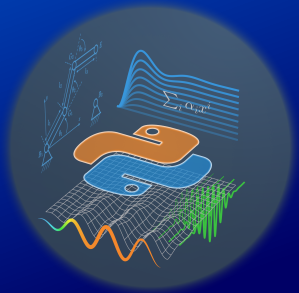
Carsten Knoll
Chair of Fundamentals of Electrical Engineering

Python for Engineers
Pythonkurs für Ingenieur:innen

GUI Programming with PyQT (Part 2)
GUI Programmierung mit PyQT (Teil 2)

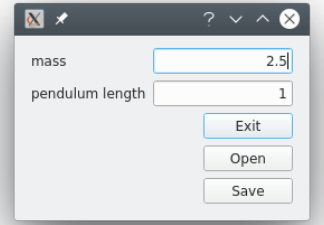
Dresden (Online), 2024-01-16

https://tu-dresden.de/pythonkurs
https://python-fuer-ingenieure.de



Review of Part 1

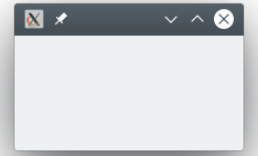
- “widget” ≙ rectangular area on the screen
  - many widgets serve as control elements (buttons, etc.)
- layout: adjusts the size and arrangement of widgets dynamically
- types of layouts: horizontal, vertical, grid
- widgets and layouts are in parent-child relationships to each other
- so far: application as dialog window (use of the `QDialog` class)



But: many elements of graphical user interfaces are not available when using `QDialog`

Main Window for Applications

For “real” applications, `QMainWindow` is used:

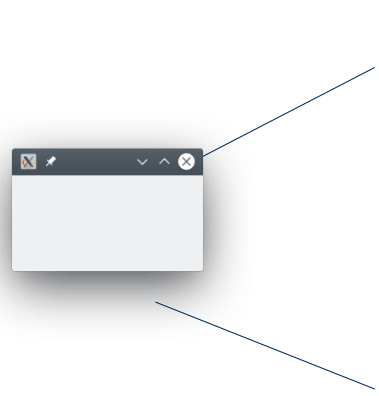


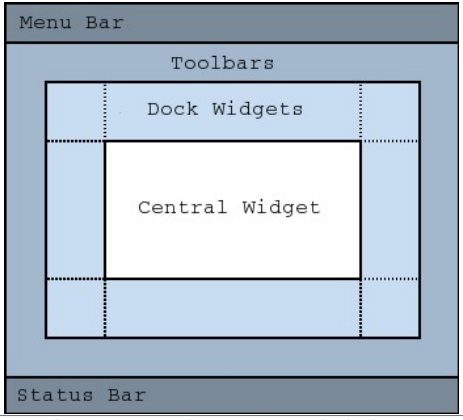
Listing: example-code/main-example1.py

```
1  import PyQt5.QtWidgets as QtWidgets
2
3
4  class Gui(QtWidgets.QMainWindow):
5      """
6      Own class (derived from QMainWindow).
7      This class (yet) does not do anything.
8      """
9
10     def __init__(self):
11         # call the "constructor" of the base-class
12         QtWidgets.QMainWindow.__init__(self)
13
14
15 app = QtWidgets.QApplication([])
16
17 gui = Gui()  # create an instance of the new class
18 gui.show()
19 app.exec_()
```

QMainWindow

`QMainWindow` already provides placeholder areas for menus, toolbars, etc.:





Source: http://qt-project.org/doc/qt-4.8/QMainWindow.html

Menus

- menus can be created directly through the menu bar of QMainWindow:

Listing: example-code/main-example2.py (14-15)

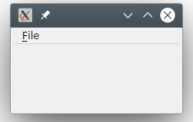
```
14          # self.menuBar is a method of the base class
15          self.menu_file = self.menuBar().addMenu("&File")
```

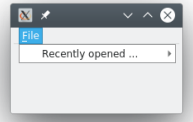
- menus can also be nested:

Listing: example-code/main-example2.py (17)

```
17          self.menu_recent = self.menu_file.addMenu("Recently opened ...")
```

- menus only define the structure, not clickable entries
- the `&` in the name string defines shortcut (Alt+F → opens file menu)





Actions

- instances of the `QAction` class can appear in different places:
  menu entry, button, key combination, …
- define action to end the program:

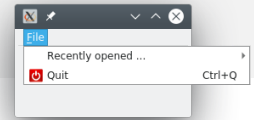
Listing: example-code/main-example3.py (19-20)

```
19          self.act_exit = QtWidgets.QAction(self)
20          self.act_exit.setText("Quit")
```

- actions represent an abstract interaction possibility with the user
- so far: `self.act_exit` only created; still needs to be added to the menu
  (and get associated with a shortcut):

Listing: example-code/main-example3.py (22-23)

```
22          self.menu_file.addAction(self.act_exit)
23          self.act_exit.setShortcut("Ctrl+Q")
```



Actions (2)

- when actions are “triggered” → function can be executed

Listing: example-code/main-example3.py (25)

```
25          self.act_exit.triggered.connect(self.close)
```

- actions can also appear in toolbars; create a new toolbar:

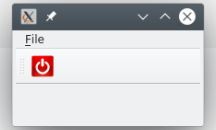
Listing: example-code/main-example4.py (28-30)

```
28          self.toolbar = QtWidgets.QToolBar("File")
29          self.toolbar.setIconSize(QtCore.QSize(24, 24))
30          self.addToolBar(self.toolbar)
```

- ...and add the action:

Listing: example-code/main-example4.py (32)

```
32          self.toolbar.addAction(self.act_exit)
```

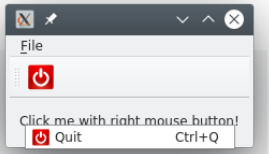


Actions (3)

- actions can appear in the context menu:

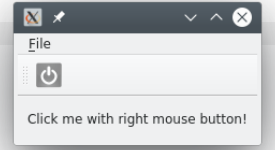
Listing: example-code/main-example5.py (32-41)

```
32          self.toolbar.addAction(self.act_exit)
33
34          self.cw = QtWidgets.QWidget()
35          self.setCentralWidget(self.cw)
36
37          self.vBox = QtWidgets.QVBoxLayout(self.cw)
38
39          self.label = QtWidgets.QLabel("Click me with right mouse button!")
40          self.label.setContextMenuPolicy(QtCore.Qt.ActionsContextMenu)
41          self.label.addAction(self.act_exit)
```



- actions can be deactivated:

```
self.act_exit.setDisabled(True)
```



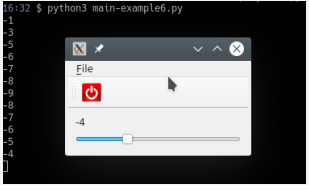
Signals and Slots

- communication mechanism within the application:
  - widgets emit “signals” (e.g. when button is clicked)
  - functions/methods (so called “slots”) can react to them
  - requirement: corresponding signal has been assigned to corresponding slot (with `connect`)

- example: output the value of a slider (via QT label and on command line):

Listing: example-code/main-example6.py (43-53)

```
53          self.vBox.addWidget(self.label)
54
55          self.slider = QtWidgets.QSlider(self)
56          self.slider.setMinimum(-10)
57          self.slider.setMaximum(10)
58          self.slider.setOrientation(QtCore.Qt.Horizontal)
59          self.vBox.addWidget(self.slider)
60
61          self.slider.valueChanged.connect(self.label.setNum)
62          self.slider.valueChanged.connect(self.print_value)
```

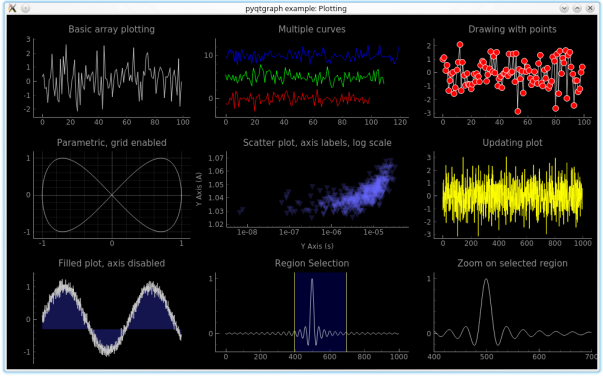


PyQtGraph

- plot library (≈ matplotlib), integrates well with Qt applications + much faster

→ advantageous for *interactive* plotting applications

- Disadvantage: additional learning effort required
- installation: `pip install pyqtgraph` or `pip install --user pyqtgraph`
- demo display: `python -m pyqtgraph.examples`



Links

- PyQt5 Overview:
  http://pyqt.sourceforge.net/Docs/PyQt5/index.html
- PyQt5 Module:
  http://pyqt.sourceforge.net/Docs/PyQt5/modules.html
- PyQt5 Widgets-Modul (most important module):
  http://pyqt.sourceforge.net/Docs/PyQt5/QtWidgets.html
- PyQtGraph project:
  https://github.com/pyqtgraph/pyqtgraph