer) and symbol type (marker/line/fill) to the constructor of parent class. `createSymbolLayer()` takes care of creating an instance of symbol layer with attributes specified in the `props` dictionary. (Beware, the keys are `QString` instances, not “str” objects). And there is `createSymbolLayerWidget()` method which returns settings widget for this symbol layer type.

O último passo para adicionar este símbolo de camada para o registro — e estamos prontos.

## 5.9.5 Creating Custom Renderers

It might be useful to create a new renderer implementation if you would like to customize the rules how to select symbols for rendering of features. Some use cases where you would want to do it: symbol is determined from a combination of fields, size of symbols changes depending on current scale etc.

The following code shows a simple custom renderer that creates two marker symbols and chooses randomly one of them for every feature

```

import random

class RandomRenderer(QgsFeatureRendererV2):
    def __init__(self, syms=None):
        QgsFeatureRendererV2.__init__(self, "RandomRenderer")
        self.syms = syms if syms else [QgsSymbolV2.defaultSymbol(QGis.Point), QgsSymbolV2.defaultSymbol]

    def symbolForFeature(self, feature):

```

```
        return random.choice(self.syms)

    def startRender(self, context, vlayer):
        for s in self.syms:
            s.startRender(context)

    def stopRender(self, context):
        for s in self.syms:
            s.stopRender(context)

    def usedAttributes(self):
        return []

    def clone(self):
        return RandomRendererer(self.syms)
```

The constructor of parent `QgsFeatureRendererV2` class needs renderer name (has to be unique among renderers). `symbolForFeature()` method is the one that decides what symbol will be used for a particular feature. `startRender()` and `stopRender()` take care of initialization/finalization of symbol rendering. `usedAttributes()` method can return a list of field names that renderer expects to be present. Finally `clone()` function should return a copy of the renderer.

Like with symbol layers, it is possible to attach a GUI for configuration of the renderer. It has to be derived from `QgsRendererV2Widget`. The following sample code creates a button that allows user to set symbol of the first symbol

```
class RandomRendererWidget(QgsRendererV2Widget):
    def __init__(self, layer, style, renderer):
        QgsRendererV2Widget.__init__(self, layer, style)
        if renderer is None or renderer.type() != "RandomRenderer":
            self.r = RandomRenderer()
        else:
            self.r = renderer
        # setup UI
        self.btn1 = QgsColorButtonV2()
        self.btn1.setColor(self.r.syms[0].color())
        self.vbox = QVBoxLayout()
        self.vbox.addWidget(self.btn1)
        self.setLayout(self.vbox)
        self.connect(self.btn1, SIGNAL("clicked()"), self.setColor1)

    def setColor1(self):
        color = QColorDialog.getColor(self.r.syms[0].color(), self)
        if not color.isValid(): return
        self.r.syms[0].setColor(color)
        self.btn1.setColor(self.r.syms[0].color())

    def renderer(self):
        return self.r
```

The constructor receives instances of the active layer (`QgsVectorLayer`), the global style (`QgsStyleV2`) and current renderer. If there is no renderer or the renderer has different type, it will be replaced with our new renderer, otherwise we will use the current renderer (which has already the type we need). The widget contents should be updated to show current state of the renderer. When the renderer dialog is accepted, widget's `renderer()` method is called to get the current renderer — it will be assigned to the layer.

The last missing bit is the renderer metadata and registration in registry, otherwise loading of layers with the renderer will not work and user will not be able to select it from the list of renderers. Let us finish our `RandomRenderer` example

```
class RandomRendererMetadata(QgsRendererV2AbstractMetadata):
    def __init__(self):
        QgsRendererV2AbstractMetadata.__init__(self, "RandomRenderer", "Random renderer")
```

```

def createRenderer(self, element):
    return RandomRenderer()
def createRendererWidget(self, layer, style, renderer):
    return RandomRendererWidget(layer, style, renderer)

```

```
QgsRendererV2Registry.instance().addRenderer(RandomRendererMetadata())
```

Similarly as with symbol layers, abstract metadata constructor awaits renderer name, name visible for users and optionally name of renderer's icon. `createRenderer()` method passes `QDomElement` instance that can be used to restore renderer's state from DOM tree. `createRendererWidget()` method creates the configuration widget. It does not have to be present or can return *None* if the renderer does not come with GUI.

To associate an icon with the renderer you can assign it in `QgsRendererV2AbstractMetadata` constructor as a third (optional) argument — the base class constructor in the `RandomRendererMetadata` `__init__()` function becomes

```

QgsRendererV2AbstractMetadata.__init__(self,
    "RandomRenderer",
    "Random renderer",
    QIcon(QPixmap("RandomRendererIcon.png", "png")))

```

The icon can be associated also at any later time using `setIcon()` method of the metadata class. The icon can be loaded from a file (as shown above) or can be loaded from a [Qt resource](#) (PyQt4 includes `.qrc` compiler for Python).

## 5.10 Outros Tópicos

### TODO:

- creating/modifying symbols
- working with style (`QgsStyleV2`)
- working with color ramps (`QgsVectorColorRampV2`)
- rule-based renderer (see [this blogpost](#))
- exploring symbol layer and renderer registries





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## Manipulação Geométrica

---

- Construção de Geometria
- Acesso a Geometria
- Operações e Predicados Geométricos

Points, linestrings and polygons that represent a spatial feature are commonly referred to as geometries. In QGIS they are represented with the `QgsGeometry` class.

Às vezes, uma geometria é realmente uma coleção de simples geometrias (single-part). Tal geometria é chamada de geometria de várias partes. Se ele contém apenas um tipo de simples geometria, podemos chamar de multi-ponto, multi-cadeia linear ou multi-polígono. Por exemplo, um país que consiste de múltiplas ilhas pode ser representado como um sistema multi-polígono.

As coordenadas de geometrias podem estar em qualquer sistema de referência de coordenadas (SRC). Ao buscar feições a partir de uma camada, geometrias associadas terão coordenadas no SRC da camada.

Description and specifications of all possible geometries construction and relationships are available in the [OGC Simple Feature Access Standards](#) for advanced details.

### 6.1 Construção de Geometria

There are several options for creating a geometry:

- a partir das coordenadas

```
gPnt = QgsGeometry.fromPoint(QgsPoint(1,1))
gLine = QgsGeometry.fromPolyline([QgsPoint(1, 1), QgsPoint(2, 2)])
gPolygon = QgsGeometry.fromPolygon([[QgsPoint(1, 1), QgsPoint(2, 2),
                                     QgsPoint(2, 1)])])
```

Coordinates are given using `QgsPoint` class.

Polyline (Linestring) is represented by a list of points. Polygon is represented by a list of linear rings (i.e. closed linestrings). First ring is outer ring (boundary), optional subsequent rings are holes in the polygon.

Geometrias multi-parte passam para um nível maior: multi-ponto é uma lista de pontos, multi-cadeia linear é uma lista de cadeias lineares e multi-polígono é uma lista de polígonos.

- a partir de textos conhecidos (WKT)

```
gem = QgsGeometry.fromWkt("POINT(3 4)")
```

- a partir de binários conhecidos (WKB)

```
>>> g = QgsGeometry()
>>> wkb = '0101000000000000000000004540000000000001440'.decode('hex')
>>> g.fromWkb(wkb)
```

```
>>> g.exportToWkt()
'Point (42 5)'
```

## 6.2 Acesso a Geometria

First, you should find out geometry type, `wkbType()` method is the one to use — it returns a value from `Qgis.WkbType` enumeration

```
>>> gPnt.wkbType() == Qgis.WKBPoint
True
>>> gLine.wkbType() == Qgis.WKBLineString
True
>>> gPolygon.wkbType() == Qgis.WKBPolygon
True
>>> gPolygon.wkbType() == Qgis.WKBMultiPolygon
False
```

As an alternative, one can use `type()` method which returns a value from `Qgis.GeometryType` enumeration. There is also a helper function `isMultipart()` to find out whether a geometry is multipart or not.

To extract information from geometry there are accessor functions for every vector type. How to use accessors

```
>>> gPnt.asPoint()
(1, 1)
>>> gLine.asPolyline()
[(1, 1), (2, 2)]
>>> gPolygon.asPolygon()
[[ (1, 1), (2, 2), (2, 1), (1, 1) ]]
```

---

**Nota:** The tuples (x,y) are not real tuples, they are `QgsPoint` objects, the values are accessible with `x()` and `y()` methods.

---

For multipart geometries there are similar accessor functions: `asMultiPoint()`, `asMultiPolyline()`, `asMultiPolygon()`.

## 6.3 Operações e Predicados Geométricos

QGIS uses GEOS library for advanced geometry operations such as geometry predicates (`contains()`, `intersects()`, ...) and set operations (`union()`, `difference()`, ...). It can also compute geometric properties of geometries, such as area (in the case of polygons) or lengths (for polygons and lines)

Here you have a small example that combines iterating over the features in a given layer and performing some geometric computations based on their geometries.

```
# we assume that 'layer' is a polygon layer
features = layer.getFeatures()
for f in features:
    geom = f.geometry()
    print "Area:", geom.area()
    print "Perimeter:", geom.length()
```

Areas and perimeters don't take CRS into account when computed using these methods from the `QgsGeometry` class. For a more powerful area and distance calculation, the `QgsDistanceArea` class can be used. If projections are turned off, calculations will be planar, otherwise they'll be done on the ellipsoid.

```
d = QgsDistanceArea()
d.setEllipsoid('WGS84')
d.setEllipsoidalMode(True)
```

```
print "distance in meters: ", d.measureLine(QgsPoint(10,10),QgsPoint(11,11))
```

Você pode encontrar muitos exemplos de algoritmos que estão incluídos no QGIS e usar esses métodos para analisar e transformar dados vetoriais. Aqui estão alguns links para o código de alguns deles.

Additional information can be found in following sources:

- Geometry transformation: [Reproject algorithm](#)
- Distance and area using the `QgsDistanceArea` class: [Distance matrix algorithm](#)
- [Multi-part to single-part algorithm](#)



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## Suporte a projeções

---

- Sistemas de Referencia de Coordenadas
- Projections

### 7.1 Sistemas de Referencia de Coordenadas

Coordinate reference systems (CRS) are encapsulated by `QgsCoordinateReferenceSystem` class. Instances of this class can be created by several different ways:

- especificar CRS pela sua identificação

```
# PostGIS SRID 4326 is allocated for WGS84
crs = QgsCoordinateReferenceSystem(4326, QgsCoordinateReferenceSystem.PostgisCrsId)
```

O QGIS usa três diferentes ID para cada sistema de referencia:

- `PostgisCrsId` — Identificação usada nos bancos de dados PostGIS
- `InternalCrsId` — Identificação usada internamente no banco de dados QGIS
- `EpsgCrsId` — Identificação designada pela organização EPSG

Se não é determinado uma coisa diferente no segundo parâmetro, o SRID PostGIS será usado por padrão..

- especificar CRS pelo seu texto conhecido (WKT)

```
wkt = 'GEOGCS["WGS84", DATUM["WGS84", SPHEROID["WGS84", 6378137.0, 298.257223563]],'
      PRIMEM["Greenwich", 0.0], UNIT["degree",0.017453292519943295],
      AXIS["Longitude",EAST], AXIS["Latitude",NORTH]]'
crs = QgsCoordinateReferenceSystem(wkt)
```

- create invalid CRS and then use one of the `create*()` functions to initialize it. In following example we use Proj4 string to initialize the projection

```
crs = QgsCoordinateReferenceSystem()
crs.createFromProj4("+proj=longlat +ellps=WGS84 +datum=WGS84 +no_defs")
```

It's wise to check whether creation (i.e. lookup in the database) of the CRS has been successful: `isValid()` must return `True`.

Note that for initialization of spatial reference systems QGIS needs to look up appropriate values in its internal database `srs.db`. Thus in case you create an independent application you need to set paths correctly with `QgsApplication.setPrefixPath()` otherwise it will fail to find the database. If you are running the commands from QGIS python console or developing a plugin you do not care: everything is already set up for you.

Accessing spatial reference system information

```
print "QGIS CRS ID:", crs.srsid()
print "PostGIS SRID:", crs.srid()
print "EPSG ID:", crs.epsg()
print "Description:", crs.description()
print "Projection Acronym:", crs.projectionAcronym()
print "Ellipsoid Acronym:", crs.ellipsoidAcronym()
print "Proj4 String:", crs.toProj4()
# check whether it's geographic or projected coordinate system
print "Is geographic:", crs.geographicFlag()
# check type of map units in this CRS (values defined in QGis::units enum)
print "Map units:", crs.mapUnits()
```

## 7.2 Projections

You can do transformation between different spatial reference systems by using `QgsCoordinateTransform` class. The easiest way to use it is to create source and destination CRS and construct `QgsCoordinateTransform` instance with them. Then just repeatedly call `transform()` function to do the transformation. By default it does forward transformation, but it is capable to do also inverse transformation

```
crsSrc = QgsCoordinateReferenceSystem(4326) # WGS 84
crsDest = QgsCoordinateReferenceSystem(32633) # WGS 84 / UTM zone 33N
xform = QgsCoordinateTransform(crsSrc, crsDest)

# forward transformation: src -> dest
pt1 = xform.transform(QgsPoint(18,5))
print "Transformed point:", pt1

# inverse transformation: dest -> src
pt2 = xform.transform(pt1, QgsCoordinateTransform.ReverseTransform)
print "Transformed back:", pt2
```

---

## Using Map Canvas

---

- Incorporar o Mapa da Tela
- Usando Ferramentas de Mapas na Tela
- Bandas raster e fazedor de vértices
- Desenhar ferramenta de mapa personalizada
- Desenhar itens da tela do mapa

The Map canvas widget is probably the most important widget within QGIS because it shows the map composed from overlaid map layers and allows interaction with the map and layers. The canvas shows always a part of the map defined by the current canvas extent. The interaction is done through the use of **map tools**: there are tools for panning, zooming, identifying layers, measuring, vector editing and others. Similar to other graphics programs, there is always one tool active and the user can switch between the available tools.

Map canvas is implemented as `QgsMapCanvas` class in `qgis.gui` module. The implementation is based on the Qt Graphics View framework. This framework generally provides a surface and a view where custom graphics items are placed and user can interact with them. We will assume that you are familiar enough with Qt to understand the concepts of the graphics scene, view and items. If not, please make sure to read the [overview of the framework](#).

Whenever the map has been panned, zoomed in/out (or some other action triggers a refresh), the map is rendered again within the current extent. The layers are rendered to an image (using `QgsMapRenderer` class) and that image is then displayed in the canvas. The graphics item (in terms of the Qt graphics view framework) responsible for showing the map is `QgsMapCanvasMap` class. This class also controls refreshing of the rendered map. Besides this item which acts as a background, there may be more **map canvas items**. Typical map canvas items are rubber bands (used for measuring, vector editing etc.) or vertex markers. The canvas items are usually used to give some visual feedback for map tools, for example, when creating a new polygon, the map tool creates a rubber band canvas item that shows the current shape of the polygon. All map canvas items are subclasses of `QgsMapCanvasItem` which adds some more functionality to the basic `QGraphicsItem` objects.

Para resumir, a arquitetura do mapa na tela são constituídas por três conceitos:

- tela do mapa — para visualização do mapa
- map canvas items — additional items that can be displayed in map canvas
- map tools — for interaction with map canvas

### 8.1 Incorporar o Mapa da Tela

Mapa natela é um widget, como qualquer outro widget Qt, então usá-lo é tão simples como criar e mostrá-lo

```
canvas = QgsMapCanvas()
canvas.show()
```

This produces a standalone window with map canvas. It can be also embedded into an existing widget or window. When using .ui files and Qt Designer, place a `QWidget` on the form and promote it to a new class: set `QgsMapCanvas` as class name and set `qgis.gui` as header file. The `pyuic4` utility will take care of it. This is a very convenient way of embedding the canvas. The other possibility is to manually write the code to construct map canvas and other widgets (as children of a main window or dialog) and create a layout.

Por padrão, o mapa na tela tem fundo preto e não usa anti-aliasing. Para definir o fundo branco e permitir anti-aliasing para renderização suave

```
canvas.setCanvasColor(Qt.white)
canvas.enableAntiAliasing(True)
```

(In case you are wondering, `Qt` comes from `PyQt4.QtCore` module and `Qt.white` is one of the predefined `QColor` instances.)

Now it is time to add some map layers. We will first open a layer and add it to the map layer registry. Then we will set the canvas extent and set the list of layers for canvas

```
layer = QgsVectorLayer(path, name, provider)
if not layer.isValid():
    raise IOError, "Failed to open the layer"

# add layer to the registry
QgsMapLayerRegistry.instance().addMapLayer(layer)

# set extent to the extent of our layer
canvas.setExtent(layer.extent())

# set the map canvas layer set
canvas.setLayerSet([QgsMapCanvasLayer(layer)])
```

Depois de executar esses comandos, a tela deve mostrar a camada que você carregou.

## 8.2 Usando Ferramentas de Mapas na Tela

The following example constructs a window that contains a map canvas and basic map tools for map panning and zooming. Actions are created for activation of each tool: panning is done with `QgsMapToolPan`, zooming in/out with a pair of `QgsMapToolZoom` instances. The actions are set as checkable and later assigned to the tools to allow automatic handling of checked/unchecked state of the actions – when a map tool gets activated, its action is marked as selected and the action of the previous map tool is deselected. The map tools are activated using `setMapTool()` method.

```
from qgis.gui import *
from PyQt4.QtGui import QAction, QMainWindow
from PyQt4.QtCore import SIGNAL, Qt, QString

class MyWnd(QMainWindow):
    def __init__(self, layer):
        QMainWindow.__init__(self)

        self.canvas = QgsMapCanvas()
        self.canvas.setCanvasColor(Qt.white)

        self.canvas.setExtent(layer.extent())
        self.canvas.setLayerSet([QgsMapCanvasLayer(layer)])

        self.setCentralWidget(self.canvas)

        actionZoomIn = QAction(QString("Zoom in"), self)
        actionZoomOut = QAction(QString("Zoom out"), self)
        actionPan = QAction(QString("Pan"), self)
```



```

actionZoomIn.setCheckable(True)
actionZoomOut.setCheckable(True)
actionPan.setCheckable(True)

self.connect(actionZoomIn, SIGNAL("triggered()"), self.zoomIn)
self.connect(actionZoomOut, SIGNAL("triggered()"), self.zoomOut)
self.connect(actionPan, SIGNAL("triggered()"), self.pan)

self.toolbar = self.addToolBar("Canvas actions")
self.toolbar.addAction(actionZoomIn)
self.toolbar.addAction(actionZoomOut)
self.toolbar.addAction(actionPan)

# create the map tools
self.toolPan = QgsMapToolPan(self.canvas)
self.toolPan.setAction(actionPan)
self.toolZoomIn = QgsMapToolZoom(self.canvas, False) # false = in
self.toolZoomIn.setAction(actionZoomIn)
self.toolZoomOut = QgsMapToolZoom(self.canvas, True) # true = out
self.toolZoomOut.setAction(actionZoomOut)

self.pan()

def zoomIn(self):
    self.canvas.setMapTool(self.toolZoomIn)

def zoomOut(self):
    self.canvas.setMapTool(self.toolZoomOut)

def pan(self):
    self.canvas.setMapTool(self.toolPan)

```

You can put the above code to a file, e.g. `mywnd.py` and try it out in Python console within QGIS. This code will put the currently selected layer into newly created canvas

```

import mywnd
w = mywnd.MyWnd(qgis.utils.iface.activeLayer())
w.show()

```

Just make sure that the `mywnd.py` file is located within Python search path (`sys.path`). If it isn't, you can simply add it: `sys.path.insert(0, '/my/path')` — otherwise the import statement will fail, not finding the module.

## 8.3 Bandas raster e fazedor de vértices

To show some additional data on top of the map in canvas, use map canvas items. It is possible to create custom canvas item classes (covered below), however there are two useful canvas item classes for convenience: `QgsRubberBand` for drawing polylines or polygons, and `QgsVertexMarker` for drawing points. They both work with map coordinates, so the shape is moved/scaled automatically when the canvas is being panned or zoomed.

Para mostrar as polilinhas

```

r = QgsRubberBand(canvas, False) # False = not a polygon
points = [QgsPoint(-1, -1), QgsPoint(0, 1), QgsPoint(1, -1)]
r.setToGeometry(QgsGeometry.fromPolyline(points), None)

```

Para mostrar o poligono

```
r = QgsRubberBand(canvas, True) # True = a polygon
points = [[QgsPoint(-1, -1), QgsPoint(0, 1), QgsPoint(1, -1)]]
r.setToGeometry(QgsGeometry.fromPolygon(points), None)
```

Note-se que aponta para polígono não é uma lista simples: na verdade, é uma lista de anéis contendo anéis lineares do polígono: primeiro anel é a borda externa, ainda mais (opcional) anéis correspondem aos buracos no polígono.

As Bandas Raster permitem alguma personalização, ou seja, para mudar sua cor e linha de largura

```
r.setColor(QColor(0, 0, 255))
r.setWidth(3)
```

The canvas items are bound to the canvas scene. To temporarily hide them (and show again, use the `hide()` and `show()` combo. To completely remove the item, you have to remove it from the scene of the canvas

```
canvas.scene().removeItem(r)
```

(em C++ é possível simplesmente apagar o item, no entanto, em Python “del r” seria apenas suprimir a referência eo objeto continuará a existir, uma vez que é de propriedade da tela)

Rubber band can be also used for drawing points, however `QgsVertexMarker` class is better suited for this (`QgsRubberBand` would only draw a rectangle around the desired point). How to use the vertex marker

```
m = QgsVertexMarker(canvas)
m.setCenter(QgsPoint(0, 0))
```

This will draw a red cross on position [0,0]. It is possible to customize the icon type, size, color and pen width

```
m.setColor(QColor(0, 255, 0))
m.setIconSize(5)
m.setIconType(QgsVertexMarker.ICON_BOX) # or ICON_CROSS, ICON_X
m.setPenWidth(3)
```

For temporary hiding of vertex markers and removing them from canvas, the same applies as for the rubber bands.

## 8.4 Desenhar ferramenta de mapa personalizada

You can write your custom tools, to implement a custom behaviour to actions performed by users on the canvas.

Map tools should inherit from the `QgsMapTool` class or any derived class, and selected as active tools in the canvas using the `setMapTool()` method as we have already seen.

Aqui está um exemplo de uma ferramenta de mapa que permite definir uma medida retangular, clicando e arrastando na tela. Quando o retângulo é definido, ele imprime coordena seu limite no console. Ele utiliza os elementos de banda de borracha descritos antes para mostrar o retângulo selecionado, uma vez que está a ser definida.

```
class RectangleMapTool(QgsMapToolEmitPoint):
    def __init__(self, canvas):
        self.canvas = canvas
        QgsMapToolEmitPoint.__init__(self, self.canvas)
        self.rubberBand = QgsRubberBand(self.canvas, Qgs.Polygon)
        self.rubberBand.setColor(Qt.red)
        self.rubberBand.setWidth(1)
        self.reset()

    def reset(self):
        self.startPoint = self.endPoint = None
        self.isEmittingPoint = False
        self.rubberBand.reset(Qgs.Polygon)

    def canvasPressEvent(self, e):
        self.startPoint = self.toMapCoordinates(e.pos())
        self.endPoint = self.startPoint
```

```

self.isEmittingPoint = True
self.showRect(self.startPoint, self.endPoint)

def canvasReleaseEvent(self, e):
    self.isEmittingPoint = False
    r = self.rectangle()
    if r is not None:
        print "Rectangle:", r.xMinimum(), r.yMinimum(), r.xMaximum(), r.yMaximum()

def canvasMoveEvent(self, e):
    if not self.isEmittingPoint:
        return

    self.endPoint = self.toMapCoordinates(e.pos())
    self.showRect(self.startPoint, self.endPoint)

def showRect(self, startPoint, endPoint):
    self.rubberBand.reset(QGis.Polygon)
    if startPoint.x() == endPoint.x() or startPoint.y() == endPoint.y():
        return

    point1 = QgsPoint(startPoint.x(), startPoint.y())
    point2 = QgsPoint(startPoint.x(), endPoint.y())
    point3 = QgsPoint(endPoint.x(), endPoint.y())
    point4 = QgsPoint(endPoint.x(), startPoint.y())

    self.rubberBand.addPoint(point1, False)
    self.rubberBand.addPoint(point2, False)
    self.rubberBand.addPoint(point3, False)
    self.rubberBand.addPoint(point4, True)    # true to update canvas
    self.rubberBand.show()

def rectangle(self):
    if self.startPoint is None or self.endPoint is None:
        return None
    elif self.startPoint.x() == self.endPoint.x() or self.startPoint.y() == self.endPoint.y():
        return None

    return QgsRectangle(self.startPoint, self.endPoint)

def deactivate(self):
    super(RectangleMapTool, self).deactivate()
    self.emit(SIGNAL("deactivated()"))

```

## 8.5 Desenhar itens da tela do mapa

**TODO:** Como criar itens do mapa na tela

```

import sys
from qgis.core import QgsApplication
from qgis.gui import QgsMapCanvas

def init():
    a = QgsApplication(sys.argv, True)
    QgsApplication.setPrefixPath('/home/martin/qgis/inst', True)
    QgsApplication.initQgis()
    return a

def show_canvas(app):
    canvas = QgsMapCanvas()
    canvas.show()

```

```
app.exec_()
app = init()
show_canvas(app)
```

---

## Renderização em impressão de mapas

---

- Renderização simples
- Renderizando camadas com CRS diferente
- Output using Map Composer
  - Output to a raster image
  - Output to PDF

There are generally two approaches when input data should be rendered as a map: either do it quick way using `QgsMapRenderer` or produce more fine-tuned output by composing the map with `QgsComposition` class and friends.

### 9.1 Renderização simples

Render some layers using `QgsMapRenderer` — create destination paint device (`QImage`, `QPainter` etc.), set up layer set, extent, output size and do the rendering

```
# create image
img = QImage(QSize(800, 600), QImage.Format_ARGB32_Premultiplied)

# set image's background color
color = QColor(255, 255, 255)
img.fill(color.rgb())

# create painter
p = QPainter()
p.begin(img)
p.setRenderHint(QPainter.Antialiasing)

render = QgsMapRenderer()

# set layer set
lst = [layer.id()] # add ID of every layer
render.setLayerSet(lst)

# set extent
rect = QgsRectangle(render.fullExtent())
rect.scale(1.1)
render.setExtent(rect)

# set output size
render.setOutputSize(img.size(), img.logicalDpiX())

# do the rendering
render.render(p)
```

```
p.end()

# save image
img.save("render.png", "png")
```

## 9.2 Renderizando camadas com CRS diferente

If you have more than one layer and they have a different CRS, the simple example above will probably not work: to get the right values from the extent calculations you have to explicitly set the destination CRS and enable OTF reprojection as in the example below (only the renderer configuration part is reported)

```
...
# set layer set
layers = QgsMapLayerRegistry.instance().mapLayers()
lst = layers.keys()
renderer.setLayerSet(lst)

# Set destination CRS to match the CRS of the first layer
renderer.setDestinationCrs(layers.values()[0].crs())
# Enable OTF reprojection
renderer.setProjectionsEnabled(True)
...
```

## 9.3 Output using Map Composer

Map composer is a very handy tool if you would like to do a more sophisticated output than the simple rendering shown above. Using the composer it is possible to create complex map layouts consisting of map views, labels, legend, tables and other elements that are usually present on paper maps. The layouts can be then exported to PDF, raster images or directly printed on a printer.

The composer consists of a bunch of classes. They all belong to the core library. QGIS application has a convenient GUI for placement of the elements, though it is not available in the GUI library. If you are not familiar with [Qt Graphics View framework](#), then you are encouraged to check the documentation now, because the composer is based on it. Also check the [Python documentation of the implementation of QGraphicView](#).

The central class of the composer is `QgsComposition` which is derived from `QGraphicsScene`. Let us create one

```
mapRenderer = iface.mapCanvas().mapRenderer()
c = QgsComposition(mapRenderer)
c.setPlotStyle(QgsComposition.Print)
```

Note that the composition takes an instance of `QgsMapRenderer`. In the code we expect we are running within QGIS application and thus use the map renderer from map canvas. The composition uses various parameters from the map renderer, most importantly the default set of map layers and the current extent. When using composer in a standalone application, you can create your own map renderer instance the same way as shown in the section above and pass it to the composition.

It is possible to add various elements (map, label, ...) to the composition — these elements have to be descendants of `QgsComposerItem` class. Currently supported items are:

- map — este item diz as bibliotecas onde colocar o próprio mapa. Aqui criamos um mapa e esticamos sobre o tamanho do papel inteiro

```
x, y = 0, 0
w, h = c.paperWidth(), c.paperHeight()
composerMap = QgsComposerMap(c, x, y, w, h)
c.addItem(composerMap)
```

- **label** — permite exibir rótulos. É possível modificar a sua fonte, cor, alinhamento e margem

```
composerLabel = QgsComposerLabel(c)
composerLabel.setText("Hello world")
composerLabel.adjustSizeToText()
c.addItem(composerLabel)
```

- **legenda**

```
legend = QgsComposerLegend(c)
legend.model().setLayerSet(mapRenderer.layerSet())
c.addItem(legend)
```

- **barra de escala**

```
item = QgsComposerScaleBar(c)
item.setStyle('Numeric') # optionally modify the style
item.setComposerMap(composerMap)
item.applyDefaultSize()
c.addItem(item)
```

- **Seta**

- **Imagem**

- **basic shape**

- **nodes based shape**

```
polygon = QPolygonF()
polygon.append(QPointF(0.0, 0.0))
polygon.append(QPointF(100.0, 0.0))
polygon.append(QPointF(200.0, 100.0))
polygon.append(QPointF(100.0, 200.0))

composerPolygon = QgsComposerPolygon(polygon, c)
c.addItem(composerPolygon)

props = {}
props["color"] = "green"
props["style"] = "solid"
props["style_border"] = "solid"
props["color_border"] = "black"
props["width_border"] = "10.0"
props["joinstyle"] = "miter"

style = QgsFillSymbolV2.createSimple(props)
composerPolygon.setPolygonStyleSymbol(style)
```

- **Tabela**

By default the newly created composer items have zero position (top left corner of the page) and zero size. The position and size are always measured in millimeters

```
# set label 1cm from the top and 2cm from the left of the page
composerLabel.setItemPosition(20, 10)
# set both label's position and size (width 10cm, height 3cm)
composerLabel.setItemPosition(20, 10, 100, 30)
```

A frame is drawn around each item by default. How to remove the frame

```
composerLabel.setFrame(False)
```

Besides creating the composer items by hand, QGIS has support for composer templates which are essentially compositions with all their items saved to a .qpt file (with XML syntax). Unfortunately this functionality is not yet available in the API.

Once the composition is ready (the composer items have been created and added to the composition), we can proceed to produce a raster and/or vector output.

The default output settings for composition are page size A4 and resolution 300 DPI. You can change them if necessary. The paper size is specified in millimeters

```
c.setPaperSize(width, height)
c.setPrintResolution(dpi)
```

### 9.3.1 Output to a raster image

The following code fragment shows how to render a composition to a raster image

```
dpi = c.printResolution()
dpmm = dpi / 25.4
width = int(dpmm * c.paperWidth())
height = int(dpmm * c.paperHeight())

# create output image and initialize it
image = QImage(QSize(width, height), QImage.Format_ARGB32)
image.setDotsPerMeterX(dpmm * 1000)
image.setDotsPerMeterY(dpmm * 1000)
image.fill(0)

# render the composition
imagePainter = QPainter(image)
c.renderPage(imagePainter, 0)
imagePainter.end()

image.save("out.png", "png")
```

### 9.3.2 Output to PDF

The following code fragment renders a composition to a PDF file

```
printer = QPrinter()
printer.setOutputFormat(QPrinter.PdfFormat)
printer.setOutputFileName("out.pdf")
printer.setPaperSize(QSizeF(c.paperWidth(), c.paperHeight()), QPrinter.Millimeter)
printer.setFullPage(True)
printer.setColorMode(QPrinter.Color)
printer.setResolution(c.printResolution())

pdfPainter = QPainter(printer)
paperRectMM = printer.pageRect(QPrinter.Millimeter)
paperRectPixel = printer.pageRect(QPrinter.DevicePixel)
c.render(pdfPainter, paperRectPixel, paperRectMM)
pdfPainter.end()
```



---

## Expressões, filtragem e cálculo dos valores

---

- Expressões de Análise
- Expressões de Avaliação
  - Expressões Básicas
  - Expressões com características
  - Manipulação de erros
- Exemplos

O QGIS possui alguns recursos para análise de expressões semelhantes à SQL. Apenas um pequeno subconjunto da sintaxe SQL é suportado. As expressões podem ser avaliadas tanto como predicados booleanos (retornando Verdadeiro ou Falso) ou como funções (retornando um valor escalar). Veja *vector\_expressions* no Manual do Usuário para uma lista completa das funções disponíveis.

Três tipos básicos são suportados:

- número — ambos os números inteiros e números decimais, por exemplo, 123, 3.14
- texto — eles devem estar entre aspas simples: *'Olá world'*
- coluna referência — ao avaliar, a referência é substituída com o valor real do campo. Os nomes não alteram.

As seguintes operações estão disponíveis:

- operadores aritméticos: +, -, \*, /, ^
- parênteses: para fazer cumprir a precedência do operador: (1 + 1) \* 3
- Sinal mais e menos: -12, +5
- funções matemáticas: sqrt, sen, cos, tan, asen, acos, atan
- Funções de conversão: "to\_int", "to\_real", "to\_string", "to\_date"
- funções geométricas: \$area, \$length
- funções de manipulação de geometria: "\$x", "\$y", "\$geometry", "num\_geometries", "centroid"

E os seguintes predicados são suportados:

- comparação: =, !=, >, >=, <, <=
- correspondência padrão: LIKE (usando % e \_), ~ (expressões regulares)
- predicados lógicos: AND, OR, NOT
- verificação de valor nulo: IS NULL, IS NOT NULL

Exemplos de predicados:

- 1 + 2 = 3
- sen(ângulo) > 0

- 'Hello' LIKE 'He%'
- (x > 10 AND y > 10) OR z = 0

Exemplos de expressões escalares:

- 2 ^ 10
- sqrt(val)
- \$length + 1

## 10.1 Expressões de Análise

```
>>> exp = QgsExpression('1 + 1 = 2')
>>> exp.hasParserError()
False
>>> exp = QgsExpression('1 + 1 = ')
>>> exp.hasParserError()
True
>>> exp.parserErrorString()
PyQt4.QtCore.QString(u'syntax error, unexpected $end')
```

## 10.2 Expressões de Avaliação

### 10.2.1 Expressões Básicas

```
>>> exp = QgsExpression('1 + 1 = 2')
>>> value = exp.evaluate()
>>> value
1
```

### 10.2.2 Expressões com características

The following example will evaluate the given expression against a feature. “Column” is the name of the field in the layer.

```
>>> exp = QgsExpression('Column = 99')
>>> value = exp.evaluate(feature, layer.pendingFields())
>>> bool(value)
True
```

You can also use `QgsExpression.prepare()` if you need check more than one feature. Using `QgsExpression.prepare()` will increase the speed that evaluate takes to run.

```
>>> exp = QgsExpression('Column = 99')
>>> exp.prepare(layer.pendingFields())
>>> value = exp.evaluate(feature)
>>> bool(value)
True
```

### 10.2.3 Manipulação de erros

```
exp = QgsExpression("1 + 1 = 2 ")
if exp.hasParserError():
    raise Exception(exp.parserErrorString())
```

```
value = exp.evaluate()
if exp.hasEvalError():
    raise ValueError(exp.evalErrorString())

print value
```

## 10.3 Exemplos

O exemplo seguinte pode ser usado para filtrar uma camada e devolver qualquer característica que corresponda a um predicado.

```
def where(layer, exp):
    print "Where"
    exp = QgsExpression(exp)
    if exp.hasParserError():
        raise Exception(exp.parserErrorString())
    exp.prepare(layer.pendingFields())
    for feature in layer.getFeatures():
        value = exp.evaluate(feature)
        if exp.hasEvalError():
            raise ValueError(exp.evalErrorString())
        if bool(value):
            yield feature

layer = qgis.utils.iface.activeLayer()
for f in where(layer, 'Test > 1.0'):
    print f + " Matches expression"
```



---

## Leitura e Armazenamento de Configurações

---

Muitas vezes é útil para o plugin salvar algumas variáveis para que o utilizador não necessite introduzir ou selecionar outra vez numa próxima vez que o plugin for acionado.

Estas variáveis podem ser salvas e recuperadas com a ajuda do Qt e QGIS API. Para cada variável, você deve pegar a chave que será usada para acessar a variável — para cor favorita do usuário use a chave “favourite\_color” ou alguma outra palavra com significado. É recomendado dar alguma estrutura para criação do nome das chaves.

We can make difference between several types of settings:

- **global settings** — they are bound to the user at particular machine. QGIS itself stores a lot of global settings, for example, main window size or default snapping tolerance. This functionality is provided directly by Qt framework by the means of `QSettings` class. By default, this class stores settings in system’s “native” way of storing settings, that is — registry (on Windows), .plist file (on macOS) or .ini file (on Unix). The [QSettings documentation](#) is comprehensive, so we will provide just a simple example

```
def store():
    s = QSettings()
    s.setValue("myplugin/mytext", "hello world")
    s.setValue("myplugin/myint", 10)
    s.setValue("myplugin/myreal", 3.14)

def read():
    s = QSettings()
    mytext = s.value("myplugin/mytext", "default text")
    myint = s.value("myplugin/myint", 123)
    myreal = s.value("myplugin/myreal", 2.71)
```

The second parameter of the `value()` method is optional and specifies the default value if there is no previous value set for the passed setting name.

- **project settings** — vary between different projects and therefore they are connected with a project file. Map canvas background color or destination coordinate reference system (CRS) are examples — white background and WGS84 might be suitable for one project, while yellow background and UTM projection are better for another one. An example of usage follows

```
proj = QgsProject.instance()

# store values
proj.writeEntry("myplugin", "mytext", "hello world")
proj.writeEntry("myplugin", "myint", 10)
proj.writeEntry("myplugin", "mydouble", 0.01)
proj.writeEntry("myplugin", "mybool", True)

# read values
mytext = proj.readEntry("myplugin", "mytext", "default text")[0]
myint = proj.readNumEntry("myplugin", "myint", 123)[0]
```

As you can see, the `writeEntry()` method is used for all data types, but several methods exist for reading the setting value back, and the corresponding one has to be selected for each data type.

- **map layer settings** — these settings are related to a particular instance of a map layer with a project. They are *not* connected with underlying data source of a layer, so if you create two map layer instances of one shapefile, they will not share the settings. The settings are stored in project file, so if the user opens the project again, the layer-related settings will be there again. This functionality has been added in QGIS v1.4. The API is similar to `QSettings` — it takes and returns `QVariant` instances

```
# save a value
layer.setCustomProperty("mytext", "hello world")

# read the value again
mytext = layer.customProperty("mytext", "default text")
```

---

## Comunicação com o usuário

---

- Showing messages. The `QgsMessageBar` class
- Mostrando progresso
- Carregando

Esta seção mostra alguns métodos e elementos que devem ser usados para se comunicar com o usuário, a fim de manter a consistência na interface do usuário.

### 12.1 Showing messages. The `QgsMessageBar` class

Usando caixas de mensagem pode ser uma má idéia, do ponto de vista da experiência do usuário. Para mostrar uma pequena linha de informação ou uma mensagem de aviso/erro, a barra de mensagens QGIS é geralmente uma opção melhor.

Usando a referência ao objeto de interface QGIS, você pode mostrar uma mensagem na barra de mensagem com o seguinte código

```
from qgis.gui import QgsMessageBar
iface.messageBar().pushMessage("Error", "I'm sorry Dave, I'm afraid I can't do that", level=QgsMe
```

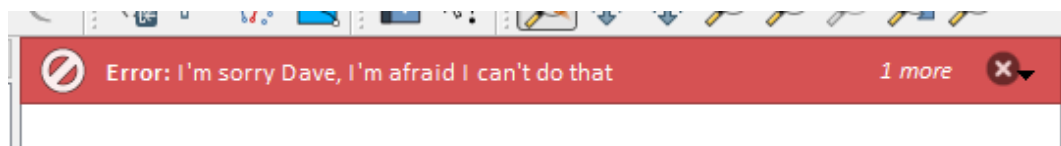


Figure 12.1: Barra de mensagem do QGIS

Você pode definir uma duração de mostrá-lo por um tempo limitado

```
iface.messageBar().pushMessage("Error", "Oops, the plugin is not working as it should", level=Qgs
```

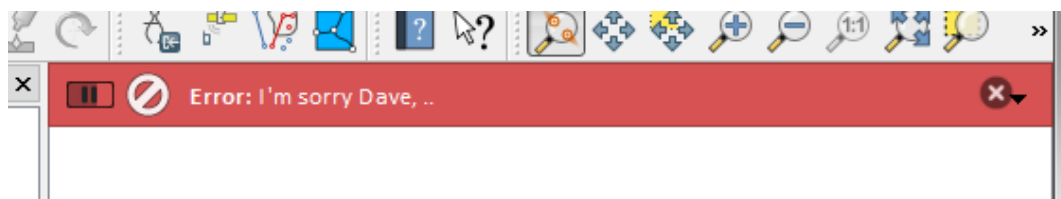


Figure 12.2: Barra de Mensagem QGIS como temporizar

The examples above show an error bar, but the `level` parameter can be used to creating warning messages or info messages, using the `QgsMessageBar.WARNING` and `QgsMessageBar.INFO` constants respectively.

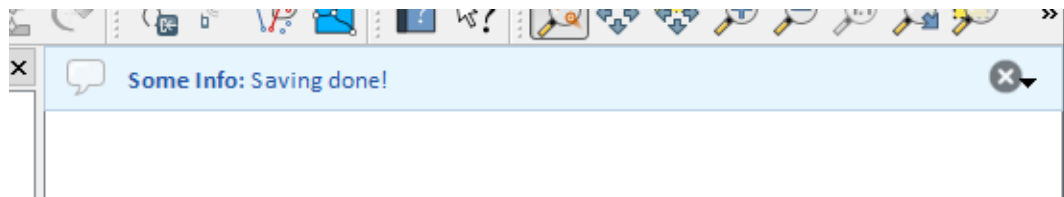


Figure 12.3: Barra de mensagens QGIS (informação)

Widgets podem ser adicionados à barra de mensagens, como por exemplo, um botão para mostrar mais informações

```
def showError():
    pass

widget = iface.messageBar().createMessage("Missing Layers", "Show Me")
button = QPushButton(widget)
button.setText("Show Me")
button.pressed.connect(showError)
widget.layout().addWidget(button)
iface.messageBar().pushWidget(widget, QgsMessageBar.WARNING)
```

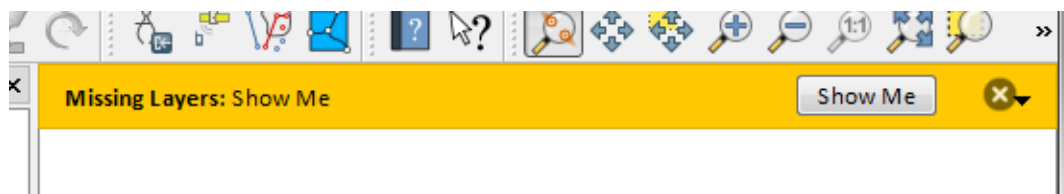


Figure 12.4: Barra de mensagens QGIS com um botão

Você ainda pode usar uma barra de mensagens em sua própria caixa de diálogo para que você não tenha de mostrar uma caixa de mensagem, ou se ela não faz sentido para mostrá-la na janela principal QGIS

```
class MyDialog(QDialog):
    def __init__(self):
        QDialog.__init__(self)
        self.bar = QgsMessageBar()
        self.bar.setSizePolicy(QSizePolicy.Minimum, QSizePolicy.Fixed)
        self.setLayout(QGridLayout())
        self.layout().setContentsMargins(0, 0, 0, 0)
        self.buttonbox = QDialogButtonBox(QDialogButtonBox.Ok)
        self.buttonbox.accepted.connect(self.run)
        self.layout().addWidget(self.buttonbox, 0, 0, 2, 1)
        self.layout().addWidget(self.bar, 0, 0, 1, 1)

    def run(self):
        self.bar.pushMessage("Hello", "World", level=QgsMessageBar.INFO)
```

## 12.2 Mostrando progresso

As barras de progresso também pode ser colocado na barra de mensagem QGIS, uma vez que, como vimos, ele aceita widgets. Aqui está um exemplo que você pode tentar no console.

```
import time
from PyQt4.QtGui import QProgressBar
from PyQt4.QtCore import *
progressMessageBar = iface.messageBar().createMessage("Doing something boring...")
progress = QProgressBar()
```



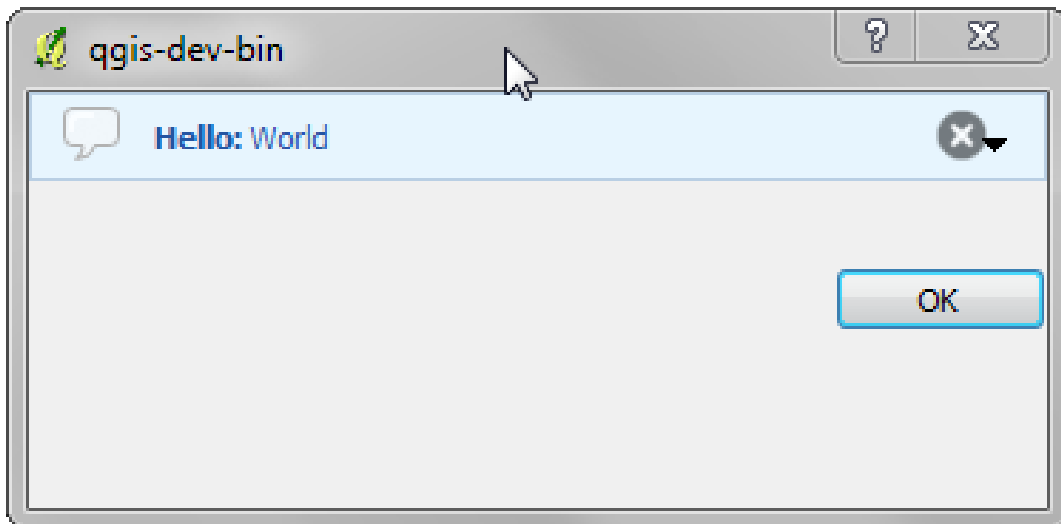


Figure 12.5: Barra de mensagens QGIS em diálogo personalizado

```

progress.setMaximum(10)
progress.setAlignment(Qt.AlignLeft|Qt.AlignVCenter)
progressMessageBar.layout().addWidget(progress)
iface.messageBar().pushWidget(progressMessageBar, iface.messageBar().INFO)
for i in range(10):
    time.sleep(1)
    progress.setValue(i + 1)
iface.messageBar().clearWidgets()

```

Also, you can use the built-in status bar to report progress, as in the next example

```

count = layers.featureCount()
for i, feature in enumerate(features):
    #do something time-consuming here
    ...
    percent = i / float(count) * 100
    iface.mainWindow().statusBar().showMessage("Processed {} %".format(int(percent)))
iface.mainWindow().statusBar().clearMessage()

```

## 12.3 Carregando

Você pode usar o sistema de registro de QGIS para registrar todas as informações que você deseja salvar sobre a execução de seu código.

```

# You can optionally pass a 'tag' and a 'level' parameters
QgsMessageLog.logMessage("Your plugin code has been executed correctly", 'MyPlugin', QgsMessageLog.INFO)
QgsMessageLog.logMessage("Your plugin code might have some problems", level=QgsMessageLog.WARNING)
QgsMessageLog.logMessage("Your plugin code has crashed!", level=QgsMessageLog.CRITICAL)

```



---

## Desenvolvimento de Complementos Python

---

- Escrevendo um complemento
  - arquivos de complementos
- Conteúdo do complemento
  - Plugin metadados
  - `__init__.py`
  - `mainPlugin.py`
  - Arquivo de Recursos
- Documentação
- Tradução
  - Software requirements
  - Files and directory
    - \* `.pro` file
    - \* `.ts` file
    - \* `.qm` file
  - Translate using Makefile
  - Carregar o complemento

É possível criar plugins usando a linguagem de programação Python. Em comparação com plugins clássicos criados em C++, esses devem ser mais fáceis de escrever, entender, manter e distribuir devido à natureza dinâmica da linguagem Python.

Python plugins are listed together with C++ plugins in QGIS plugin manager. They are searched for in these paths:

- UNIX/Mac: `~/ .qgis2/python/plugins` and `(qgis_prefix)/share/qgis/python/plugins`
- Windows: `~/ .qgis2/python/plugins` and `(qgis_prefix)/python/plugins`

Home directory (denoted by above `~`) on Windows is usually something like `C:\Documents and Settings\ (user)` (on Windows XP or earlier) or `C:\Users\ (user)`. Since QGIS is using Python 2.7, subdirectories of these paths have to contain an `__init__.py` file to be considered Python packages that can be imported as plugins.

---

**Nota:** By setting `QGIS_PLUGINPATH` to an existing directory path, you can add this path to the list of paths that are searched for plugins.

---

Passos:

1. *Ideia:* Tenha uma ideia sobre o que você quer fazer com seu novo plugin QGIS. Por que você quer fazê-lo? Qual problema você gostaria de resolver? Já existe outro plugin para este tipo de problema?
2. *Create files:* Create the files described next. A starting point (`__init__.py`). Fill in the *Plugin metadados* (`metadata.txt`) A main python plugin body (`mainplugin.py`). A form in QT-Designer (`form.ui`), with its `resources.qrc`.
3. *Write code:* Write the code inside the `mainplugin.py`

4. *Test*: Close and re-open QGIS and import your plugin again. Check if everything is OK.
5. *Publish*: Publish your plugin in QGIS repository or make your own repository as an “arsenal” of personal “GIS weapons”.

## 13.1 Escrevendo um complemento

Since the introduction of Python plugins in QGIS, a number of plugins have appeared - on [Plugin Repositories wiki page](#) you can find some of them, you can use their source to learn more about programming with PyQGIS or find out whether you are not duplicating development effort. The QGIS team also maintains an [Repositório oficial de complementos python](#). Ready to create a plugin but no idea what to do? [Python Plugin Ideas wiki page](#) lists wishes from the community!

### 13.1.1 arquivos de complementos

Está é a estrutura de diretórios do nosso exemplo de complemento

```
PYTHON_PLUGINS_PATH/  
MyPlugin/  
  __init__.py    --> *required*  
  mainPlugin.py --> *required*  
  metadata.txt  --> *required*  
  resources.qrc --> *likely useful*  
  resources.py  --> *compiled version, likely useful*  
  form.ui       --> *likely useful*  
  form.py       --> *compiled version, likely useful*
```

Qual o significado dos arquivos:

- `__init__.py` = The starting point of the plugin. It has to have the `classFactory()` method and may have any other initialisation code.
- `mainPlugin.py` = The main working code of the plugin. Contains all the information about the actions of the plugin and the main code.
- `resources.qrc` = The .xml document created by Qt Designer. Contains relative paths to resources of the forms.
- `resources.py` = A tradução do arquivo .qrc descrito acima para Python.
- `form.ui` = A GUI criada pelo Qt Designer.
- `form.py` = A tradução do formulário .ui descrito acima para Python.
- `metadata.txt` = Required for QGIS >= 1.8.0. Contains general info, version, name and some other metadata used by plugins website and plugin infrastructure. Since QGIS 2.0 the metadata from `__init__.py` are not accepted anymore and the `metadata.txt` is required.

[Here](#) is an online automated way of creating the basic files (skeleton) of a typical QGIS Python plugin.

Also there is a QGIS plugin called [Plugin Builder](#) that creates plugin template from QGIS and doesn't require internet connection. This is the recommended option, as it produces 2.0 compatible sources.

**Aviso:** If you plan to upload the plugin to the [Repositório oficial de complementos python](#) you must check that your plugin follows some additional rules, required for plugin [Validação](#)

## 13.2 Conteúdo do complemento

Here you can find information and examples about what to add in each of the files in the file structure described above.

### 13.2.1 Plugin metadados

First, plugin manager needs to retrieve some basic information about the plugin such as its name, description etc. File `metadata.txt` is the right place to put this information.

**Importante:** Todos os metadados devem estar codificados em UTF-8.

Nome metadados	re-querida	Notas
Nome	Verdadeiro	a short string containing the name of the plugin
qgisMinimumVersion	Verdadeiro	dotted notation of minimum QGIS version
qgisMaximumVersion	Falso	versão QGIS máxima com notação pontilhada
Descrição	Verdadeiro	texto pequeno que descreve o complemento, HTML não é permitido
sobre	Verdadeiro	texto longo que descreve o complemento em detalhes, HTML não é permitido
Versão	Verdadeiro	caracteres curtos com a versão com notação pontilhada
Autor	Verdadeiro	nome do autor
email	Verdadeiro	email of the author, not shown in the QGIS plugin manager or in the website unless by a registered logged in user, so only visible to other plugin authors and plugin website administrators
changelog	Falso	string, can be multiline, no HTML allowed
experimental	Falso	valor booleano, <i>True</i> ou <i>False</i>
desaprovado	Falso	valor booleano, 'True' ou 'False', aplica-se a todo o plugin e não apenas para a versão carregada
etiquetas	Falso	lista separada por vírgulas, espaços são permitidos dentro das etiquetas individuais
página inicial	Falso	uma URL válida apontando para a página inicial do seu plugin
Repositório	Verdadeiro	uma URL válida para repositório do código fonte
rastreador	Falso	uma URL válida para o reporte de chamadas e erros
Ícone	Falso	a file name or a relative path (relative to the base folder of the plugin's compressed package) of a web friendly image (PNG, JPEG)
Categoria	Falso	one of <i>Raster</i> , <i>Vector</i> , <i>Database</i> and <i>Web</i>

By default, plugins are placed in the *Plugins* menu (we will see in the next section how to add a menu entry for your plugin) but they can also be placed the into *Raster*, *Vector*, *Database* and *Web* menus.

A corresponding “category” metadata entry exists to specify that, so the plugin can be classified accordingly. This metadata entry is used as tip for users and tells them where (in which menu) the plugin can be found. Allowed values for “category” are: *Vector*, *Raster*, *Database* or *Web*. For example, if your plugin will be available from *Raster* menu, add this to `metadata.txt`

```
category=Raster
```

**Nota:** If `qgisMaximumVersion` is empty, it will be automatically set to the major version plus `.99` when uploaded to the *Repositório oficial de complementos python*.

Um exemplo para este `metadata.txt`

```
; the next section is mandatory

[general]
name=HelloWorld
email=me@example.com
author=Just Me
qgisMinimumVersion=2.0
description=This is an example plugin for greeting the world.
    Multiline is allowed:
    lines starting with spaces belong to the same
    field, in this case to the "description" field.
    HTML formatting is not allowed.
about=This paragraph can contain a detailed description
    of the plugin. Multiline is allowed, HTML is not.
version=version 1.2
tracker=http://bugs.itopen.it
repository=http://www.itopen.it/repo
; end of mandatory metadata

; start of optional metadata
category=Raster
changelog=The changelog lists the plugin versions
    and their changes as in the example below:
    1.0 - First stable release
    0.9 - All features implemented
    0.8 - First testing release

; Tags are in comma separated value format, spaces are allowed within the
; tag name.
; Tags should be in English language. Please also check for existing tags and
; synonyms before creating a new one.
tags=wkt,raster,hello world

; these metadata can be empty, they will eventually become mandatory.
homepage=http://www.itopen.it
icon=icon.png

; experimental flag (applies to the single version)
experimental=True

; deprecated flag (applies to the whole plugin and not only to the uploaded version)
deprecated=False

; if empty, it will be automatically set to major version + .99
qgisMaximumVersion=2.0
```

### 13.2.2 `__init__.py`

This file is required by Python's import system. Also, QGIS requires that this file contains a `classFactory()` function, which is called when the plugin gets loaded to QGIS. It receives reference to instance of `QgisInterface` and must return instance of your plugin's class from the `mainplugin.py` — in our case it's called `TestPlugin` (see below). This is how `__init__.py` should look like

```
def classFactory(iface):
    from mainPlugin import TestPlugin
    return TestPlugin(iface)

## any other initialisation needed
```

### 13.2.3 mainPlugin.py

This is where the magic happens and this is how magic looks like: (e.g. mainPlugin.py)

```

from PyQt4.QtCore import *
from PyQt4.QtGui import *
from qgis.core import *

# initialize Qt resources from file resources.py
import resources

class TestPlugin:

    def __init__(self, iface):
        # save reference to the QGIS interface
        self.iface = iface

    def initGui(self):
        # create action that will start plugin configuration
        self.action = QAction(QIcon(":/plugins/testplug/icon.png"), "Test plugin", self.iface.mainWindow)
        self.action.setObjectName("testAction")
        self.action.setWhatsThis("Configuration for test plugin")
        self.action.setStatusTip("This is status tip")
        QObject.connect(self.action, SIGNAL("triggered()"), self.run)

        # add toolbar button and menu item
        self.iface.addToolBarIcon(self.action)
        self.iface.addPluginToMenu("&Test plugins", self.action)

        # connect to signal renderComplete which is emitted when canvas
        # rendering is done
        QObject.connect(self.iface.mapCanvas(), SIGNAL("renderComplete(QPainter *)"), self.renderTest)

    def unload(self):
        # remove the plugin menu item and icon
        self.iface.removePluginMenu("&Test plugins", self.action)
        self.iface.removeToolBarIcon(self.action)

        # disconnect from signal of the canvas
        QObject.disconnect(self.iface.mapCanvas(), SIGNAL("renderComplete(QPainter *)"), self.renderTest)

    def run(self):
        # create and show a configuration dialog or something similar
        print "TestPlugin: run called!"

    def renderTest(self, painter):
        # use painter for drawing to map canvas
        print "TestPlugin: renderTest called!"

```

The only plugin functions that must exist in the main plugin source file (e.g. mainPlugin.py) are:

- `__init__` -> Dá acesso à interface QGIS
- `initGui()` -> chamada quando o complemento é carregado
- `unload()` -> chamada quando o complemento é descarregado

You can see that in the above example, the `addPluginToMenu()` is used. This will add the corresponding menu action to the *Plugins* menu. Alternative methods exist to add the action to a different menu. Here is a list of those methods:

- `addPluginToRasterMenu()`
- `addPluginToVectorMenu()`
- `addPluginToDatabaseMenu()`

- `addPluginToWebMenu()`

All of them have the same syntax as the `addPluginToMenu()` method.

Adding your plugin menu to one of those predefined method is recommended to keep consistency in how plugin entries are organized. However, you can add your custom menu group directly to the menu bar, as the next example demonstrates:

```
def initGui(self):
    self.menu = QMenu(self.iface.mainWindow())
    self.menu.setObjectName("testMenu")
    self.menu.setTitle("MyMenu")

    self.action = QAction(QIcon(":/plugins/testplug/icon.png"), "Test plugin", self.iface.mainWindow())
    self.action.setObjectName("testAction")
    self.action.setWhatsThis("Configuration for test plugin")
    self.action.setStatusTip("This is status tip")
    QObject.connect(self.action, SIGNAL("triggered()"), self.run)
    self.menu.addAction(self.action)

    menuBar = self.iface.mainWindow().menuBar()
    menuBar.insertMenu(self.iface.firstRightStandardMenu().menuAction(), self.menu)

def unload(self):
    self.menu.deleteLater()
```

Don't forget to set `QAction` and `QMenu` `objectName` to a name specific to your plugin so that it can be customized.

## 13.2.4 Arquivo de Recursos

You can see that in `initGui()` we've used an icon from the resource file (called `resources.qrc` in our case)

```
<RCC>
  <qresource prefix="/plugins/testplug" >
    <file>icon.png</file>
  </qresource>
</RCC>
```

It is good to use a prefix that will not collide with other plugins or any parts of QGIS, otherwise you might get resources you did not want. Now you just need to generate a Python file that will contain the resources. It's done with **pyrcc4** command:

```
pyrcc4 -o resources.py resources.qrc
```

---

**Nota:** In Windows environments, attempting to run the **pyrcc4** from Command Prompt or Powershell will probably result in the error "Windows cannot access the specified device, path, or file [...]". The easiest solution is probably to use the OSGeo4W Shell but if you are comfortable modifying the `PATH` environment variable or specifying the path to the executable explicitly you should be able to find it at `<Your QGIS Install Directory>\bin\pyrcc4.exe`.

---

E isso é tudo... nada complicado :)

If you've done everything correctly you should be able to find and load your plugin in the plugin manager and see a message in console when toolbar icon or appropriate menu item is selected.

When working on a real plugin it's wise to write the plugin in another (working) directory and create a makefile which will generate UI + resource files and install the plugin to your QGIS installation.



## 13.3 Documentação

The documentation for the plugin can be written as HTML help files. The `qgis.utils` module provides a function, `showPluginHelp()` which will open the help file browser, in the same way as other QGIS help.

The `showPluginHelp()` function looks for help files in the same directory as the calling module. It will look for, in turn, `index-ll_cc.html`, `index-ll.html`, `index-en.html`, `index-en_us.html` and `index.html`, displaying whichever it finds first. Here `ll_cc` is the QGIS locale. This allows multiple translations of the documentation to be included with the plugin.

The `showPluginHelp()` function can also take parameters `packageName`, which identifies a specific plugin for which the help will be displayed, `filename`, which can replace “index” in the names of files being searched, and `section`, which is the name of an html anchor tag in the document on which the browser will be positioned.

## 13.4 Tradução

With a few steps you can set up the environment for the plugin localization so that depending on the locale settings of your computer the plugin will be loaded in different languages.

### 13.4.1 Software requirements

The easiest way to create and manage all the translation files is to install [Qt Linguist](#). In a Debian-based GNU/Linux environment you can install it typing:

```
sudo apt-get install qt4-dev-tools
```

### 13.4.2 Files and directory

When you create the plugin you will find the `i18n` folder within the main plugin directory.

**All the translation files have to be within this directory.**

#### .pro file

First you should create a `.pro` file, that is a *project* file that can be managed by **Qt Linguist**.

In this `.pro` file you have to specify all the files and forms you want to translate. This file is used to set up the localization files and variables. A possible project file, matching the structure of our *example plugin*:

```
FORMS = ../form.ui
SOURCES = ../your_plugin.py
TRANSLATIONS = your_plugin_it.ts
```

Your plugin might follow a more complex structure, and it might be distributed across several files. If this is the case, keep in mind that `pylupdate4`, the program we use to read the `.pro` file and update the translatable string, does not expand wild card characters, so you need to place every file explicitly in the `.pro` file. Your project file might then look like something like this:

```
FORMS = ../ui/about.ui ../ui/feedback.ui \
        ../ui/main_dialog.ui
SOURCES = ../your_plugin.py ../computation.py \
        ../utils.py
```

Furthermore, the `your_plugin.py` file is the file that *calls* all the menu and sub-menus of your plugin in the QGIS toolbar and you want to translate them all.

Finally with the `TRANSLATIONS` variable you can specify the translation languages you want.

**Aviso:** Be sure to name the `ts` file like `your_plugin_ + language + .ts` otherwise the language loading will fail! Use 2 letters shortcut for the language (**it** for Italian, **de** for German, etc...)

### .ts file

Once you have created the `.pro` you are ready to generate the `.ts` file(s) of the language(s) of your plugin.

Open a terminal, go to `your_plugin/i18n` directory and type:

```
pylupdate4 your_plugin.pro
```

you should see the `your_plugin_language.ts` file(s).

Open the `.ts` file with **Qt Linguist** and start to translate.

### .qm file

When you finish to translate your plugin (if some strings are not completed the source language for those strings will be used) you have to create the `.qm` file (the compiled `.ts` file that will be used by QGIS).

Just open a terminal `cd` in `your_plugin/i18n` directory and type:

```
lrelease your_plugin.ts
```

now, in the `i18n` directory you will see the `your_plugin.qm` file(s).

## 13.4.3 Translate using Makefile

Alternatively you can use the makefile to extract messages from python code and Qt dialogs, if you created your plugin with Plugin Builder. At the beginning of the Makefile there is a `LOCALES` variable:

```
LOCALES = en
```

Add the abbreviation of the language to this variable, for example for Hungarian language:

```
LOCALES = en hu
```

Now you can generate or update the `hu.ts` file (and the `en.ts` too) from the sources by:

```
make transup
```

After this, you have updated `.ts` file for all languages set in the `LOCALES` variable. Use **Qt4 Linguist** to translate the program messages. Finishing the translation the `.qm` files can be created by the `transcompile`:

```
make transcompile
```

You have to distribute `.ts` files with your plugin.

## 13.4.4 Carregar o complemento

In order to see the translation of your plugin just open QGIS, change the language (*Settings* → *Options* → *Language*) and restart QGIS.

You should see your plugin in the correct language.

**Aviso:** If you change something in your plugin (new UIs, new menu, etc..) you have to **generate again** the update version of both `.ts` and `.qm` file, so run again the command of above.

---

## Authentication infrastructure

---

- Introduction
- Glossary
- QgsAuthManager the entry point
  - Init the manager and set the master password
  - Populate authdb with a new Authentication Configuration entry
    - \* Available Authentication methods
    - \* Populate Authorities
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  - Remove entry from authdb
  - Leave authcfg expansion to QgsAuthManager
    - \* PKI examples with other data providers
- Adapt plugins to use Authentication infrastructure
- Authentication GUIs
  - GUI to select credentials
  - Authentication Editor GUI
  - Authorities Editor GUI

### 14.1 Introduction

User reference of the Authentication infrastructure can be read in the User Manual in the *authentication\_overview* paragraph.

This chapter describes the best practices to use the Authentication system from a developer perspective.

- Aviso:** Authentication system API is more than the classes and methods exposed here, but it's strongly suggested to use the ones described here and exposed in the following snippets for two main reasons
1. Authentication API will change during the move to QGIS3
  2. Python bindings will be restricted to the `QgsAuthManager` class use.

Most of the following snippets are derived from the code of Geoserver Explorer plugin and its tests. This is the first plugin that used Authentication infrastructure. The plugin code and its tests can be found at this [link](#). Other good code reference can be read from the authentication infrastructure [tests code](#)

### 14.2 Glossary

Here are some definition of the most common objects treated in this chapter.

**Master Password** Password to allow access and decrypt credential stored in the QGIS Authentication DB

**Authentication Database** A *Master Password* crypted sqlite db <user home>/`.qgis2/qgis-auth.db` where *Authentication Configuration* are stored. e.g user/password, personal certificates and keys, Certificate Authorities

**Authentication DB** *Authentication Database*

**Authentication Configuration** A set of authentication data depending on *Authentication Method*. e.g Basic authentication method stores the couple of user/password.

**Authentication config** *Authentication Configuration*

**Authentication Method** A specific method used to get authenticated. Each method has its own protocol used to gain the authenticated level. Each method is implemented as shared library loaded dynamically during QGIS authentication infrastructure init.

## 14.3 QgsAuthManager the entry point

The `QgsAuthManager` singleton is the entry point to use the credentials stored in the QGIS encrypted *Authentication DB*:

```
<user home>/.qgis2/qgis-auth.db
```

This class takes care of the user interaction: by asking to set master password or by transparently using it to access crypted stored info.

### 14.3.1 Init the manager and set the master password

The following snippet gives an example to set master password to open the access to the authentication settings. Code comments are important to understand the snippet.

```
authMgr = QgsAuthManager.instance()
# check if QgsAuthManager has been already initialized... a side effect
# of the QgsAuthManager.init() is that AuthDbPath is set.
# QgsAuthManager.init() is executed during QGIS application init and hence
# you do not normally need to call it directly.
if authMgr.authenticationDbPath():
    # already initilised => we are inside a QGIS app.
    if authMgr.masterPasswordIsSet():
        msg = 'Authentication master password not recognized'
        assert authMgr.masterPasswordSame( "your master password" ), msg
    else:
        msg = 'Master password could not be set'
        # The verify parameter check if the hash of the password was
        # already saved in the authentication db
        assert authMgr.setMasterPassword( "your master password",
                                         verify=True), msg
else:
    # outside qgis, e.g. in a testing environment => setup env var before
    # db init
    os.environ['QGIS_AUTH_DB_DIR_PATH'] = "/path/where/located/qgis-auth.db"
    msg = 'Master password could not be set'
    assert authMgr.setMasterPassword("your master password", True), msg
    authMgr.init( "/path/where/located/qgis-auth.db" )
```

### 14.3.2 Populate authdb with a new Authentication Configuration entry

Any stored credential is a *Authentication Configuration* instance of the `QgsAuthMethodConfig` class accessed using a unique string like the following one:

```
authcfg = 'fmls770'
```

that string is generated automatically when creating an entry using QGIS API or GUI.

*QgsAuthMethodConfig* is the base class for any *Authentication Method*. Any Authentication Method sets a configuration hash map where authentication informations will be stored. Hereafter an useful snippet to store PKI-path credentials for an hypothetical alice user:

```
authMgr = QgsAuthManager.instance()
# set alice PKI data
p_config = QgsAuthMethodConfig()
p_config.setName("alice")
p_config.setMethod("PKI-Paths")
p_config.setUri("http://example.com")
p_config.setConfig("certpath", "path/to/alice-cert.pem" )
p_config.setConfig("keypath", "path/to/alice-key.pem" )
# check if method parameters are correctly set
assert p_config.isValid()

# register alice data in authdb returning the ``authcfg`` of the stored
# configuration
authMgr.storeAuthenticationConfig(p_config)
newAuthCfgId = p_config.id()
assert (newAuthCfgId)
```

### Available Authentication methods

*Authentication Methods* are loaded dynamically during authentication manager init. The list of Authentication method can vary with QGIS evolution, but the original list of available methods is:

1. Basic User and password authentication
2. Identity-Cert Identity certificate authentication
3. PKI-Paths PKI paths authentication
4. PKI-PKCS#12 PKI PKCS#12 authentication

The above strings are that identify authentication methods in the QGIS authentication system. In [Development](#) section is described how to create a new c++ *Authentication Method*.

### Populate Authorities

```
authMgr = QgsAuthManager.instance()
# add authorities
cacerts = QSslCertificate.fromPath( "/path/to/ca_chains.pem" )
assert cacerts is not None
# store CA
authMgr.storeCertAuthorities(cacerts)
# and rebuild CA caches
authMgr.rebuildCaCertsCache()
authMgr.rebuildTrustedCaCertsCache()
```

**Aviso:** Due to QT4/OpenSSL interface limitation, updated cached CA are exposed to OpenSsl only almost a minute later. Hope this will be solved in QT5 authentication infrastructure.

### Manage PKI bundles with QgsPkiBundle

A convenience class to pack PKI bundles composed on SslCert, SslKey and CA chain is the *QgsPkiBundle* class. Hereafter a snippet to get password protected:

```
# add alice cert in case of key with pwd
bundle = QgsPkiBundle.fromPemPaths( "/path/to/alice-cert.pem",
                                     "/path/to/alice-key_w-pass.pem",
                                     "unlock_pwd",
                                     "list_of_CAs_to_bundle" )

assert bundle is not None
assert bundle.isValid()
```

Refer to `QgsPkiBundle` class documentation to extract cert/key/CAs from the bundle.

### 14.3.3 Remove entry from authdb

We can remove an entry from *Authentication Database* using its `authcfg` identifier with the following snippet:

```
authMgr = QgsAuthManager.instance()
authMgr.removeAuthenticationConfig( "authCfg_Id_to_remove" )
```

### 14.3.4 Leave authcfg expansion to QgsAuthManager

The best way to use an *Authentication Config* stored in the *Authentication DB* is referring it with the unique identifier `authcfg`. Expanding, means convert it from an identifier to a complete set of credentials. The best practice to use stored *Authentication Configs*, is to leave it managed automatically by the Authentication manager. The common use of a stored configuration is to connect to an authentication enabled service like a WMS or WFS or to a DB connection.

---

**Nota:** Take into account that not all QGIS data providers are integrated with the Authentication infrastructure. Each authentication method, derived from the base class `QgsAuthMethod` and support a different set of Providers. For example `Identity-Cert` method supports the following list of providers:

```
In [19]: authM = QgsAuthManager.instance()
In [20]: authM.authMethod("Identity-Cert").supportedDataProviders()
Out[20]: [u'ows', u'wfs', u'wcs', u'wms', u'postgres']
```

---

For example, to access a WMS service using stored credentials identified with `authcfg = 'fm1s770'`, we just have to use the `authcfg` in the data source URL like in the following snippet:

```
authCfg = 'fm1s770'
quri = QgsDataSourceURI()
quri.setParam("layers", 'usa:states')
quri.setParam("styles", '')
quri.setParam("format", 'image/png')
quri.setParam("crs", 'EPSG:4326')
quri.setParam("dpiMode", '7')
quri.setParam("featureCount", '10')
quri.setParam("authcfg", authCfg) # <---- here my authCfg url parameter
quri.setParam("contextualWMSLegend", '0')
quri.setParam("url", 'https://my_auth_enabled_server_ip/wms')
rlayer = QgsRasterLayer(quri.encodedUri(), 'states', 'wms')
```

In the upper case, the wms provider will take care to expand `authcfg` URI parameter with credential just before setting the HTTP connection.

**Aviso:** Developer would have to leave `authcfg` expansion to the `QgsAuthManager`, in this way he will be sure that expansion is not done too early.

Usually an URI string, build using `QgsDataSourceURI` class, is used to set QGIS data source in the following way:

```
rlayer = QgsRasterLayer( quri.uri(False), 'states', 'wms')
```

**Nota:** The `False` parameter is important to avoid URI complete expansion of the `authcfg id` present in the URI.

## PKI examples with other data providers

Other example can be read directly in the QGIS tests upstream as in `test_authmanager_pki_ows` or `test_authmanager_pki_postgres`.

## 14.4 Adapt plugins to use Authentication infrastructure

Many third party plugins are using `httplib2` to create HTTP connections instead of integrating with `QgsNetworkAccessManager` and its related Authentication Infrastructure integration. To facilitate this integration an helper python function has been created called `NetworkAccessManager`. Its code can be found [here](#).

This helper class can be used as in the following snippet:

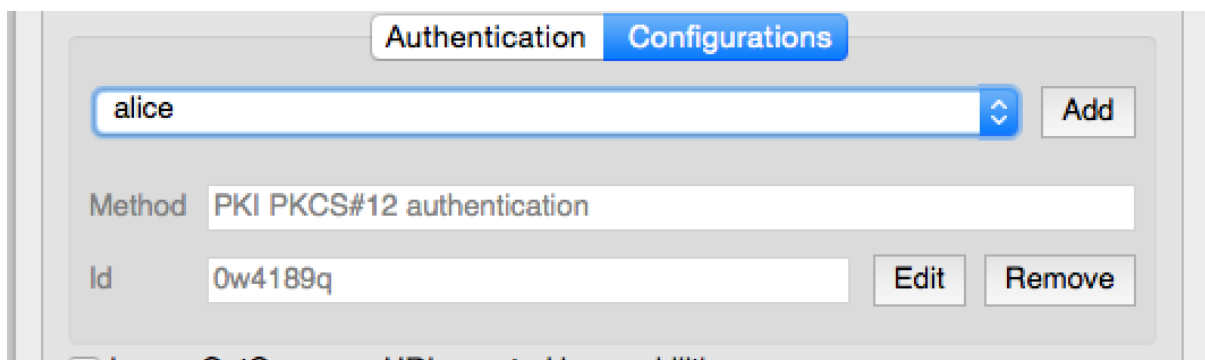
```
http = NetworkAccessManager(authid="my_authCfg", exception_class=My_FailedRequestError)
try:
    response, content = http.request( "my_rest_url" )
except My_FailedRequestError, e:
    # Handle exception
    pass
```

## 14.5 Authentication GUIs

In this paragraph are listed the available GUIs useful to integrate authentication infrastructure in custom interfaces.

### 14.5.1 GUI to select credentials

If it's necessary to select a *Authentication Configuration* from the set stored in the *Authentication DB* it is available in the GUI class `QgsAuthConfigSelect`



and can be used as in the following snippet:

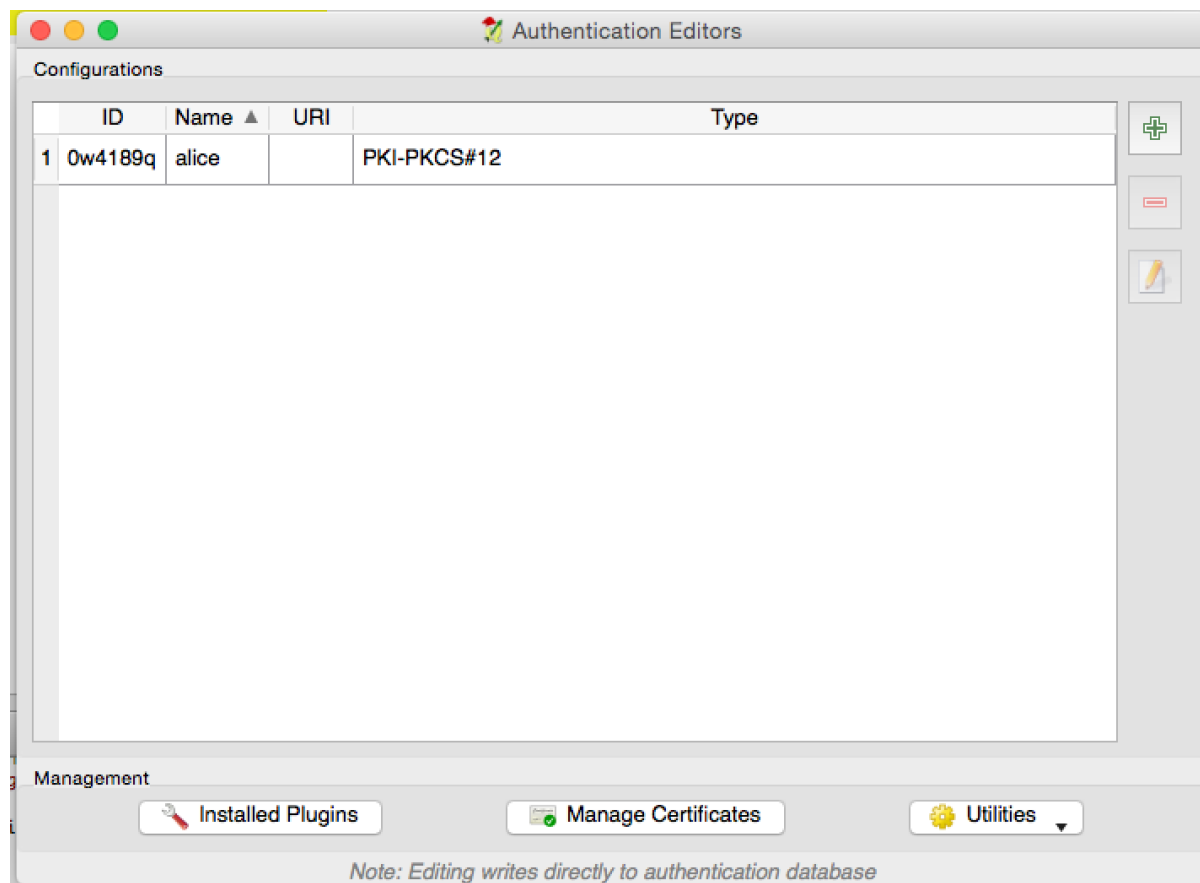
```
# create the instance of the QgsAuthConfigSelect GUI hierarchically linked to
# the widget referred with 'parent'
gui = QgsAuthConfigSelect( parent, "postgres" )
# add the above created gui in a new tab of the interface where the
```

```
# GUI has to be integrated
tabGui.insertTab( 1, gui, "Configurations" )
```

The above example is get from the QGIS source code The second parameter of the GUI constructor refers to data provider type. The parameter is used to restrict the compatible *Authentication Methods* with the specified provider.

## 14.5.2 Authentication Editor GUI

The complete GUI used to manage credentials, authorities and to access to Authentication utilities is managed by the class `QgsAuthEditorWidgets`



and can be used as in the following snippet:

```
# create the instance of the QgsAuthEditorWidgets GUI hierarchically linked to
# the widget referred with 'parent'
gui = QgsAuthConfigSelect( parent )
gui.show()
```

an integrated example can be found in the related test

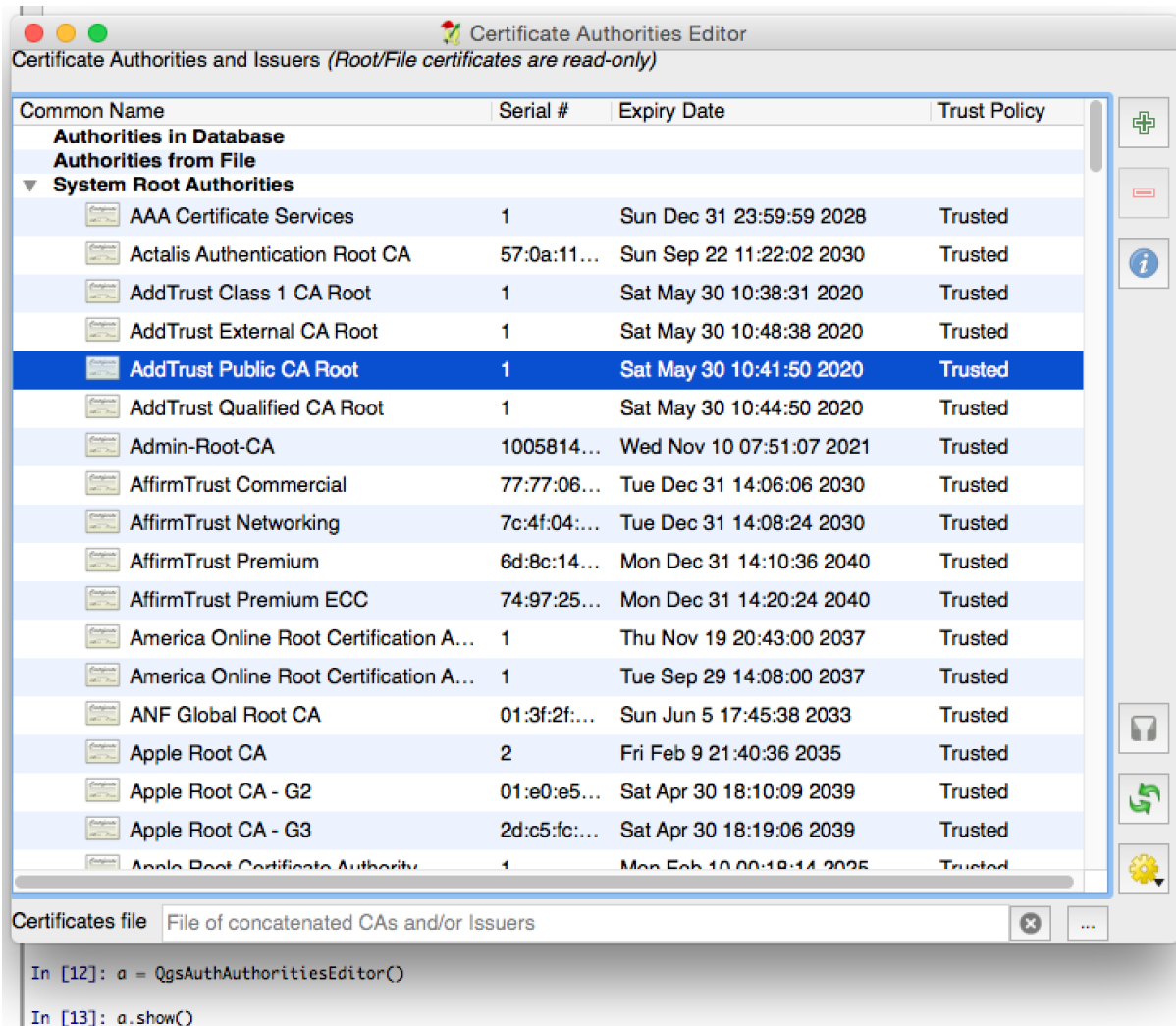
## 14.5.3 Authorities Editor GUI

A GUI used to manage only authorities is managed by the class `QgsAuthAuthoritiesEditor`

and can be used as in the following snippet:

```
# create the instance of the QgsAuthAuthoritiesEditor GUI hierarchically
# linked to the widget referred with 'parent'
```





```
gui = QgsAuthAuthoritiesEditor( parent )  
gui.show()
```

---

## Configurações de IDE para escrita e depuração de plugins

---

- Uma nota na configuração IDE para Windows
- Depuração usando Eclipse e PyDev
  - Instalação
  - Preparando QGIS
  - Configurando Eclipse
  - Configurando o depurador
  - Fazendo eclipse entender a API
- Depuração usando PDB

Embora cada programador tem seu editor de Texto/IDE preferido, aqui estão algumas recomendações para configurar o IDE populares para escrever e depurar plugins QGIS Python.

### 15.1 Uma nota na configuração IDE para Windows

No Linux não é necessária configuração adicional para desenvolver complementos. Se você estiver utilizando Windows, certifique-se de possuir as mesmas configurações de ambiente e utilizar as mesmas bibliotecas e interpretador utilizados pelo QGIS. A forma mais rápida de fazer isso, é modificar o arquivo em lote de inicialização do QGIS.

Se você utilizou o instalador OSGeo4W, o arquivo de inicialização pode ser encontrado dentro da pasta `bin` do diretório de instalação do OSGeo4W. Procure por algo como `C:\OSGeo4W\bin\qgis-unstable.bat`.

Para usar `PyScripter IDE`, eis o que tem de fazer:

- Faça uma cópia do arquivo `qgis-unstable.bat` e renomeie para `pyscripter.bat`.
- Abra-o em um editor. E remova a última linha, a que inicia o QGIS.
- Adicione uma linha que aponte para o seu executável `PyScripter` e adicione o argumento de linha de comando que define a versão do Python a ser utilizada (2.7 no caso do QGIS >= 2.0).
- Além disso, adicione o argumento de que aponta para a pasta onde `PyScripter` encontrará a `dll Python` usado pelo QGIS, você pode encontrá-la na pasta de arquivos binários da instalação `OSGeoW`

```
@echo off
SET OSGEO4W_ROOT=C:\OSGeo4W
call "%OSGEO4W_ROOT%\bin\o4w_env.bat
call "%OSGEO4W_ROOT%\bin\gdal16.bat
@echo off
path %PATH%;%GISBASE%\bin
Start C:\pyscripter\pyscripter.exe --python25 --pythondllpath=C:\OSGeo4W\bin
```

Agora, quando você clicar duas vezes neste arquivo de lote, vai iniciar `PyScripter`, com o caminho correto.

Mais popular que o Pyscripter, o Eclipse é uma escolha comum entre os desenvolvedores. Nas seções seguintes, nós iremos explicar como configurá-lo para desenvolver e testar complementos. No Windows, para preparar o ambiente para a utilização do Eclipse, você também precisará criar um arquivo em lote para iniciá-lo.

Para criar o arquivo em lote, siga os passos a seguir:

- Localize a pasta onde está o arquivo `qgis_core.dll`. Normalmente ele pode ser encontrado em `C:\OSGeo4W\apps\qgis\bin`, mas se você compilou seu próprio QGIS, o arquivo estará na sua pasta de compilação em `output/bin/RelWithDebInfo`.
- Localize seu executável `eclipse.exe`.
- Crie o seguinte script e use para iniciar eclipse quando estiver desenvolvendo plugins QGIS.

```
call "C:\OSGeo4W\bin\o4w_env.bat"  
set PATH=%PATH%;C:\path\to\your\qgis_core.dll\parent\folder  
C:\path\to\your\eclipse.exe
```

## 15.2 Depuração usando Eclipse e PyDev

### 15.2.1 Instalação

Para usar Eclipse, certifique-se que tem instalado o seguinte:

- Eclipse
- Aptana Eclipse Plugin ou PyDev
- QGIS 2.x

### 15.2.2 Preparando QGIS

É preciso fazer uma preparação no próprio QGIS. Existem dois complementos necessários: **Remote Debug e Plugin reloader**.

- Vá para *Complementos* → *Gerenciar e Instalar Complementos...*
- Procure por *Remote Debug* (no momento este complemento ainda é experimental, portanto você precisa habilitar a exibição de complementos experimentais em *Opções* no menu à esquerda caso ele não apareça) . Instale ele.
- Procurar por *Plugin reloader* e instalá-lo. Isso permitirá que você recarregue um plugin em vez de ter que fechar e reiniciar QGIS para ter o plugin recarregado.

### 15.2.3 Configurando Eclipse

Em Eclipse, crie um novo projeto. Você pode selecionar *General Project* e vincular suas fontes reais mais tarde, por isso realmente não importa onde você coloca este projeto.

Agora clique com o botão direito no seu novo projeto e selecione *New* → *Folder*.

Click [**Advanced**] and choose *Link to alternate location (Linked Folder)*. In case you already have sources you want to debug, choose these. In case you don't, create a folder as it was already explained.

Agora, na visão *Project Explorer*, sua árvore de origem aparece e você pode começar a trabalhar com o código. Você já tem destaque de sintaxe e todas as outras ferramentas IDE disponíveis.

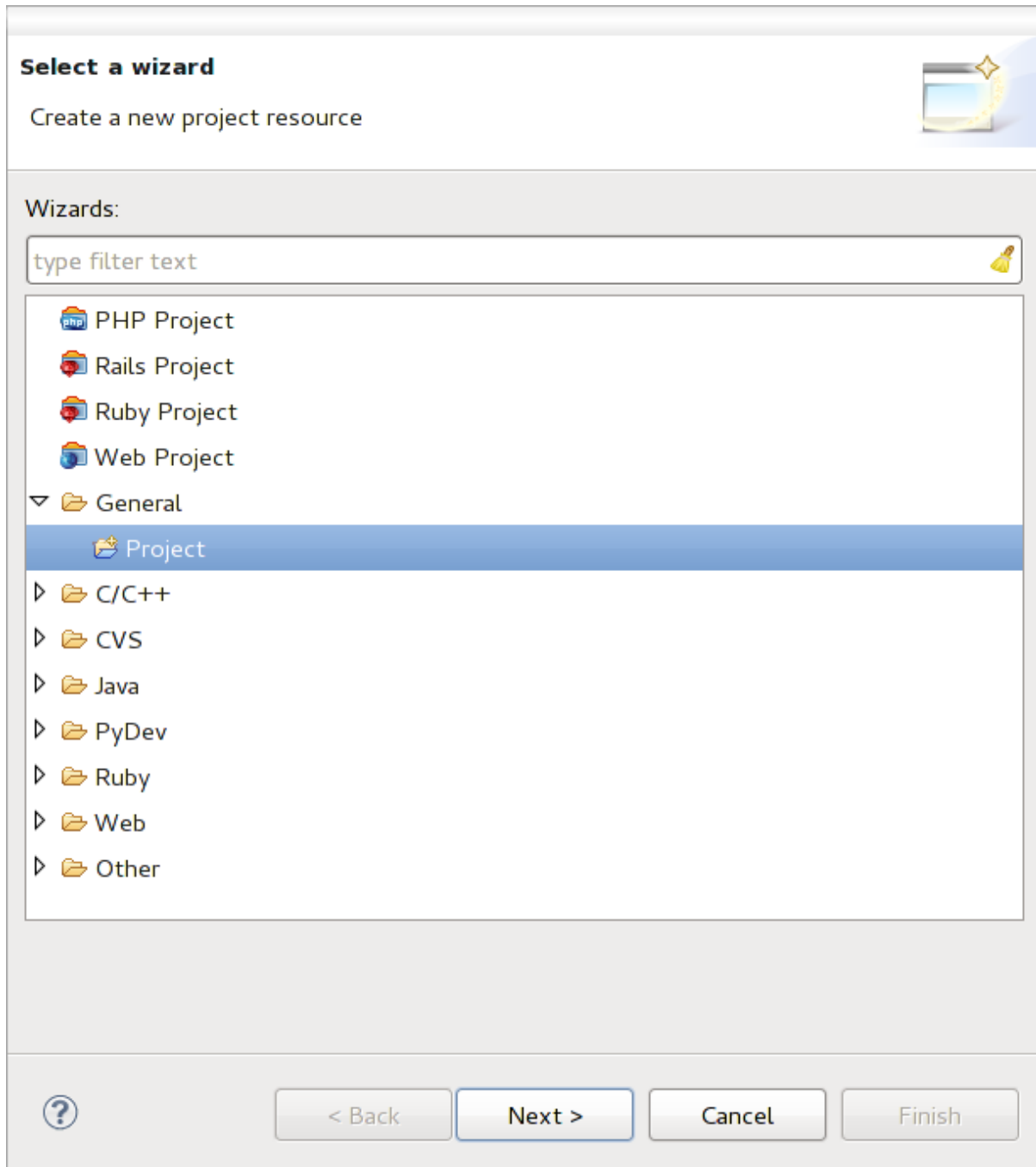


Figure 15.1: Projeto Eclipse

## 15.2.4 Configurando o depurador

Para obter o depurador trabalhando, alterne para a perspectiva de depuração no Eclipse (*Window* → *Open Perspective* → *Other* → *Debug*).

Agora inicie o servidor de depuração PyDev selecionando *PyDev* → *Start Debug Server*.

Eclipse is now waiting for a connection from QGIS to its debug server and when QGIS connects to the debug server it will allow it to control the python scripts. That's exactly what we installed the *Remote Debug* plugin for. So start QGIS in case you did not already and click the bug symbol.

Now you can set a breakpoint and as soon as the code hits it, execution will stop and you can inspect the current state of your plugin. (The breakpoint is the green dot in the image below, set one by double clicking in the white space left to the line you want the breakpoint to be set).

```

87         self.verticalExaggerationChanged.emit(val)
88
89     def printProfile(self):
90         printer = QPrinter( QPrinter.HighResolution )
91         printer.setOutputFormat( QPrinter.PdfFormat )
92         printer.setPaperSize( QPrinter.A4 )
93         printer.setOrientation( QPrinter.Landscape )
94
95         printPreviewDlg = QPrintPreviewDialog( )
96         printPreviewDlg.paintRequested.connect( self.printRequested )
97
98         printPreviewDlg.exec_()
99
100     @pyqtSlot( QPrinter )
101     def printRequested( self, printer ):
102         self.webView.print_( printer )

```

Figure 15.2: Ponto de interrupção

Uma coisa muito interessante que você pode fazer uso de agora é o console de depuração. Certifique-se de que a execução está parado em um ponto de interrupção, antes de prosseguir.

Abra a visualização da Console (*Window* → *Show view*). Ela vai mostrar console *Debug Server* que não é muito interessante. Mas há um botão **[Open Console]** que lhe permite mudar para uma console PyDev Debug mais interessante. Clique na seta ao lado do botão **[Open Console]** e escolha *PyDev Debug Console*. Uma janela se abre para perguntar-lhe qual console você quer começar. Escolha *PyDev Debug Console*. No caso de estar acinzentado e dizer-lhe para iniciar o depurador e selecionar o quadro válido, certifique-se de que você tem o depurador remoto ligado e estão atualmente em um ponto de interrupção.

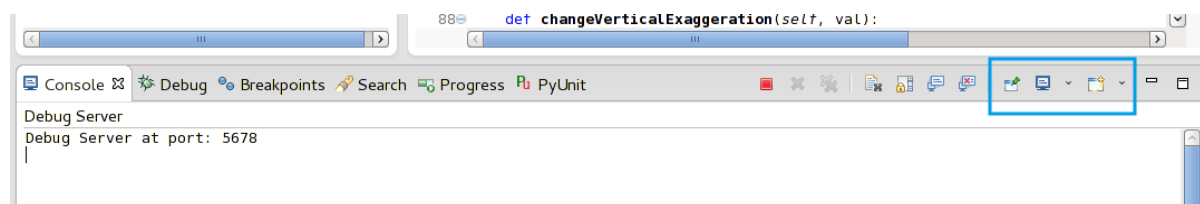


Figure 15.3: Consolde de depuração PyDev

Agora você tem um console interativo que lhe permite testar os comandos de dentro do contexto atual. Você pode manipular as variáveis ou fazer chamadas de API ou o que quer que você queira.

Um pouco chato é que, cada vez que você digitar um comando, o console volta para o Debug Server. Para parar esse comportamento, você pode clicar no botão *Pin Console* quando estiver na página Debug Server e ele deve se lembrar esta decisão, pelo menos, para a sessão de depuração atual.

## 15.2.5 Fazendo eclipse entender a API

Uma característica muito útil é ter Eclipse realmente informado sobre a QGIS API. Isto permite-lhe verificar o seu código de erros de digitação. Mas não é só isso, ele também permite que o Eclipse ajudá-lo com o completamento automático das importações de chamadas da API.

Para fazer isso, Eclipse analisa os arquivos da biblioteca do QGIS e recebe toda a informação lá. A única coisa que você tem a fazer é dizer ao Eclipse onde encontrar as bibliotecas.

Click *Window* → *Preferences* → *PyDev* → *Interpreter* → *Python*.

Você vai ver o seu interpretador Python configurado na parte superior da janela (no momento python2.7 para QGIS) e algumas guias na parte inferior. As guias interessantes para nós são *Libraries* e *Forced Builtins*

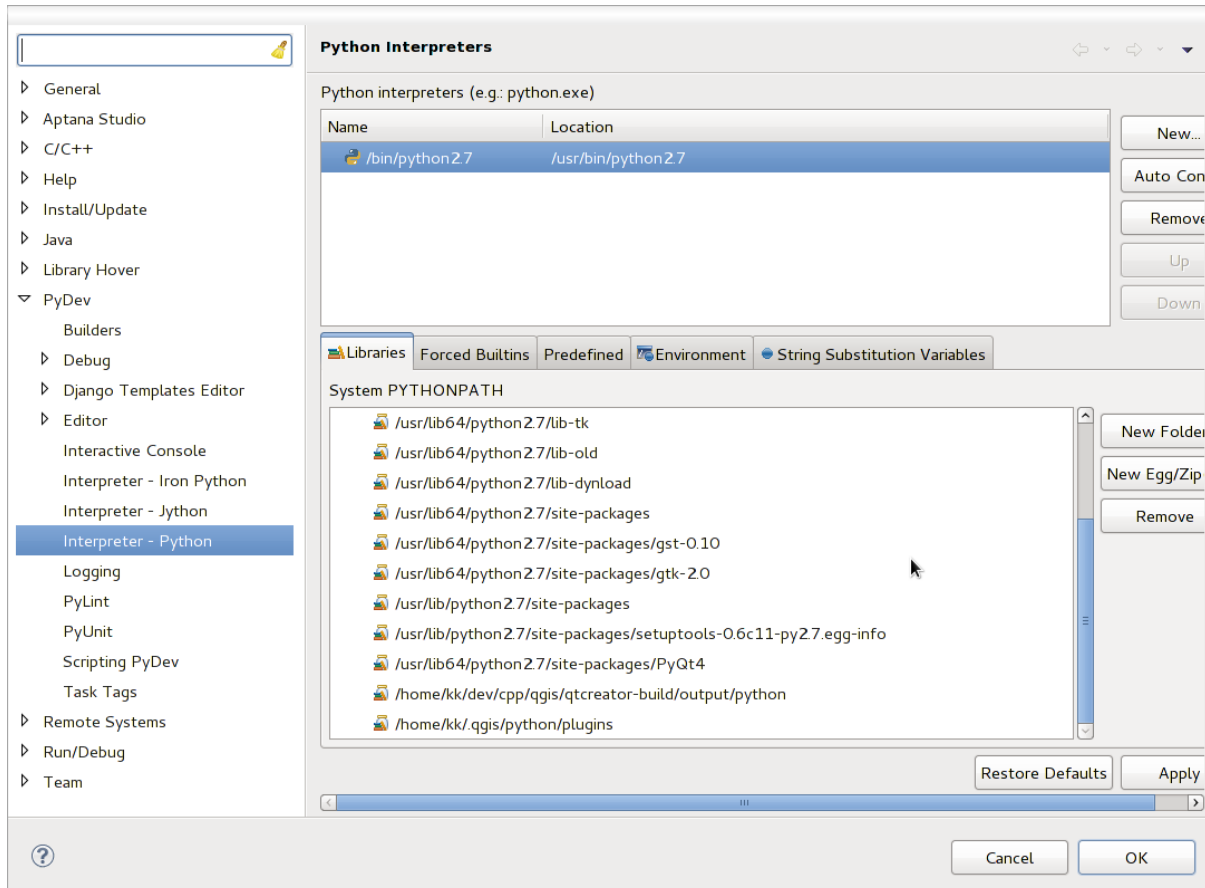


Figure 15.4: Consolde de depuração PyDev

Primeiro, abra a guia Bibliotecas. Adicione uma nova pasta e escolha a pasta python de sua instalação QGIS. Se você não sabe onde está pasta (não é a pasta plugins) abra QGIS, inicie um console python e basta digitar “ qgis “ e pressione Enter. Ela vai mostrar que módulo qgis usa e seu caminho. Tira o final /qgis/ \_\_init\_\_.pyc deste caminho e você tem o caminho que está procurando.

You should also add your plugins folder here (on Linux it is `~/ .qgis2/python/plugins`).

Next jump to the *Forced Builtins* tab, click on *New...* and enter `qgis`. This will make Eclipse parse the QGIS API. You probably also want Eclipse to know about the PyQt4 API. Therefore also add PyQt4 as forced builtin. That should probably already be present in your libraries tab.

Clique *OK* e está feito.

**Nota:** Every time the QGIS API changes (e.g. if you're compiling QGIS master and the SIP file changed), you should go back to this page and simply click *Apply*. This will let Eclipse parse all the libraries again.

## 15.3 Depuração usando PDB

Se você não usar um IDE como o Eclipse, você pode depurar usando PDB, seguindo estes passos.

Primeiro adicione este código no local onde você gostaria de depurar

```
# Use pdb for debugging
import pdb
# These lines allow you to set a breakpoint in the app
pyqtRemoveInputHook()
pdb.set_trace()
```

Em seguida, execute QGIS a partir da linha de comando.

On Linux do:

```
$ ./Qgis
```

On macOS do:

```
$ /Applications/Qgis.app/Contents/MacOS/Qgis
```

E quando o aplicativo atingir o seu ponto de interrupção você pode digitar no console!

**TODO:** Adicione informação de testes



---

## Usando Camadas de Plugins

---

Se o seu plugin usa seus próprios métodos para tornar uma camada de mapa, escrever o seu próprio tipo de camada com base em `QgsPluginLayer` pode ser a melhor maneira de implementar isso.

**A FAZER:** Verifique a exatidão e elabore bons casos de uso para `QgsPluginLayer`, ...

### 16.1 Subclasses `QgsPluginLayer`

Abaixo está um exemplo de uma implementação mínima `QgsPluginLayer`. É um trecho de exemplo do plugin `Watermark`

```
class WatermarkPluginLayer(QgsPluginLayer):
    LAYER_TYPE="watermark"

    def __init__(self):
        QgsPluginLayer.__init__(self, WatermarkPluginLayer.LAYER_TYPE, "Watermark plugin layer")
        self.setValid(True)

    def draw(self, rendererContext):
        image = QImage("myimage.png")
        painter = rendererContext.painter()
        painter.save()
        painter.drawImage(10, 10, image)
        painter.restore()
        return True
```

Os métodos para ler e escrever informações específicas para o arquivo de projeto também podem ser adicionados

```
def readXml(self, node):
    pass

def writeXml(self, node, doc):
    pass
```

Ao carregar um projeto que contém uma tal camada, uma classe de fábrica é necessária

```
class WatermarkPluginLayerType(QgsPluginLayerType):
    def __init__(self):
        QgsPluginLayerType.__init__(self, WatermarkPluginLayer.LAYER_TYPE)

    def createLayer(self):
        return WatermarkPluginLayer()
```

Você também pode adicionar código para exibir informações personalizadas nas propriedades da camada

```
def showLayerProperties(self, layer):  
    pass
```

---

## Compatibilidade com versões anteriores do QGIS

---

### 17.1 menu Complementos

Se você colocar o plugin de itens do menu em um dos novos menus (*Raster*, *Vector*, *Database* or *Web*), você deve modificar o código das funções : func: *initGUI()* e: *unload()*. Uma vez que estes novos menus estão disponíveis somente no QGIS 2,0 e maior, o primeiro passo é verificar se a versão do QGIS em execução tem todas as funções necessárias. Se os novos menus estão disponíveis, vamos colocar nosso plugin neste menu, caso contrário, vamos usar o velho: *Plugins*. Aqui está um exemplo para menu *Raster*

```
def initGui(self):
    # create action that will start plugin configuration
    self.action = QAction(QIcon(":/plugins/testplug/icon.png"), "Test plugin", self.iface.mainWindow)
    self.action.setWhatsThis("Configuration for test plugin")
    self.action.setStatusTip("This is status tip")
    QObject.connect(self.action, SIGNAL("triggered()"), self.run)

    # check if Raster menu available
    if hasattr(self.iface, "addPluginToRasterMenu"):
        # Raster menu and toolbar available
        self.iface.addRasterToolBarIcon(self.action)
        self.iface.addPluginToRasterMenu("&Test plugins", self.action)
    else:
        # there is no Raster menu, place plugin under Plugins menu as usual
        self.iface.addToolBarIcon(self.action)
        self.iface.addPluginToMenu("&Test plugins", self.action)

    # connect to signal renderComplete which is emitted when canvas rendering is done
    QObject.connect(self.iface.mapCanvas(), SIGNAL("renderComplete(QPainter *)"), self.renderTest)

def unload(self):
    # check if Raster menu available and remove our buttons from appropriate
    # menu and toolbar
    if hasattr(self.iface, "addPluginToRasterMenu"):
        self.iface.removePluginRasterMenu("&Test plugins", self.action)
        self.iface.removeRasterToolBarIcon(self.action)
    else:
        self.iface.removePluginMenu("&Test plugins", self.action)
        self.iface.removeToolBarIcon(self.action)

    # disconnect from signal of the canvas
    QObject.disconnect(self.iface.mapCanvas(), SIGNAL("renderComplete(QPainter *)"), self.renderTest)
```



---

## Liberao seu complemento

---

- Metadados e nome
- C3digo e ajuda
- Reposit3rio oficial de complementos python
  - Permiss3es
  - Gerenciamento de confian7a
  - Valida73o
  - Estrutura dos complementos

Uma vez que o seu complemento estiver pronto e voc3 achar que o complemento pode ser 3til para algumas pessoas, n3o hesite em envi3-lo para *Reposit3rio oficial de complementos python*. Nessa p3gina voc3 pode encontrar tamb3m pacotes de orienta73es sobre como preparar o complemento para funcionar bem com o instalador de complementos. Ou no caso de voc3 gostaria de criar o seu pr3prio reposit3rio de complementos, criando um arquivo XML simples que ir3 listar os complementos e seus metadados, para exemplos, ver outros [reposit3rios de complementos](#).

Por favor tenha um cuidado especial com estas sugest3es

### 18.1 Metadados e nome

- evitar o uso de um nome muito semelhante ao de complementos existentes
- Se seu complemento tem a funcionalda semelhante a de um complemento j3 existente, por favor explique as diferen7as n campo Sobre, ent3o o usu3rio saber3 qual usar sem a necessidade de intal3-lo e testar.
- evitar repetir “plugin” no nome do complemento
- use o campo de descri7ao em metadados para a descri73o de 1 linha, e no campo Sobre para instru73es mais detalhadas
- Adicione um reposit3rio de c3digo, um rastreador de erros, e uma p3gina inicial; isso vai melhorar muito a possibilidade de colabora73o, e pode ser feito muito facilmente com uma das infra-estruturas dispon3veis na web (GitHub, GitLab, Bitbucket, etc.)
- Escolha etiquetas com cuidado, evite as n3o informativas (por exemplo vetor) e prefira as usualmente usada pelos outros (veja o website de complementos)
- Adicione um 3cone pr3prio, n3o deixe o padr3o; veja a interface QGIS por sugest3o de estilos para usar

### 18.2 C3digo e ajuda

- n3o adicione arquivos gerados (ui\_\*.py, resources\_rc.py, generated help files...) coisas in3teis (por exemplo. .gitignore) no reposit3rio

- Adicione o complemento no menu apropriado (Vector, Raster, Web, Database)
- quando apropriado (complements realizando análises), considere acrescentar o complemento como uma sub-complemento do quadro de processamento: isso vai permitir que os usuários executem em lote, para integrá-lo em fluxos de trabalho mais complexos, e vai livrá-lo do fardo de projetar uma interface
- Adicione no mínimo uma pequena documentação, se for útil para teste e entendimento, dados de exemplo

## 18.3 Repositório oficial de complementos python

Você pode encontrar o repositório *oficial* de complementos python em <http://plugins.qgis.org/>.

Para usar o repositório oficial, deve obter uma ID OSGEO do [portal web OSGEO](#).

Depois de carregado o seu complemento será aprovado por um membro da equipe e você será notificado.

**TODO:** Insira um link para o documento de governança.

### 18.3.1 Permissões

Estas regras foram implementadas no repositório oficial de complementos:

- todos os usuários registrados podem adicionar um novo plugin
- A *equipe* de usuários podem aprovar ou reprovar todas as versões do plugin
- Os usuários que têm permissão especial *plugins.can\_approve* automaticamente têm suas versões de extensão aprovado
- usuários que têm a permissão especial *plugins.can\_approve* pode aprovar versões carregadas por outros, enquanto eles estão na lista do *proprietários* de complementos
- um complemento específico pode ser apagado e editado apenas pela *equipe* de usuários e pelos *proprietários* do complemento
- se um usuário sem permissão *plugins.can\_approve* carrega uma nova versão, a versão do plugin é automaticamente não aprovado.

### 18.3.2 Gerenciamento de confiança

Os membros da equipe podem conceder *permissão* para criadores de complementos selecionado definindo permissão *plugins.can\_approve* através da aplicação front-end.

A visão de detalhes do complemento oferece links diretos para conceder permissão para o criador do complemento ou o *proprietários* do complemento.

### 18.3.3 Validação

Metadados do complemento são automaticamente importados e validados a partir do pacote compactado quando o complemento é carregado.

Aqui estão algumas regras de validação que você deve estar ciente quando desejar fazer o upload de um complemento no repositório oficial:

1. o nome de sua pasta principal contendo seu complemento deve conter apenas caracteres ASCII (A-Z e a-z), números e os caracteres underscore (`_`) e menos (`-`), e também não pode iniciar com um número.
2. `metadata.txt` é necessário
3. todos metadados requeridos e que devem estar presentes estão listados em [metadata table](#)
4. o campo *versão* metadados deve ser exclusivo

### 18.3.4 Estrutura dos complementos

Seguindo as regras de validação, o pacote compactado (.zip) de seu plugin deve ter uma estrutura específica para ser validado como um plugin funcional. Como o plugin será descompactado dentro da pasta de plugins de usuários ele deve ter seu próprio diretório dentro do arquivo .zip para não interferir em outros plugins. Arquivos obrigatórios: `metadata.txt` e `__init__.py`. Seria melhor se tivesse um `README` e também um ícone representando o plugin (`resources.qrc`). A seguir, um exemplo de como um `plugin.zip` deve se parecer.

```
plugin.zip
  pluginfolder/
    |-- i18n
    |   |-- translation_file_de.ts
    |-- img
    |   |-- icon.png
    |   |-- iconsources.svg
    |-- __init__.py
    |-- Makefile
    |-- metadata.txt
    |-- more_code.py
    |-- main_code.py
    |-- README
    |-- resources.qrc
    |-- resources_rc.py
    |-- ui_Qt_user_interface_file.ui
```





---

## Fragmentos de código

---

- Cómo llamar a un método por un atajo de teclado
- Como alternar capas
- Cómo acceder a la tabla de atributos de los objetos espaciales seleccionados

Esta sección cuenta con fragmentos de código para facilitar el desarrollo de complementos.

### 19.1 Cómo llamar a un método por un atajo de teclado

No complemento adicione `initGui()`

```
self.keyAction = QAction("Test Plugin", self.iface.mainWindow())
self.iface.registerMainWindowAction(self.keyAction, "F7") # action1 triggered by F7 key
self.iface.addPluginToMenu("&Test plugins", self.keyAction)
QObject.connect(self.keyAction, SIGNAL("triggered()"), self.keyActionF7)
```

Para `unload()` adicione

```
self.iface.unregisterMainWindowAction(self.keyAction)
```

O método que ~e chamado quando F7 é pressionada

```
def keyActionF7(self):
    QMessageBox.information(self.iface.mainWindow(), "Ok", "You pressed F7")
```

### 19.2 Como alternar capas

Desde QGIS 2.4 há uma nova estrutura de camada de API que permite o acesso direto à estrutura de camada na legenda. Aqui está um exemplo de como alternar a visibilidade da camada ativa

```
root = QgsProject.instance().layerTreeRoot()
node = root.findLayer(iface.activeLayer().id())
new_state = Qt.Checked if node.isVisible() == Qt.Unchecked else Qt.Unchecked
node.setVisible(new_state)
```

## 19.3 Cómo acceder a la tabla de atributos de los objetos espaciales seleccionados

```
def changeValue(self, value):
    layer = self.iface.activeLayer()
    if(layer):
        nF = layer.selectedFeatureCount()
        if (nF > 0):
            layer.startEditing()
            ob = layer.selectedFeaturesIds()
            b = QVariant(value)
            if (nF > 1):
                for i in ob:
                    layer.changeAttributeValue(int(i), 1, b) # 1 being the second column
            else:
                layer.changeAttributeValue(int(ob[0]), 1, b) # 1 being the second column
            layer.commitChanges()
        else:
            QMessageBox.critical(self.iface.mainWindow(), "Error",
                                "Please select at least one feature from current layer")
    else:
        QMessageBox.critical(self.iface.mainWindow(), "Error", "Please select a layer")
```

Este método requer um parâmetro (o novo valor para o campo de atributo da característica(s) selecionada) e pode ser chamado por

```
self.changeValue(50)
```

---

## Escrevendo um complemento de processamento

---

- Creating a plugin that adds an algorithm provider
- Creating a plugin that contains a set of processing scripts

Depending on the kind of plugin that you are going to develop, it might be better option to add its functionality as a Processing algorithm (or a set of them). That would provide a better integration within QGIS, additional functionality (since it can be run in the components of Processing, such as the modeler or the batch processing interface), and a quicker development time (since Processing will take of a large part of the work).

This document describes how to create a new plugin that adds its functionality as Processing algorithms.

There are two main mechanisms for doing that:

- Creating a plugin that adds an algorithm provider: This options is more complex, but provides more flexibility
- Creating a plugin that contains a set of processing scripts: The simplest solution, you just need a set of Processing script files.

### 20.1 Creating a plugin that adds an algorithm provider

To create an algorithm provider, follow these steps:

- Instale o complemento Plugin Builder
- Crie um novo complemento usando o Plugin Builder. Quando o Plugin Builder perguntar qual modelo usar, selecione “Processing provider”.
- The created plugin contains a provider with a single algorithm. Both the provider file and the algorithm file are fully commented and contain information about how to modify the provider and add additional algorithms. Refer to them for more information.

### 20.2 Creating a plugin that contains a set of processing scripts

To create a set of processing scripts, follow these steps:

- Create your scripts as described in the PyQGIS cookbook. All the scripts that you want to add, you should have them available in the Processing toolbox.
- In the *Scripts/Tools* group in the Processing toolbox, double-click on the *Create script collection plugin* item. You will see a window where you should select the scripts to add to the plugin (from the set of available ones in the toolbox), and some additional information needed for the plugin metadata.
- Click on OK and the plugin will be created.

- You can add additional scripts to the plugin by adding scripts python files to the *scripts* folder in the resulting plugin folder.

---

## Biblioteca de análise de rede

---

- Informação Geral
- Elaborando um gráfico
- Análise de Gráficos
  - Encontrando os caminhos mais curtos
  - Areas of availability

Starting from revision [ee19294562](#) (QGIS  $\geq$  1.8) the new network analysis library was added to the QGIS core analysis library. The library:

- criar gráfico matemático para dado geográfico (camadas vetor polígono)
- implements basic methods from graph theory (currently only Dijkstra's algorithm)

The network analysis library was created by exporting basic functions from the RoadGraph core plugin and now you can use it's methods in plugins or directly from the Python console.

### 21.1 Informação Geral

Resumidamente, um caso típico pode ser descrito assim:

1. criar gráfico para geodata (camada vetorial polígono usual)
2. rodar análise gráfica
3. usar resultados das análises (por exemplo, visualizá-los)

### 21.2 Elaborando um gráfico

A primeira coisa que você deve fazer — é preparar os dados de entrada, que é converter uma camada vetor em um gráfico. Todas as próximas ações irão usar este gráfico e não a camada.

As a source we can use any polyline vector layer. Nodes of the polylines become graph vertexes, and segments of the polylines are graph edges. If several nodes have the same coordinates then they are the same graph vertex. So two lines that have a common node become connected to each other.

Additionally, during graph creation it is possible to “fix” (“tie”) to the input vector layer any number of additional points. For each additional point a match will be found — the closest graph vertex or closest graph edge. In the latter case the edge will be split and a new vertex added.

Vector layer attributes and length of an edge can be used as the properties of an edge.

Converting from a vector layer to the graph is done using the **Builder** programming pattern. A graph is constructed using a so-called Director. There is only one Director for now: `QgsLineVectorLayerDirector`. The director sets the basic settings that will be used to construct a graph from a line vector layer, used by the builder to create the

graph. Currently, as in the case with the director, only one builder exists: `QgsGraphBuilder`, that creates `QgsGraph` objects. You may want to implement your own builders that will build a graphs compatible with such libraries as `BGL` or `NetworkX`.

To calculate edge properties the programming pattern `strategy` is used. For now only `QgsDistanceArcProperter` strategy is available, that takes into account the length of the route. You can implement your own strategy that will use all necessary parameters. For example, `RoadGraph` plugin uses a strategy that computes travel time using edge length and speed value from attributes.

It's time to dive into the process.

First of all, to use this library we should import the `networkanalysis` module

```
from qgis.networkanalysis import *
```

Then some examples for creating a director

```
# don't use information about road direction from layer attributes,
# all roads are treated as two-way
director = QgsLineVectorLayerDirector(vLayer, -1, '', '', '', 3)

# use field with index 5 as source of information about road direction.
# one-way roads with direct direction have attribute value "yes",
# one-way roads with reverse direction have the value "1", and accordingly
# bidirectional roads have "no". By default roads are treated as two-way.
# This scheme can be used with OpenStreetMap data
director = QgsLineVectorLayerDirector(vLayer, 5, 'yes', '1', 'no', 3)
```

To construct a director we should pass a vector layer, that will be used as the source for the graph structure and information about allowed movement on each road segment (one-way or bidirectional movement, direct or reverse direction). The call looks like this

```
director = QgsLineVectorLayerDirector(vl, directionFieldId,
                                     directDirectionValue,
                                     reverseDirectionValue,
                                     bothDirectionValue,
                                     defaultDirection)
```

Aqui segue uma lista de todos os significados dos parâmetros:

- `vl` — vector layer used to build the graph
- `directionFieldId` — index of the attribute table field, where information about roads direction is stored. If `-1`, then don't use this info at all. An integer.
- `directDirectionValue` — field value for roads with direct direction (moving from first line point to last one). A string.
- `reverseDirectionValue` — field value for roads with reverse direction (moving from last line point to first one). A string.
- `bothDirectionValue` — field value for bidirectional roads (for such roads we can move from first point to last and from last to first). A string.
- `defaultDirection` — default road direction. This value will be used for those roads where field `directionFieldId` is not set or has some value different from any of the three values specified above. An integer. 1 indicates direct direction, 2 indicates reverse direction, and 3 indicates both directions.

It is necessary then to create a strategy for calculating edge properties

```
properter = QgsDistanceArcProperter()
```

And tell the director about this strategy

```
director.addProperter(properter)
```

Now we can use the builder, which will create the graph. The `QgsGraphBuilder` class constructor takes several arguments:

- `src` — sistema de referência de coordenadas para uso. Argumento prioritário.
- `otfAtivado` — uso ou não da reprojeção “voe livre”. Por padrão consta: *Verdadeiro* (use OTF).
- `tolerânciaTopológica` — tolerância topológica. Valor padrão é 0.
- `elipsóideID` — elipsóide usado. Por padrão “WGS84”.

```
# only CRS is set, all other values are defaults
builder = QgsGraphBuilder(myCRS)
```

Também podemos definir vários pontos, que serão usados na análise. Por exemplo

```
startPoint = QgsPoint(82.7112, 55.1672)
endPoint = QgsPoint(83.1879, 54.7079)
```

Now all is in place so we can build the graph and “tie” these points to it

```
tiedPoints = director.makeGraph(builder, [startPoint, endPoint])
```

Building the graph can take some time (which depends on the number of features in a layer and layer size). `tiedPoints` is a list with coordinates of “tied” points. When the build operation is finished we can get the graph and use it for the analysis

```
graph = builder.graph()
```

With the next code we can get the vertex indexes of our points

```
startId = graph.findVertex(tiedPoints[0])
endId = graph.findVertex(tiedPoints[1])
```

## 21.3 Análise de Gráficos

Networks analysis is used to find answers to two questions: which vertexes are connected and how to find a shortest path. To solve these problems the network analysis library provides Dijkstra’s algorithm.

Dijkstra’s algorithm finds the shortest route from one of the vertexes of the graph to all the others and the values of the optimization parameters. The results can be represented as a shortest path tree.

The shortest path tree is a directed weighted graph (or more precisely — tree) with the following properties:

- only one vertex has no incoming edges — the root of the tree
- todos os outros vértices têm apenas uma borda chegando
- if vertex B is reachable from vertex A, then the path from A to B is the single available path and it is optimal (shortest) on this graph

To get the shortest path tree use the methods `shortestTree()` and `dijkstra()` of `QgsGraphAnalyzer` class. It is recommended to use method `dijkstra()` because it works faster and uses memory more efficiently.

The `shortestTree()` method is useful when you want to walk around the shortest path tree. It always creates a new graph object (`QgsGraph`) and accepts three variables:

- `fonte` — gráfico de entrada
- `startVertexIdx` — index of the point on the tree (the root of the tree)
- `criterionNum` — number of edge property to use (started from 0).

```
tree = QgsGraphAnalyzer.shortestTree(graph, startId, 0)
```

The `dijkstra()` method has the same arguments, but returns two arrays. In the first array element `i` contains index of the incoming edge or `-1` if there are no incoming edges. In the second array element `i` contains distance from the root of the tree to vertex `i` or `DOUBLE_MAX` if vertex `i` is unreachable from the root.

```
(tree, cost) = QgsGraphAnalyzer.dijkstra(graph, startId, 0)
```

Here is some very simple code to display the shortest path tree using the graph created with the `shortestTree()` method (select linestring layer in TOC and replace coordinates with your own). **Warning:** use this code only as an example, it creates a lots of `QgsRubberBand` objects and may be slow on large data-sets.

```
from PyQt4.QtCore import *
from PyQt4.QtGui import *

from qgis.core import *
from qgis.gui import *
from qgis.networkanalysis import *

vl = qgis.utils.iface.mapCanvas().currentLayer()
director = QgsLineVectorLayerDirector(vl, -1, '', '', '', 3)
properter = QgsDistanceArcProperter()
director.addProperter(properter)
crs = qgis.utils.iface.mapCanvas().mapRenderer().destinationCrs()
builder = QgsGraphBuilder(crs)

pStart = QgsPoint(-0.743804, 0.22954)
tiedPoint = director.makeGraph(builder, [pStart])
pStart = tiedPoint[0]

graph = builder.graph()

idStart = graph.findVertex(pStart)

tree = QgsGraphAnalyzer.shortestTree(graph, idStart, 0)

i = 0;
while (i < tree.arcCount()):
    rb = QgsRubberBand(qgis.utils.iface.mapCanvas())
    rb.setColor (Qt.red)
    rb.addPoint (tree.vertex(tree.arc(i).inVertex()).point())
    rb.addPoint (tree.vertex(tree.arc(i).outVertex()).point())
    i = i + 1
```

Same thing but using `dijkstra()` method

```
from PyQt4.QtCore import *
from PyQt4.QtGui import *

from qgis.core import *
from qgis.gui import *
from qgis.networkanalysis import *

vl = qgis.utils.iface.mapCanvas().currentLayer()
director = QgsLineVectorLayerDirector(vl, -1, '', '', '', 3)
properter = QgsDistanceArcProperter()
director.addProperter(properter)
crs = qgis.utils.iface.mapCanvas().mapRenderer().destinationCrs()
builder = QgsGraphBuilder(crs)

pStart = QgsPoint(-1.37144, 0.543836)
tiedPoint = director.makeGraph(builder, [pStart])
pStart = tiedPoint[0]

graph = builder.graph()
```



```

idStart = graph.findVertex(pStart)

(tree, costs) = QgsGraphAnalyzer.dijkstra(graph, idStart, 0)

for edgeId in tree:
    if edgeId == -1:
        continue
    rb = QgsRubberBand(qgis.utils.iface.mapCanvas())
    rb.setColor (Qt.red)
    rb.addPoint (graph.vertex(graph.arc(edgeId).inVertex()).point())
    rb.addPoint (graph.vertex(graph.arc(edgeId).outVertex()).point())

```

### 21.3.1 Encontrando os caminhos mais curtos

To find the optimal path between two points the following approach is used. Both points (start A and end B) are “tied” to the graph when it is built. Then using the methods `shortestTree()` or `dijkstra()` we build the shortest path tree with root in the start point A. In the same tree we also find the end point B and start to walk through the tree from point B to point A. The whole algorithm can be written as

```

assign = B
while != A
    add point to path
    get incoming edge for point
    look for point , that is start point of this edge
    assign =
add point to path

```

At this point we have the path, in the form of the inverted list of vertexes (vertexes are listed in reversed order from end point to start point) that will be visited during traveling by this path.

Here is the sample code for QGIS Python Console (you will need to select linestring layer in TOC and replace coordinates in the code with yours) that uses method `shortestTree()`

```

from PyQt4.QtCore import *
from PyQt4.QtGui import *

from qgis.core import *
from qgis.gui import *
from qgis.networkanalysis import *

vl = qgis.utils.iface.mapCanvas().currentLayer()
director = QgsLineVectorLayerDirector(vl, -1, '', '', '', 3)
properter = QgsDistanceArcProperter()
director.addProperter(properter)
crs = qgis.utils.iface.mapCanvas().mapRenderer().destinationCrs()
builder = QgsGraphBuilder(crs)

pStart = QgsPoint(-0.835953, 0.15679)
pStop = QgsPoint(-1.1027, 0.699986)

tiedPoints = director.makeGraph(builder, [pStart, pStop])
graph = builder.graph()

tStart = tiedPoints[0]
tStop = tiedPoints[1]

idStart = graph.findVertex(tStart)
tree = QgsGraphAnalyzer.shortestTree(graph, idStart, 0)

idStart = tree.findVertex(tStart)
idStop = tree.findVertex(tStop)

```

```
if idStop == -1:
    print "Path not found"
else:
    p = []
    while (idStart != idStop):
        l = tree.vertex(idStop).inArc()
        if len(l) == 0:
            break
        e = tree.arc(l[0])
        p.insert(0, tree.vertex(e.inVertex()).point())
        idStop = e.outVertex()

    p.insert(0, tStart)
    rb = QgsRubberBand(qgis.utils.iface.mapCanvas())
    rb.setColor(Qt.red)

    for pnt in p:
        rb.addPoint(pnt)
```

And here is the same sample but using `dijkstra()` method

```
from PyQt4.QtCore import *
from PyQt4.QtGui import *

from qgis.core import *
from qgis.gui import *
from qgis.networkanalysis import *

vl = qgis.utils.iface.mapCanvas().currentLayer()
director = QgsLineVectorLayerDirector(vl, -1, '', '', '', 3)
properter = QgsDistanceArcProperter()
director.addProperter(properter)
crs = qgis.utils.iface.mapCanvas().mapRenderer().destinationCrs()
builder = QgsGraphBuilder(crs)

pStart = QgsPoint(-0.835953, 0.15679)
pStop = QgsPoint(-1.1027, 0.699986)

tiedPoints = director.makeGraph(builder, [pStart, pStop])
graph = builder.graph()

tStart = tiedPoints[0]
tStop = tiedPoints[1]

idStart = graph.findVertex(tStart)
idStop = graph.findVertex(tStop)

(tree, cost) = QgsGraphAnalyzer.dijkstra(graph, idStart, 0)

if tree[idStop] == -1:
    print "Path not found"
else:
    p = []
    curPos = idStop
    while curPos != idStart:
        p.append(graph.vertex(graph.arc(tree[curPos]).inVertex()).point())
        curPos = graph.arc(tree[curPos]).outVertex();

    p.append(tStart)

    rb = QgsRubberBand(qgis.utils.iface.mapCanvas())
    rb.setColor(Qt.red)
```

```
for pnt in p:
    rb.addPoint(pnt)
```

### 21.3.2 Areas of availability

The area of availability for vertex A is the subset of graph vertexes that are accessible from vertex A and the cost of the paths from A to these vertexes are not greater than some value.

More clearly this can be shown with the following example: “There is a fire station. Which parts of city can a fire truck reach in 5 minutes? 10 minutes? 15 minutes?”. Answers to these questions are fire station’s areas of availability.

To find the areas of availability we can use method `dijkstra()` of the `QgsGraphAnalyzer` class. It is enough to compare the elements of the cost array with a predefined value. If `cost[i]` is less than or equal to a predefined value, then vertex `i` is inside the area of availability, otherwise it is outside.

A more difficult problem is to get the borders of the area of availability. The bottom border is the set of vertexes that are still accessible, and the top border is the set of vertexes that are not accessible. In fact this is simple: it is the availability border based on the edges of the shortest path tree for which the source vertex of the edge is accessible and the target vertex of the edge is not.

Aqui está um exemplo

```
from PyQt4.QtCore import *
from PyQt4.QtGui import *

from qgis.core import *
from qgis.gui import *
from qgis.networkanalysis import *

vl = qgis.utils.iface.mapCanvas().currentLayer()
director = QgsLineVectorLayerDirector(vl, -1, '', '', '', 3)
properter = QgsDistanceArcProperter()
director.addProperter(properter)
crs = qgis.utils.iface.mapCanvas().mapRenderer().destinationCrs()
builder = QgsGraphBuilder(crs)

pStart = QgsPoint(65.5462, 57.1509)
delta = qgis.utils.iface.mapCanvas().getCoordinateTransform().mapUnitsPerPixel() * 1

rb = QgsRubberBand(qgis.utils.iface.mapCanvas(), True)
rb.setColor(Qt.green)
rb.addPoint(QgsPoint(pStart.x() - delta, pStart.y() - delta))
rb.addPoint(QgsPoint(pStart.x() + delta, pStart.y() - delta))
rb.addPoint(QgsPoint(pStart.x() + delta, pStart.y() + delta))
rb.addPoint(QgsPoint(pStart.x() - delta, pStart.y() + delta))

tiedPoints = director.makeGraph(builder, [pStart])
graph = builder.graph()
tStart = tiedPoints[0]

idStart = graph.findVertex(tStart)

(tree, cost) = QgsGraphAnalyzer.dijkstra(graph, idStart, 0)

upperBound = []
r = 2000.0
i = 0
while i < len(cost):
    if cost[i] > r and tree[i] != -1:
        outVertexId = graph.arc(tree[i]).outVertex()
        if cost[outVertexId] < r:
```

```
        upperBound.append(i)
    i = i + 1

for i in upperBound:
    centerPoint = graph.vertex(i).point()
    rb = QgsRubberBand(qgis.utils.iface.mapCanvas(), True)
    rb.setColor(Qt.red)
    rb.addPoint(QgsPoint(centerPoint.x() - delta, centerPoint.y() - delta))
    rb.addPoint(QgsPoint(centerPoint.x() + delta, centerPoint.y() - delta))
    rb.addPoint(QgsPoint(centerPoint.x() + delta, centerPoint.y() + delta))
    rb.addPoint(QgsPoint(centerPoint.x() - delta, centerPoint.y() + delta))
```

---

## Complementos de servidores Python do QGIS

---

- Server Filter Plugins architecture
  - requestReady
  - sendResponse
  - responseComplete
- Raising exception from a plugin
- Writing a server plugin
  - Plugin files
  - `__init__.py`
  - `HelloServer.py`
  - Modifying the input
  - Modifying or replacing the output
- Access control plugin
  - Plugin files
  - `__init__.py`
  - `AccessControl.py`
  - `layerFilterExpression`
  - `layerFilterSubsetString`
  - `layerPermissions`
  - `authorizedLayerAttributes`
  - `allowToEdit`
  - `cacheKey`

Python plugins can also run on QGIS Server (see *label\_qgisserver*): by using the *server interface* (`QgsServerInterface`) a Python plugin running on the server can alter the behavior of existing core services (**WMS**, **WFS** etc.).

With the *server filter interface* (`QgsServerFilter`) we can change the input parameters, change the generated output or even by providing new services.

With the *access control interface* (`QgsAccessControlFilter`) we can apply some access restriction per requests.

### 22.1 Server Filter Plugins architecture

Server python plugins are loaded once when the FCGI application starts. They register one or more `QgsServerFilter` (from this point, you might find useful a quick look to the [server plugins API docs](#)). Each filter should implement at least one of three callbacks:

- `requestReady ()`
- `responseComplete ()`
- `sendResponse ()`

All filters have access to the request/response object (`QgsRequestHandler`) and can manipulate all its properties (input/output) and raise exceptions (while in a quite particular way as we'll see below).

Here is a pseudo code showing a typical server session and when the filter's callbacks are called:

- **Get the incoming request**
  - create GET/POST/SOAP request handler
  - pass request to an instance of `QgsServerInterface`
  - call plugins `requestReady()` filters
  - **if there is not a response**
    - \* **if SERVICE is WMS/WFS/WCS**
      - **criar servidor WMS/WFS/WCS**
        - call server's `executeRequest()` and possibly call `sendResponse()` plugin filters when streaming output or store the byte stream output and content type in the request handler
      - \* call plugins `responseComplete()` filters
    - call plugins `sendResponse()` filters
    - request handler output the response

The following paragraphs describe the available callbacks in details.

### 22.1.1 requestReady

This is called when the request is ready: incoming URL and data have been parsed and before entering the core services (WMS, WFS etc.) switch, this is the point where you can manipulate the input and perform actions like:

- authentication/authorization
- redirects
- add/remove certain parameters (typenames for example)
- raise exceptions

You could even substitute a core service completely by changing **SERVICE** parameter and hence bypassing the core service completely (not that this make much sense though).

### 22.1.2 sendResponse

This is called whenever output is sent to **FCGI** `stdout` (and from there, to the client), this is normally done after core services have finished their process and after `responseComplete` hook was called, but in a few cases XML can become so huge that a streaming XML implementation was needed (WFS `GetFeature` is one of them), in this case, `sendResponse()` is called multiple times before the response is complete (and before `responseComplete()` is called). The obvious consequence is that `sendResponse()` is normally called once but might be exceptionally called multiple times and in that case (and only in that case) it is also called before `responseComplete()`.

`sendResponse()` is the best place for direct manipulation of core service's output and while `responseComplete()` is typically also an option, `sendResponse()` is the only viable option in case of streaming services.

### 22.1.3 responseComplete

This is called once when core services (if hit) finish their process and the request is ready to be sent to the client. As discussed above, this is normally called before `sendResponse()` except for streaming services (or other plugin filters) that might have called `sendResponse()` earlier.

`responseComplete()` is the ideal place to provide new services implementation (WPS or custom services) and to perform direct manipulation of the output coming from core services (for example to add a watermark upon a WMS image).

## 22.2 Raising exception from a plugin

Some work has still to be done on this topic: the current implementation can distinguish between handled and unhandled exceptions by setting a `QgsRequestHandler` property to an instance of `QgsMapServiceException`, this way the main C++ code can catch handled python exceptions and ignore unhandled exceptions (or better: log them).

This approach basically works but it is not very “pythonic”: a better approach would be to raise exceptions from python code and see them bubbling up into C++ loop for being handled there.

## 22.3 Writing a server plugin

A server plugins is just a standard QGIS Python plugin as described in *Desenvolvimento de Complementos Python*, that just provides an additional (or alternative) interface: a typical QGIS desktop plugin has access to QGIS application through the `QgisInterface` instance, a server plugin has also access to a `QgsServerInterface`.

To tell QGIS Server that a plugin has a server interface, a special metadata entry is needed (in *metadata.txt*)

```
server=True
```

The example plugin discussed here (with many more example filters) is available on github: [QGIS HelloServer Example Plugin](#)

### 22.3.1 Plugin files

Here’s the directory structure of our example server plugin

```
PYTHON_PLUGINS_PATH/
HelloServer/
  __init__.py    --> *required*
  HelloServer.py --> *required*
  metadata.txt   --> *required*
```

### 22.3.2 \_\_init\_\_.py

This file is required by Python’s import system. Also, QGIS Server requires that this file contains a `serverClassFactory()` function, which is called when the plugin gets loaded into QGIS Server when the server starts. It receives reference to instance of `QgsServerInterface` and must return instance of your plugin’s class. This is how the example plugin *\_\_init\_\_.py* looks like:

```
# -*- coding: utf-8 -*-

def serverClassFactory(serverIface):
    from HelloServer import HelloServerServer
    return HelloServerServer(serverIface)
```

### 22.3.3 HelloServer.py

This is where the magic happens and this is how magic looks like: (e.g. `HelloServer.py`)

A server plugin typically consists in one or more callbacks packed into objects called `QgsServerFilter`.

Each `QgsServerFilter` implements one or more of the following callbacks:

- `requestReady()`
- `responseComplete()`
- `sendResponse()`

The following example implements a minimal filter which prints *HelloServer!* in case the **SERVICE** parameter equals to “HELLO”:

```
from qgis.server import *
from qgis.core import *

class HelloFilter(QgsServerFilter):

    def __init__(self, serverIface):
        super(HelloFilter, self).__init__(serverIface)

    def responseComplete(self):
        request = self.serverInterface().requestHandler()
        params = request.parameterMap()
        if params.get('SERVICE', '').upper() == 'HELLO':
            request.clearHeaders()
            request.setHeader('Content-type', 'text/plain')
            request.clearBody()
            request.appendBody('HelloServer!')
```

The filters must be registered into the **serverIface** as in the following example:

```
class HelloServerServer:
    def __init__(self, serverIface):
        # Save reference to the QGIS server interface
        self.serverIface = serverIface
        serverIface.registerFilter( HelloFilter, 100 )
```

The second parameter of `registerFilter()` allows to set a priority which defines the order for the callbacks with the same name (the lower priority is invoked first).

By using the three callbacks, plugins can manipulate the input and/or the output of the server in many different ways. In every moment, the plugin instance has access to the `QgsRequestHandler` through the `QgsServerInterface`, the `QgsRequestHandler` has plenty of methods that can be used to alter the input parameters before entering the core processing of the server (by using `requestReady()`) or after the request has been processed by the core services (by using `sendResponse()`).

The following examples cover some common use cases:

### 22.3.4 Modifying the input

The example plugin contains a test example that changes input parameters coming from the query string, in this example a new parameter is injected into the (already parsed) `parameterMap`, this parameter is then visible by core services (WMS etc.), at the end of core services processing we check that the parameter is still there:

```
from qgis.server import *
from qgis.core import *

class ParamsFilter(QgsServerFilter):
```



```

def __init__(self, serverIface):
    super(ParamsFilter, self).__init__(serverIface)

def requestReady(self):
    request = self.serverInterface().requestHandler()
    params = request.parameterMap()
    request.setParameter('TEST_NEW_PARAM', 'ParamsFilter')

def responseComplete(self):
    request = self.serverInterface().requestHandler()
    params = request.parameterMap()
    if params.get('TEST_NEW_PARAM') == 'ParamsFilter':
        QgsMessageLog.logMessage("SUCCESS - ParamsFilter.responseComplete", 'plugin', QgsMess
    else:
        QgsMessageLog.logMessage("FAIL - ParamsFilter.responseComplete", 'plugin', QgsMess

```

This is an extract of what you see in the log file:

```

src/core/qgsmessageolog.cpp: 45: (logMessage) [0ms] 2014-12-12T12:39:29 plugin[0] HelloServerServ
src/core/qgsmessageolog.cpp: 45: (logMessage) [1ms] 2014-12-12T12:39:29 Server[0] Server plugin H
src/core/qgsmessageolog.cpp: 45: (logMessage) [0ms] 2014-12-12T12:39:29 Server[0] Server python p
src/mapserver/qgsgetrequesthandler.cpp: 35: (parseInput) [0ms] query string is: SERVICE=HELLO&re
src/mapserver/qgshttprequesthandler.cpp: 547: (requestStringToParameterMap) [1ms] inserting pair
src/mapserver/qgshttprequesthandler.cpp: 547: (requestStringToParameterMap) [0ms] inserting pair
src/mapserver/qgsserverfilter.cpp: 42: (requestReady) [0ms] QgsServerFilter plugin default reques
src/core/qgsmessageolog.cpp: 45: (logMessage) [0ms] 2014-12-12T12:39:29 plugin[0] HelloFilter.req
src/mapserver/qgis_map_serv.cpp: 235: (configPath) [0ms] Using default configuration file path: .
src/mapserver/qgshttprequesthandler.cpp: 49: (setHttpResponse) [0ms] Checking byte array is ok t
src/mapserver/qgshttprequesthandler.cpp: 59: (setHttpResponse) [0ms] Byte array looks good, sett
src/core/qgsmessageolog.cpp: 45: (logMessage) [0ms] 2014-12-12T12:39:29 plugin[0] HelloFilter.res
src/core/qgsmessageolog.cpp: 45: (logMessage) [0ms] 2014-12-12T12:39:29 plugin[0] SUCCESS - Param
src/core/qgsmessageolog.cpp: 45: (logMessage) [0ms] 2014-12-12T12:39:29 plugin[0] RemoteConsoleFi
src/mapserver/qgshttprequesthandler.cpp: 158: (sendResponse) [0ms] Sending HTTP response
src/core/qgsmessageolog.cpp: 45: (logMessage) [0ms] 2014-12-12T12:39:29 plugin[0] HelloFilter.sen

```

On the highlighted line the “SUCCESS” string indicates that the plugin passed the test.

The same technique can be exploited to use a custom service instead of a core one: you could for example skip a **WFS SERVICE** request or any other core request just by changing the **SERVICE** parameter to something different and the core service will be skipped, then you can inject your custom results into the output and send them to the client (this is explained here below).

### 22.3.5 Modifying or replacing the output

The watermark filter example shows how to replace the WMS output with a new image obtained by adding a watermark image on the top of the WMS image generated by the WMS core service:

```

import os

from qgis.server import *
from qgis.core import *
from PyQt4.QtCore import *
from PyQt4.QtGui import *

class WatermarkFilter(QgsServerFilter):

    def __init__(self, serverIface):
        super(WatermarkFilter, self).__init__(serverIface)

```

```
def responseComplete(self):
    request = self.serverInterface().requestHandler()
    params = request.parameterMap()
    # Do some checks
    if (request.parameter('SERVICE').upper() == 'WMS' \
        and request.parameter('REQUEST').upper() == 'GETMAP' \
        and not request.exceptionRaised()):
        QgsMessageLog.logMessage("WatermarkFilter.responseComplete: image ready %s" % request
            # Get the image
            img = QImage()
            img.loadFromData(request.body())
            # Adds the watermark
            watermark = QImage(os.path.join(os.path.dirname(__file__), 'media/watermark.png'))
            p = QPainter(img)
            p.drawImage(QRect( 20, 20, 40, 40), watermark)
            p.end()
            ba = QByteArray()
            buffer = QBuffer(ba)
            buffer.open(QIODevice.WriteOnly)
            img.save(buffer, "PNG")
            # Set the body
            request.clearBody()
            request.appendBody(ba)
```

In this example the **SERVICE** parameter value is checked and if the incoming request is a **WMS GETMAP** and no exceptions have been set by a previously executed plugin or by the core service (WMS in this case), the WMS generated image is retrieved from the output buffer and the watermark image is added. The final step is to clear the output buffer and replace it with the newly generated image. Please note that in a real-world situation we should also check for the requested image type instead of returning PNG in any case.

## 22.4 Access control plugin

### 22.4.1 Plugin files

Here's the directory structure of our example server plugin:

```
PYTHON_PLUGINS_PATH/
  MyAccessControl/
    __init__.py    --> *required*
    AccessControl.py --> *required*
    metadata.txt  --> *required*
```

### 22.4.2 \_\_init\_\_.py

This file is required by Python's import system. As for all QGIS server plugins, this file contains a `serverClassFactory()` function, which is called when the plugin gets loaded into QGIS Server when the server starts. It receives reference to instance of `QgsServerInterface` and must return instance of your plugin's class. This is how the example plugin `__init__.py` looks like:

```
# -*- coding: utf-8 -*-

def serverClassFactory(serverIface):
    from MyAccessControl.AccessControl import AccessControl
    return AccessControl(serverIface)
```

### 22.4.3 AccessControl.py

```
class AccessControl(QgsAccessControlFilter):

    def __init__(self, server_iface):
        super(QgsAccessControlFilter, self).__init__(server_iface)

    def layerFilterExpression(self, layer):
        """ Return an additional expression filter """
        return super(QgsAccessControlFilter, self).layerFilterExpression(layer)

    def layerFilterSubsetString(self, layer):
        """ Return an additional subset string (typically SQL) filter """
        return super(QgsAccessControlFilter, self).layerFilterSubsetString(layer)

    def layerPermissions(self, layer):
        """ Return the layer rights """
        return super(QgsAccessControlFilter, self).layerPermissions(layer)

    def authorizedLayerAttributes(self, layer, attributes):
        """ Return the authorised layer attributes """
        return super(QgsAccessControlFilter, self).authorizedLayerAttributes(layer, attributes)

    def allowToEdit(self, layer, feature):
        """ Are we authorise to modify the following geometry """
        return super(QgsAccessControlFilter, self).allowToEdit(layer, feature)

    def cacheKey(self):
        return super(QgsAccessControlFilter, self).cacheKey()
```

This example gives a full access for everybody.

It's the role of the plugin to know who is logged on.

On all those methods we have the layer on argument to be able to customise the restriction per layer.

### 22.4.4 layerFilterExpression

Used to add an Expression to limit the results, e.g.:

```
def layerFilterExpression(self, layer):
    return "$role = 'user'"
```

To limit on feature where the attribute role is equals to "user".

### 22.4.5 layerFilterSubsetString

Same than the previous but use the SubsetString (executed in the database)

```
def layerFilterSubsetString(self, layer):
    return "role = 'user'"
```

To limit on feature where the attribute role is equals to "user".

### 22.4.6 layerPermissions

Limit the access to the layer.

Return an object of type `QgsAccessControlFilter.LayerPermissions`, who has the properties:

- `canRead` to see him in the `GetCapabilities` and have read access.
- `canInsert` to be able to insert a new feature.
- `canUpdate` to be able to update a feature.
- `candelelete` to be able to delete a feature.

Exemplo:

```
def layerPermissions(self, layer):
    rights = QgsAccessControlFilter.LayerPermissions()
    rights.canRead = True
    rights.canRead = rights.canInsert = rights.canUpdate = rights.canDelete = False
    return rights
```

To limit everything on read only access.

### 22.4.7 authorizedLayerAttributes

Used to limit the visibility of a specific subset of attribute.

The argument attribute return the current set of visible attributes.

Exemplo:

```
def authorizedLayerAttributes(self, layer, attributes):
    return [a for a in attributes if a != "role"]
```

To hide the 'role' attribute.

### 22.4.8 allowToEdit

This is used to limit the editing on a subset of features.

It is used in the WFS-Transaction protocol.

Exemplo:

```
def allowToEdit(self, layer, feature):
    return feature.attribute('role') == 'user'
```

To be able to edit only feature that has the attribute role with the value user.

### 22.4.9 cacheKey

QGIS server maintain a cache of the capabilities then to have a cache per role you can return the role in this method. Or return `None` to completely disable the cache.

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