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About the Tutorial

PyQt5 is the latest version of a GUI widgets toolkit developed by Riverbank Computing. It is a Python interface for **Qt**, one of the most powerful, and popular cross-platform GUI library. PyQt5 is a blend of Python programming language and the Qt library. This introductory tutorial will assist you in creating graphical applications with the help of PyQt. Our tutorial on earlier version - PyQt4 is available [here](#).

Audience

This tutorial is designed for software programmers who are keen on learning how to develop graphical applications using PyQt.

Prerequisites

You should have a basic understanding of computer programming terminologies. A basic knowledge of Python programming is a desirable.

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1. PyQt5 — Introduction

PyQt is a GUI widgets toolkit. It is a Python interface for **Qt**, one of the most powerful, and popular cross-platform GUI libraries. PyQt was developed by RiverBank Computing Ltd. PyQt5 is the latest version. It can be downloaded from its official website – riverbankcomputing.com.

PyQt API is a set of modules containing a large number of classes and functions. While **QtCore** module contains non-GUI functionality for working with file and directory etc., **QtGui** module contains all the graphical controls. In addition, there are modules for working with XML (**QtXml**), SVG (**QtSvg**), and SQL (**QtSql**), etc.

A list of frequently used modules is given below:

- **QtCore**: Core non-GUI classes used by other modules
- **QtGui**: Graphical user interface components
- **QtMultimedia**: Classes for low-level multimedia programming
- **QtNetwork**: Classes for network programming
- **QtOpenGL**: OpenGL support classes
- **QtScript**: Classes for evaluating Qt Scripts
- **QtSql**: Classes for database integration using SQL
- **QtSvg**: Classes for displaying the contents of SVG files
- **QtWebKit**: Classes for rendering and editing HTML
- **QtXml**: Classes for handling XML
- **QtWidgets**: Classes for creating classic desktop-style UIs
- **QtDesigner**: Classes for extending Qt Designer

Supporting Environments

PyQt is compatible with all the popular operating systems including Windows, Linux, and Mac OS. It is dual licensed, available under GPL as well as commercial license. The latest stable version is **PyQt5-5.13.2**.

Windows

Wheels for 32-bit or 64-bit architecture are provided that are compatible with Python version 3.5 or later. The recommended way to install is using **PIP** utility:

```
pip3 install PyQt5
```

To install development tools such as Qt Designer to support PyQt5 wheels, following is the command:

```
pip3 install pyqt5-tools
```

You can also build PyQt5 on Linux/macOS from the source code:

<https://www.riverbankcomputing.com/static/Downloads/PyQt5/5.13.2/PyQt5-5.13.2.tar.gz>

2. PyQt5 — What's New

PyQt5 API is not automatically compatible with earlier versions. Hence, Python code involving PyQt4 modules should be upgraded manually by making relevant changes. In this chapter, main differences between PyQt4 and PyQt5 have been listed.

PyQt5 is not supported on versions of Python earlier than v2.6.

PyQt5 doesn't support `connect()` method of `QObject` class for connection between signal and slot. Hence the usage can no more be implemented:

```
QObject.connect(widget, QtCore.SIGNAL('signalname'), slot_function)
```

Only the following syntax is defined:

```
widget.signal.connect(slot_function)
```

Classes defined in earlier `QtGui` module have been distributed in **QtGui**, **QtPrintSupport** and **QtWidgets** modules.

In the new `QFileDialog` class, The **`getOpenFileNameAndFilter()`** method is replaced by **`getOpenFileName()`**, **`getOpenFileNamesAndFilter()`** by **`getOpenFileNames()`** and **`getSaveFileNameAndFilter()`** by **`getSaveFileName()`**. Older signatures of these methods also have changed.

PyQt5 doesn't have provision to define a class that is sub-classed from more than one Qt class.

pyuic5 utility (to generates Python code from Designer's XML file) does not support the `-pyqt3-wrapper` flag.

pyrcc5 does not support the `-py2` and `-py3` flags. The output of `pyrcc5` is compatible with all versions of Python v2.6 onwards.

PyQt5 always invokes **`sip.setdestroyonexit()`** automatically and calls the C++ destructor of all wrapped instances that it owns.

3. PyQt5 — Hello World

Creating a simple GUI application using PyQt involves the following steps:

- Import QtCore, QtGui and QtWidgets modules from PyQt5 package.
- Create an application object of QApplication class.
- A QWidget object creates top level window. Add QLabel object in it.
- Set the caption of label as "hello world".
- Define the size and position of window by setGeometry() method.
- Enter the mainloop of application by **app.exec_()** method.

Following is the code to execute Hello World program in PyQt:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *
def window():
    app = QApplication(sys.argv)
    w = QWidget()
    b = QLabel(w)
    b.setText("Hello World!")
    w.setGeometry(100,100,200,50)
    b.move(50,20)
    w.setWindowTitle("PyQt5")
    w.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    window()
```

The above code produces the following output:



It is also possible to develop an object oriented solution of the above code.

- Import QtCore, QtGui and QtWidgets modules from PyQt5 package.

- Create an application object of QApplication class.
- Declare window class based on QWidget class
- Add a QLabel object and set the caption of label as "hello world".
- Define the size and position of window by setGeometry() method.
- Enter the mainloop of application by **app.exec_()** method.

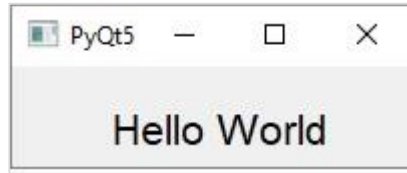
Following is the complete code of the object oriented solution:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *
class window(QWidget):
    def __init__(self, parent = None):
        super(window, self).__init__(parent)
        self.resize(200,50)
        self.setWindowTitle("PyQt5")
        self.label = QLabel(self)
        self.label.setText("Hello World")
        font = QFont()
        font.setFamily("Arial")
        font.setPointSize(16)
        self.label.setFont(font)
        self.label.move(50,20)

def main():

    app = QApplication(sys.argv)
    ex = window()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()
```



4. PyQt5 — Major Classes

PyQt API is a large collection of classes and methods. These classes are defined in more than 20 modules.

Following are some of the frequently used modules:

Sr.No.	Modules & Description
1	QtCore Core non-GUI classes used by other modules
2	QtGui Graphical user interface components
3	QtMultimedia Classes for low-level multimedia programming
4	QtNetwork Classes for network programming
5	QtOpenGL OpenGL support classes
6	QtScript Classes for evaluating Qt Scripts
7	QtSql Classes for database integration using SQL
8	QtSvg Classes for displaying the contents of SVG files
9	QtWebKit Classes for rendering and editing HTML
10	QtXml Classes for handling XML
11	QtWidgets Classes for creating classic desktop-style UIs.
12	QtDesigner Classes for extending Qt Designer

13	QtAssistant Support for online help
----	---

PyQt5 development tools is a collection of useful utilities for Qt development. Following is a select list of such utilities:

Tool Name	Description
assistant	Qt Assistant documentation tool
pyqt5designer	Qt Designer GUI layout tool
linguist	Qt Linguist translation tool
lrelease	compile ts files to qm files
pylupdate5	extract translation strings and generate or update ts files
qmake	Qt software build tool
pyqt5qmlscene	QML file viewer
pyqmlviewer	QML file viewer
pyrcc5	Qt resource file compiler
pyuic5	Qt User Interface Compiler for generating code from ui files
pyqmltestrunner	running unit tests on QML code
qdbus	command-line tool to list D-Bus services
QDoc	documentation generator for software projects.
Qhelpgenerator	generating and viewing Qt help files.
qmlimportscanner	parses and reports on QML imports

PyQt API contains more than 400 classes. The **QObject** class is at the top of class hierarchy. It is the base class of all Qt objects. Additionally, **QPaintDevice** class is the base class for all objects that can be painted.

QApplication class manages the main settings and control flow of a GUI application. It contains main event loop inside which events generated by window elements and other sources are processed and dispatched. It also handles system-wide and application-wide settings.

QWidget class, derived from **QObject** and **QPaintDevice** classes is the base class for all user interface objects. **QDialog** and **QFrame** classes are also derived from **QWidget** class. They have their own sub-class system.

Here is a select list of frequently used widgets:

Sr.No.	Widgets & Description
1	QLabel Used to display text or image
2	QLineEdit Allows the user to enter one line of text
3	QTextEdit Allows the user to enter multi-line text
4	QPushButton A command button to invoke action
5	QRadioButton Enables to choose one from multiple options
6	QCheckBox Enables choice of more than one options
7	QSpinBox Enables to increase/decrease an integer value
8	QScrollBar Enables to access contents of a widget beyond display aperture
9	QSlider Enables to change the bound value linearly.
10	QComboBox Provides a dropdown list of items to select from
11	QMenuBar Horizontal bar holding QMenu objects
12	QStatusBar Usually at bottom of QMainWindow, provides status information.
13	QToolBar Usually at top of QMainWindow or floating. Contains action buttons
14	QListView Provides a selectable list of items in ListMode or IconMode

15	QPixmap Off-screen image representation for display on QLabel or QPushButton object
16	QDialog Modal or modeless window which can return information to parent window

A typical GUI based application's top level window is created by **QMainWindow** widget object. Some widgets as listed above take their appointed place in this main window, while others are placed in the central widget area using various layout managers.

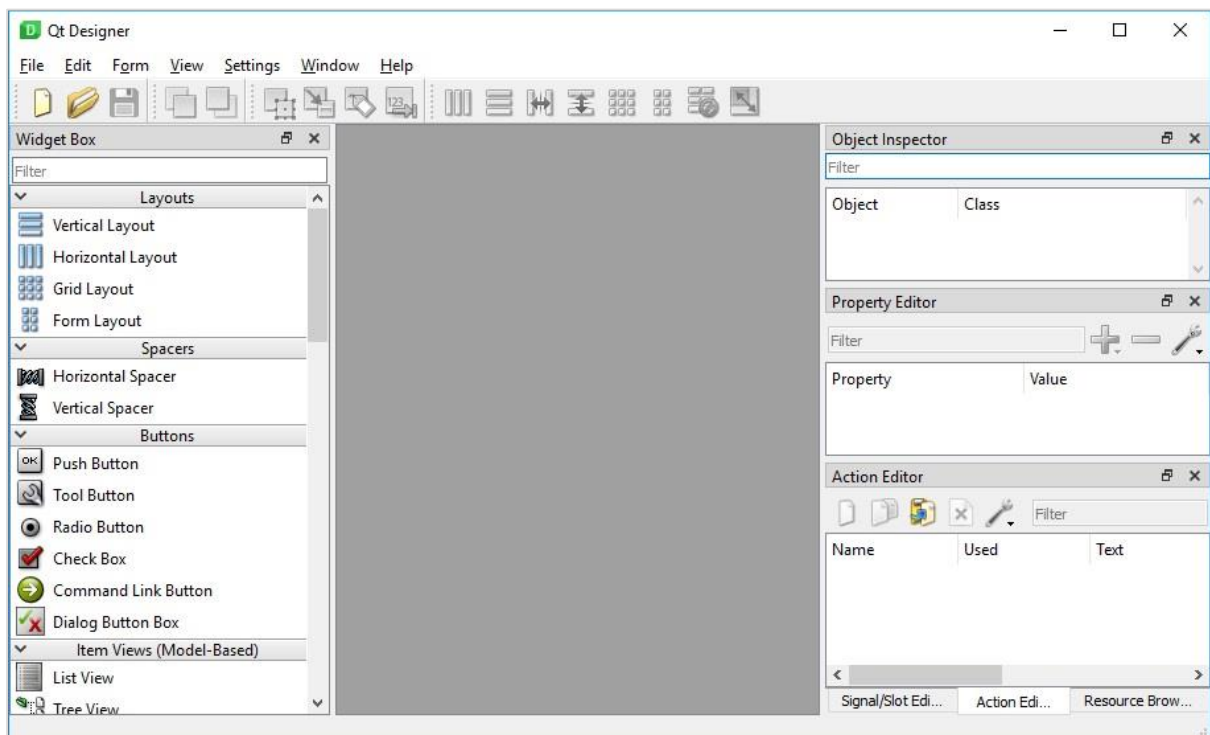
The following diagram shows the QMainWindow framework:



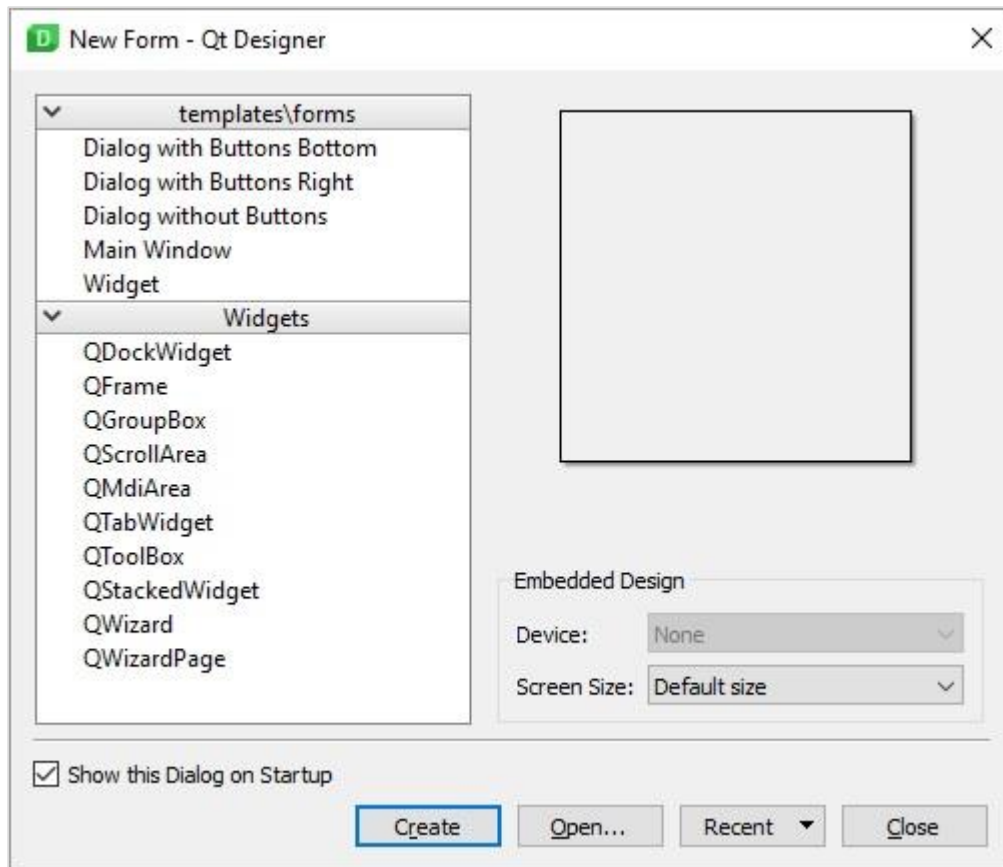
5. PyQt5 — Using Qt Designer

The PyQt installer comes with a GUI builder tool called **Qt Designer**. Using its simple drag and drop interface, a GUI interface can be quickly built without having to write the code. It is however, not an IDE such as Visual Studio. Hence, Qt Designer does not have the facility to debug and build the application.

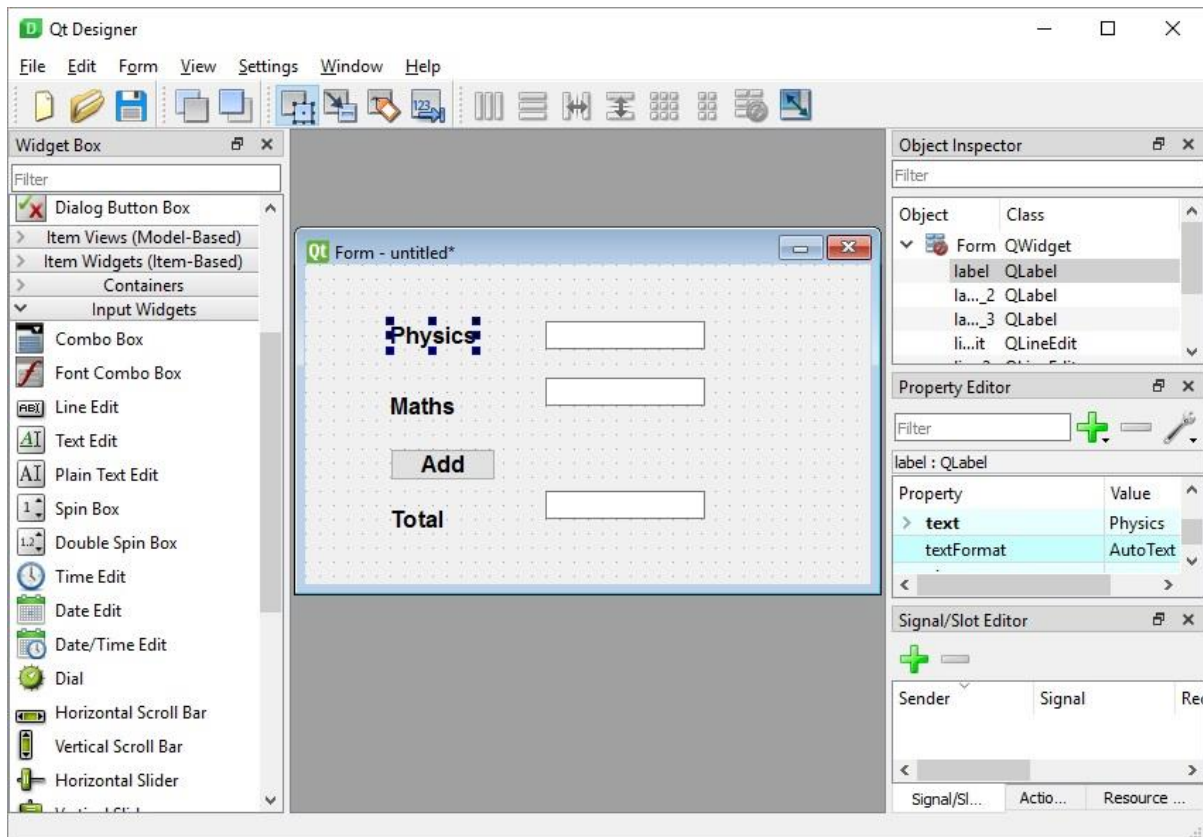
Start Qt Designer application which is a part of development tools and installed in scripts folder of the virtual environment.



Start designing GUI interface by choosing File -> New menu.



You can then drag and drop required widgets from the widget box on the left pane. You can also assign value to properties of widget laid on the form.



The designed form is saved as demo.ui. This ui file contains XML representation of widgets and their properties in the design. This design is translated into Python equivalent by using pyuic5 command line utility. This utility is a wrapper for uic module of Qt toolkit. The usage of pyuic5 is as follows:

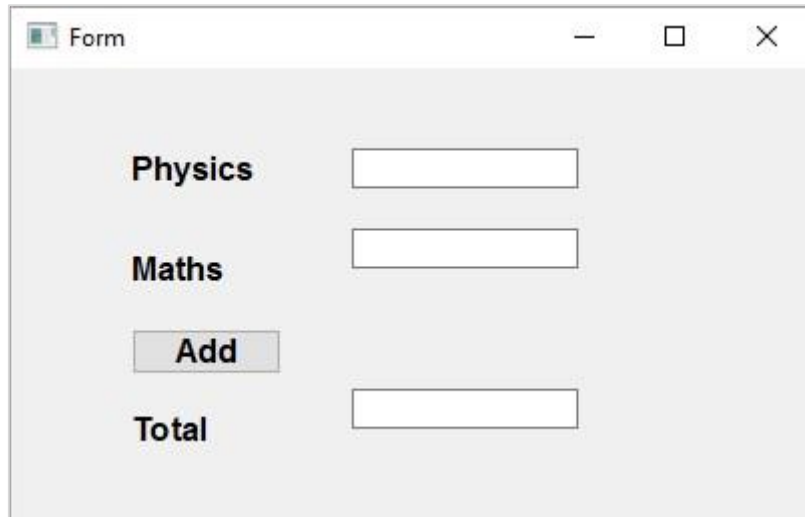
```
pyuic5 -x demo.ui -o demo.py
```

In the above command, -x switch adds a small amount of additional code to the generated Python script (from XML) so that it becomes a self-executable standalone application.

```
if __name__ == "__main__":
    import sys
    app = QtGui.QApplication(sys.argv)
    Dialog = QtGui.QDialog()
    ui = Ui_Dialog()
    ui.setupUi(Dialog)
    Dialog.show()
    sys.exit(app.exec_())
```

The resultant python script is executed to show the following dialog box:

```
python demo.py
```



The image shows a window titled "Form" with a standard Windows-style title bar (minimize, maximize, close buttons). Inside the window, there are three input fields. The first is labeled "Physics", the second "Maths", and the third "Total". An "Add" button is located between the "Maths" and "Total" fields. All fields and the button are currently empty.

The user can input data in input fields but clicking on Add button will not generate any action as it is not associated with any function. Reacting to user-generated response is called as **event handling**.

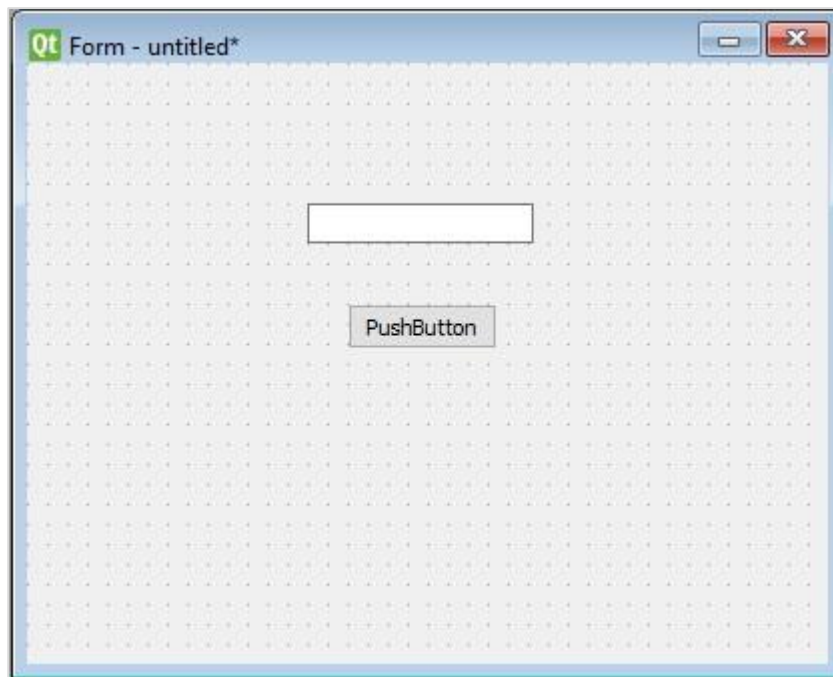
6. PyQt5 — Signals & Slots

Unlike a console mode application, which is executed in a sequential manner, a GUI based application is event driven. Functions or methods are executed in response to user's actions like clicking on a button, selecting an item from a collection or a mouse click etc., called **events**.

Widgets used to build the GUI interface act as the source of such events. Each PyQt widget, which is derived from QObject class, is designed to emit '**signal**' in response to one or more events. The signal on its own does not perform any action. Instead, it is 'connected' to a '**slot**'. The slot can be any **callable Python function**.

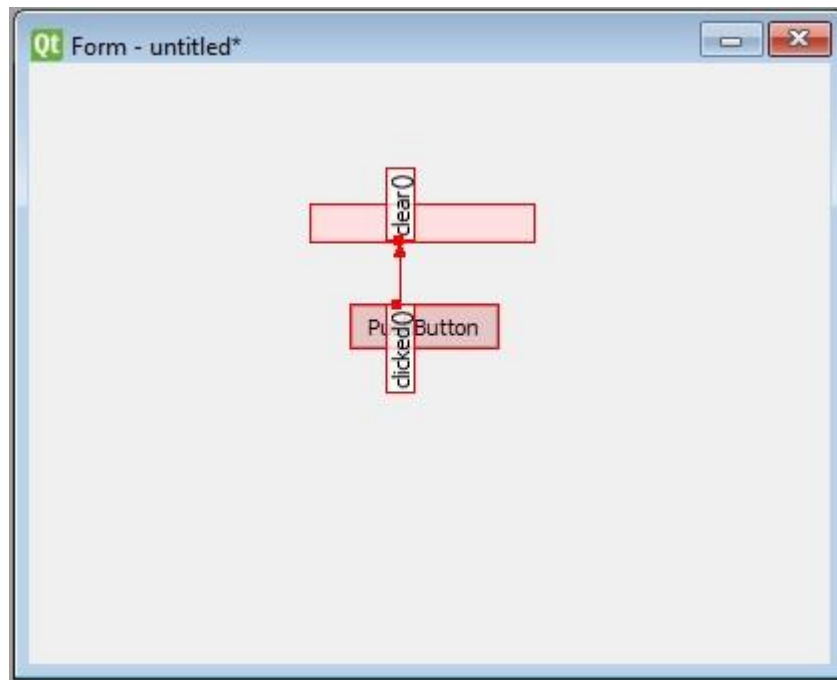
Using Qt Designer's Signal/Slot Editor

First design a simple form with a QLineEdit control and a PushButton.

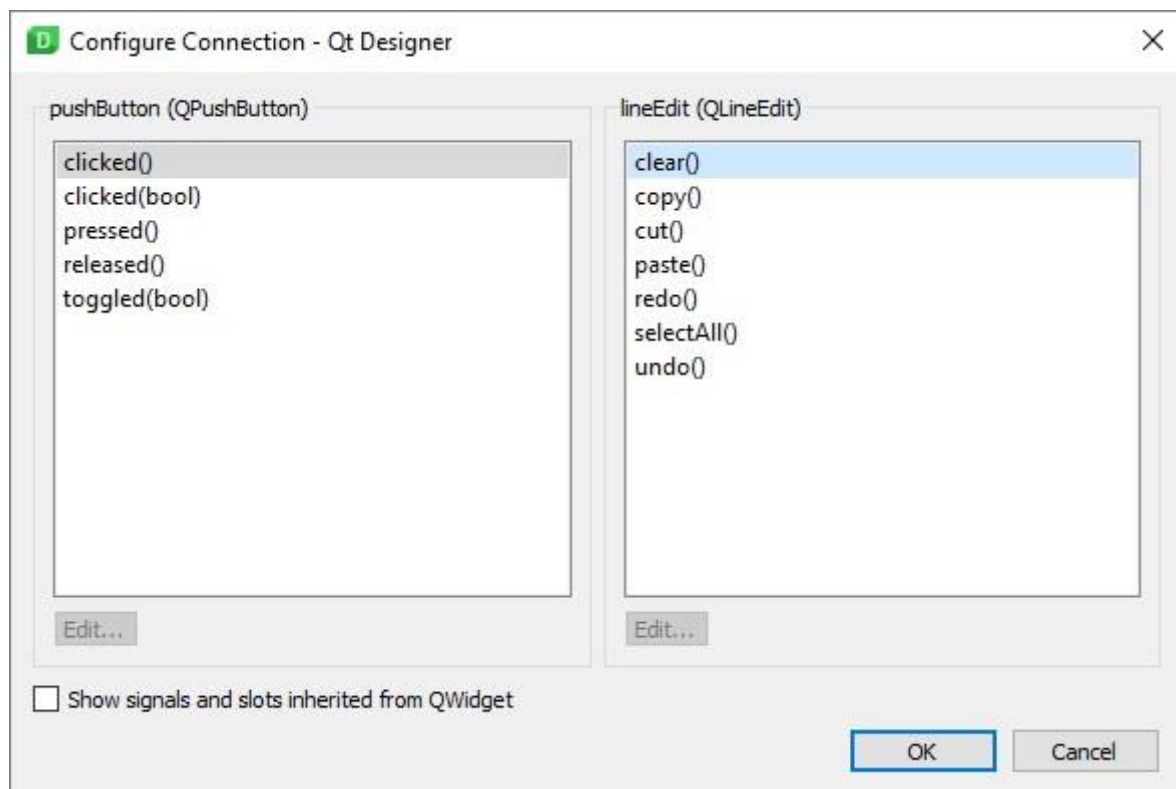


It is desired that if button is pressed, contents of text box should be erased. The QLineEdit widget has a clear() method for this purpose. Hence, the button's **clicked** signal is to be connected to **clear()** method of the text box.

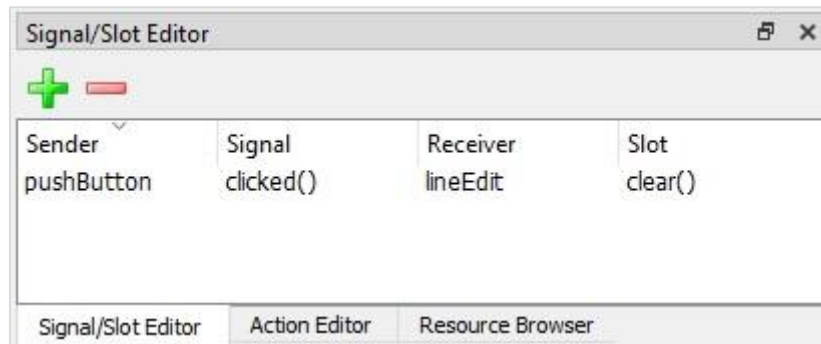
To start with, choose Edit signals/slots from Edit menu (or press F4). Then highlight the button with mouse and drag the cursor towards the textbox



As the mouse is released, a dialog showing signals of button and methods of slot will be displayed. Select clicked signal and clear() method



The Signal/Slot Editor window at bottom right will show the result:



Save ui and Build and Python code from ui file as shown in the below code:

```
pyuic5 -x signalslot.ui -o signalslot.py
```

Generated Python code will have the connection between signal and slot by the following statement:

```
self.pushButton.clicked.connect(self.lineEdit.clear)
```

Run signalslot.py and enter some text in the LineEdit. The text will be cleared if the button is pressed.

Building Signal-slot Connection

Instead of using Designer, you can directly establish signal-slot connection by following syntax:

```
widget.signal.connect(slot_function)
```

Suppose if a function is to be called when a button is clicked. Here, the clicked signal is to be connected to a callable function. It can be achieved in any of the following technique:

```
button.clicked.connect(slot_function)
```

Example

In the following example, two QPushButton objects (b1 and b2) are added in QDialog window. We want to call functions b1_clicked() and b2_clicked() on clicking b1 and b2 respectively.

When b1 is clicked, the clicked() signal is connected to b1_clicked() function:

```
b1.clicked.connect(b1_clicked())
```

When b2 is clicked, the clicked() signal is connected to b2_clicked() function.

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *
```

```
def window():
    app = QApplication(sys.argv)
    win = QDialog()
    b1 = QPushButton(win)
    b1.setText("Button1")
    b1.move(50,20)
    b1.clicked.connect(b1_clicked)

    b2 = QPushButton(win)
    b2.setText("Button2")
    b2.move(50,50)
    b2.clicked.connect(b2_clicked)

    win.setGeometry(100,100,200,100)

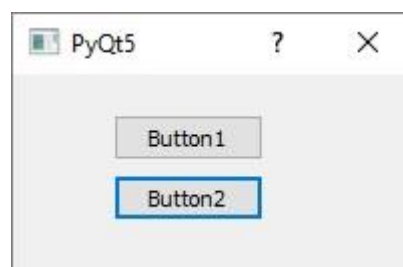
    win.setWindowTitle("PyQt5")
    win.show()
    sys.exit(app.exec_())

def b1_clicked():
    print ("Button 1 clicked")

def b2_clicked():
    print ("Button 2 clicked")

if __name__ == '__main__':
    window()
```

The above code produces the following output:



Output

```
Button 1 clicked  
Button 2 clicked
```

7. PyQt5 — Layout Management

A GUI widget can be placed inside the container window by specifying its absolute coordinates measured in pixels. The coordinates are relative to the dimensions of the window defined by `setGeometry()` method.

`setGeometry()` syntax

The following is the syntax of `setGeometry()`:

```
QWidget.setGeometry(xpos, ypos, width, height)
```

In the following code snippet, the top level window of 300 by 100 pixels dimensions is displayed at position (50,20) on the monitor.

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

def window():
    app = QApplication(sys.argv)
    w = QWidget()

    b = QPushButton(w)
    b.setText("Hello World!")
    b.move(50,20)

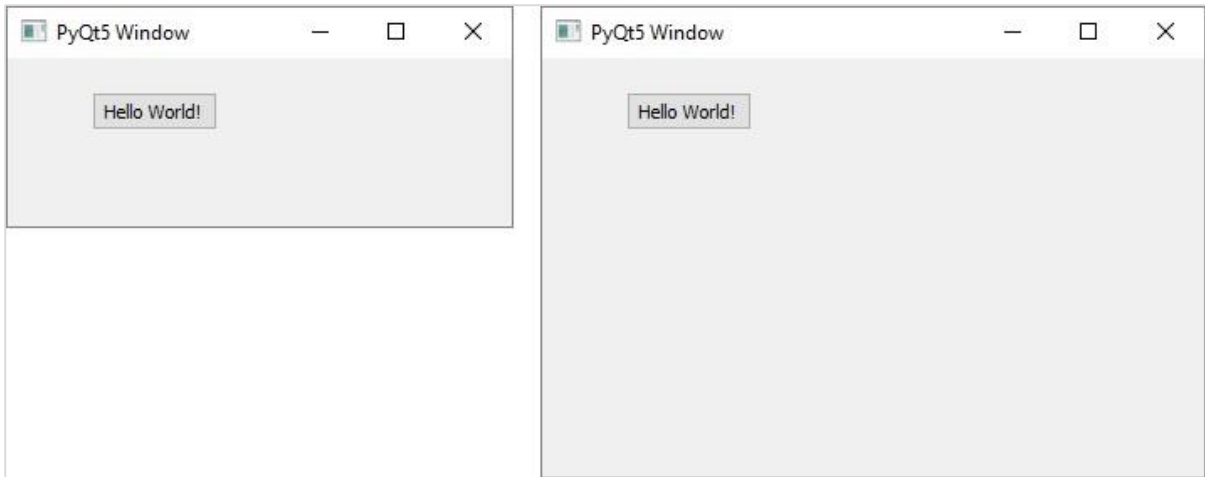
    w.setGeometry(100,100,300,100)
    w.setWindowTitle('PyQt5 Window')
    w.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    window()
```

A **PushButton** widget is added in the window and placed at a position 50 pixels towards right and 20 pixels below the top left position of the window.

This Absolute Positioning, however, is not suitable because of the following reasons:

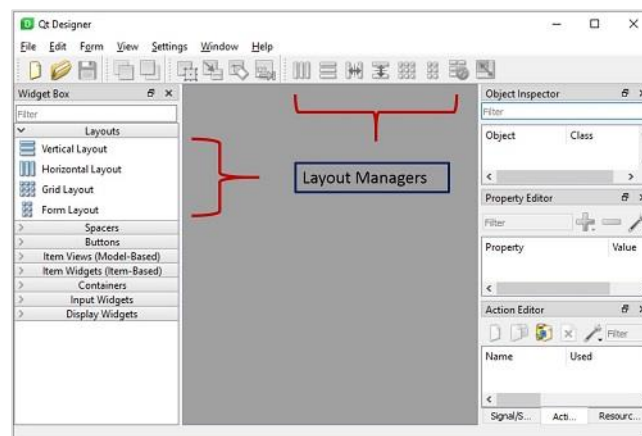
- The position of the widget does not change even if the window is resized.
- The appearance may not be uniform on different display devices with different resolutions.
- Modification in the layout is difficult as it may need redesigning the entire form.



PyQt API provides layout classes for more elegant management of positioning of widgets inside the container. The advantages of Layout managers over absolute positioning are:

- Widgets inside the window are automatically resized.
- Ensures uniform appearance on display devices with different resolutions.
- Adding or removing widget dynamically is possible without having to redesign.

Qt toolkit defines various layouts that can be used with Qt Designer utility.



Here is the list of Classes which we will discuss one by one in this chapter.

Sr.No.	Classes & Description
1	<p>QBoxLayout</p> <p>QBoxLayout class lines up the widgets vertically or horizontally. Its derived classes are QVBoxLayout (for arranging widgets vertically) and QHBoxLayout (for arranging widgets horizontally).</p>
2	<p>QGridLayout</p> <p>A GridLayout class object presents with a grid of cells arranged in rows and columns. The class contains addWidget() method. Any widget can be added by specifying the number of rows and columns of the cell.</p>
3	<p>QFormLayout</p>

	QFormLayout is a convenient way to create two column form, where each row consists of an input field associated with a label. As a convention, the left column contains the label and the right column contains an input field.
--	---

QBoxLayout

QBoxLayout class lines up the widgets vertically or horizontally. Its derived classes are **QVBoxLayout** (for arranging widgets vertically) and **QHBoxLayout** (for arranging widgets horizontally). Following table shows the important methods of QBoxLayout class:

Sr.No.	Methods & Description
1	addWidget() Adds a widget to the BoxLayout
2	addStretch() Creates empty stretchable box
3	addLayout() Adds another nested layout

Example 1

Here two buttons are added in the vertical box layout. A stretchable empty space is added between them by **addStretch()** method. Therefore, if the top level window is resized, the position of buttons automatically gets relocated.

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

def window():
    app = QApplication(sys.argv)
    win = QWidget()

    b1 = QPushButton("Button1")
    b2 = QPushButton("Button2")

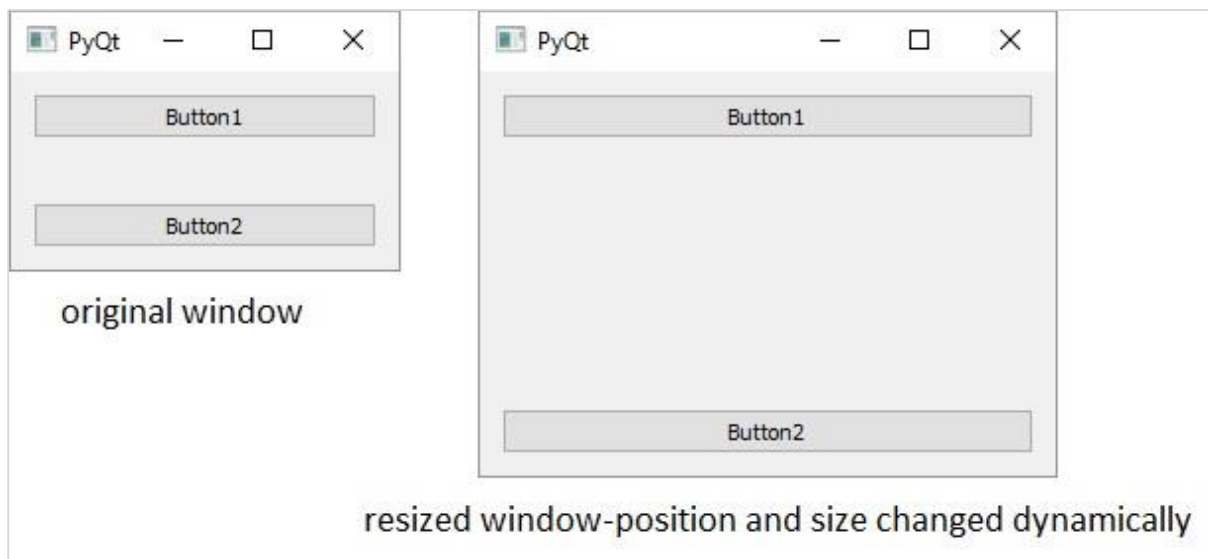
    vbox = QVBoxLayout()
    vbox.addWidget(b1)
    vbox.addStretch()
    vbox.addWidget(b2)
    win.setLayout(vbox)

    win.setWindowTitle("PyQt")
    win.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
```

```
window()
```

The above code produces the following output:



Example 2

This example uses horizontal box layout. **addStretch()** method inserts a stretchable empty space between the two button objects. Hence, as the window is resized, the size and position of the button changes dynamically.

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

def window():
    app = QApplication(sys.argv)
    win = QWidget()

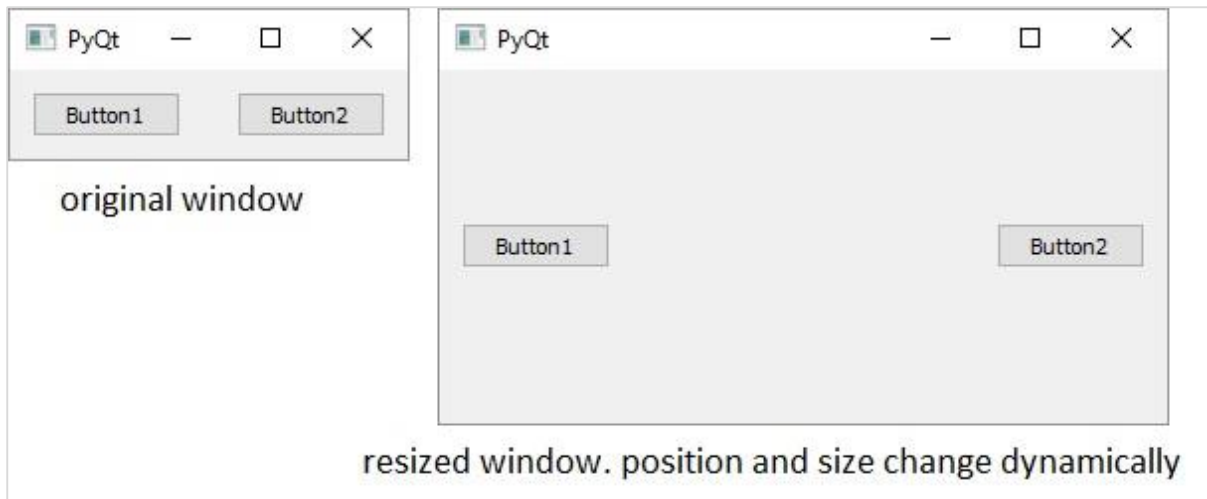
    b1 = QPushButton("Button1")
    b2 = QPushButton("Button2")

    hbox = QHBoxLayout()

    hbox.addWidget(b1)
    hbox.addStretch()
    hbox.addWidget(b2)
    win.setLayout(hbox)
    win.setWindowTitle("PyQt")
    win.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    window()
```

The above code produces the following output:



Example 3

This example shows how the layouts can be nested. Here, two buttons are added to vertical box layout. Then, a horizontal box layout object with two buttons and a stretchable empty space is added to it. Finally, the vertical box layout object is applied to the top level window by the `setLayout()` method.

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

def window():
    app = QApplication(sys.argv)
    win = QWidget()

    b1 = QPushButton("Button1")
    b2 = QPushButton("Button2")

    vbox = QVBoxLayout()
    vbox.addWidget(b1)
    vbox.addStretch()
    vbox.addWidget(b2)
    hbox = QHBoxLayout()

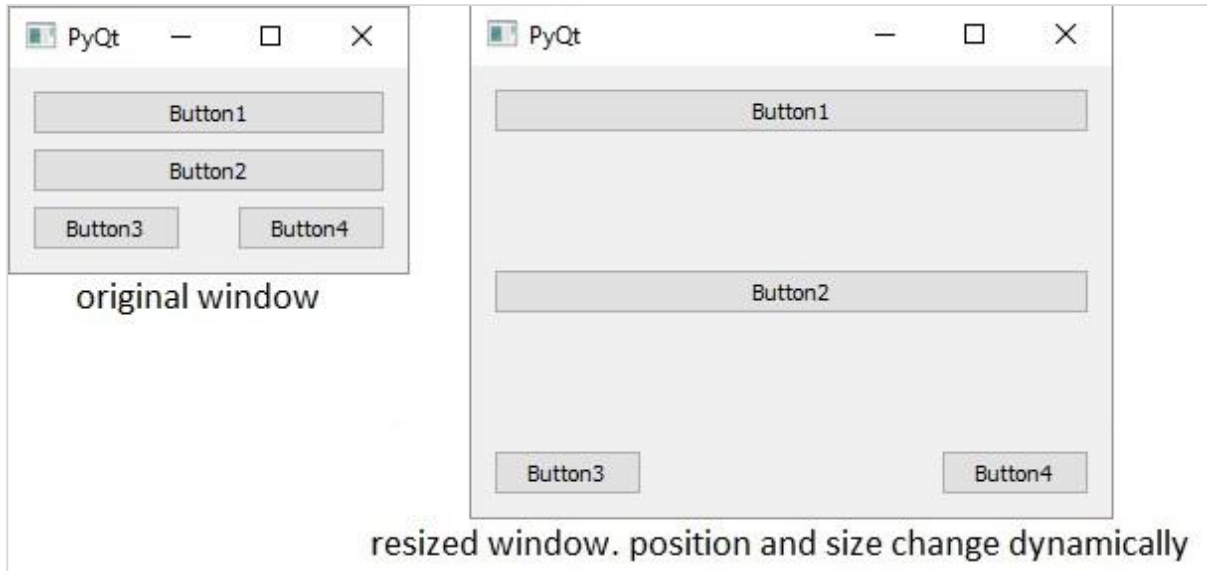
    b3 = QPushButton("Button3")
    b4 = QPushButton("Button4")
    hbox.addWidget(b3)
    hbox.addStretch()
    hbox.addWidget(b4)

    vbox.addStretch()
    vbox.addLayout(hbox)
    win.setLayout(vbox)

    win.setWindowTitle("PyQt")
    win.show()
    sys.exit(app.exec_())
```

```
if __name__ == '__main__':  
    window()
```

The above code produces the following output:



QGridLayout Class

A **GridLayout** class object presents with a grid of cells arranged in rows and columns. The class contains **addWidget()** method. Any widget can be added by specifying the number of rows and columns of the cell. Optionally, a spanning factor for row as well as column, if specified makes the widget wider or taller than one cell. Two overloads of **addWidget()** method are as follows:

Sr.No.	Methods & Description
1	addWidget(QWidget, int r, int c) Adds a widget at specified row and column
2	addWidget(QWidget, int r, int c, int rowspan, int colspan) Adds a widget at specified row and column and having specified width and/or height

A child layout object can also be added at any cell in the grid.

Sr.No.	Methods & Description
1	addLayout(QLayout, int r, int c) Adds a layout object at specified row and column

Example

The following code creates a grid layout of 16 push buttons arranged in a grid layout of 4 rows and 4 columns.

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

def window():
    app = QApplication(sys.argv)
    win = QWidget()
    grid = QGridLayout()

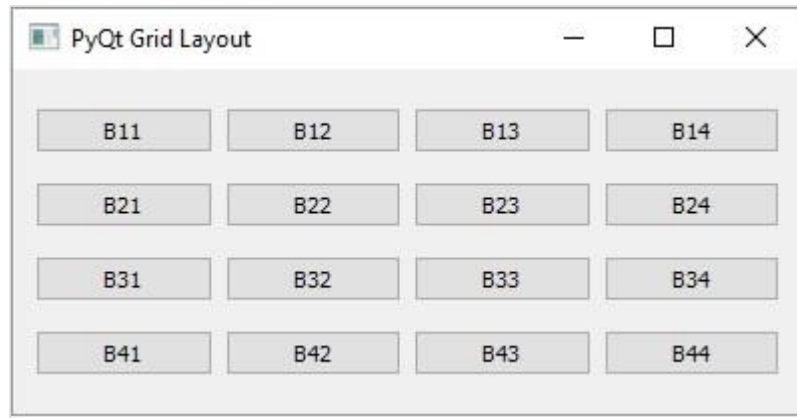
    for i in range(1,5):
        for j in range(1,5):
            grid.addWidget(QPushButton("B"+str(i)+str(j)),i,j)

    win.setLayout(grid)
    win.setGeometry(100,100,200,100)
    win.setWindowTitle("PyQt Grid Layout")
    win.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    window()
```

The code uses two nested for loops for row and column numbers, denoted by variables i and j . They are converted to string to concatenate the caption of each push button to be added at i^{th} row and j^{th} column.

The above code produces the following output:



QFormLayout Class

QFormLayout is a convenient way to create two column form, where each row consists of an input field associated with a label. As a convention, the left column contains the label and the right column contains an input field. There are mainly three overloaded versions of **addRow()** method that are commonly used.

Sr.No.	Methods & Description
1	addRow(QLabel, QWidget) Adds a row containing label and input field
2	addRow(QLabel, QLayout) Adds a child layout in the second column
3	addRow(QWidget) Adds a widget spanning both columns

Example

This code adds a QLineEdit field to input name in the first row. Then it adds a vertical box layout for two address fields in the second column of the next row. Next, a horizontal box layout object containing two Radio button fields is added in the second column of the third row. The fourth row shows two buttons 'Submit' and 'Cancel'.

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

def window():
    app = QApplication(sys.argv)
    win = QWidget()
```

```
l1 = QLabel("Name")
nm = QLineEdit()

l2 = QLabel("Address")
add1 = QLineEdit()
add2 = QLineEdit()
fbox = QFormLayout()
fbox.addRow(l1,nm)
vbox = QVBoxLayout()

vbox.addWidget(add1)
vbox.addWidget(add2)
fbox.addRow(l2,vbox)
hbox = QHBoxLayout()

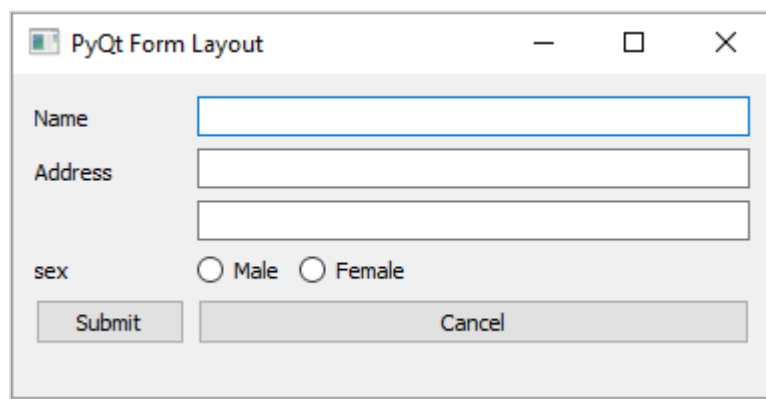
r1 = QRadioButton("Male")
r2 = QRadioButton("Female")
hbox.addWidget(r1)
hbox.addWidget(r2)
hbox.addStretch()
fbox.addRow(QLabel("sex"),hbox)
fbox.addRow(QPushButton("Submit"),QPushButton("Cancel"))

win.setLayout(fbox)

win.setWindowTitle("PyQt5 Form Layout")
win.show()
sys.exit(app.exec_())

if __name__ == '__main__':
    window()
```

The above code produces the following output:



8. PyQt5 — Basic Widgets

Here is the list of Widgets which we will discuss one by one in this chapter.

Sr.No	Widgets & Description
	QLabel
1	A QLabel object acts as a placeholder to display non-editable text or image, or a movie or animated GIF. It can also be used as a mnemonic key for other widgets.
	QLineEdit
2	QLineEdit object is the most commonly used input field. It provides a box in which one line of text can be entered. In order to enter multi-line text, QTextEdit object is required.
	QPushButton
3	In PyQt API, the QPushButton class object presents a button which when clicked can be programmed to invoke a certain function.
	QRadioButton
4	A QRadioButton class object presents a selectable button with a text label. The user can select one of many options presented on the form. This class is derived from QAbstractButton class.
	QCheckBox
5	A rectangular box before the text label appears when a QCheckBox object is added to the parent window. Just as QRadioButton, it is also a selectable button.
	QComboBox
6	A QComboBox object presents a dropdown list of items to select from. It takes minimum screen space on the form required to display only the currently selected item.
	QSpinBox
7	A QSpinBox object presents the user with a textbox which displays an integer with up/down button on its right.
	QSlider Widget & Signal
8	QSlider class object presents the user with a groove over which a handle can be moved. It is a classic widget to control a bounded value.
	QMenuBar, QMenu & QAction
9	A horizontal QMenuBar just below the title bar of a QMainWindow object is reserved for displaying QMenu objects.

QToolBar

- 10 A QToolBar widget is a movable panel consisting of text buttons, buttons with icons or other widgets.

QInputDialog

- 11 This is a preconfigured dialog with a text field and two buttons, OK and Cancel. The parent window collects the input in the text box after the user clicks on Ok button or presses Enter.

QFontDialog

- 12 Another commonly used dialog, a font selector widget is the visual appearance of QDialog class. Result of this dialog is a QFont object, which can be consumed by the parent window.

QFileDialog

- 13 This widget is a file selector dialog. It enables the user to navigate through the file system and select a file to open or save. The dialog is invoked either through static functions or by calling exec_() function on the dialog object.

QTab

- 14 If a form has too many fields to be displayed simultaneously, they can be arranged in different pages placed under each tab of a Tabbed Widget. The QTabWidget provides a tab bar and a page area.

QStacked

- 15 Functioning of QStackedWidget is similar to QTabWidget. It also helps in the efficient use of window's client area.

QSplitter

- 16 This is another advanced layout manager which allows the size of child widgets to be changed dynamically by dragging the boundaries between them. The Splitter control provides a handle that can be dragged to resize the controls.

QDock

- 17 A dockable window is a subwindow that can remain in floating state or can be attached to the main window at a specified position. Main window object of QMainWindow class has an area reserved for dockable windows.

QStatusBar

- 18 QMainWindow object reserves a horizontal bar at the bottom as the status bar. It is used to display either permanent or contextual status information.

QList

- 19 QListWidget class is an item-based interface to add or remove items from a list. Each item in the list is a QListWidgetItem object. ListWidget can be set to be multiselectable.

QScrollBar

- 20 A scrollbar control enables the user to access parts of the document that is outside the viewable area. It provides visual indicator to the current position.

QCalendar

- 21 QCalendar widget is a useful date picker control. It provides a month-based view. The user can select the date by the use of the mouse or the keyboard, the default being today's date.

QLabel Widget

A **QLabel** object acts as a placeholder to display non-editable text or image, or a movie of animated GIF. It can also be used as a mnemonic key for other widgets. Plain text, hyperlink or rich text can be displayed on the label.

The following table lists the important methods defined in QLabel class:

Sr.No.	Methods & Description
	setAlignment()
	Aligns the text as per alignment constants
1	Qt.AlignLeft Qt.AlignRight Qt.AlignCenter Qt.AlignJustify
2	setIndent() Sets the labels text indent
3	setPixmap() Displays an image
4	Text() Displays the caption of the label
5	setText() Programmatically sets the caption
6	selectedText() Displays the selected text from the label (The textInteractionFlag must be set to TextSelectableByMouse)
7	setBuddy()

Associates the label with any input widget

setWordWrap()

8

Enables or disables wrapping text in the label

Signals of QLabel Class

linkActivated If the label containing embedded hyperlink is clicked, the URL will open. **setOpenExternalLinks** feature must be set to true.

linkHovered Slot method associated with this signal will be called when the label having embedded hyperlink is hovered by the mouse.

Example

In this example, QLabel objects l2 and l4 have the caption containing hyperlink. setOpenExternalLinks for l2 is set to true. Hence, if this label is clicked, the associated URL will open in the browser. linkHovered signal of l4 is connected to hovered() function. So, whenever the mouse hovers over it, the function will be executed.

QPixmap object prepares offscreen image from python.jpg file. It is displayed as label l3 by using **setPixmap()** method.

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *
def window():
    app = QApplication(sys.argv)
    win = QWidget()

    l1 = QLabel()
    l2 = QLabel()
    l3 = QLabel()
    l4 = QLabel()

    l1.setText("Hello World")
    l4.setText("TutorialsPoint")
    l2.setText("welcome to Python GUI Programming")

    l1.setAlignment(Qt.AlignCenter)
    l3.setAlignment(Qt.AlignCenter)
    l4.setAlignment(Qt.AlignRight)
```

```
l3.setPixmap(QPixmap("python.png"))

vbox = QVBoxLayout()
vbox.addWidget(l1)
vbox.addStretch()
vbox.addWidget(l2)
vbox.addStretch()
vbox.addWidget(l3)
vbox.addStretch()
vbox.addWidget(l4)

l4.setOpenExternalLinks(True)
l4.linkActivated.connect(clicked)
l2.linkHovered.connect(hovered)
l1.setTextInteractionFlags(Qt.TextSelectableByMouse)
win.setLayout(vbox)

win.setWindowTitle("QLabel Demo")
win.show()
sys.exit(app.exec_())

def hovered():
    print ("hovering")
def clicked():
    print ("clicked")

if __name__ == '__main__':
    window()
```

The above code produces the following output:



QLineEdit Widget

QLineEdit object is the most commonly used input field. It provides a box in which one line of text can be entered. In order to enter multi-line text, **QTextEdit** object is required.

The following table lists a few important methods of QLineEdit class:

Sr.No.	Methods & Description
	setAlignment()
	Aligns the text as per alignment constants
1	Qt.AlignLeft Qt.AlignRight Qt.AlignCenter Qt.AlignJustify
	clear()
2	Erases the contents
	setEchoMode()
	Controls the appearance of the text inside the box. Echomode values are –
3	QLineEdit.Normal QLineEdit.NoEcho QLineEdit.Password QLineEdit.PasswordEchoOnEdit
	setMaxLength()
4	Sets the maximum number of characters for input
	setReadOnly()
5	Makes the text box non-editable
	setText()
6	Programmatically sets the text
	text()
7	Retrieves text in the field
	setValidator()
	Sets the validation rules. Available validators are
8	QIntValidator – Restricts input to integer QDoubleValidator – Fraction part of number limited to specified decimals

QRegExpValidator – Checks input against a Regex expression

setInputMask()

9

Applies mask of combination of characters for input

setFont()

10

Displays the contents QFont object

QLineEdit object emits the following signals:

Given below are the most commonly used methods of signals.

Sr.No.	Methods & Description
1	cursorPositionChanged() Whenever the cursor moves
2	editingFinished() When you press 'Enter' or the field loses focus
3	returnPressed() When you press 'Enter'
4	selectionChanged() Whenever the selected text changes
5	textChanged() As text in the box changes either by input or by programmatic means
6	textEdited() Whenever the text is edited

Example

QLineEdit objects in this example demonstrate use of some of these methods.

First field **e1** shows text using a custom font, in right alignment and allows integer input. Second field restricts input to a number with 2 digits after decimal point. An input mask for entering the phone number is applied on the third field. textChanged() signal on the field **e4** is connected to textchanged() slot method.

Contents of **e5** field are echoed in password form as its EchoMode property is set to Password. Its editingfinished() signal is connected to presenter() method. So, once the user presses the Enter key, the function will be executed. The field **e6** shows a default text, which cannot be edited as it is set to read only.

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
```



```
from PyQt5.QtWidgets import *

def window():
    app = QApplication(sys.argv)
    win = QWidget()

    e1 = QLineEdit()
    e1.setValidator(QIntValidator())
    e1.setMaxLength(4)
    e1.setAlignment(Qt.AlignRight)
    e1.setFont(QFont("Arial",20))

    e2 = QLineEdit()
    e2.setValidator(QDoubleValidator(0.99,99.99,2))

    flo = QFormLayout()
    flo.addRow("integer validator", e1)
    flo.addRow("Double validator",e2)

    e3 = QLineEdit()
    e3.setInputMask('+99_9999_999999')
    flo.addRow("Input Mask",e3)

    e4 = QLineEdit()
    e4.textChanged.connect(textchanged)
    flo.addRow("Text changed",e4)

    e5 = QLineEdit()
    e5.setEchoMode(QLineEdit.Password)
    flo.addRow("Password",e5)

    e6 = QLineEdit("Hello Python")
    e6.setReadOnly(True)
    flo.addRow("Read Only",e6)

    e5.editingFinished.connect(enterPress)
    win.setLayout(flo)
```

```

win.setWindowTitle("PyQt")
win.show()

sys.exit(app.exec_())

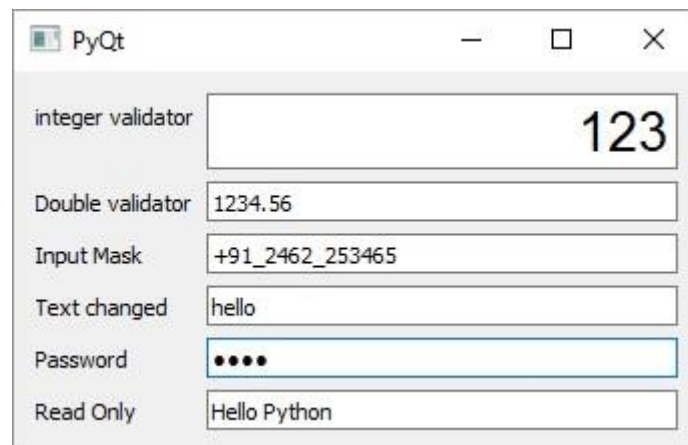
def textchanged(text):
    print ("contents of text box: {}".format(text))

def enterPress():
    print ("editeing finished")

if __name__ == '__main__':
    window()

```

The above code produces the following output:



```

contents of text box: h
contents of text box: he
contents of text box: hel
contents of text box: hell
contents of text box: hello
editing finished

```

QPushButton Widget

In any GUI design, the command button is the most important and most often used control. Buttons with Save, Open, OK, Yes, No and Cancel, etc., as caption are familiar to any computer user. In PyQt API, the **QPushButton** class object presents a button which when clicked can be programmed to invoke a certain function.

QPushButton class inherits its core functionality from **QAbstractButton** class. It is rectangular in shape and a text caption or icon can be displayed on its face.

Following are some of the most commonly used methods of QPushButton class:

Sr.No.	Methods & Description
1	setCheckable() Recognizes pressed and released states of button if set to true
2	toggle() Toggles between checkable states
3	setIcon() Shows an icon formed out of pixmap of an image file
4	setEnabled() When set to false, the button becomes disabled, hence clicking it doesn't emit a signal
5	isChecked() Returns Boolean state of button
6	setDefault() Sets the button as default
7	setText() Programmatically sets buttons' caption
8	text() Retrieves buttons' caption

Example

Four QPushButton objects are set with some of the above attributes. The example is written in object oriented form, because the source of the event is needed to be passed as an argument to slot function.

Four QPushButton objects are defined as instance variables in the class. First button **b1** is converted into toggle button by the statements:

```
self.b1.setCheckable(True)
```

```
self.b1.toggle()
```

Clicked signal of this button is connected to a member method `btnstate()` which identifies whether button is pressed or released by checking `isChecked()` property.

```
def btnstate(self):
    if self.b1.isChecked():
        print "button pressed"
    else:
        print "button released"
```

Second button **b2** displays an icon on the face. `setIcon()` method takes a pixmap object of any image file as argument.

```
b2.setIcon(QIcon(QPixmap("python.gif")))
```

Button **b3** is set to be disabled by using `setEnabled()` method:

```
b3.setEnabled(False)
```

PushButton **b4** is set to default button by `setDefault()` method. Shortcut to its caption is created by prefixing `&` to the caption (`&Default`). As a result, by using the keyboard combination `Alt+D`, connected slot method will be called.

Buttons `b1` and `b4` are connected to `whichbtn()` slot method. Since the function is intended to retrieve caption of the clicked button, the button object should be passed as an argument. This is achieved by the use of lambda function.

Following is the example of the above statement:

```
b4.clicked.connect(lambda:self.whichbtn(self.b4))
```

The complete code is given below:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class Form(QDialog):
    def __init__(self, parent=None):
        super(Form, self).__init__(parent)

        layout = QVBoxLayout()
        self.b1 = QPushButton("Button1")
        self.b1.setCheckable(True)
```

```
self.b1.toggle()
self.b1.clicked.connect(lambda:self.whichbtn(self.b1))
self.b1.clicked.connect(self.btnstate)
layout.addWidget(self.b1)

self.b2 = QPushButton()
self.b2.setIcon(QIcon(QPixmap("pythonlogo.png")))
self.b2.clicked.connect(lambda:self.whichbtn(self.b2))
layout.addWidget(self.b2)
self.setLayout(layout)
self.b3 = QPushButton("Disabled")
self.b3.setEnabled(False)
layout.addWidget(self.b3)

self.b4 = QPushButton("&Default")
self.b4.setDefault(True)
self.b4.clicked.connect(lambda:self.whichbtn(self.b4))
layout.addWidget(self.b4)

self.setWindowTitle("Button demo")

def btnstate(self):
    if self.b1.isChecked():
        print ("button pressed")
    else:
        print ("button released")

def whichbtn(self,b):
    print ("clicked button is "+b.text())

def main():
    app = QApplication(sys.argv)
    ex = Form()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
```

```
main()
```

The above code produces the following output.



```
clicked button is Button1  
button released  
clicked button is Button1  
button pressed  
clicked button is &Default
```

QRadioButton Widget

A **QRadioButton** class object presents a selectable button with a text label. The user can select one of many options presented on the form. This class is derived from **QAbstractButton** class.

Radio buttons are autoexclusive by default. Hence, only one of the radio buttons in the parent window can be selected at a time. If one is selected, previously selected button is automatically deselected. Radio buttons can also be put in a **QGroupBox** or **QButtonGroup** to create more than one selectable fields on the parent window.

The following listed methods of **QRadioButton** class are most commonly used.

Sr.No.	Methods & Description
1	setChecked() Changes the state of radio button
2	setText() Sets the label associated with the button
3	text() Retrieves the caption of button
4	isChecked() Checks if the button is selected

Default signal associated with **QRadioButton** object is `toggled()`, although other signals inherited from **QAbstractButton** class can also be implemented.

Example

Here two mutually exclusive radio buttons are constructed on a top level window.

Default state of `b1` is set to checked by the statement:

```
self.b1.setChecked(True)
```

The `toggled()` signal of both the buttons is connected to `btnstate()` function. Use of lambda allows the source of signal to be passed to the function as an argument.

```
self.b1.toggled.connect(lambda:self.btnstate(self.b1))
self.b2.toggled.connect(lambda:self.btnstate(self.b2))
```

The `btnstate()` function checks state of button emitting `toggled()` signal.

```
if b.isChecked() == True:
    print b.text()+" is selected"
else:
```

```
print b.text()+" is deselected"
```

Complete code for QRadioButton example is as below:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class Radiodemo(QWidget):

    def __init__(self, parent = None):
        super(Radiodemo, self).__init__(parent)

        layout = QHBoxLayout()
        self.b1 = QRadioButton("Button1")
        self.b1.setChecked(True)
        self.b1.toggled.connect(lambda:self.btnstate(self.b1))
        layout.addWidget(self.b1)

        self.b2 = QRadioButton("Button2")
        self.b2.toggled.connect(lambda:self.btnstate(self.b2))

        layout.addWidget(self.b2)
        self.setLayout(layout)
        self.setWindowTitle("RadioButton demo")

    def btnstate(self,b):

        if b.text() == "Button1":
            if b.isChecked() == True:
                print (b.text()+" is selected")
            else:
                print (b.text()+" is deselected")

        if b.text() == "Button2":
            if b.isChecked() == True:
```



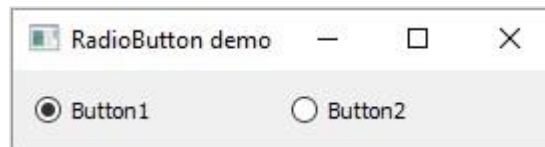
```
        print (b.text()+" is selected")
    else:
        print (b.text()+" is deselected")

def main():

    app = QApplication(sys.argv)
    ex = Radiodemo()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()
```

The above code produces the following output:



```
Button1 is deselected
Button2 is selected
Button2 is deselected
Button1 is selected
```

QCheckBox Widget

A rectangular box before the text label appears when a **QCheckBox** object is added to the parent window. Just as **QRadioButton**, it is also a selectable button. Its common use is in a scenario when the user is asked to choose one or more of the available options.

Unlike Radio buttons, check boxes are not mutually exclusive by default. In order to restrict the choice to one of the available items, the check boxes must be added to **QButtonGroup**.

The following table lists commonly used **QCheckBox** class methods:

Sr.No.	Methods & Description
1	setChecked() Changes the state of checkbox button
2	setText() Sets the label associated with the button
3	text() Retrieves the caption of the button
4	isChecked() Checks if the button is selected
5	setTriState() Provides no change state to checkbox

Each time a checkbox is either checked or cleared, the object emits **stateChanged()** signal.

Example

Here, two **QCheckBox** objects are added to a horizontal layout. Their **stateChanged()** signal is connected to **btnstate()** function. The source object of signal is passed to the function using lambda.

```
self.b1.stateChanged.connect(lambda:self.btnstate(self.b1))
self.b2.toggled.connect(lambda:self.btnstate(self.b2))
```

The **isChecked()** function is used to check if the button is checked or not.

```
if b.text() == "Button1":
    if b.isChecked() == True:
        print b.text()+" is selected"
    else:
        print b.text()+" is deselected"
```

The complete code is as follows:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class checkdemo(QWidget):
    def __init__(self, parent = None):
        super(checkdemo, self).__init__(parent)

        layout = QHBoxLayout()
        self.b1 = QCheckBox("Button1")
        self.b1.setChecked(True)
        self.b1.stateChanged.connect(lambda:self.btnstate(self.b1))
        layout.addWidget(self.b1)

        self.b2 = QCheckBox("Button2")
        self.b2.toggled.connect(lambda:self.btnstate(self.b2))

        layout.addWidget(self.b2)
        self.setLayout(layout)
        self.setWindowTitle("checkbox demo")

    def btnstate(self,b):
        if b.text() == "Button1":
            if b.isChecked() == True:
                print (b.text()+" is selected")
            else:
                print (b.text()+" is deselected")

        if b.text() == "Button2":
            if b.isChecked() == True:
                print (b.text()+" is selected")

            else:
                print (b.text()+" is deselected")

def main():
```

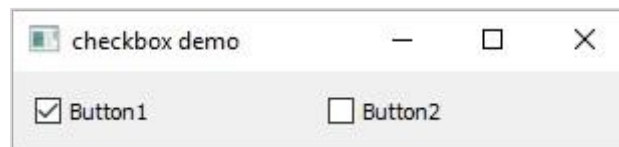
```

app = QApplication(sys.argv)
ex = checkdemo()
ex.show()
sys.exit(app.exec_())

if __name__ == '__main__':
    main()

```

The above code produces the following output:



```

Button2 is selected
Button2 is deselected
Button1 is deselected
Button1 is selected

```

As mentioned earlier, checkBox buttons can be made mutually exclusive by adding them in the **QButtonGroup** object.

```

self.bg = QButtonGroup()
self.bg.addButton(self.b1,1)
self.bg.addButton(self.b2,2)

```

QButtonGroup object, provides abstract container for buttons and doesn't have a visual representation. It emits buttonClicked() signal and sends Button object's reference to the slot function btn_group().

```

self.bg.buttonClicked[QAbstractButton].connect(self.btn_group)

```

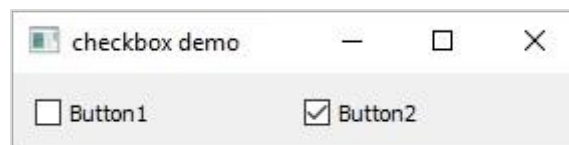
The btn_group() function displays the caption of the clicked checkbox.

```

def btn_group(self,btn):
    print (btn.text()+" is selected")

```

After above changes, the application window appears as follows:



```

Button1 is selected
Button2 is selected
Button1 is selected

```

QComboBox Widget

A **QComboBox** object presents a dropdown list of items to select from. It takes minimum screen space on the form required to display only the currently selected item.

A Combo box can be set to be editable; it can also store pixmap objects. The following methods are commonly used:

Sr.No.	Methods & Description
1	addItem() Adds string to collection
2	addItems() Adds items in a list object
3	Clear() Deletes all items in the collection
4	count() Retrieves number of items in the collection
5	currentText() Retrieves the text of currently selected item
6	itemText() Displays text belonging to specific index
7	currentIndex() Returns index of selected item
8	setItemText() Changes text of specified index

QComboBox Signals

The following methods are commonly used in QComboBox Signals:

Sr.No.	Methods & Description
1	activated() When the user chooses an item

- 2 **currentIndexChanged()**
Whenever the current index is changed either by the user or programmatically
- 3 **highlighted()**
When an item in the list is highlighted

Example

Let us see how some features of QComboBox widget are implemented in the following example.

Items are added in the collection individually by addItem() method or items in a List object by **addItem()** method.

```
self.cb.addItem("C++")
self.cb.addItem(["Java", "C#", "Python"])
```

QComboBox object emits currentIndexChanged() signal. It is connected to **selectionchange()** method.

Items in a combo box are listed using itemText() method for each item. Label belonging to the currently chosen item is accessed by **currentText()** method.

```
def selectionchange(self,i):
    print ("Items in the list are :")

    for count in range(self.cb.count()):
        print (self.cb.itemText(count))
    print ("Current index",i,"selection changed ",self.cb.currentText())
```

The entire code is as follows:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class combodemo(QWidget):
    def __init__(self, parent = None):
        super(combodemo, self).__init__(parent)

        layout = QHBoxLayout()
        self.cb = QComboBox()
        self.cb.addItem("C")
```

```

self.cb.addItem("C++")
self.cb.addItems(["Java", "C#", "Python"])
self.cb.currentIndexChanged.connect(self.selectionchange)

layout.addWidget(self.cb)
self.setLayout(layout)
self.setWindowTitle("combo box demo")

def selectionchange(self,i):
    print ("Items in the list are :")

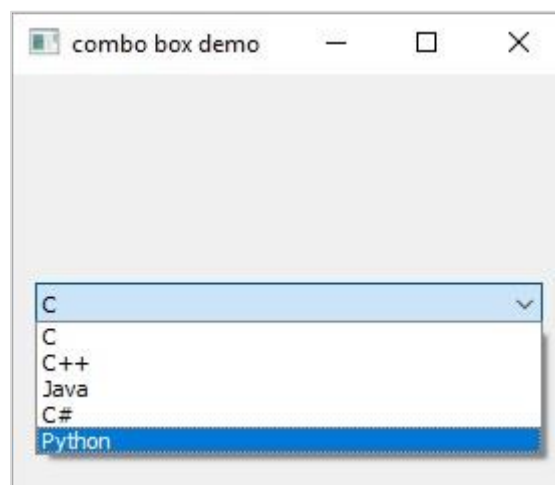
    for count in range(self.cb.count()):
        print (self.cb.itemText(count))
    print ("Current index",i,"selection changed ",self.cb.currentText())

def main():
    app = QApplication(sys.argv)
    ex = combodemo()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()

```

The above code produces the following output:



Items in the list are as follows:

```
C
C++
Java
C#
Python
Current selection index 4 selection changed Python
```

QSpinBox Widget

A **QSpinBox** object presents the user with a textbox which displays an integer with up/down button on its right. The value in the textbox increases/decreases if the up/down button is pressed.

By default, the integer number in the box starts with 0, goes upto 99 and changes by step 1. You can use **QDoubleSpinBox** for float values.

Important methods of **QSpinBox** class are listed in the following table:

Sr.No.	Methods & Description
1	setMinimum() Sets the lower bound of counter
2	setMaximum() Sets the upper bound of counter
3	setRange() Sets the minimum, maximum and step value
4	setValue() Sets the value of spin box programmatically
5	Value() Returns the current value
6	singleStep() Sets the step value of counter

QSpinBox object emits **valueChanged()** signal every time when up/down button is pressed. The associated slot function can retrieve current value of the widget by **value()** method.

Following example has a label (l1) and spinbox (sp) put in vertical layout of a top window. The **valueChanged()** signal is connected to **valuechange()** method.


```
self.sp.valueChanged.connect(self.valuechange)
```

The valueChange() function displays the current value as caption of the label.

```
self.l1.setText("current value:"+str(self.sp.value()))
```

The complete code is as follows:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class spindemo(QWidget):
    def __init__(self, parent = None):
        super(spindemo, self).__init__(parent)

        layout = QVBoxLayout()
        self.l1 = QLabel("current value:")
        self.l1.setAlignment(Qt.AlignCenter)
        layout.addWidget(self.l1)
        self.sp = QSpinBox()

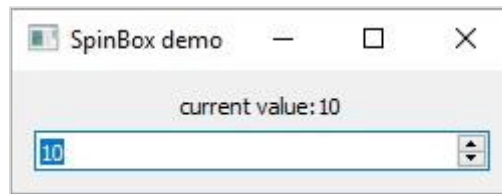
        layout.addWidget(self.sp)
        self.sp.valueChanged.connect(self.valuechange)
        self.setLayout(layout)
        self.setWindowTitle("SpinBox demo")

    def valuechange(self):
        self.l1.setText("current value:"+str(self.sp.value()))

def main():
    app = QApplication(sys.argv)
    ex = spindemo()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()
```

The above code produces the following output:



QSlider Widget

QSlider class object presents the user with a groove over which a handle can be moved. It is a classic widget to control a bounded value. Position of the handle on the groove is equivalent to an integer between the lower and the upper bounds of the control.

A slider control can be displayed in horizontal or vertical manner by mentioning the orientation in the constructor.

```
self.sp = QSlider(Qt.Horizontal)
self.sp = QSlider(Qt.Vertical)
```

The following table lists some of the frequently used methods of QSlider class:

Sr.No.	Methods & Description
1	setMinimum() Sets the lower bound of the slider
2	setMaximum() Sets the upper bound of the slider
3	setSingleStep() Sets the increment/decrement step
4	setValue() Sets the value of the control programmatically
5	value() Returns the current value
6	setTickInterval() Puts the number of ticks on the groove
7	setTickPosition() Places the ticks on the groove. Values are – QSlider.NoTicks No tick marks QSlider.TicksBothSides Tick marks on both sides

QSlider.TicksAbove	Tick marks above the slider
QSlider.TicksBelow	Tick marks below the slider
QSlider.TicksLeft	Tick marks to the left of the slider
QSlider.TicksRight	Tick marks to the right of the slider

QSlider Signals

The following are the methods in QSlider Signals:

Sr.No.	Methods & Description
1	valueChanged() When the slider's value has changed
2	sliderPressed() When the user starts to drag the slider
3	sliderMoved() When the user drags the slider
4	sliderReleased() When the user releases the slider

valueChanged() signal is the one which is most frequently used.

Example

The following example demonstrates the above functionality. A Label and a horizontal slider is placed in a vertical layout. Slider's valueChanged() signal is connected to valuechange() method.

```
self.sl.valueChanged.connect(self.valuechange)
```

The slot function valuechange() reads current value of the slider and uses it as the size of font for label's caption.

```
size = self.sl.value()
self.l1.setFont(QFont("Arial",size))
```

The complete code is as follows:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
```

```

from PyQt5.QtWidgets import *

class sliderdemo(QWidget):
    def __init__(self, parent = None):
        super(sliderdemo, self).__init__(parent)
        layout = QVBoxLayout()
        self.l1 = QLabel("Hello")
        self.l1.setAlignment(Qt.AlignCenter)
        layout.addWidget(self.l1)

        self.sl = QSlider(Qt.Horizontal)
        self.sl.setMinimum(10)
        self.sl.setMaximum(30)
        self.sl.setValue(20)
        self.sl.setTickPosition(QSlider.TicksBelow)
        self.sl.setTickInterval(5)

        layout.addWidget(self.sl)
        self.sl.valueChanged.connect(self.valuechange)
        self.setLayout(layout)
        self.setWindowTitle("Slider Demo")

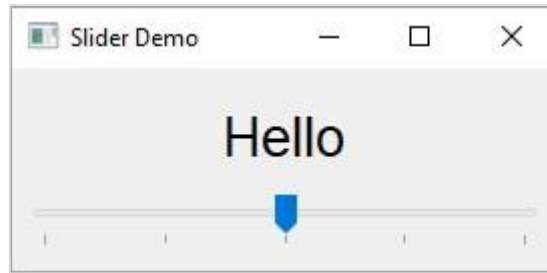
    def valuechange(self):
        size = self.sl.value()
        self.l1.setFont(QFont("Arial",size))

def main():
    app = QApplication(sys.argv)
    ex = sliderdemo()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()

```

The above code produces the following output –



The font size of the label changes as handle of the slider is moved across the handle.

QMenuBar, QMenu & QAction Widgets

A horizontal **QMenuBar** just below the title bar of a QMainWindow object is reserved for displaying QMenu objects.

QMenu class provides a widget which can be added to menu bar. It is also used to create context menu and popup menu. Each QMenu object may contain one or more **QAction** objects or cascaded QMenu objects.

To create a popup menu, PyQt API provides **createPopupMenu()** function. **menuBar()** function returns main window's QMenuBar object. **addMenu()** function lets addition of menu to the bar. In turn, actions are added in the menu by **addAction()** method.

Following table lists some of the important methods used in designing a menu system.

Sr.No.	Methods & Description
1	menuBar() Returns main window's QMenuBar object
2	addMenu() Adds a new QMenu object to menu bar
3	addAction() Adds an action button to QMenu widget consisting of text or icon
4	setEnabled() Sets state of action button to enabled/disabled
5	addSeperator() Adds a separator line in the menu
6	Clear() Removes contents of menu/menu bar
7	setShortcut() Associates keyboard shortcut to action button
8	setText()

- Assigns text to action button
- 9 **setTitle()**
Sets the title of QMenu widget
- 10 **text()**
Retrieves the text associated with QAction object
- 11 **title()**
Retrieves the text associated with QMenu object

QMenu object emits **triggered()** signal whenever any QAction button is clicked. Reference to the clicked QAction object is passed on to the connected slot function.

Example

In this example, first all reference to QMenuBar object of top level window (which has to be a QMainWindow object) is stored.

```
bar = self.menuBar()
```

File menu is added to the menu bar by addMenu() method.

```
file = bar.addMenu("File")
```

An action button in the menu may be a string or a QAction object.

```
file.addAction("New")
save = QAction("Save",self)
save.setShortcut("Ctrl+S")
file.addAction(save)
```

A submenu is added to top level menu.

```
edit = file.addMenu("Edit")
edit.addAction("copy")
edit.addAction("paste")
```

triggered() signal emitted by file menu is connected to processtrigger() method, which receives QAction object causing the signal.

```
file.triggered[QAction].connect(self.processtrigger)
```

The complete code is as follows:

```
import sys
from PyQt5.QtCore import *
```

```
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class menudemo(QMainWindow):
    def __init__(self, parent = None):
        super(menudemo, self).__init__(parent)

        layout = QHBoxLayout()
        bar = self.menuBar()
        file = bar.addMenu("File")
        file.addAction("New")

        save = QAction("Save",self)
        save.setShortcut("Ctrl+S")
        file.addAction(save)

        edit = file.addMenu("Edit")
        edit.addAction("copy")
        edit.addAction("paste")

        quit = QAction("Quit",self)
        file.addAction(quit)
        file.triggered[QAction].connect(self.processtrigger)
        self.setLayout(layout)
        self.setWindowTitle("Menu Demo")

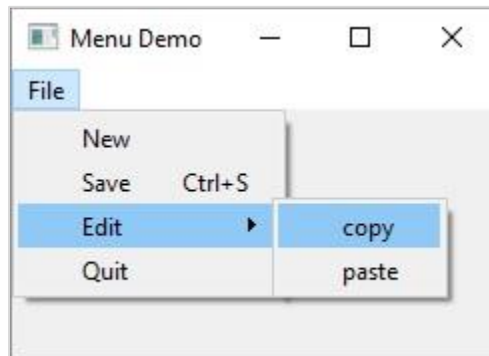
    def processtrigger(self,q):
        print (q.text()+" is triggered")

def main():
    app = QApplication(sys.argv)
    ex = menudemo()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
```

```
main()
```

The above code produces the following output:



QToolBar Widget

A **QToolBar** widget is a movable panel consisting of text buttons, buttons with icons or other widgets.

It is usually situated in a horizontal bar below menu bar, although it can be floating. Some useful methods of QToolBar class are as follows:

Sr.No.	Methods & Description
1	addAction() Adds tool buttons having text or icon
2	addSeparator() Shows tool buttons in groups
3	addWidget() Adds controls other than button in the toolbar
4	addToolBar() QMainWindow class method adds a new toolbar
5	setMovable() Toolbar becomes movable
6	setOrientation() Toolbar's orientation sets to Qt.Horizontal or Qt.vertical

Whenever a button on the toolbar is clicked, **ActionTriggered()** signal is emitted. Additionally, it sends reference to QAction object associated with the event to the connected function.

A File toolbar is added in the toolbar area by calling **addToolBar()** method.


```
tb = self.addToolBar("File")
```

Although tool buttons with text captions can be added, a toolbar usually contains graphic buttons. A QAction object with an icon and name is added to the toolbar.

```
new = QAction(QIcon("new.bmp"),"new",self)
tb.addAction(new)
```

Similarly, open and save buttons are added.

Finally, actionTriggered() signal is connected to a slot function toolbtnpressed().

```
tb.actionTriggered[QAction].connect(self.toolbtnpressed)
```

The complete code to execute the example is as follows:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class tooldemo(QMainWindow):
    def __init__(self, parent = None):
        super(tooldemo, self).__init__(parent)
        layout = QVBoxLayout()
        tb = self.addToolBar("File")

        new = QAction(QIcon("new.png"),"new",self)
        tb.addAction(new)

        open = QAction(QIcon("open.png"),"open",self)
        tb.addAction(open)

        save = QAction(QIcon("save.png"),"save",self)
        tb.addAction(save)

        tb.actionTriggered[QAction].connect(self.toolbtnpressed)
        self.setLayout(layout)
        self.setWindowTitle("toolbar demo")

    def toolbtnpressed(self,a):
        print ("pressed tool button is",a.text())
```

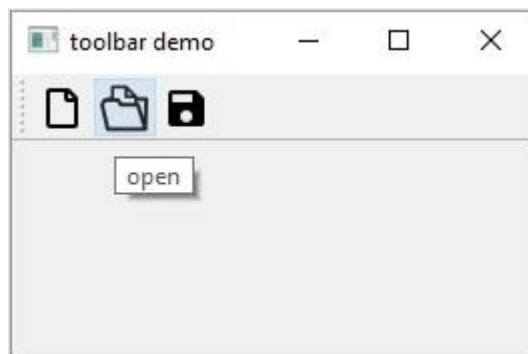
```

def main():
    app = QApplication(sys.argv)
    ex = tooldemo()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()

```

The above code produces the following output:



QInputDialog Widget

This is a preconfigured dialog with a text field and two buttons, OK and Cancel. The parent window collects the input in the text box after the user clicks on Ok button or presses Enter.

The user input can be a number, a string or an item from the list. A label prompting the user what he should do is also displayed.

The **QInputDialog** class has the following static methods to accept input from the user:

Sr.No.	Methods & Description
1	<p>getInt() Creates a spinner box for integer number</p>
2	<p>getDouble() Spinner box with floating point number can be input</p>
3	<p>getText() A simple line edit field to type text</p>
4	<p>getItem() A combo box from which user can choose item</p>

Example

The following example implements the input dialog functionality. The top level window has three buttons. Their **clicked()** signal pops up InputDialog through connected slots.

```

items = ("C", "C++", "Java", "Python")

item, ok = QInputDialog.getItem(self, "select input dialog",
    "list of languages", items, 0, False)

if ok and item:
    self.le.setText(item)

def gettext(self):
    text, ok = QInputDialog.getText(self, 'Text Input Dialog', 'Enter your
name:')

    if ok:
        self.le1.setText(str(text))

def getint(self):
    num,ok = QInputDialog.getInt(self,"integer input dialog","enter a
number")

    if ok:
        self.le2.setText(str(num))

```

The complete code is as follows:

```

import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class inputdialogdemo(QWidget):
    def __init__(self, parent = None):
        super(inputdialogdemo, self).__init__(parent)

        layout = QFormLayout()
        self.btn = QPushButton("Choose from list")

```

```
self.btn.clicked.connect(self.getItem)

self.le = QLineEdit()
layout.addRow(self.btn,self.le)
self.btn1 = QPushButton("get name")
self.btn1.clicked.connect(self.gettext)

self.le1 = QLineEdit()
layout.addRow(self.btn1,self.le1)
self.btn2 = QPushButton("Enter an integer")
self.btn2.clicked.connect(self.getint)

self.le2 = QLineEdit()
layout.addRow(self.btn2,self.le2)
self.setLayout(layout)
self.setWindowTitle("Input Dialog demo")

def getItem(self):
    items = ("C", "C++", "Java", "Python")

    item, ok = QInputDialog.getItem(self, "select input dialog",
        "list of languages", items, 0, False)

    if ok and item:
        self.le.setText(item)

def gettext(self):
    text, ok = QInputDialog.getText(self, 'Text Input Dialog', 'Enter your
name:')

    if ok:
        self.le1.setText(str(text))

def getint(self):
    num,ok = QInputDialog.getInt(self,"integer input dialog","enter a
number")
```

```

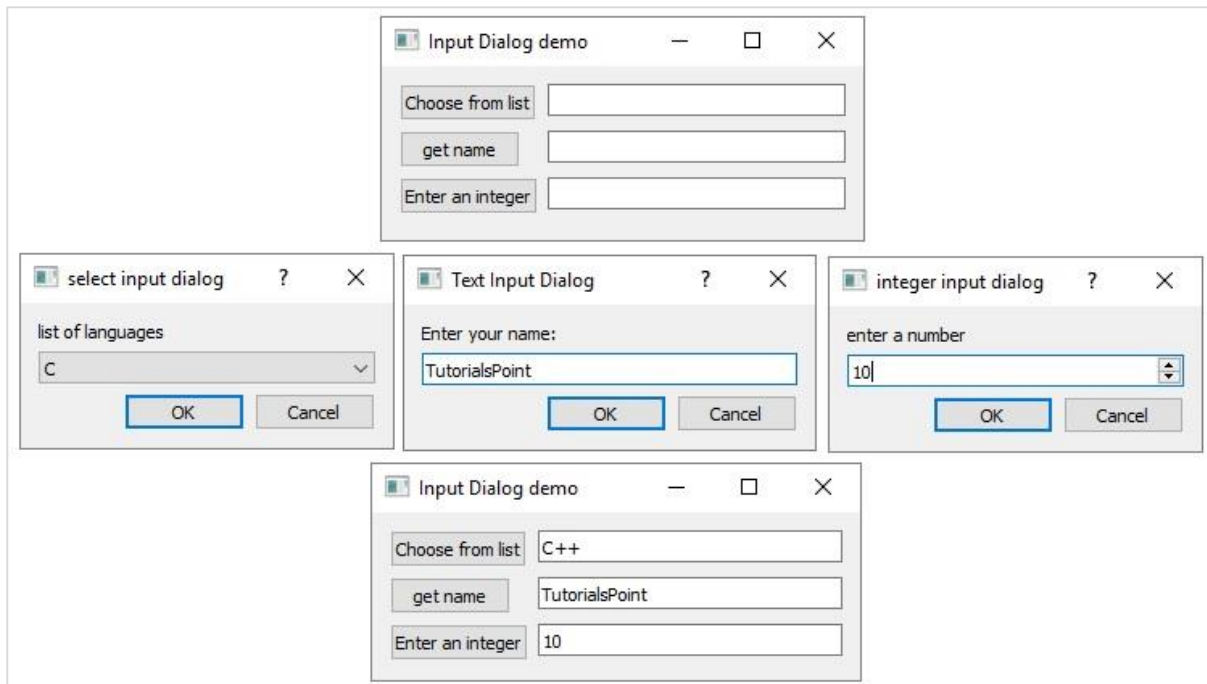
        if ok:
            self.le2.setText(str(num))

def main():
    app = QApplication(sys.argv)
    ex = inputdialogdemo()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()

```

The above code produces the following output:



QFontDialog Widget

Another commonly used dialog, a font selector widget is the visual appearance of **QDialog** class. Result of this dialog is a **QFont** object, which can be consumed by the parent window.

The class contains a static method **getFont()**. It displays the font selector dialog. **setCurrentFont()** method sets the default Font of the dialog.

Example

The following example has a button and a label. When the button is clicked, the font dialog pops up. The font chosen by the user (face, style and size) is applied to the text on the label.

The complete code is as follows:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class fontdialogdemo(QWidget):
    def __init__(self, parent = None):
        super(fontdialogdemo, self).__init__(parent)

        layout = QVBoxLayout()
        self.btn = QPushButton("choose font")
        self.btn.clicked.connect(self.getfont)

        layout.addWidget(self.btn)
        self.le = QLabel("Hello")

        layout.addWidget(self.le)
        self.setLayout(layout)
        self.setWindowTitle("Font Dialog demo")

    def getfont(self):
        font, ok = QFontDialog.getFont()

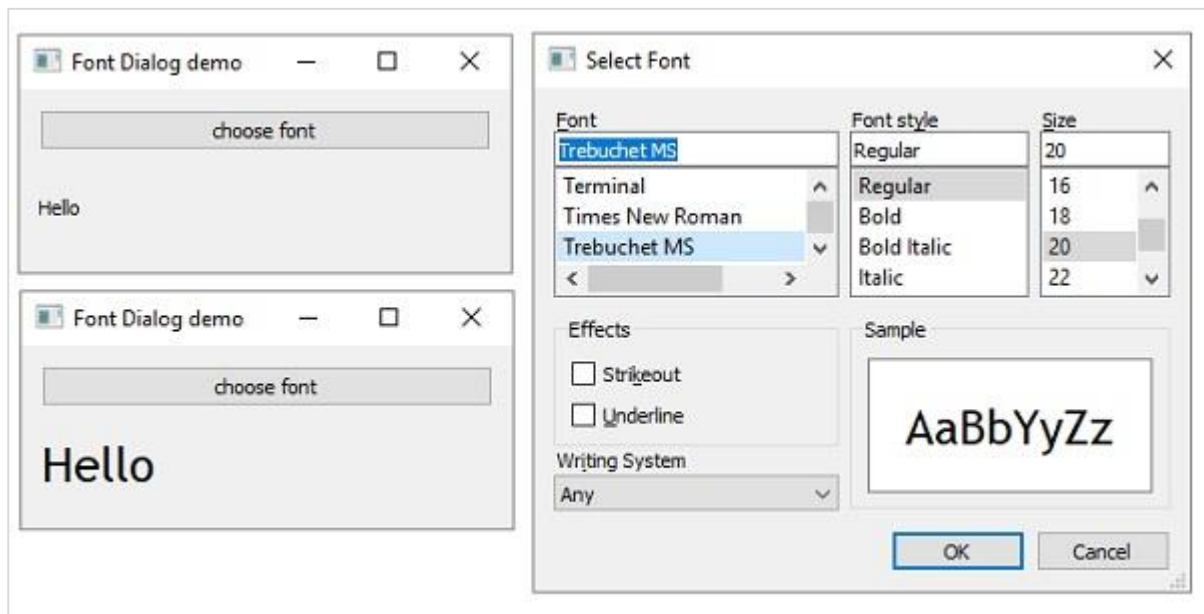
        if ok:
            self.le.setFont(font)

def main():
    app = QApplication(sys.argv)
    ex = fontdialogdemo()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
```

```
main()
```

The above code produces the following output:



QFileDialog Widget

This widget is a file selector dialog. It enables the user to navigate through the file system and select a file to open or save. The dialog is invoked either through static functions or by calling **exec_()** function on the dialog object.

Static functions of **QFileDialog** class (**getOpenFileName()** and **getSaveFileName()**) call the native file dialog of the current operating system.

A file filter can also be applied to display only files of the specified extensions. The starting directory and default file name can also be set.

Important methods and enumerations of QFileDialog class are listed in the following table:

Sr.No.	Methods & Description
1	getOpenFileName() Returns name of the file selected by the user to open it
2	getSaveFileName() Uses the file name selected by the user to save the file
3	setAcceptMode() Determines whether the file box acts as open or save dialog QFileDialog.AcceptOpen QFileDialog.AcceptSave
4	setFileMode() Type of selectable files. Enumerated constants are – QFileDialog.AnyFile QFileDialog.ExistingFile QFileDialog.Directory QFileDialog.ExistingFiles
5	setFilter() Displays only those files having mentioned extensions

Example

Both methods of invoking the file dialog are demonstrated in the following example.

The first button invokes the file dialog by the static method.

```
fname = QFileDialog.getOpenFileName(self, 'Open file',
    'c:\\', "Image files (*.jpg *.gif)")
```


The selected image file is displayed on a label widget. The second button invokes the file dialog by calling `exec_()` method on `QFileDialog` object.

```
dlg = QFileDialog()
dlg.setFileMode(QFileDialog.AnyFile)
dlg.setFilter("Text files (*.txt)")
filenames = QStringList()

if dlg.exec_():
    filenames = dlg.selectedFiles()
```

The contents of the selected file are displayed in the `TextEdit` widget.

```
f = open(filenames[0], 'r')
with f:
    data = f.read()
    self.contents.setText(data)
```

The complete code for static method is as follows:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class filedialogdemo(QWidget):
    def __init__(self, parent = None):
        super(filedialogdemo, self).__init__(parent)

        layout = QVBoxLayout()
        self.btn = QPushButton("QFileDialog static method demo")
        self.btn.clicked.connect(self.getfile)

        layout.addWidget(self.btn)
        self.le = QLabel("")

        layout.addWidget(self.le)

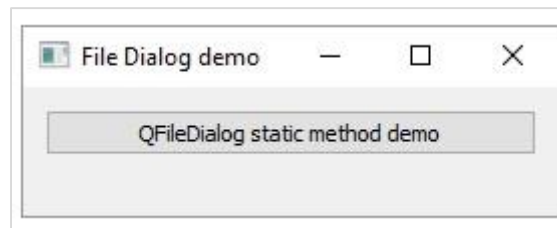
        self.setLayout(layout)
        self.setWindowTitle("File Dialog demo")
```

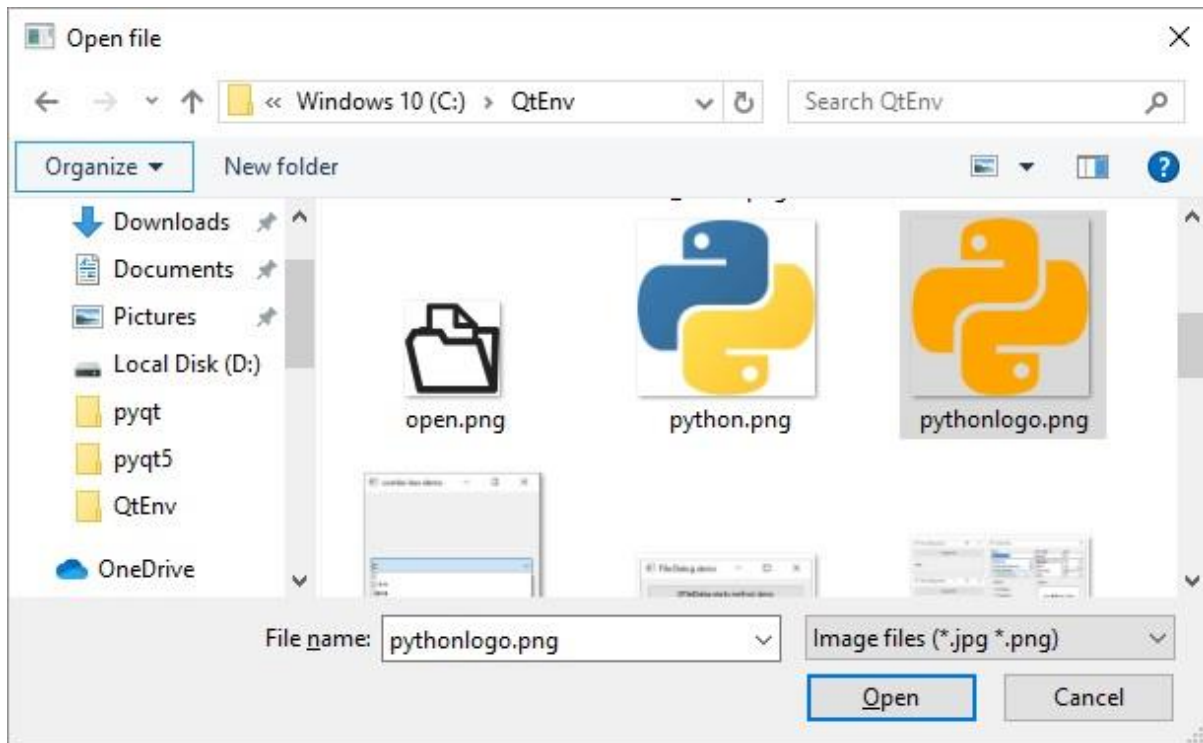
```
def getfile(self):
    fname = QFileDialog.getOpenFileName(self, 'Open file',
        'd:\\', "Image files (*.jpg *.png)")
    self.le.setPixmap(QPixmap(fname[0]))

def main():
    app = QApplication(sys.argv)
    ex = filedialogdemo()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()
```

The above code produces the following output:





The complete code for `exec_()` method is as follows:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *
class CustomDialog(QFileDialog):
```

```

def __init__(self, *args, **kwargs):
    super(CustomDialog, self).__init__(*args, **kwargs)

    self.setWindowTitle("HELLO!")

    QBtn = QDialogButtonBox.Ok | QDialogButtonBox.Cancel

    self.buttonBox = QDialogButtonBox(QBtn)
    self.buttonBox.accepted.connect(self.accept)
    self.buttonBox.rejected.connect(self.reject)

    self.layout = QVBoxLayout()
    self.layout.addWidget(self.buttonBox)
    self.setLayout(self.layout)

class filedialogdemo(QWidget):
    def __init__(self, parent = None):

        super(filedialogdemo, self).__init__(parent)

        layout = QVBoxLayout()

        self.btn1 = QPushButton("QFileDialog object")
        self.btn1.clicked.connect(self.getfiles)
        layout.addWidget(self.btn1)

        self.contents = QTextEdit()
        layout.addWidget(self.contents)
        self.setLayout(layout)
        self.setWindowTitle("File Dialog demo")

    def getfiles(self, s):
        print("click", s)
        dlg = CustomDialog(self)
        if dlg.exec_():

```

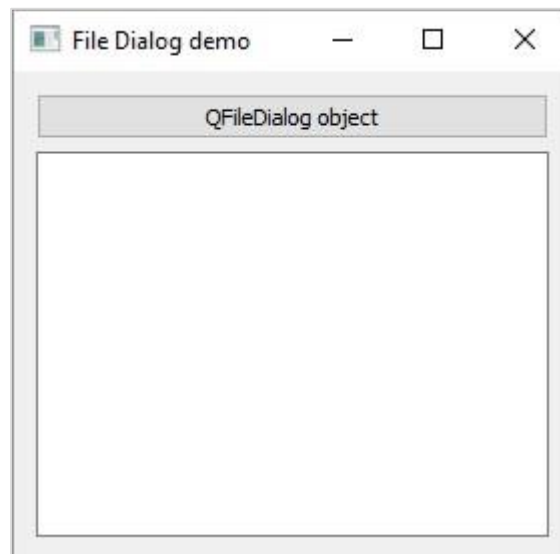
```
        filenames = dlg.selectedFiles()
        f = open(filenames[0], 'r')

        with f:
            data = f.read()
            self.contents.setText(data)
def main():

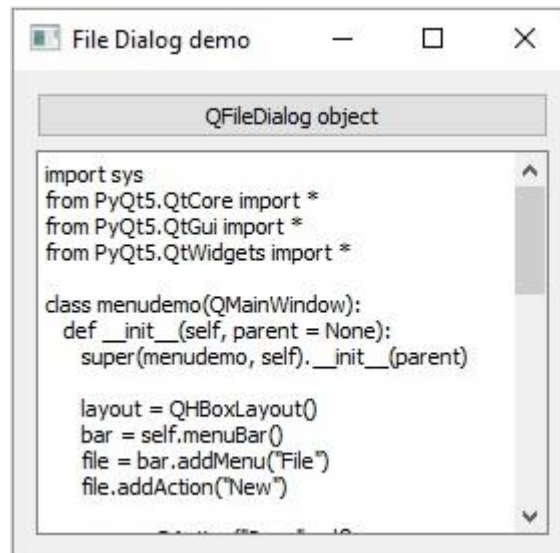
    app = QApplication(sys.argv)
    ex = filedialogdemo()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()
```

The above code produces the following output:



Text in selected file will be displayed in TextEdit control.



```
File Dialog demo  -  □  ×  
QFileDialog object  
import sys  
from PyQt5.QtCore import *  
from PyQt5.QtGui import *  
from PyQt5.QtWidgets import *  
  
class menudemo(QMainWindow):  
    def __init__(self, parent = None):  
        super(menudemo, self).__init__(parent)  
  
        layout = QHBoxLayout()  
        bar = self.menuBar()  
        file = bar.addMenu("File")  
        file.addAction("New")
```

QTab Widget

If a form has too many fields to be displayed simultaneously, they can be arranged in different pages placed under each tab of a Tabbed Widget. The **QTabWidget** provides a tab bar and a page area. The page under the first tab is displayed and others are hidden. The user can view any page by clicking on the desired tab.

Following are some of the frequently used methods of QTabWidget class:

Sr.No.	Methods & Description
1	<p>addTab()</p> <p>Adds a tab associated with a widget page</p>
2	<p>insertTab()</p> <p>Inserts a tab with the page at the desired position</p>
3	<p>removeTab()</p> <p>Removes tab at given index</p>
4	<p>setCurrentIndex()</p> <p>Sets the index of the currently visible page as current</p>
5	<p>setCurrentWidget()</p> <p>Makes the visible page as current</p>
6	<p>setTabBar()</p> <p>Sets the tab bar of the widget</p>
7	<p>setTabPosition()</p> <p>Position of the tabs are controlled by the values</p> <p>QTabWidget.North above the pages</p> <p>QTabWidget.South below the pages</p> <p>QTabWidget.West to the left of the pages</p> <p>QTabWidget.East to the right of the pages</p>
8	<p>setTabText()</p> <p>Defines the label associated with the tab index</p>

The following signals are associated with QTabWidget object:

Sr.No.	Methods & Description
1	<p>currentChanged()</p> <p>Whenever the current page index changes</p>

- 2 **tabClosedRequested()**
 When the close button on the tab is clicked

Example

In the following example, the contents of a form are grouped in three categories. Each group of widgets is displayed under a different tab.

Top level window itself is a QTabWidget. Three tabs are added into it.

```
self.addTab(self.tab1,"Tab 1")
self.addTab(self.tab2,"Tab 2")
self.addTab(self.tab3,"Tab 3")
```

Each tab displays a sub form designed using a layout. Tab text is altered by the statement.

```
self.setTabText(0,"Contact Details")
self.setTabText(1,"Personal Details")
self.setTabText(2,"Education Details")
```

The complete code is as follows:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class tabdemo(QTabWidget):
    def __init__(self, parent = None):
        super(tabdemo, self).__init__(parent)
        self.tab1 = QWidget()
        self.tab2 = QWidget()
        self.tab3 = QWidget()

        self.addTab(self.tab1,"Tab 1")
        self.addTab(self.tab2,"Tab 2")
        self.addTab(self.tab3,"Tab 3")
        self.tab1UI()
        self.tab2UI()
        self.tab3UI()
        self.setWindowTitle("tab demo")
```



```

def tab1UI(self):
    layout = QFormLayout()
    layout.addRow("Name",QLineEdit())
    layout.addRow("Address",QLineEdit())
    self.setTabText(0,"Contact Details")
    self.tab1.setLayout(layout)

def tab2UI(self):
    layout = QFormLayout()
    sex = QHBoxLayout()
    sex.addWidget(QRadioButton("Male"))
    sex.addWidget(QRadioButton("Female"))
    layout.addRow(QLabel("Sex"),sex)
    layout.addRow("Date of Birth",QLineEdit())
    self.setTabText(1,"Personal Details")
    self.tab2.setLayout(layout)

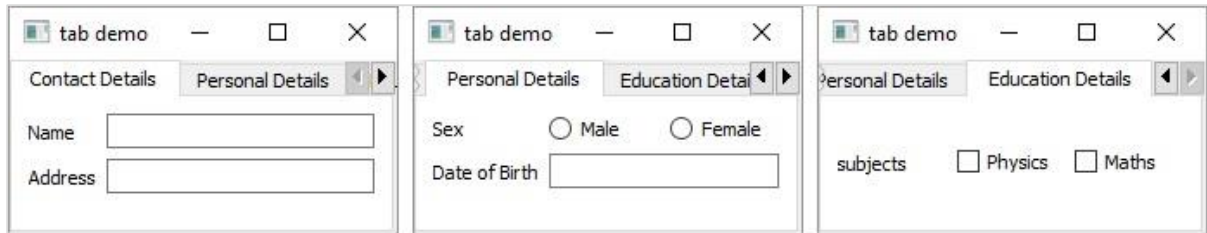
def tab3UI(self):
    layout = QHBoxLayout()
    layout.addWidget(QLabel("subjects"))
    layout.addWidget(QCheckBox("Physics"))
    layout.addWidget(QCheckBox("Maths"))
    self.setTabText(2,"Education Details")
    self.tab3.setLayout(layout)

def main():
    app = QApplication(sys.argv)
    ex = tabdemo()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()

```

All three tabs are shown in the following output:



QStackedWidget

Functioning of **QStackedWidget** is similar to **QTabWidget**. It also helps in the efficient use of window's client area.

QStackedWidget provides a stack of widgets, only one of which can be viewed at a time. It is a useful layout built on top of **QStackedLayout**.

Example

A parent **QStackedWidget** object is populated with more than one child widget.

```
self.Stack = QStackedWidget (self)
self.stack1 = QWidget()
self.stack2 = QWidget()
self.stack3 = QWidget()

self.Stack.addWidget (self.stack1)
self.Stack.addWidget (self.stack2)
self.Stack.addWidget (self.stack3)
```

Each child widget can have its own layout of form elements. **QStackedWidget** on its own cannot switch between the pages. It is linked with the currently selected index of **QListWidget**.

```
self.leftlist = QListWidget ()
self.leftlist.insertItem (0, 'Contact' )
self.leftlist.insertItem (1, 'Personal' )
self.leftlist.insertItem (2, 'Educational' )
self.leftlist.currentRowChanged.connect(self.display)
```

Here, the **currentRowChanged()** signal of **QListWidget** is connected to **display()** function, which changes the view of stacked widget.

```
def display(self,i):
    self.Stack.setCurrentIndex(i)
```

The complete code is as follows:

```
import sys
```

```

from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class stackedExample(QWidget):

    def __init__(self):
        super(stackedExample, self).__init__()
        self.leftlist = QListWidget ()
        self.leftlist.insertItem (0, 'Contact' )
        self.leftlist.insertItem (1, 'Personal' )
        self.leftlist.insertItem (2, 'Educational' )

        self.stack1 = QWidget()
        self.stack2 = QWidget()
        self.stack3 = QWidget()

        self.stack1UI()
        self.stack2UI()
        self.stack3UI()

        self.Stack = QStackedWidget (self)
        self.Stack.addWidget (self.stack1)
        self.Stack.addWidget (self.stack2)
        self.Stack.addWidget (self.stack3)

        hbox = QHBoxLayout(self)
        hbox.addWidget(self.leftlist)
        hbox.addWidget(self.Stack)

        self.setLayout(hbox)
        self.leftlist.currentRowChanged.connect(self.display)
        self.setGeometry(300, 50, 10,10)
        self.setWindowTitle('StackedWidget demo')
        self.show()

    def stack1UI(self):

```

```

    layout = QFormLayout()
    layout.addRow("Name",QLineEdit())
    layout.addRow("Address",QLineEdit())
    #self.setTabText(0,"Contact Details")

    self.stack1.setLayout(layout)

def stack2UI(self):
    layout = QFormLayout()
    sex = QHBoxLayout()
    sex.addWidget(QRadioButton("Male"))
    sex.addWidget(QRadioButton("Female"))
    layout.addRow(QLabel("Sex"),sex)
    layout.addRow("Date of Birth",QLineEdit())

    self.stack2.setLayout(layout)

def stack3UI(self):
    layout = QHBoxLayout()
    layout.addWidget(QLabel("subjects"))
    layout.addWidget(QCheckBox("Physics"))
    layout.addWidget(QCheckBox("Maths"))
    self.stack3.setLayout(layout)

def display(self,i):
    self.Stack.setCurrentIndex(i)

def main():
    app = QApplication(sys.argv)
    ex = stackedExample()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()

```

The above code produces the following output:

The image displays three stacked windows, each titled "StackedWidget demo". Each window contains a vertical sidebar with three options: "Contact", "Personal", and "Educational".

- Top window:** "Contact" is selected. The form contains two text input fields: "Name" and "Address".
- Middle window:** "Personal" is selected. The form contains two radio buttons for "Sex" (Male and Female) and a "Date of Birth" text input field.
- Bottom window:** "Educational" is selected. The form contains two checkboxes for "subjects": "Physics" and "Maths".

QSplitter Widget

This is another advanced layout manager which allows the size of child widgets to be changed dynamically by dragging the boundaries between them. The Splitter control provides a handle that can be dragged to resize the controls.

The widgets in a **QSplitter** object are laid horizontally by default although the orientation can be changed to Qt.Vertical.

Following are the methods and signals of QSplitter class:

Sr.No.	Methods & Description
1	addWidget() Adds the widget to splitter's layout
2	indexOf() Returns the index of the widget in the layout
3	insetWidget() Inserts a widget at the specified index
4	setOrientation() Sets the layout of splitter to Qt.Horizontal or Qt.Vertical
5	setSizes() Sets the initial size of each widget
6	count() Returns the number of widgets in splitter widget

splitterMoved() is the only signal emitted by QSplitter object whenever the splitter handle is dragged.

Example

The following example has a splitter object, splitter1, in which a frame and QTextEdit object are horizontally added.

```

topleft = QFrame()
textedit = QTextEdit()
splitter1.addWidget(topleft)
splitter1.addWidget(textedit)

```

This splitter object splitter1 and a bottom frame object are added in another splitter, splitter2, vertically. The object splitters is finally added in the top level window.

```

bottom = QFrame()

```

```

splitter2 = QSplitter(Qt.Vertical)
splitter2.addWidget(splitter1)
splitter2.addWidget(bottom)

hbox.addWidget(splitter2)
self.setLayout(hbox)

```

The complete code is as follows:

```

import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class Example(QWidget):

    def __init__(self):
        super(Example, self).__init__()
        self.initUI()

    def initUI(self):

        hbox = QHBoxLayout(self)

        topleft = QFrame()
        topleft.setFrameShape(QFrame.StyledPanel)
        bottom = QFrame()
        bottom.setFrameShape(QFrame.StyledPanel)

        splitter1 = QSplitter(Qt.Horizontal)
        textedit = QTextEdit()
        splitter1.addWidget(topleft)
        splitter1.addWidget(textedit)
        splitter1.setSizes([100,200])

        splitter2 = QSplitter(Qt.Vertical)
        splitter2.addWidget(splitter1)
        splitter2.addWidget(bottom)

```

```
hbox.addWidget(splitter2)

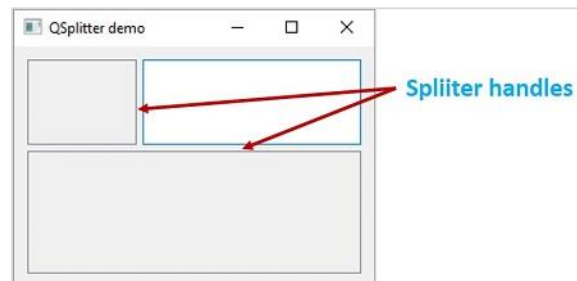
self.setLayout(hbox)
QApplication.setStyle(QStyleFactory.create('Cleanlooks'))

self.setGeometry(300, 300, 300, 200)
self.setWindowTitle('QSplitter demo')
self.show()

def main():
    app = QApplication(sys.argv)
    ex = Example()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()
```

The above code produces the following output:



QDock Widget

A dockable window is a subwindow that can remain in floating state or can be attached to the main window at a specified position. Main window object of QMainWindow class has an area reserved for dockable windows. This area is around the central widget.

A dock window can be moved inside the main window, or they can be undocked to be moved into a new area by the user. These properties are controlled by the following **QDockWidget** class methods:

Sr.No.	Methods & Description
1	<p>setWidget()</p> <p>Sets any QWidget in the dock window's area</p>
2	<p>setFloating()</p> <p>If set to true, the dock window can float</p> <p>setAllowedAreas()</p> <p>Sets the areas to which the window can be docked</p> <p>LeftDockWidgetArea</p>
3	<p>RightDockWidgetArea</p> <p>TopDockWidgetArea</p> <p>BottomDockWidgetArea</p> <p>NoDockWidgetArea</p> <p>setFeatures()</p> <p>Sets the features of dock window</p> <p>DockWidgetClosable</p>
4	<p>DockWidgetMovable</p> <p>DockWidgetFloatable</p> <p>DockWidgetVerticalTitleBar</p> <p>NoDockWidgetFeatures</p>

Example

In the following example, top level window is a QMainWindow object. A QTextEdit object is its central widget.

```
self.setCentralWidget(QTextEdit())
```

A dockable window is first created.

```
self.items = QDockWidget("Dockable", self)
```

A QListWidget object is added as a dock window.

```
self.listWidget = QListWidget()
self.listWidget.addItem("item1")
self.listWidget.addItem("item2")
self.listWidget.addItem("item3")
self.items.setWidget(self.listWidget)
```

Dockable object is placed towards the right side of the central widget.

```
self.addDockWidget(Qt.RightDockWidgetArea, self.items)
```

The complete code is as follows:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class dockdemo(QMainWindow):
    def __init__(self, parent = None):
        super(dockdemo, self).__init__(parent)

        layout = QHBoxLayout()
        bar = self.menuBar()
        file = bar.addMenu("File")
        file.addAction("New")
        file.addAction("save")
        file.addAction("quit")

        self.items = QDockWidget("Dockable", self)
        self.listWidget = QListWidget()
        self.listWidget.addItem("item1")
        self.listWidget.addItem("item2")
        self.listWidget.addItem("item3")

        self.items.setWidget(self.listWidget)
```

```

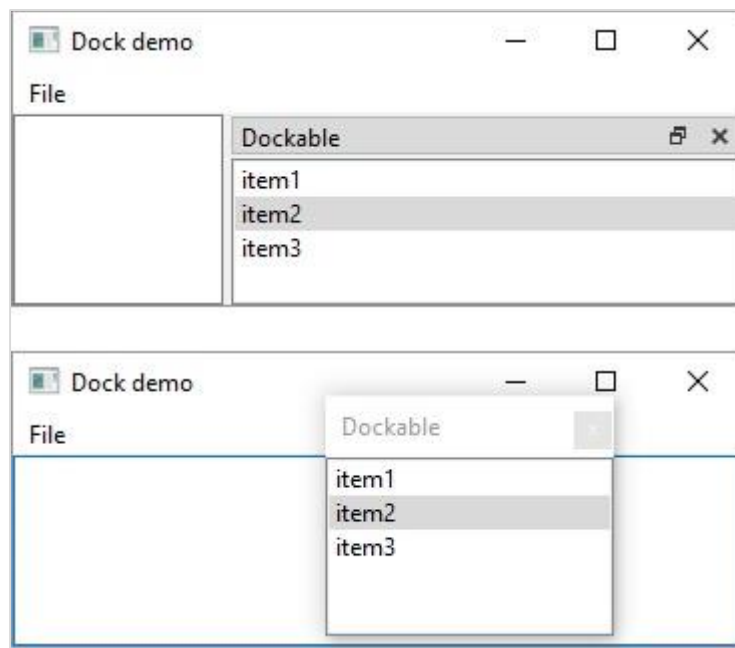
self.items.setFloating(False)
self.setCentralWidget(QTextEdit())
self.addDockWidget(Qt.RightDockWidgetArea, self.items)
self.setLayout(layout)
self.setWindowTitle("Dock demo")

def main():
    app = QApplication(sys.argv)
    ex = dockdemo()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()

```

The above code produces the following output. Click on Dock icon to undock the ListWidget window. Double click to dock again:



QStatusBar Widget

QMainWindow object reserves a horizontal bar at the bottom as the **status bar**. It is used to display either permanent or contextual status information.

There are three types of status indicators:

Temporary: Briefly occupies most of the status bar. For example, used to explain tool tip texts or menu entries.

Normal: Occupies part of the status bar and may be hidden by temporary messages. For example, used to display the page and line number in a word processor.

Permanent: It is never hidden. Used for important mode indications. For example, some applications put a Caps Lock indicator in the status bar.

Status bar of QMainWindow is retrieved by statusBar() function. setStatusBar() function activates it.

```
self.statusBar = QStatusBar()
self.setStatusBar(self.statusBar)
```

Methods of QStatusBar Class

Sr.No.	Methods & Description
1	addWidget() Adds the given widget object in the status bar
2	addPermanentWidget() Adds the given widget object in the status bar permanently
3	showMessage() Displays a temporary message in the status bar for a specified time interval
4	clearMessage() Removes any temporary message being shown
5	removeWidget() Removes specified widget from the status bar

Example

In the following example, a top level QMainWindow has a menu bar and a QTextEdit object as its central widget.

Window's status bar is activated as explained above.

Menu's triggered signal is passed to processtrigger() slot function. If 'show' action is triggered, it displays a temporary message in the status bar as:

```

if (q.text() == "show"):
    self.statusBar.showMessage(q.text()+" is clicked",2000)

```

The message will be erased after 2000 milliseconds (2 sec). If 'add' action is triggered, a button widget is added.

```

if q.text() == "add":
    self.statusBar.addWidget(self.b)

```

Remove action will remove the button from the status bar.

```

if q.text() == "remove":
    self.statusBar.removeWidget(self.b)
    self.statusBar.show()

```

The complete code is as follows:

```

import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class statusdemo(QMainWindow):
    def __init__(self, parent = None):
        super(statusdemo, self).__init__(parent)

        bar = self.menuBar()
        file = bar.addMenu("File")
        file.addAction("show")
        file.addAction("add")
        file.addAction("remove")
        file.triggered[QAction].connect(self.processtrigger)
        self.setCentralWidget(QTextEdit())

        self.statusBar = QStatusBar()
        self.b = QPushButton("click here")
        self.setWindowTitle("QStatusBar Example")
        self.setStatusBar(self.statusBar)

```

```

def processtrigger(self,q):

    if (q.text() == "show"):
        self.statusBar.showMessage(q.text()+" is clicked",2000)

    if q.text() == "add":
        self.statusBar.addWidget(self.b)

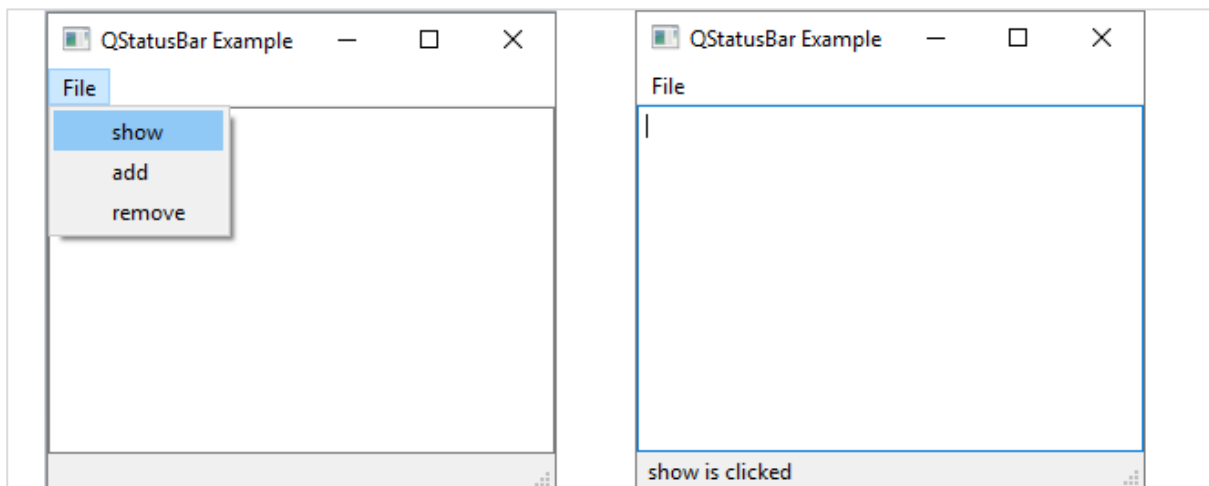
    if q.text() == "remove":
        self.statusBar.removeWidget(self.b)
        self.statusBar.show()

def main():
    app = QApplication(sys.argv)
    ex = statusdemo()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()

```

The above code produces the following output. Status bar shows caption of selected menu button:



QListWidget

QListWidget class is an item-based interface to add or remove items from a list. Each item in the list is a **QListWidgetItem** object. **QListWidget** can be set to be multiselectable.

Following are the frequently used methods of **QListWidget** class:

Sr.No.	Methods & Description
1	addItem() Adds QListWidgetItem object or string in the list
2	addItems() Adds each item in the list
3	insertItem() Inserts item at the specified index
4	clear() Removes contents of the list
5	setCurrentItem() Sets currently selected item programmatically
6	sortItems() Rearranges items in ascending order

Following are the signals emitted by **QListWidget**:

Sr.No.	Methods & Description
1	currentItemChanged() Whenever current item changes
2	itemClicked() Whenever an item in the list is clicked

Example

The following example shows the click event being captured to pop up a message box.

```
from PyQt4.QtGui import *
from PyQt4.QtCore import *

import sys

class myListWidget(QListWidget):
```

```
def Clicked(self,item):
    QMessageBox.information(self, "ListWidget", "You clicked: "+item.text())

def main():
    app = QApplication(sys.argv)
    listWidget = myListWidget()

    #Resize width and height
    listWidget.resize(300,120)

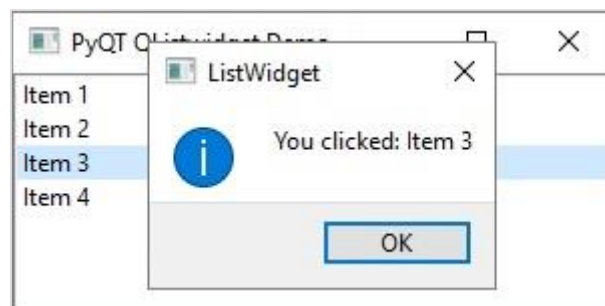
    listWidget.addItem("Item 1");
    listWidget.addItem("Item 2");
    listWidget.addItem("Item 3");
    listWidget.addItem("Item 4");

    listWidget.setWindowTitle('PyQT QListwidget Demo')
    listWidget.itemClicked.connect(listWidget.Clicked)

    listWidget.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()
```

The above code produces the following output. Status bar shows caption of selected menu button:



QScrollBar Widget

A QScrollbar control enables the user to access parts of the document that is outside the viewable area. It provides visual indicator to the current position. It has a slider by which a value between a preset range is set in analogous fashion. This value is usually correlated to bring a hidden data inside the viewport.

The **QScrollbar** has four controls:

- a: slider
- b: Two Scroll arrows Scroll Bar
- c: Page control

Following signals of QScrollbar class are frequently used:

Sr.No.	Methods & Description
1	valueChanged() When the scrollbar's value changes
2	sliderMoved() When the user drags the slider

Example

In the following example, three scroll bars are placed to control RGB values of font color for the text displayed in a label. The complete code is as follows:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class Example(QWidget):

    def __init__(self):
        super(Example, self).__init__()
        self.initUI()

    def initUI(self):
        vbox = QVBoxLayout(self)
        self.setLayout(vbox)

        hbox = QHBoxLayout()
        self.l1 = QLabel("Drag scrollbar sliders to change color")
```

```
self.l1.setFont(QFont("Arial",16))

hbox.addWidget(self.l1)
self.s1 = QScrollBar()
self.s1.setMaximum(255)

self.s1.sliderMoved.connect(self.sliderval)
self.s2 = QScrollBar()
self.s2.setMaximum(255)
self.s2.sliderMoved.connect(self.sliderval)

self.s3 = QScrollBar()
self.s3.setMaximum(255)
self.s3.sliderMoved.connect(self.sliderval)

hbox.addWidget(self.s1)
hbox.addWidget(self.s2)
hbox.addWidget(self.s3)
vbox.addLayout(hbox)

self.setGeometry(300, 300, 300, 200)
self.setWindowTitle('QSplitter demo')
self.show()

def sliderval(self):
    palette = QPalette()
    c = QColor(self.s1.value(),self.s2.value(), self.s3.value(),255)
    palette.setColor(QPalette.Foreground,c)
    self.l1.setPalette(palette)

def main():
    app = QApplication(sys.argv)
    ex = Example()
    sys.exit(app.exec_())

if __name__ == '__main__':
```

```
main()
```

The above code produces the following output:



QCalendar Widget

QCalendar widget is a useful date picker control. It provides a month-based view. The user can select the date by the use of the mouse or the keyboard, the default being today's date. Calendar's date range can also be stipulated.

Given below are the most commonly used methods of QCalendar:

Sr.No.	Methods & Description
1	<p>setDateRange()</p> <p>Sets the lower and upper date available for selection</p> <p>setFirstDayOfWeek()</p> <p>Determines the day of the first column in the calendar</p> <p>The predefined day constants are:</p> <p>Qt.Monday</p> <p>Qt.Tuesday</p>
2	<p>Qt.Wednesday</p> <p>Qt.Thursday</p> <p>Qt.Friday</p> <p>Qt.Saturday</p> <p>Qt.Sunday</p>
3	<p>setMinimumDate()</p> <p>Sets the lower date for selection</p>

- 4 **setMaximumDate()**
 Sets the upper date for selection
- 5 **setSelectedDate()**
 Sets a QDate object as the selected date
- 6 **showToday()**
 Shows the month of today
- 7 **selectedDate()**
 Retrieves the selected date
- 8 **setGridvisible()**
 Turns the calendar grid on or off

Example

The following example has a calendar widget and a label which displays the currently selected date. The complete code is as follows:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class Example(QWidget):

    def __init__(self):
        super(Example, self).__init__()

        self.initUI()

    def initUI(self):

        cal = QCalendarWidget(self)
        cal.setGridVisible(True)
        cal.move(20, 20)
        cal.clicked[QDate].connect(self.showDate)

        self.lbl = QLabel(self)
        date = cal.selectedDate()
```

```

self.lbl.setText(date.toString())
self.lbl.move(100, 250)

self.setGeometry(100,100,300,300)
self.setWindowTitle('Calendar')
self.show()

def showDate(self, date):

    self.lbl.setText(date.toString())

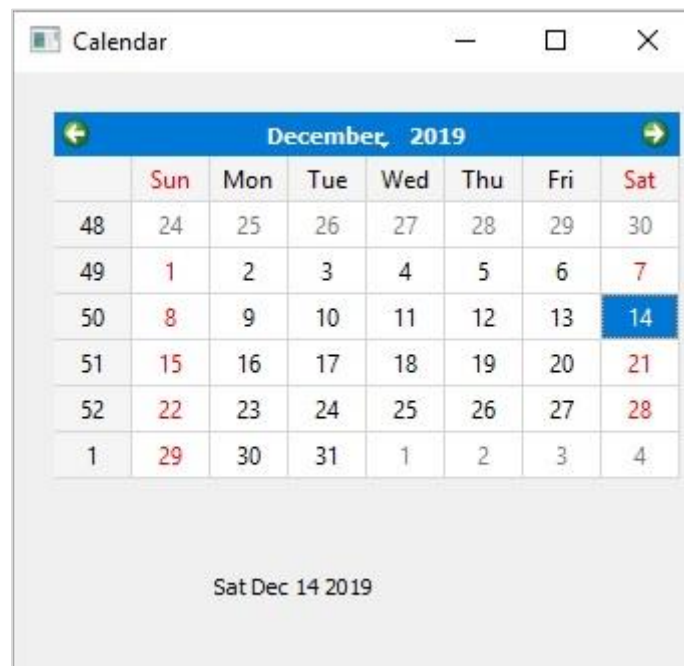
def main():

    app = QApplication(sys.argv)
    ex = Example()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()

```

The above code produces the following output. Selected date is displayed on the label:



9. PyQt5 — QDialog Class

A **QDialog** widget presents a top level window mostly used to collect response from the user. It can be configured to be **Modal** (where it blocks its parent window) or **Modeless** (the dialog window can be bypassed).

PyQt API has a number of preconfigured Dialog widgets such as InputDialog, FileDialog, FontDialog, etc.

Example

In the following example, **WindowModality** attribute of Dialog window decides whether it is modal or modeless. Any one button on the dialog can be set to be default. The dialog is discarded by **QDialog.reject()** method when the user presses the Escape key.

A PushButton on a top level QWidget window, when clicked, produces a Dialog window. A Dialog box doesn't have minimize and maximize controls on its title bar.

The user cannot relegate this dialog box in the background because its WindowModality is set to **ApplicationModal**.

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

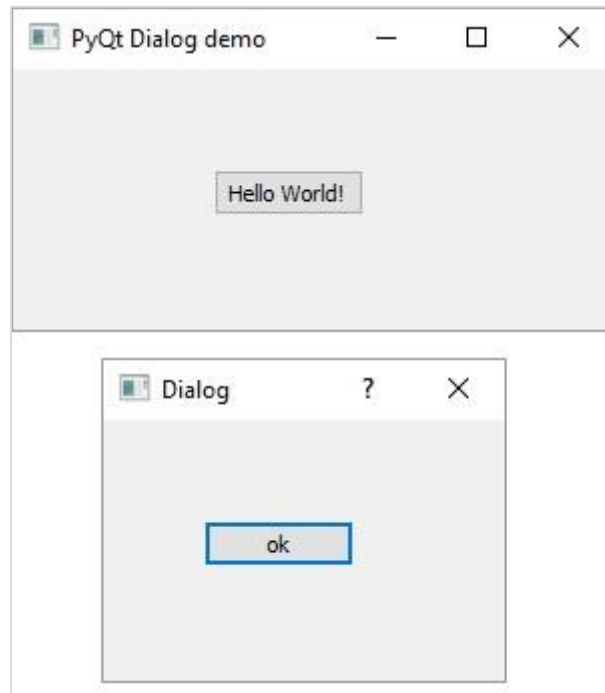
def window():
    app = QApplication(sys.argv)
    w = QWidget()
    btn = QPushButton(w)
    btn.setText("Hello World!")
    btn.move(100,50)
    btn.clicked.connect(showdialog)
    w.setWindowTitle("PyQt Dialog demo")
    w.show()
    sys.exit(app.exec_())

def showdialog():
    dlg = QDialog()
    b1 = QPushButton("ok",dlg)
    b1.move(50,50)
    dlg.setWindowTitle("Dialog")
```

```
dlg.setWindowModality(Qt.ApplicationModal)
dlg.exec_()

if __name__ == '__main__':
    window()
```

The above code produces the following output. Click on button in main window and dialog box pops up:



10. PyQt5 — QMessageBox

QMessageBox is a commonly used modal dialog to display some informational message and optionally ask the user to respond by clicking any one of the standard buttons on it. Each standard button has a predefined caption, a role and returns a predefined hexadecimal number.

Important methods and enumerations associated with QMessageBox class are given in the following table:

Sr.No.	Methods & Description
1	setIcon() Displays predefined icon corresponding to severity of the message Question Information Warning Critical
2	setText() Sets the text of the main message to be displayed
3	setInformativeText() Displays additional information
4	setDetailText() Dialog shows a Details button. This text appears on clicking it
5	setTitle() Displays the custom title of dialog
6	setStandardButtons() List of standard buttons to be displayed. Each button is associated with QMessageBox.Ok 0x00000400 QMessageBox.Open 0x00002000 QMessageBox.Save 0x00000800 QMessageBox.Cancel 0x00400000


```

QMessageBox.Close 0x00200000
QMessageBox.Yes 0x00004000
QMessageBox.No 0x00010000
QMessageBox.Abort 0x00040000
QMessageBox.Retry 0x00080000
QMessageBox.Ignore 0x00100000

```

7 **setDefaultButton()**

Sets the button as default. It emits the clicked signal if Enter is pressed

8 **setEscapeButton()**

Sets the button to be treated as clicked if the escape key is pressed

Example

In the following example, click signal of the button on the top level window, the connected function displays the messagebox dialog.

```

msg = QMessageBox()
msg.setIcon(QMessageBox.Information)
msg.setText("This is a message box")
msg.setInformativeText("This is additional information")
msg.setWindowTitle("MessageBox demo")
msg.setDetailedText("The details are as follows:")

```

setStandardButton() function displays desired buttons.

```

msg.setStandardButtons(QMessageBox.Ok | QMessageBox.Cancel)

```

buttonClicked() signal is connected to a slot function, which identifies the caption of source of the signal.

```

msg.buttonClicked.connect(msgbtn)

```

The complete code for the example is as follows:

```

import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

def window():

```

```

app = QApplication(sys.argv)
w = QWidget()
b = QPushButton(w)
b.setText("Show message!")

b.move(100,50)
b.clicked.connect(showdialog)
w.setWindowTitle("PyQt MessageBox demo")
w.show()
sys.exit(app.exec_())

def showdialog():
    msg = QMessageBox()
    msg.setIcon(QMessageBox.Information)

    msg.setText("This is a message box")
    msg.setInformativeText("This is additional information")
    msg.setWindowTitle("MessageBox demo")
    msg.setDetailedText("The details are as follows:")
    msg.setStandardButtons(QMessageBox.Ok | QMessageBox.Cancel)
    msg.buttonClicked.connect(msgbtn)

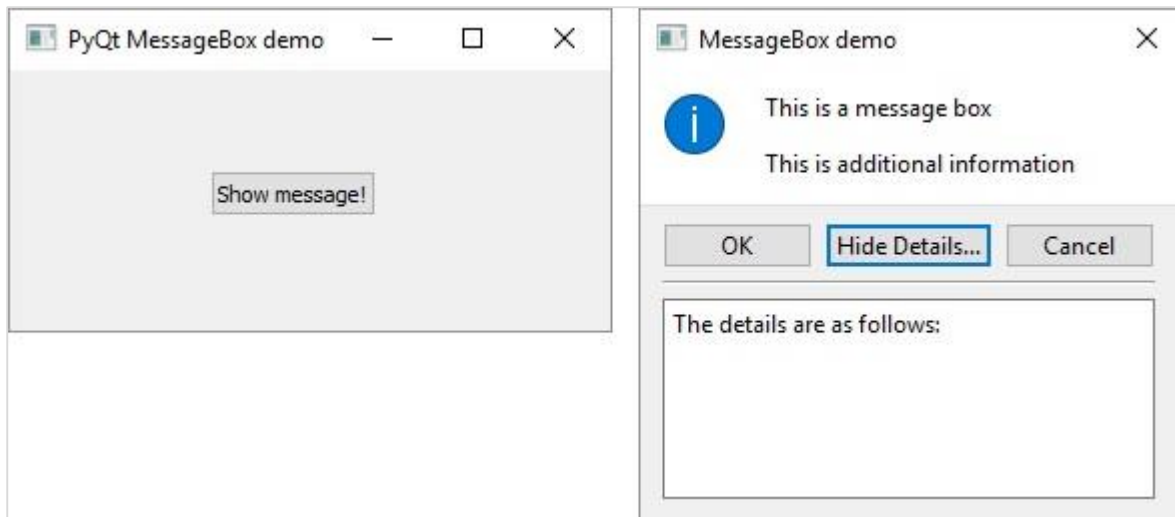
    retval = msg.exec_()

def msgbtn(i):
    print ("Button pressed is:",i.text())

if __name__ == '__main__':
    window()

```

The above code produces the following output. Message Box pops up when main windows' button is clicked:



If you click on Ok or Cancel button on MessageBox, the following output is produced on the console:

```
Button pressed is: OK  
Button pressed is: Cancel
```

11. PyQt5 — Multiple Document Interface

A typical GUI application may have multiple windows. Tabbed and stacked widgets allow to activate one such window at a time. However, many a times this approach may not be useful as view of other windows is hidden.

One way to display multiple windows simultaneously is to create them as independent windows. This is called as SDI (**single Document Interface**). This requires more memory resources as each window may have its own menu system, toolbar, etc.

MDI (**Multiple Document Interface**) applications consume less memory resources. The sub windows are laid down inside main container with relation to each other. The container widget is called **QMdiArea**.

QMdiArea widget generally occupies the central widget of QMainWindow object. Child windows in this area are instances of **QMdiSubWindow** class. It is possible to set any QWidget as the internal widget of subWindow object. Sub-windows in the MDI area can be arranged in cascaded or tile fashion.

The following table lists important methods of QMdiArea class and QMdiSubWindow class:

Sr.No.	Methods & Description
1	addSubWindow() Adds a widget as a new subwindow in MDI area
2	removeSubWindow() Removes a widget that is internal widget of a subwindow
3	setActiveSubWindow() Activates a subwindow
4	cascadeSubWindows() Arranges subwindows in MDiArea in a cascaded fashion
5	tileSubWindows() Arranges subwindows in MDiArea in a tiled fashion
6	closeActiveSubWindow() Closes the active subwindow
7	subWindowList() Returns the list of subwindows in MDI Area
8	setWidget() Sets a QWidget as an internal widget of a QMdiSubwindow instance

QMdiArea object emits subWindowActivated() signal whereas windowStateChanged() signal is emitted by QMdiSubWindow object.

Example

In the following example, the top level window comprising of QMainWindow has a menu and MdiArea.

```
self.mdi = QMdiArea()
self.setCentralWidget(self.mdi)
bar = self.menuBar()
file = bar.addMenu("File")

file.addAction("New")
file.addAction("cascade")
file.addAction("Tiled")
```

Triggered() signal of the menu is connected to windowaction() function.

```
file.triggered[QAction].connect(self.windowaction)
```

The new action of menu adds a subwindow in MDI area with a title having an incremental number to it.

```
MainWindow.count = MainWindow.count+1
sub = QMdiSubWindow()
sub.setWidget(QTextEdit())
sub.setWindowTitle("subwindow"+str(MainWindow.count))
self.mdi.addSubWindow(sub)
sub.show()
```

Cascaded and tiled buttons of the menu arrange currently displayed subwindows in cascaded and tiled fashion respectively.

The complete code is as follows:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class MainWindow(QMainWindow):
    count = 0
```

```
def __init__(self, parent = None):
    super(MainWindow, self).__init__(parent)
    self.mdi = QMdiArea()
    self.setCentralWidget(self.mdi)
    bar = self.menuBar()

    file = bar.addMenu("File")
    file.addAction("New")
    file.addAction("cascade")
    file.addAction("Tiled")
    file.triggered[QAction].connect(self.windowaction)
    self.setWindowTitle("MDI demo")

def windowaction(self, q):
    print ("triggered")

    if q.text() == "New":
        MainWindow.count = MainWindow.count+1
        sub = QMdiSubWindow()
        sub.setWidget(QTextEdit())
        sub.setWindowTitle("subwindow"+str(MainWindow.count))
        self.mdi.addSubWindow(sub)
        sub.show()

    if q.text() == "cascade":
        self.mdi.cascadeSubWindows()

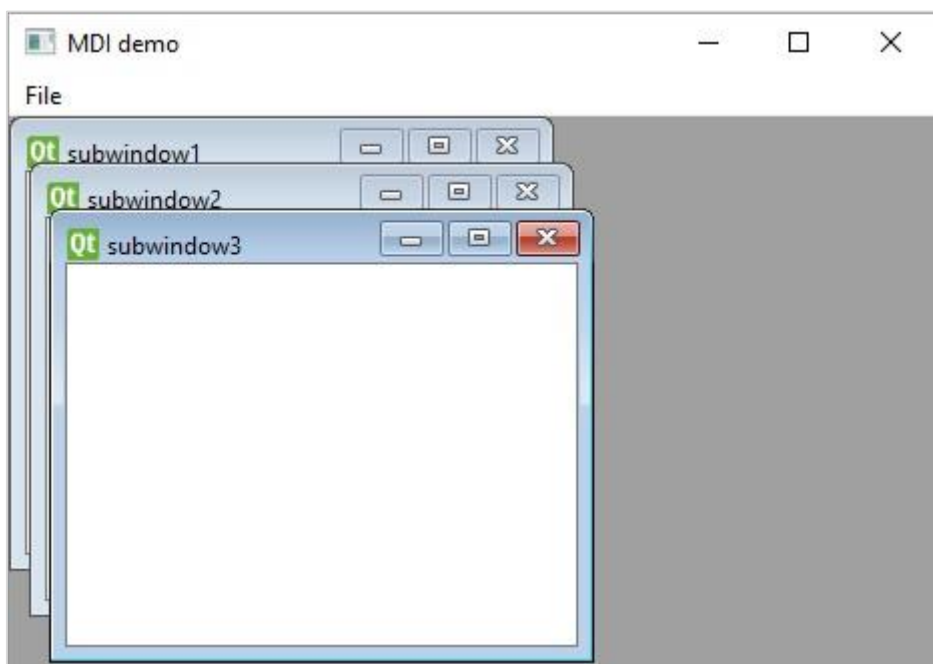
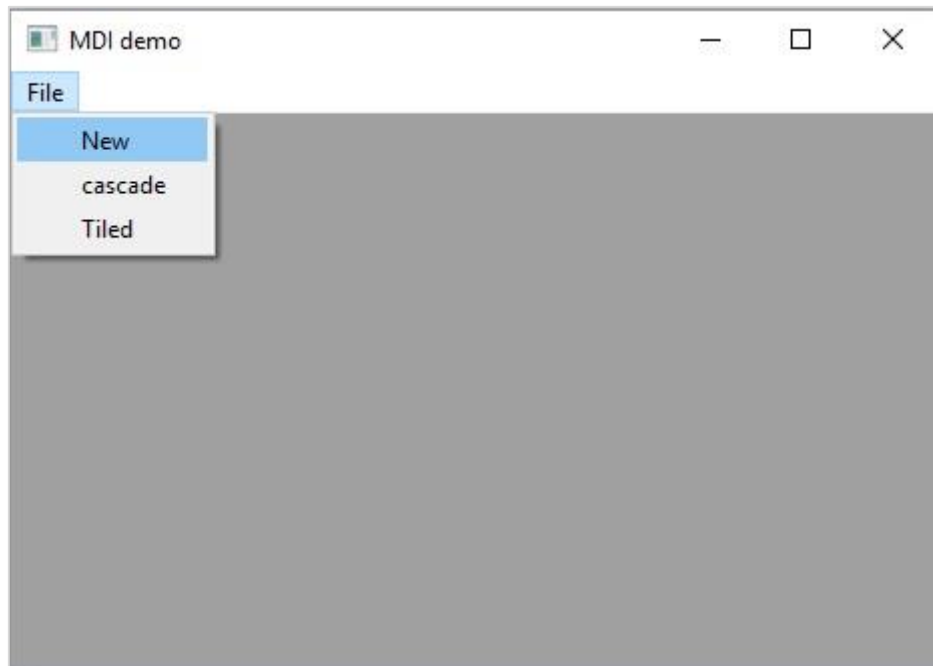
    if q.text() == "Tiled":
        self.mdi.tileSubWindows()

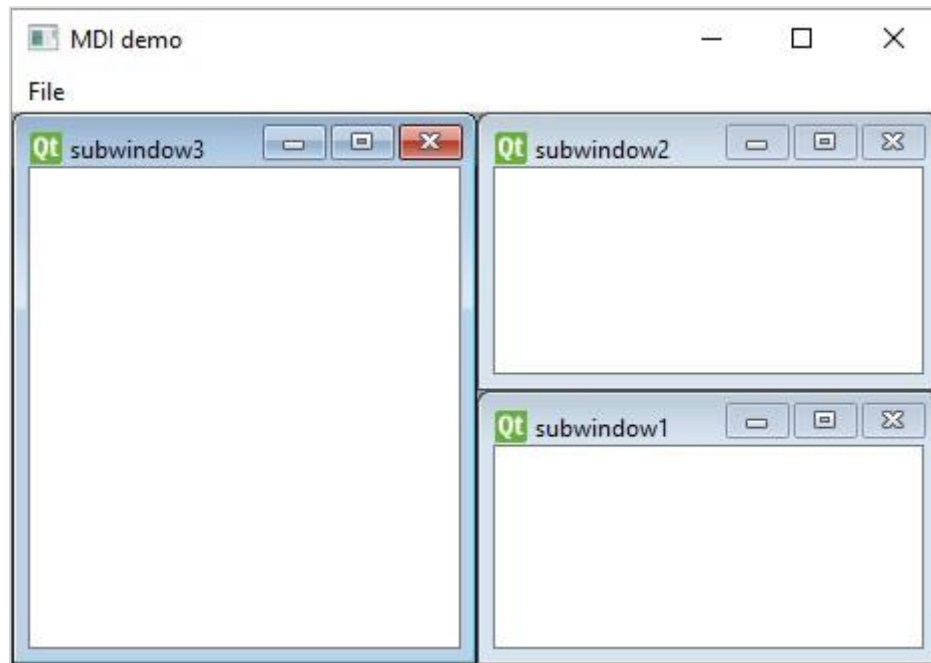
def main():
    app = QApplication(sys.argv)
    ex = MainWindow()
    ex.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
```

```
main()
```

Run above code and three windows in cascaded and tiled formation:





12. PyQt5 — Drag & Drop

The provision of **drag and drop** is very intuitive for the user. It is found in many desktop applications where the user can copy or move objects from one window to another.

MIME based drag and drop data transfer is based on **QDrag** class. **QMimeData** objects associate the data with their corresponding MIME type. It is stored on clipboard and then used in the drag and drop process.

The following QMimeData class functions allow the MIME type to be detected and used conveniently.

Tester	Getter	Setter	MIME Types
hasText()	text()	setText()	text/plain
hasHtml()	html()	setHtml()	text/html
hasUrls()	urls()	setUrls()	text/uri-list
hasImage()	imageData()	setImageData()	image/ *
hasColor()	colorData()	setColorData()	application/x-color

Many QWidget objects support the drag and drop activity. Those that allow their data to be dragged have `setDragEnabled()` which must be set to true. On the other hand, the widgets should respond to the drag and drop events in order to store the data dragged into them.

- **DragEnterEvent** provides an event which is sent to the target widget as dragging action enters it.
- **DragMoveEvent** is used when the drag and drop action is in progress.
- **DragLeaveEvent** is generated as the drag and drop action leaves the widget.
- **DropEvent**, on the other hand, occurs when the drop is completed. The event's proposed action can be accepted or rejected conditionally.

Example

In the following code, the **DragEnterEvent** verifies whether the MIME data of the event contains text. If yes, the event's proposed action is accepted and the text is added as a new item in the ComboBox.

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *
```

```
class combo(QComboBox):

    def __init__(self, title, parent):
        super(combo, self).__init__(parent)

        self.setAcceptDrops(True)

    def dragEnterEvent(self, e):
        print (e)

        if e.mimeData().hasText():
            e.accept()
        else:
            e.ignore()

    def dropEvent(self, e):
        self.addItem(e.mimeData().text())

class Example(QWidget):

    def __init__(self):
        super(Example, self).__init__()

        self.initUI()

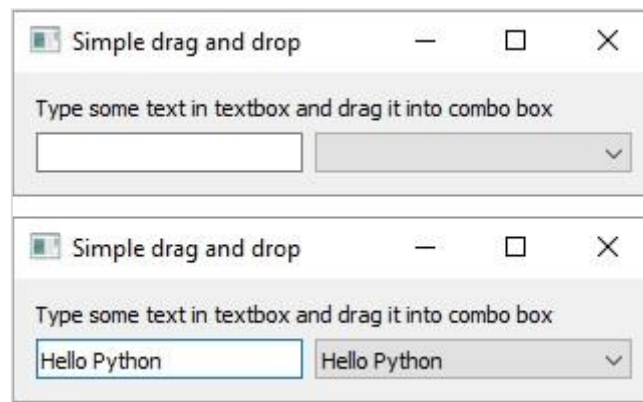
    def initUI(self):
        lo = QFormLayout()
        lo.addRow(QLabel("Type some text in textbox and drag it into combo box"))

        edit = QLineEdit()
        edit.setDragEnabled(True)
        com = combo("Button", self)
        lo.addRow(edit, com)
        self.setLayout(lo)
        self.setWindowTitle('Simple drag and drop')
```

```
def main():
    app = QApplication(sys.argv)
    ex = Example()
    ex.show()
    app.exec_()

if __name__ == '__main__':
    main()
```

The above code produces the following output:



13. PyQt5 — Database Handling

PyQt5 library contains **QtSql** module. It is an elaborate class system to communicate with many SQL based databases. Its **QSqlDatabase** provides access through a Connection object. Following is the list of currently available SQL drivers:

Sr.No.	Driver Type & Description
1	QDB2 IBM DB2
2	QIBASE Borland InterBase Driver
3	QMYSQL MySQL Driver
4	QOCI Oracle Call Interface Driver
5	QODBC ODBC Driver (includes Microsoft SQL Server)
6	QPSQL PostgreSQL Driver
7	QSQLITE SQLite version 3 or above
8	QSQLITE2 SQLite version 2

Example

For this chapter, a connection with a SQLite database is established using the static method:

```
db = QSql.QSqlDatabase.addDatabase('QSQLITE')
db.setDatabaseName('sports.db')
```

Other methods of QSqlDatabase class are as follows:

Sr.No.	Methods & Description
1	setDatabaseName() Sets the name of the database with which connection is sought
2	setHostName() Sets the name of the host on which the database is installed
3	setUserName() Specifies the user name for connection
4	setPassword() Sets the connection object's password if any
5	commit() Commits the transactions and returns true if successful
6	rollback() Rolls back the database transaction
7	close() Closes the connection

QSqlQuery class has the functionality to execute and manipulate SQL commands. Both DDL and DML type of SQL queries can be executed. First step is to create SQLite database using the following statements:

```
db = QSqlDatabase.addDatabase('QSQLITE')
db.setDatabaseName('sportsdatabase.db')
```

Next, obtain Query object with **QSqlQuery()** method and call its most important method **exec_()**, which takes as an argument a string containing SQL statement to be executed.

```
query = QSqlQuery()
query.exec_("create table sportsmen(id int primary key,
    " "firstname varchar(20), lastname varchar(20))")
```

The following script creates a SQLite database sports.db with a table of sportsperson populated with five records.

```
import sys
from PyQt5.QtSql import *
from PyQt5.QtCore import *
from PyQt5.QtGui import *
```

```

from PyQt5.QtWidgets import *

def createDB():
    db = QSqlDatabase.addDatabase('QSQLITE')
    db.setDatabaseName('sportsdatabase.db')

    if not db.open():
        msg = QMessageBox()
        msg.setIcon(QMessageBox.Critical)
        msg.setText("Error in Database Creation")
        retval = msg.exec_()
        return False

    query = QSqlQuery()

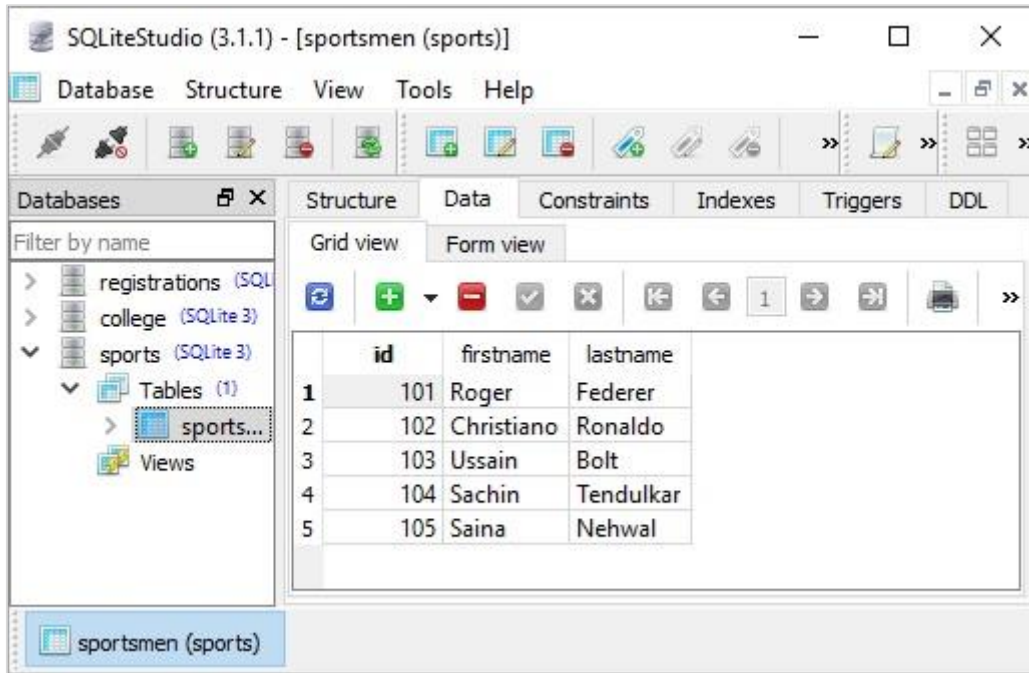
    query.exec_("create table sportsmen(id int primary key, "
    "firstname varchar(20), lastname varchar(20))")

    query.exec_("insert into sportsmen values(101, 'Roger', 'Federer')")
    query.exec_("insert into sportsmen values(102, 'Christiano', 'Ronaldo')")
    query.exec_("insert into sportsmen values(103, 'Ussain', 'Bolt')")
    query.exec_("insert into sportsmen values(104, 'Sachin', 'Tendulkar')")
    query.exec_("insert into sportsmen values(105, 'Saina', 'Nehwal')")
    return True

if __name__ == '__main__':
    app = QApplication(sys.argv)
    createDB()

```

To confirm that the SQLite database is created with above records added in sportsmen table in it, use a SQLite Gui utility called **SQLiteStudio**.



QSqlTableModel class in PyQt is a high-level interface that provides editable data model for reading and writing records in a single table. This model is used to populate a **QTableView** object. It presents to the user a scrollable and editable view that can be put on any top level window.

A QSqlTableModel object is declared in the following manner:

```
model = QSql.QSqlTableModel()
```

Its editing strategy can be set to any of the following:

- QSqlTableModel.OnFieldChange** All changes will be applied immediately
- QSqlTableModel.OnRowChange** Changes will be applied when the user selects a different row
- QSqlTableModel.OnManualSubmit** All changes will be cached until either submitAll() or revertAll() is called

Example

In the following example, sportsperson table is used as a model and the strategy is set as:

```
model.setTable('sportsmen')
model.setEditStrategy(QSql.QSqlTableModel.OnFieldChange)

model.select()
```

QTableView class is part of Model/View framework in PyQt. The QTableView object is created as follows:

```

view = QtGui.QTableView()
view.setModel(model)
view.setWindowTitle(title)
return view

```

This QTableView object and two QPushButton widgets are added to the top level QDialog window. Clicked() signal of add button is connected to addrow() which performs insertRow() on the model table.

```

button.clicked.connect(addrow)
def addrow():
    print model.rowCount()
    ret = model.insertRows(model.rowCount(), 1)
    print ret

```

The slot associated with the delete button executes a lambda function that deletes a row, which is selected by the user.

```

btn1.clicked.connect(lambda: model.removeRow(view1.currentIndex().row()))

```

The complete code is as follows:

```

import sys
from PyQt5.QtSql import *
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

def initializeModel(model):
    model.setTable('sportsmen')
    model.setEditStrategy(QSqlTableModel.OnFieldChange)
    model.select()
    model.setHeaderData(0, Qt.Horizontal, "ID")
    model.setHeaderData(1, Qt.Horizontal, "First name")
    model.setHeaderData(2, Qt.Horizontal, "Last name")

def createView(title, model):
    view = QTableView()
    view.setModel(model)
    view.setWindowTitle(title)
    return view

```



```
def addrow():
    print (model.rowCount())
    ret = model.insertRows(model.rowCount(), 1)
    print (ret)

def findrow(i):
    delrow = i.row()

if __name__ == '__main__':

    app = QApplication(sys.argv)
    db = QSqlDatabase.addDatabase('QSQLITE')
    db.setDatabaseName('sportsdatabase.db')
    model = QSqlTableModel()
    delrow = -1
    initializeModel(model)

    view1 = createView("Table Model (View 1)", model)
    view1.clicked.connect(findrow)

    dlg = QDialog()
    layout = QVBoxLayout()
    layout.addWidget(view1)

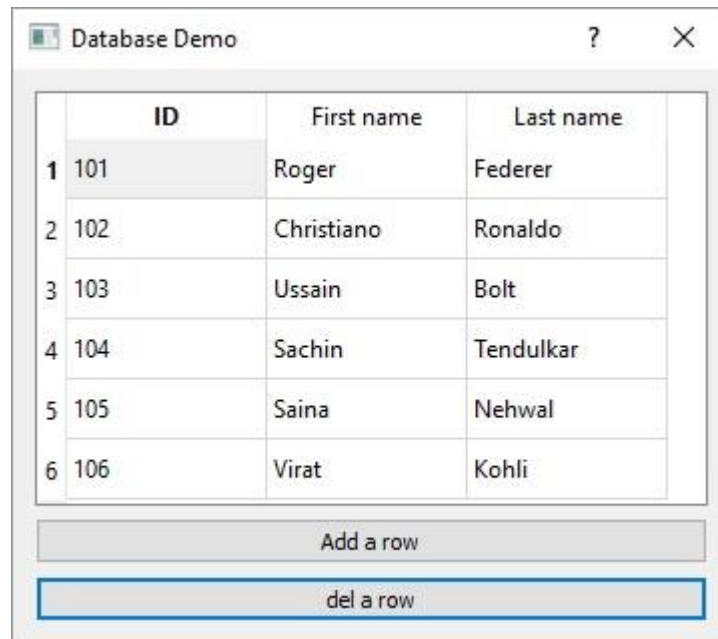
    button = QPushButton("Add a row")
    button.clicked.connect(addrow)
    layout.addWidget(button)

    btn1 = QPushButton("del a row")
    btn1.clicked.connect(lambda: model.removeRow(view1.currentIndex().row()))
    layout.addWidget(btn1)

    dlg.setLayout(layout)
    dlg.setWindowTitle("Database Demo")
    dlg.show()
```

```
sys.exit(app.exec_())
```

The above code produces the following output:



	ID	First name	Last name
1	101	Roger	Federer
2	102	Christiano	Ronaldo
3	103	Ussain	Bolt
4	104	Sachin	Tendulkar
5	105	Saina	Nehwal
6	106	Virat	Kohli

Add a row

del a row

Try adding and deleting a few records and go back to SQLiteStudio to confirm the transactions.

14. PyQt5 — Drawing API

All the **QWidget** classes in PyQt are sub classed from **QPaintDevice** class. A **QPaintDevice** is an abstraction of two dimensional space that can be drawn upon using a **QPainter**. Dimensions of paint device are measured in pixels starting from the top-left corner.

QPainter class performs low level painting on widgets and other paintable devices such as printer. Normally, it is used in widget's paint event. The **QPaintEvent** occurs whenever the widget's appearance is updated.

The painter is activated by calling the **begin()** method, while the **end()** method deactivates it. In between, the desired pattern is painted by suitable methods as listed in the following table.

Sr.No.	Methods & Description
1	begin() Starts painting on the target device
2	drawArc() Draws an arc between the starting and the end angle
3	drawEllipse() Draws an ellipse inside a rectangle
4	drawLine() Draws a line with endpoint coordinates specified
5	drawPixmap() Extracts pixmap from the image file and displays it at the specified position
6	drawPolygon() Draws a polygon using an array of coordinates
7	drawRect() Draws a rectangle starting at the top-left coordinate with the given width and height
8	drawText() Displays the text at given coordinates
9	fillRect() Fills the rectangle with the QColor parameter

- 10 **setBrush()**
 Sets a brush style for painting
- 11 **setPen()**
 Sets the color, size and style of pen to be used for drawing

Example

In the following code, various methods of PyQt's drawing methods are used.

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class Example(QWidget):

    def __init__(self):
        super(Example, self).__init__()
        self.initUI()

    def initUI(self):
        self.text = "hello world"
        self.setGeometry(100,100, 400,300)
        self.setWindowTitle('Draw Demo')
        self.show()

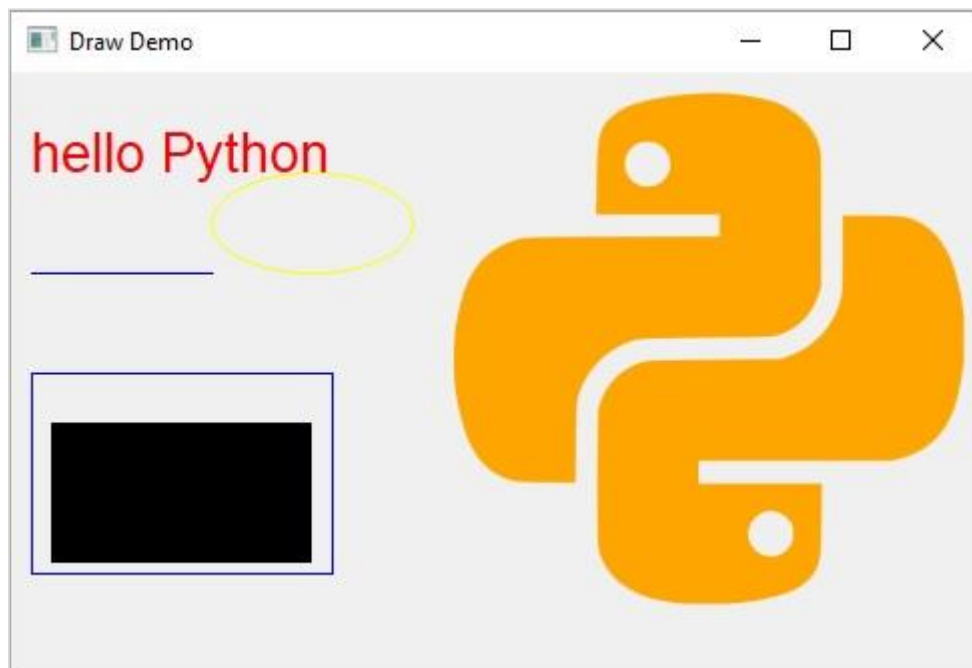
    def paintEvent(self, event):
        qp = QPainter()
        qp.begin(self)
        qp.setPen(QColor(Qt.red))
        qp.setFont(QFont('Arial', 20))
        qp.drawText(10,50, "hello Python")
        qp.setPen(QColor(Qt.blue))
        qp.drawLine(10,100,100,100)
        qp.drawRect(10,150,150,100)
        qp.setPen(QColor(Qt.yellow))
        qp.drawEllipse(100,50,100,50)
        qp.drawPixmap(220,10,QPixmap("pythonlogo.png"))
```

```
qp.fillRect(20,175,130,70,QBrush(Qt.SolidPattern))
qp.end()

def main():
    app = QApplication(sys.argv)
    ex = Example()
    sys.exit(app.exec_())

if __name__ == '__main__':
    main()
```

The above code produces the following output:



15. PyQt5 — Brush Style Constants

In this chapter, we shall learn Brush Style Constants.

Brush Style Constants

Given below are the Brush Style Constants:

Qt.NoBrush	No brush pattern.
Qt.SolidPattern	Uniform color.
Qt.Dense1Pattern	Extremely dense pattern. Density 1-7
Qt.HorPattern	Horizontal lines.
Qt.VerPattern	Vertical lines.
Qt.CrossPattern	Crossing horizontal and vertical lines.
Qt.BDiagPattern	Backward diagonal lines.
Qt.FDiagPattern	Forward diagonal lines.
Qt.DiagCrossPattern	Crossing diagonal lines.

Predefined QColor Styles

Given below are the Predefined QColor Styles:

Qt.NoBrush	No brush pattern
Qt.SolidPattern	Uniform color
Qt.Dense1Pattern	Extremely dense brush pattern
Qt.HorPattern	Horizontal lines
Qt.VerPattern	Vertical lines
Qt.CrossPattern	Crossing horizontal and vertical lines
Qt.BDiagPattern	Backward diagonal lines
Qt.FDiagPattern	Forward diagonal lines
Qt.DiagCrossPattern	Crossing diagonal lines

Predefined QColor Objects

Given below are the Predefined QColor Objects:

Qt.white

Qt.black

Qt.red

Qt.darkRed

Qt.green

Qt.darkGreen

Qt.blue

Qt.cyan

Qt.magenta

Qt.yellow

Qt.darkYellow

Qt.gray

Custom color can be chosen by specifying RGB or CMYK or HSV values.

16. PyQt5 — QClipboard

The **QClipboard** class provides access to system-wide clipboard that offers a simple mechanism to copy and paste data between applications. Its action is similar to **QDrag** class and uses similar data types.

QApplication class has a static **clipboard()** method which returns reference to clipboard object. Any type of MimeData can be copied to or pasted from the clipboard.

Following are the clipboard class methods that are commonly used:

Sr.No.	Methods & Description
1	clear() Clears clipboard contents
2	setImage() Copies QImage into clipboard
3	setMimeData() Sets MIME data into clipboard
4	setPixmap() Copies QPixmap object in clipboard
5	setText() Copies QString in clipboard
6	text() Retrieves text from clipboard

Signal associated with clipboard object is:

Sr.No.	Method & Description
1	dataChanged() Whenever clipboard data changes

Example

In the following example, two TextEdit objects and two Pushbuttons are added to a top level window.

To begin with the clipboard object is instantiated. Copy() method of textedit object copies the data onto the system clipboard. When the Paste button is clicked, it fetches the clipboard data and pastes it in other textedit object.

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

class Example(QWidget):

    def __init__(self):
        super(Example, self).__init__()

        self.initUI()

    def initUI(self):

        hbox = QHBoxLayout()
        self.edit1=QTextEdit()
        hbox.addWidget(self.edit1)
        self.btn1=QPushButton("Copy")
        hbox.addWidget(self.btn1)
        self.edit2=QTextEdit()
        self.btn2=QPushButton("Paste")
        hbox.addWidget(self.edit2)
        hbox.addWidget(self.btn2)
        self.btn1.clicked.connect(self.copytext)
        self.btn2.clicked.connect(self.pastetext)
        self.setLayout(hbox)

        self.setGeometry(300, 300, 300, 200)
        self.setWindowTitle('Clipboard')
        self.show()

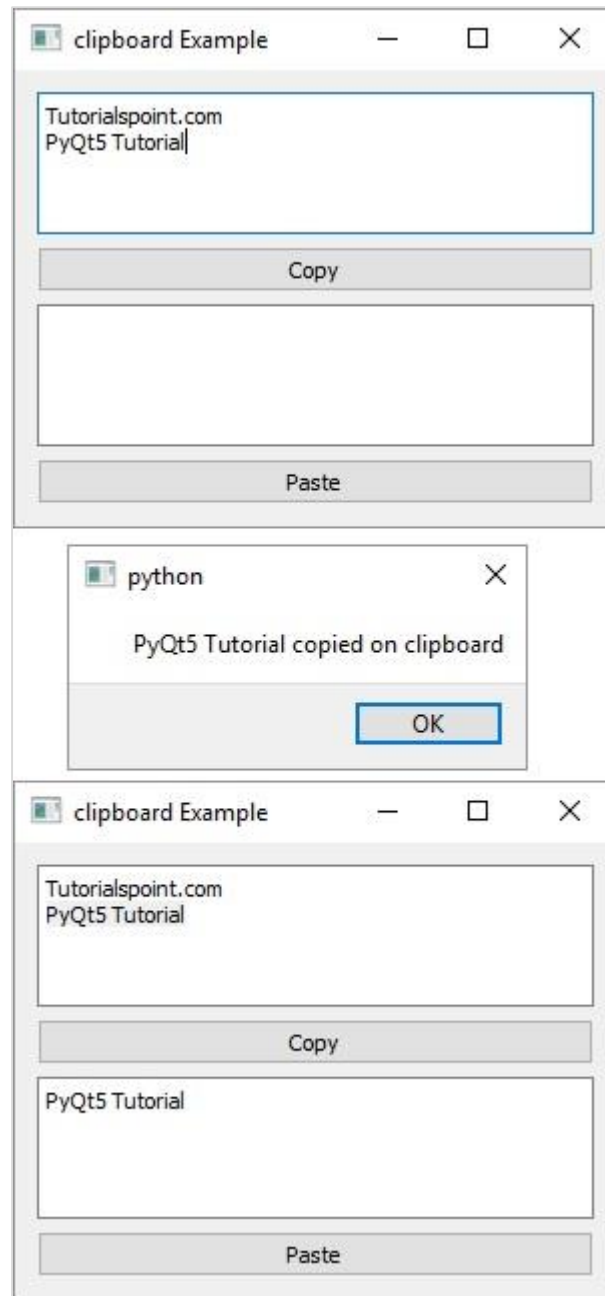
    def copytext(self):
```

```
#clipboard.setText(self.edit1.copy())
self.edit1.copy()
print (clipboard.text())

msg=QMessageBox()
msg.setText(clipboard.text()+" copied on clipboard")
msg.exec_()
def pastetext(self):
    self.edit2.setText(clipboard.text())

app = QApplication(sys.argv)
clipboard=app.clipboard()
ex = Example()
ex.setWindowTitle("clipboard Example")
sys.exit(app.exec_())
```

The above code produces the following output:



17. PyQt5 — QPixmap Class

QPixmap class provides an off-screen representation of an image. It can be used as a QPaintDevice object or can be loaded into another widget, typically a label or button.

Qt API has another similar class **QImage**, which is optimized for I/O and other pixel manipulations. QPixmap, on the other hand, is optimized for showing it on screen. Both formats are interconvertible.

The types of image files that can be read into a QPixmap object are as follows:

BMP	Windows Bitmap
GIF	Graphic Interchange Format (optional)
JPG	Joint Photographic Experts Group
JPEG	Joint Photographic Experts Group
PNG	Portable Network Graphics
PBM	Portable Bitmap
PGM	Portable Graymap
PPM	Portable Pixmap
XBM	X11 Bitmap
XPM	X11 Pixmap

Following methods are useful in handling QPixmap object:

Sr.No.	Methods & Description
1	copy() Copies pixmap data from a QRect object
2	fromImage() Converts QImage object into QPixmap
3	grabWidget() Creates a pixmap from the given widget
4	grabWindow() Create pixmap of data in a window
5	Load()

Loads an image file as pixmap

save()

6

Saves the QPixmap object as a file

toImage

7

Converts a QPixmap to QImage

The most common use of QPixmap is to display image on a label/button.

Example

The following example shows an image displayed on a QLabel by using the **setPixmap()** method.

The complete code is as follows:

```
import sys
from PyQt5.QtCore import *
from PyQt5.QtGui import *
from PyQt5.QtWidgets import *

def window():
    app = QApplication(sys.argv)
    win = QWidget()
    l1 = QLabel()
    l1.setPixmap(QPixmap("python.png"))

    vbox = QVBoxLayout()
    vbox.addWidget(l1)
    win.setLayout(vbox)
    win.setWindowTitle("QPixmap Demo")
    win.show()
    sys.exit(app.exec_())

if __name__ == '__main__':
    window()
```

The above code produces the following output:

