

Chapter 9

GUI Programming Using Tkinter



Text-based User Interfaces

- **Text-based user interfaces (TUI)** is a user interface that uses text, symbols, and colors. It runs in a character-based terminal.
- alternately called **terminal user interfaces**, or a character-based user interfaces to reflect a dependence upon the properties of computer terminals.
- Like GUIs, they may use the entire screen area and accept mouse and other inputs. They may also use color and often structure the display using special graphical characters such as `┌` and `┐`, referred to in Unicode as the "box drawing" set.
- The modern context of use is usually a **terminal emulator**.



Text-based User Interfaces

| Left | File | Command | Options | Right | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------|--|--------------|---------|---------|-----|------|-------------|----------------|------|------------|-------------|------|-------------|------------|------|-------------|------------|------|------------|-------------|------|-------------|----------|------|-------------|----------|----|------------|----------|----|-------------|----------|------|--------------|----------------|------|-------------|----------------|------|------------|----------------|------|------------|----------------|------|-------------|---------------|------|------------|--|--|--|------|------|-------|-----|------|-------------|--------|----|-------------|------|------|------------|-------|-----|-------------|---------|------|-------------|---------|-----|--------------|----------|----|-------------|-----|----|------------|-----------|----|------------|----------|----|-------------|--------|----|-------------|---------|------|--------------|-----|------|------------|-------------|------|------------|-------|------|-------------|
| /software | | | | /etc | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th>Name</th> <th>Size</th> <th>HTime</th> </tr> </thead> <tbody> <tr> <td>../</td> <td>4096</td> <td>Oct 2 04:02</td> </tr> <tr> <td>/ICAClient-3.0</td> <td>2048</td> <td>Jan 6 2003</td> </tr> <tr> <td>/aida-2.1.1</td> <td>2048</td> <td>Apr 28 2003</td> </tr> <tr> <td>/amber-6.0</td> <td>2048</td> <td>Feb 27 2004</td> </tr> <tr> <td>/amber-7.0</td> <td>2048</td> <td>Mar 5 2004</td> </tr> <tr> <td>/amber-7.0p</td> <td>2048</td> <td>Apr 16 2004</td> </tr> <tr> <td>/amber-8</td> <td>2048</td> <td>Dec 22 2004</td> </tr> <tr> <td>~ansys61</td> <td>34</td> <td>Jan 7 2003</td> </tr> <tr> <td>~ansys71</td> <td>34</td> <td>Nov 28 2003</td> </tr> <tr> <td>/ant-1.6</td> <td>2048</td> <td>Aug 10 13:26</td> </tr> <tr> <td>/apache-1.3.27</td> <td>2048</td> <td>Dec 16 2002</td> </tr> <tr> <td>/apache-1.3.28</td> <td>2048</td> <td>Jan 6 2004</td> </tr> <tr> <td>/apache-1.3.33</td> <td>2048</td> <td>Feb 7 2005</td> </tr> <tr> <td>/autoconf-2.57</td> <td>2048</td> <td>May 27 2004</td> </tr> <tr> <td>/autodock-305</td> <td>2048</td> <td>Jan 5 2001</td> </tr> </tbody> </table> | Name | Size | HTime | ../ | 4096 | Oct 2 04:02 | /ICAClient-3.0 | 2048 | Jan 6 2003 | /aida-2.1.1 | 2048 | Apr 28 2003 | /amber-6.0 | 2048 | Feb 27 2004 | /amber-7.0 | 2048 | Mar 5 2004 | /amber-7.0p | 2048 | Apr 16 2004 | /amber-8 | 2048 | Dec 22 2004 | ~ansys61 | 34 | Jan 7 2003 | ~ansys71 | 34 | Nov 28 2003 | /ant-1.6 | 2048 | Aug 10 13:26 | /apache-1.3.27 | 2048 | Dec 16 2002 | /apache-1.3.28 | 2048 | Jan 6 2004 | /apache-1.3.33 | 2048 | Feb 7 2005 | /autoconf-2.57 | 2048 | May 27 2004 | /autodock-305 | 2048 | Jan 5 2001 | | | <table border="1"> <thead> <tr> <th>Name</th> <th>Size</th> <th>HTime</th> </tr> </thead> <tbody> <tr> <td>../</td> <td>4096</td> <td>Oct 2 04:02</td> </tr> <tr> <td>/.java</td> <td>30</td> <td>May 13 2004</td> </tr> <tr> <td>/ada</td> <td>4096</td> <td>Aug 9 2001</td> </tr> <tr> <td>/conf</td> <td>151</td> <td>Jul 19 2000</td> </tr> <tr> <td>/config</td> <td>4096</td> <td>Dec 13 2004</td> </tr> <tr> <td>/cron.d</td> <td>133</td> <td>Sep 29 20:23</td> </tr> <tr> <td>/default</td> <td>75</td> <td>Aug 12 2004</td> </tr> <tr> <td>/dt</td> <td>27</td> <td>Apr 5 2003</td> </tr> <tr> <td>/fscklogs</td> <td>39</td> <td>Aug 3 2000</td> </tr> <tr> <td>~fstyp.d</td> <td>15</td> <td>Apr 25 2000</td> </tr> <tr> <td>~httpd</td> <td>20</td> <td>Jul 19 2000</td> </tr> <tr> <td>/init.d</td> <td>4096</td> <td>Sep 21 15:45</td> </tr> <tr> <td>/js</td> <td>4096</td> <td>Aug 9 2001</td> </tr> <tr> <td>/lost+found</td> <td>4096</td> <td>Oct 8 2004</td> </tr> <tr> <td>/mail</td> <td>4096</td> <td>May 2 10:04</td> </tr> </tbody> </table> | Name | Size | HTime | ../ | 4096 | Oct 2 04:02 | /.java | 30 | May 13 2004 | /ada | 4096 | Aug 9 2001 | /conf | 151 | Jul 19 2000 | /config | 4096 | Dec 13 2004 | /cron.d | 133 | Sep 29 20:23 | /default | 75 | Aug 12 2004 | /dt | 27 | Apr 5 2003 | /fscklogs | 39 | Aug 3 2000 | ~fstyp.d | 15 | Apr 25 2000 | ~httpd | 20 | Jul 19 2000 | /init.d | 4096 | Sep 21 15:45 | /js | 4096 | Aug 9 2001 | /lost+found | 4096 | Oct 8 2004 | /mail | 4096 | May 2 10:04 |
| Name | Size | HTime | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ../ | 4096 | Oct 2 04:02 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /ICAClient-3.0 | 2048 | Jan 6 2003 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /aida-2.1.1 | 2048 | Apr 28 2003 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /amber-6.0 | 2048 | Feb 27 2004 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /amber-7.0 | 2048 | Mar 5 2004 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /amber-7.0p | 2048 | Apr 16 2004 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /amber-8 | 2048 | Dec 22 2004 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ~ansys61 | 34 | Jan 7 2003 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ~ansys71 | 34 | Nov 28 2003 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /ant-1.6 | 2048 | Aug 10 13:26 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /apache-1.3.27 | 2048 | Dec 16 2002 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /apache-1.3.28 | 2048 | Jan 6 2004 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /apache-1.3.33 | 2048 | Feb 7 2005 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /autoconf-2.57 | 2048 | May 27 2004 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /autodock-305 | 2048 | Jan 5 2001 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Name | Size | HTime | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ../ | 4096 | Oct 2 04:02 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /.java | 30 | May 13 2004 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /ada | 4096 | Aug 9 2001 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /conf | 151 | Jul 19 2000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /config | 4096 | Dec 13 2004 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /cron.d | 133 | Sep 29 20:23 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /default | 75 | Aug 12 2004 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /dt | 27 | Apr 5 2003 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /fscklogs | 39 | Aug 3 2000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ~fstyp.d | 15 | Apr 25 2000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ~httpd | 20 | Jul 19 2000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /init.d | 4096 | Sep 21 15:45 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /js | 4096 | Aug 9 2001 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /lost+found | 4096 | Oct 8 2004 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /mail | 4096 | May 2 10:04 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| /ICAClient-3.0 | | | | /cron.d | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Hint: Keys not working in xterms? Use our xterm.ad, .ti and .tcap files.

aisa:/software>\$

[^]

1Help 2Menu 3View 4Edit 5Copy 6RenMov 7Mkdir 8Delete 9PullDr 10Quit

Types of text terminals

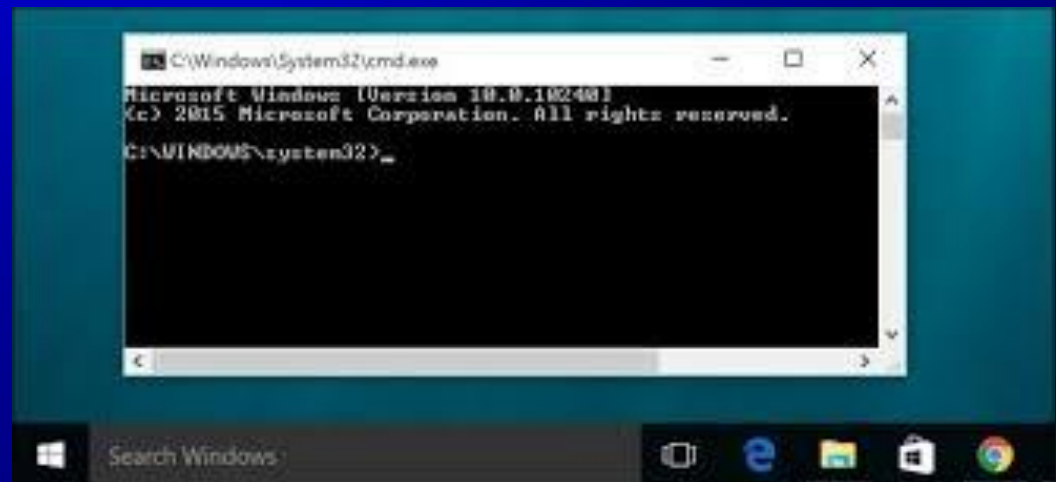
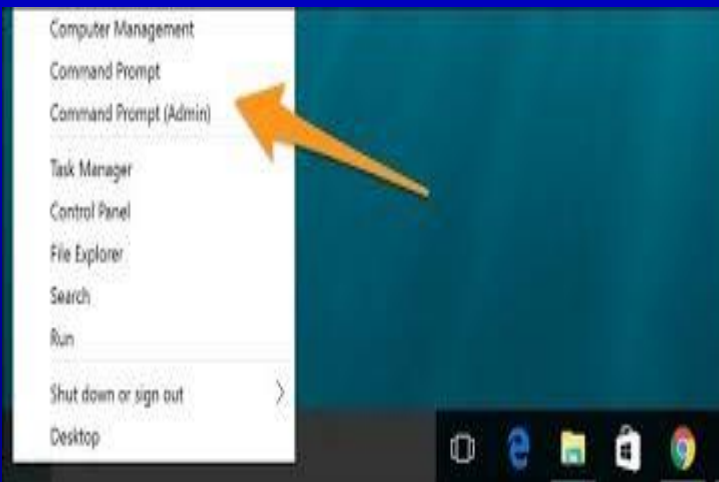
From text application's point of view, a text screen (and communications with it) can belong to one of three types (here ordered in order of decreasing accessibility):

- A genuine text mode display, controlled by a video adapter or the central processor itself. This is a normal condition for a locally running application on various types of personal computers and mobile devices. If not deterred by the operating system, a smart program may exploit the full power of a hardware text mode.
- A text mode emulator. Examples are xterm for X Window System and win32 console (in a window mode) for Microsoft Windows. This usually supports programs which expect a real text mode display, but may run considerably slower. Certain functions of an advanced text mode, such as an own font uploading, almost certainly become unavailable.
- A remote text terminal. The communication capabilities usually become reduced to a serial line or its emulation, possibly with few ioctl()s as an out-of-band channel in such cases as Telnet and Secure Shell. This is the worst case, because software restrictions hinder the use of capabilities of a remote display device.



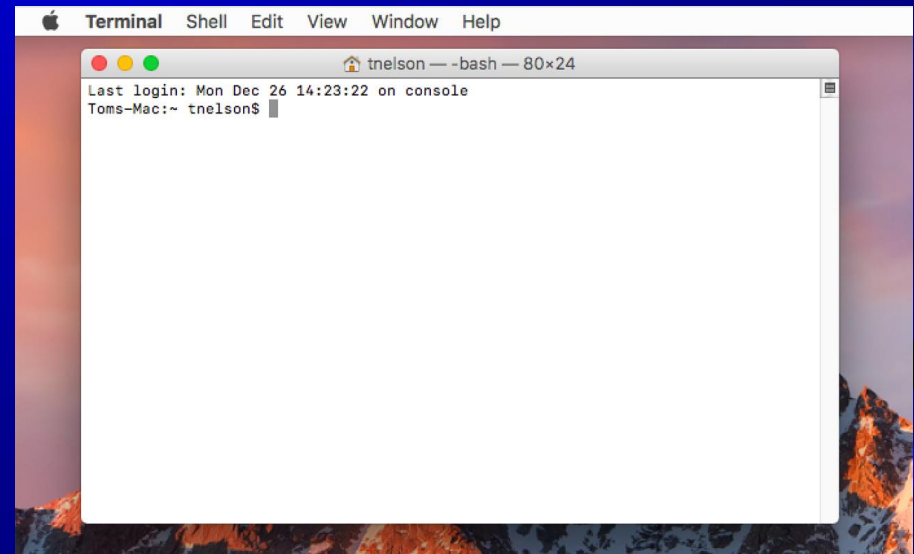
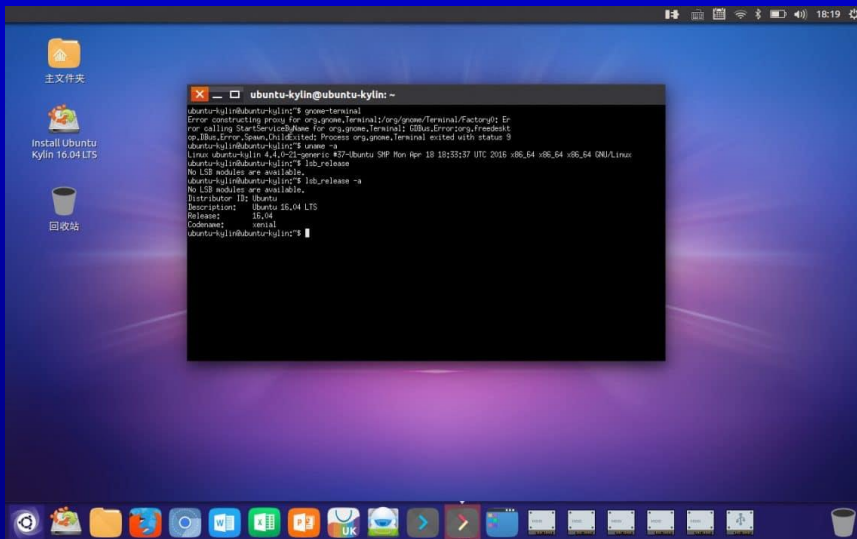
Microsoft Windows command-line interface

- All versions of Microsoft Windows have had an **MS-DOS-like command-line interface (CLI)** called **Command Prompt**. This could run many DOS and variously Win32, OS/2 1.x and POSIX command line utilities in the same command-line session, allowing piping between commands



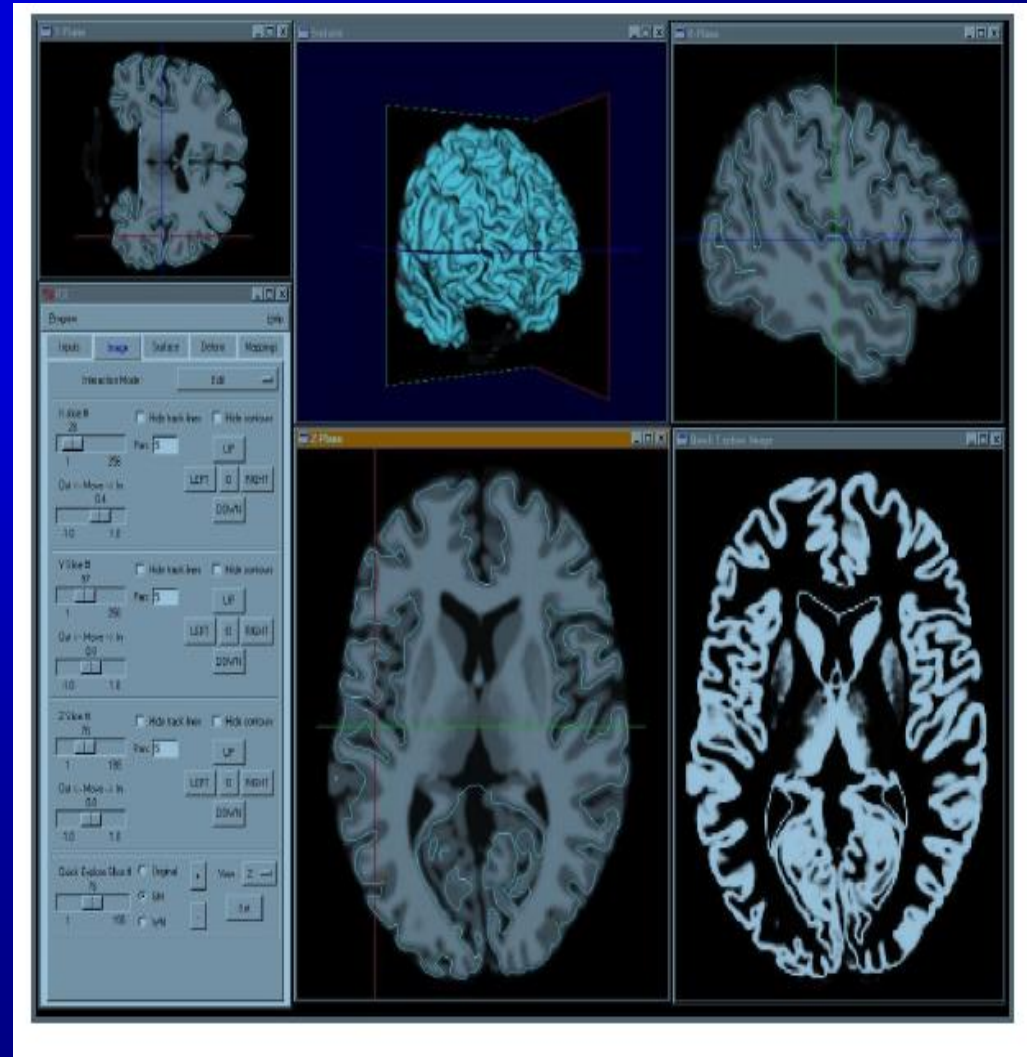
Terminal Emulators

- Terminal emulators replicate the functionality of a traditional computer terminal to provide users with access to a local or distant host. The emulator presents a terminal window to appear as though it is directly connected to the client. Most terminal emulators are designed for specific uses and function only with specific operating systems. Companies use these tools to access data and programs on remote devices, servers, or mainframes.



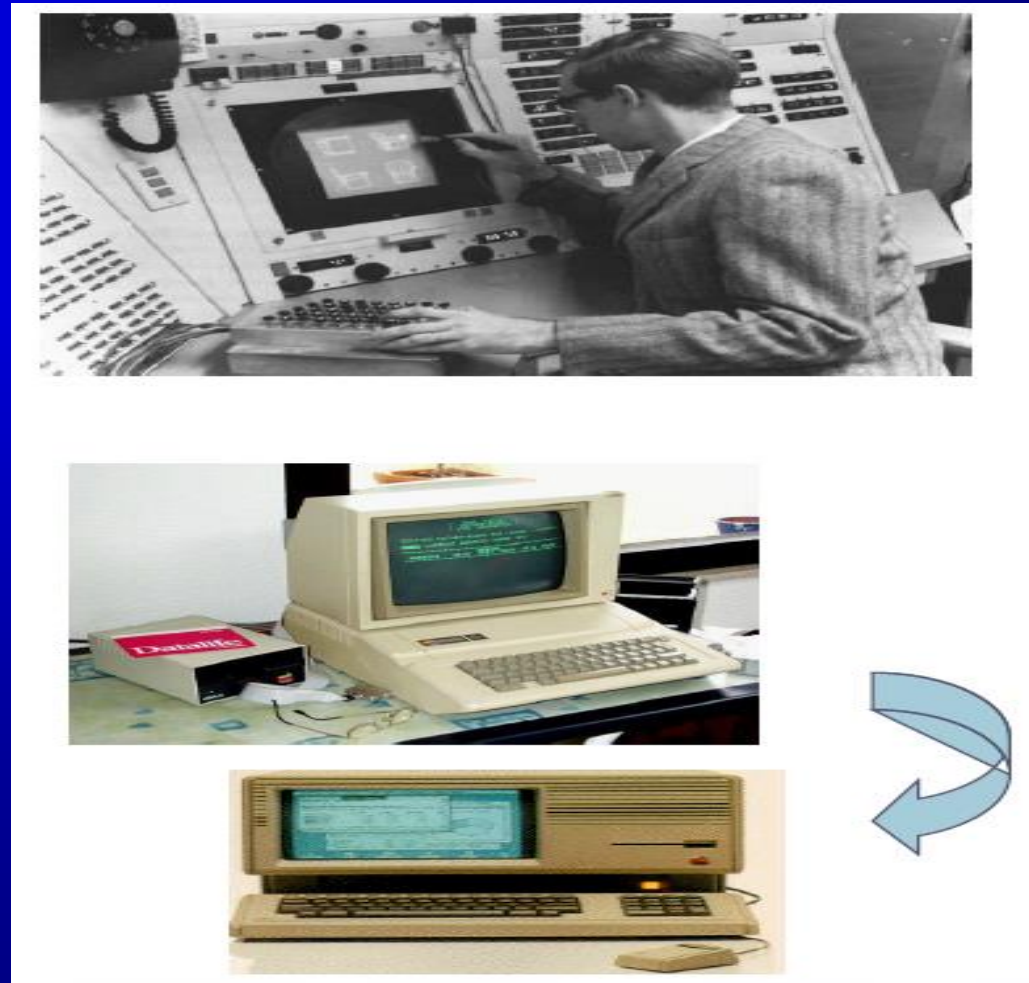
Graphical User Interface (GUI)

- The graphical user interface is a form of user interface that allows users to interact with electronic devices through graphical icons or elements instead of text-based user interfaces.
- GUIs were introduced in reaction to the perceived steep (high) learning curve of command-line interfaces (CLIs) which require commands to be typed on a computer keyboard.
- The actions in a GUI are usually performed through direct manipulation of the graphical elements.



GUIs

- The precursor to GUIs was invented by researchers at the Stanford Research Institute, led by Douglas Engelbart. They developed the use of text-based hyperlinks manipulated with a mouse (1963).
- In 1983, the Apple Lisa was first GUI offering.

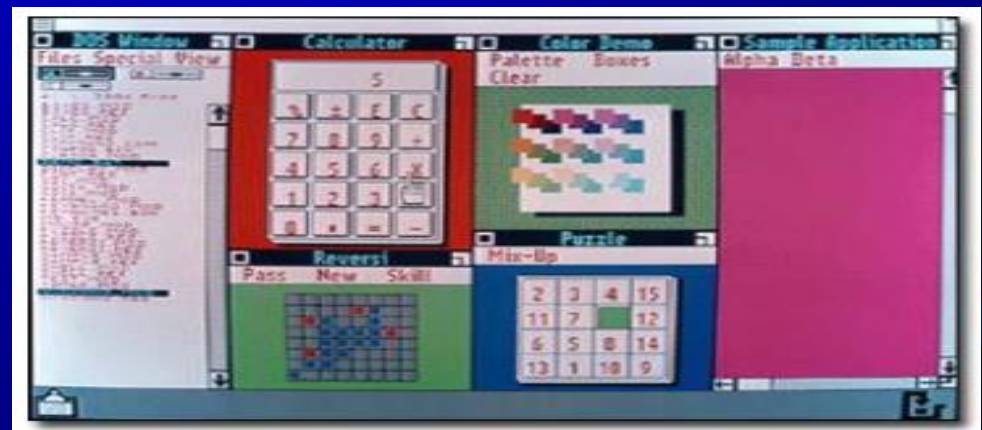


GUIs

- The X Windows System was introduced in the mid-1980s to provide graphical support for unix operating systems.



- Microsoft introduced A Windows 1.0 in 1985



GUIs

- The GUIs familiar to most people today are
 - Microsoft Windows,
 - Mac OS X, and
 - the X Window System interfaces for desktop and laptop computers in Unix based systems,
 - Android, Windows Phone, and Apple's iOS for handheld ("smartphone") devices.



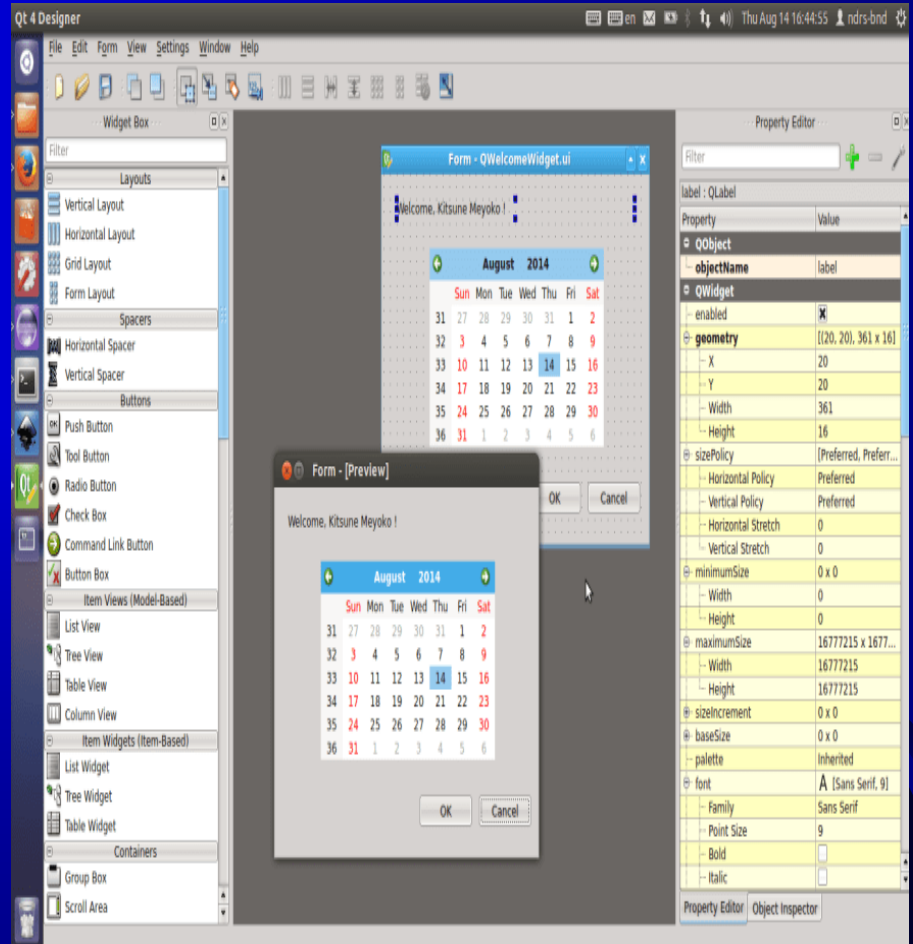
GUI programming in Python

- Python has a huge number of **GUI frameworks (or toolkits)** available for it, from Tkinter (traditionally bundled with Python, using Tk) to a number of other cross-platform solutions, as well as bindings to platform-specific technologies.



Python GUI Frameworks

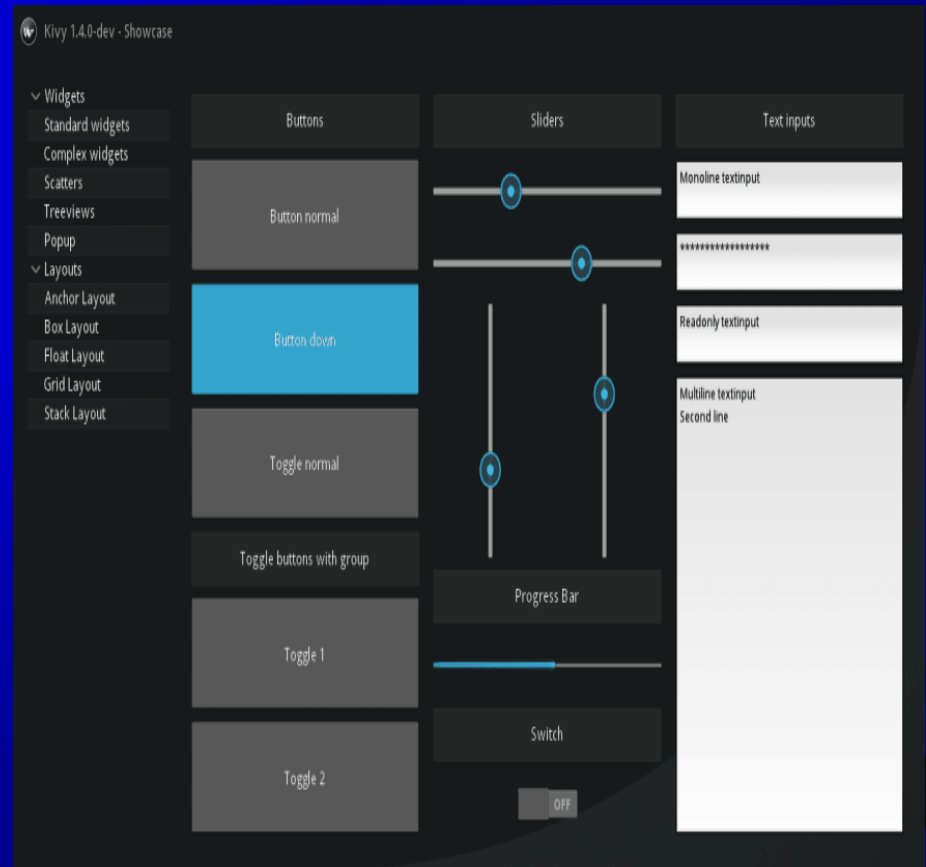
- **PyQT:** PyQT is one of the favoured cross-platform Python bindings implementing the Qt library for the Qt (owned by Nokia) application development framework. Currently, PyQT is available for Unix/Linux, Windows, Mac OS X and Sharp Zaurus. It combines the best of Python and Qt and it up to the programmer to decide whether to create a program by coding or using Qt Designer to create visual dialogs.
- It is available in both, commercial as well as GPL license. Although some features may not be available in the free version, if your application is open source, then you can use it under the free license.



Resource: <https://blog.resellerclub.com/the-6-best-python-gui-frameworks-for-developers/>

Python GUI Frameworks

- **Kivy** : Kivy is an OpenGL ES 2 accelerated framework for the creation of new user interfaces. It supports multiple platforms namely Windows, MacOSX, Linux, Android iOS and Raspberry Pi. It is open source and comes with over 20 widgets in its toolkit.



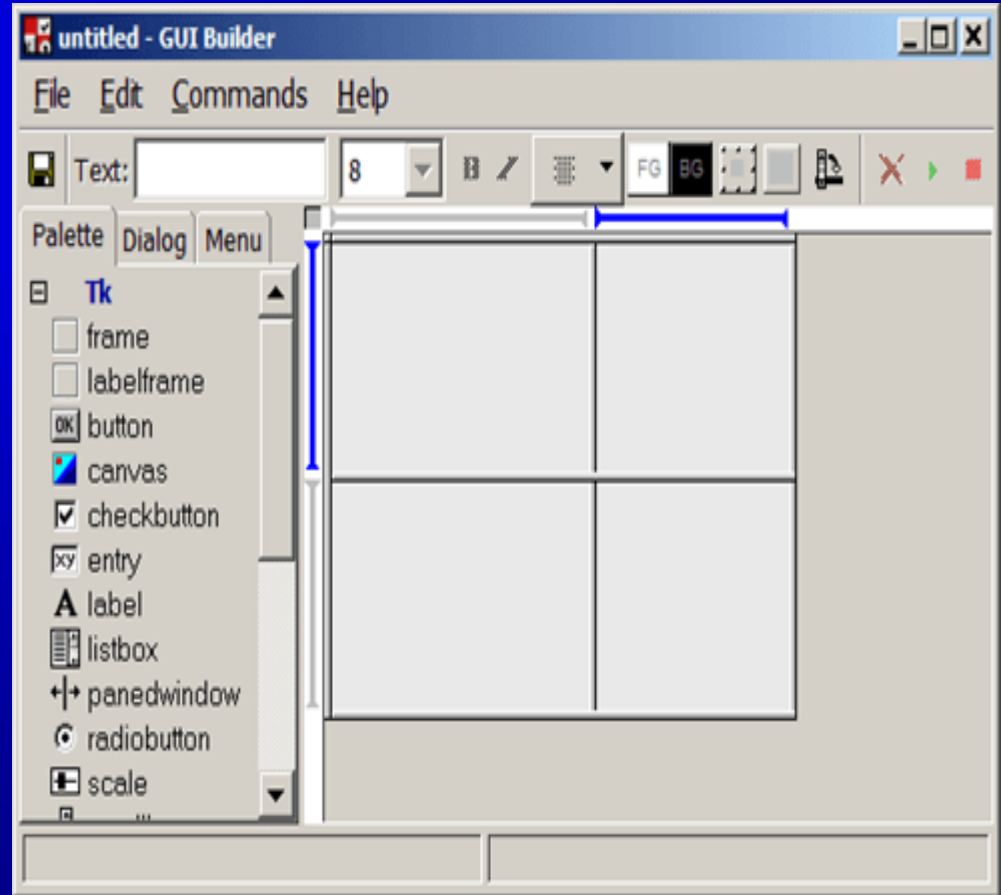
Python GUI Frameworks

- **WxPython** : WxPython is an open source wrapper for cross-platform GUI library WxWidgets (earlier known as WxWindows) and implemented as a Python extension module. With WxPython you as a developer can create native applications for Windows, Mac OS and Unix. If you're just beginning to develop applications in WxPython, here is a good simple tutorial you can go through.
- **PyGUI** : PyGUI is a graphical application cross-platform framework for Unix, Macintosh and Windows. Compared to some other GUI frameworks, PyGUI is by far the simplest and lightweight of them all, as the API is purely in sync with Python. PyGUI inserts very less code between the GUI platform and Python application, hence the display of the application usually displays the natural GUI of the platform.
- **PySide**: PySide is a free and cross-platform GUI toolkit Qt initiated and sponsored by Nokia, Qt is a UI framework and a cross-platform application. PySide currently supports Linux/X11, Mac OS X, Maemo and Windows and, support for Android is in the plans for the near future. PySide provides tools to works with multimedia, XML documents, network, databases and GUI. A key feature of PySide is its API compatibility with PyQt4, so if you wish to migrate to PySide then the process will be hassle-free.
- For a complete list: <http://wiki.python.org/moin/GuiProgramming>



Python GUI Frameworks

- **Tkinter:** Tkinter is the most popular programming package for graphical user interface or desktop apps. It is so named because of its simplicity. Tkinter is the combination of Tk and Python's standard GUI framework.
- TKinter comes with an abundance of resources of codes and reference books which is the major merit of choosing it as a package. It provides diverse widgets, such as labels, buttons, and text boxes used in a graphical user interface application. The Button control also called widgets are used to display buttons in developed application while the Canvas widget is used to draw shapes (lines, ovals, polygon...) in your application.



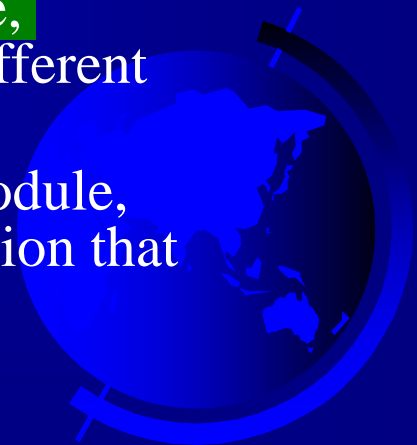
Motivations

- We will learn Tkinter.
- Tkinter is not only a useful tool for developing GUI projects, but also a valuable pedagogical tool for learning object-oriented programming.



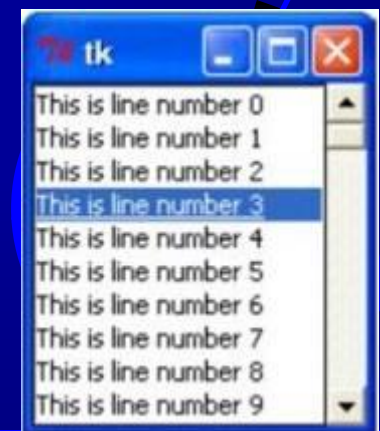
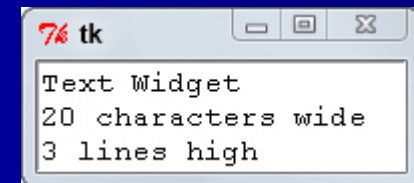
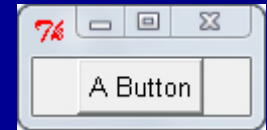
Tkinter Programming

- Tkinter is the standard GUI library for Python. Python when combined with Tkinter provides a fast and easy way to create GUI applications. Tkinter provides a powerful object-oriented interface to the Tk GUI toolkit.
- Tkinter (pronounced tea-kay-inter) is the Python interface to Tk, the GUI toolkit for Tcl/Tk.
- Tcl (pronounced "tickle" and is an acronym for Tool Command Language) is a popular scripting language in the domains of embedded applications, testing, prototyping, and GUI development. Tk on the other hand is an open source, multiplatform widget toolkit that is used by many different languages for building GUI programs.
- The Tkinter interface is implemented as a Python module, tkinter.py, which is just a wrapper around a C-extension that uses Tcl/Tk libraries.



Tkinter Programming : Widgets

- ❑ **tkinter** is one of the libraries which provides a number of graphical components to implement GUI based programs. They are called widgets.
- ❑ **Widgets** are standard graphical user interface (GUI) elements like buttons, labels, textboxes.
- ❑ In a GUI program, there is a window with various graphical widgets/components with which the user can interact.
- ❑ Widgets are basic building blocks of a GUI application. Over the years, several widgets became a standard in all toolkits on all OS platforms; for example a button, a check box or a scroll bar. Some of them might have different names. For instance, a check box is called a check button in Tkinter.
- ❑ Tkinter has a small set of widgets which cover basic programming needs. More specialised widgets can be created as custom widgets.
- ❑ Widgets are something like elements in the HTML. You will find different types of widgets to the different types of elements in the Tkinter.



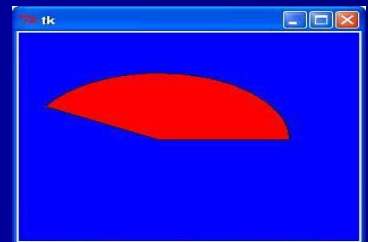
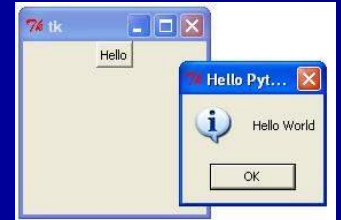
Tkinter Programming : Widgets

Button: The Button widget is used to display buttons in your application.

Canvas: The Canvas widget is used to draw shapes, such as lines, ovals, polygons and rectangles, in your application.

Checkbutton: The Checkbutton widget is used to display a number of options as checkboxes. The user can select multiple options at a time.

Entry: The Entry widget is used to display a single-line text field for accepting values from a user.

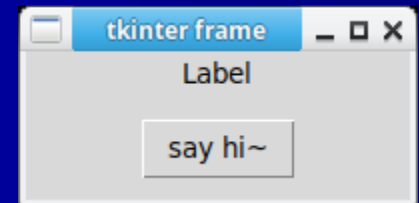


Tkinter Programming : Widgets

Frame: The Frame widget is used as a container widget to organize other widgets.

Label: The Label widget is used to provide a single-line caption for other widgets. It can also contain images.

Listbox: The Listbox widget is used to provide a list of options to a user.



Tkinter Programming : Widgets

Menubutton: The Menubutton widget is used to display menus in your application.



Menu: The Menu widget is used to provide various commands to a user. These commands are contained inside Menubutton.



Message: The Message widget is used to display multiline text fields for accepting values from a user.



Radiobutton: The Radiobutton widget is used to display a number of options as radio buttons. The user can select only one option at a time.

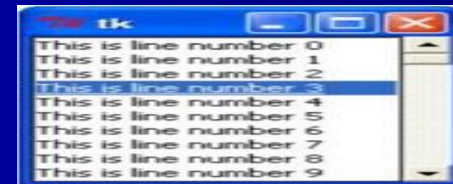


Tkinter Programming : Widgets

Scale: The Scale widget is used to provide a slider widget.



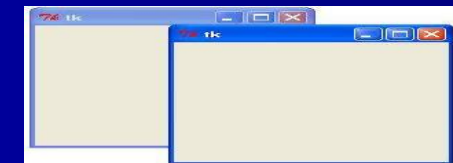
Scrollbar: The Scrollbar widget is used to add scrolling capability to various widgets, such as list boxes.



Text: The Text widget is used to display text in multiple lines.



Toplevel: The Toplevel widget is used to provide a separate window container.



Spinbox: The Spinbox widget is a variant of the standard Tkinter Entry widget, which can be used to select from a fixed number of values.

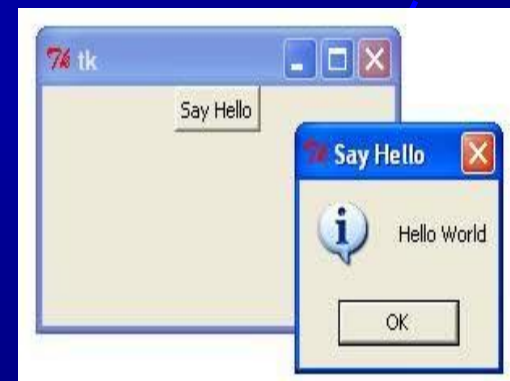


Tkinter Programming : Widgets

PanedWindow: A PanedWindow is a container widget that may contain any number of panes, arranged horizontally or vertically.

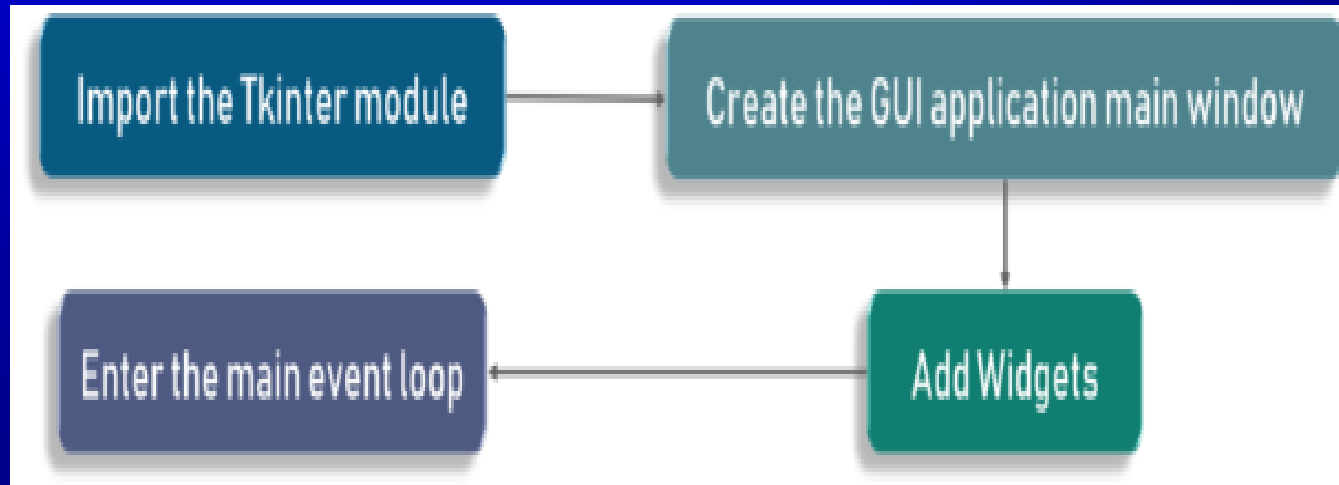
LabelFrame: A labelframe is a simple container widget. Its primary purpose is to act as a spacer or container for complex window layouts.

tkMessageBox: This module is used to display message boxes in your applications.



Tkinter Programming

- Creating a GUI application using Tkinter is an easy task. All you need to do is perform the following steps:
 - **Import** the Tkinter module.
 - **Generate** the GUI application **main (root) window**.
 - **Add** one or more **widgets** to the GUI application.
 - Enter the **main event loop** to take action against each event triggered by the user



Root Window

- The root window is just like a piece of paper on which you can draw graphical objects. The actual UI construction is pretty standardized. You create a root window, add widgets and then add functionality to widgets.
- Following are the steps you are required to follow:
 1. Create a root window
 2. Add widgets to the root window
 3. Customize widgets
 4. The geometry of the widgets
 5. Bind event handlers to widget events
 6. Start the main event loop



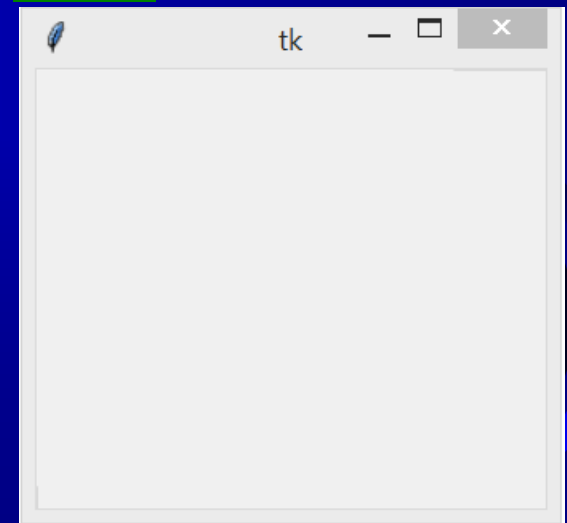
Generating An Empty Root Window

`import tkinter` imports all the methods, classes, and attributes of tkinter module into the current workspace. (import `Tkinter` in Python 2.X, import `ttkinter` in python 3.X)

`root = tkinter.Tk()` generates an instance of tkinter's Tk class which is a root window and assigned it to the variable `root`. Simply speaking, it is Tk class's constructor method to create the main window.

`root.mainloop()` executes the mainloop function. This function runs like an infinite loop until you close the main window. (An event loop is basically telling the code to keep displaying the window until we manually close it. It runs in an infinite loop in the back-end.)

```
import tkinter
def main():
    #Create a root window
    root = tkinter.Tk()
    #Call the event loop
    root.mainloop()
#Call the function main
main()
```



Adding widgets to root window

- We have **generated our main or main, top-level or root window**. Now we've to **add components** within it. These components, as previously described, are called Widgets.
- The basic syntax of creating widgets is as follows:

Syntax:

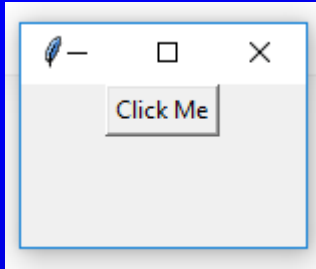
<var_name for widget> =

WidgetName(its container window, its configuration options)

- **The container window** can be the root window, a frame or a pane. So, add or place widgets on the root window.



Adding widgets to root window



```
import tkinter
```

```
def main():
```

```
    # Create a root window
```

```
    root = tkinter.Tk()
```

```
    # create a button widget
```

```
    button = tkinter.Button(root, text="Click Me")
```

```
    button.pack()
```

```
    # Call the event loop
```

```
    root.mainloop()
```

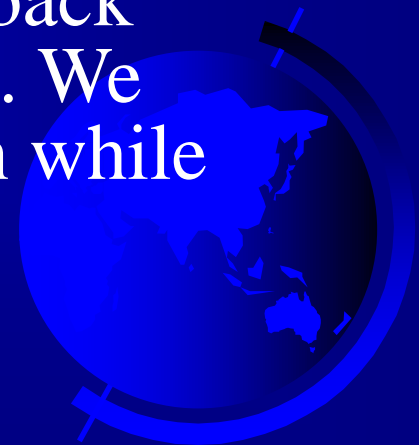
```
# Call the function main
```

```
main()
```

- The code added a new instance (for the sake of simplicity we will call it an object) **named button** for the Button widget.
- The **first parameter defined root** as its container.
- The **second parameter** is a configuration parameter which configured its **text option** as "Click Me".
- We call the **pack** method on this widget. This tells it to size itself to place and fit the given text, and make itself visible.

Adding functionality to a button

- We will write a **callback function** to add behavior to our button.
- A callback function is also known as an **event handler** because it handles the event that occurs when the user clicks the button.
- After writing the event handler or callback function, **we register it with the button**. We provide one more configuration option while creating a button.



Adding functionality to a button

```
import tkinter
from tkinter import messagebox

#callback function
def do_something():
    #the following line of code show messagebox
    messagebox.showinfo('Response', 'You have clicked the button')

def main():
    # Create a root window
    root = tkinter.Tk()
    # create a button widget
    button = tkinter.Button(root, text="Click Me", command = do_something)
    button.pack()
    # Call the event loop
    root.mainloop()

# Call the function main
main()
```



Three Components Of GUI Programming

- There are mainly three components or fundamentals of GUI programming in Python:
 1. What to place on the screen? (Widgets)
 - Generate root window
 - Add widgets
 2. Where to place widgets on the screen and how to organize them? (Geometry Management)
 3. How do widgets work? (Events and callback functions)
 - Write callback or event handler functions to the events such as button click.



Geometry Management

- All Tkinter widgets have access to specific geometry management methods, which have the purpose of organizing widgets throughout the parent widget area. Tkinter exposes the following geometry manager classes: pack, grid, and place.
 - The `pack()` Method – This geometry manager organizes widgets in blocks before placing them in the parent widget.
 - The `grid()` Method – This geometry manager organizes widgets in a table-like structure in the parent widget.
 - The `place()` Method – This geometry manager organizes widgets by placing them in a specific position in the parent widget.



pack() Method

- This geometry manager **organizes widgets in blocks** before placing them in the parent widget.
- Syntax : **widget.pack(pack_options)**
- Here is the list of **possible options** —
 - **expand** — When set to true, widget expands to fill any space not otherwise used in widget's parent.
 - **fill** — Determines whether widget fills any extra space allocated to it by the packer, or keeps its own minimal dimensions: NONE (default), X (fill only horizontally), Y (fill only vertically), or BOTH (fill both horizontally and vertically).
 - **side** — Determines which side of the parent widget packs against: TOP (default), BOTTOM, LEFT, or RIGHT.



pack() Method

```
import tkinter
```

```
window = tkinter.Tk()  
window.title("GUI")
```

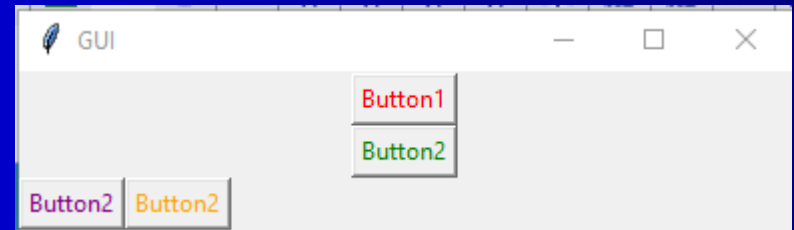
```
# creating 2 frames TOP and BOTTOM
```

```
top_frame = tkinter.Frame(window).pack()  
bottom_frame = tkinter.Frame(window).pack(side = "bottom")
```

```
# now, create some widgets in the top_frame and bottom_frame
```

```
btn1 = tkinter.Button(top_frame, text = "Button1", fg = "red").pack()# 'fg - foreground' is used to color the contents  
btn2 = tkinter.Button(top_frame, text = "Button2", fg = "green").pack()# 'text' is used to write the text on the Button  
btn3 = tkinter.Button(bottom_frame, text = "Button2", fg = "purple").pack(side = "left")# 'side' is used to align the widgets  
btn4 = tkinter.Button(bottom_frame, text = "Button2", fg = "orange").pack(side = "left")
```

```
window.mainloop()
```



LEFT places the three label side by side

fill Option

```
import tkinter as tk
```

```
root = tk.Tk()
```

```
w = tk.Label(root, text="Red Sun", bg="red", fg="white")
```

```
w.pack()
```

```
w = tk.Label(root, text="Green Grass", bg="green", fg="black")
```

```
w.pack(fill=tk.X)
```

```
w = tk.Label(root, text="Blue Sky", bg="blue", fg="white")
```

```
w.pack(fill=tk.X)
```

```
tk.mainloop()
```



If you want to make the widgets as wide as the parent widget, you have to use the `fill=tk.X` option

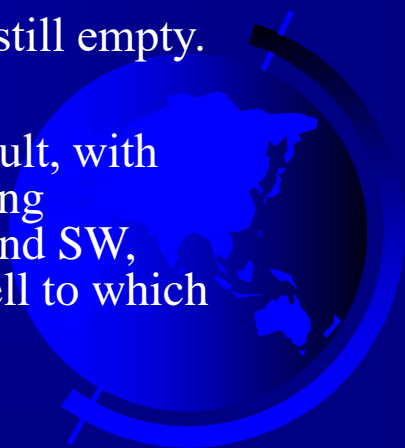
Grid Manager

- The first geometry manager of Tk had been **pack**. The algorithmic behaviour of pack is **not easy to understand** and it can be difficult to change an existing design.
- Grid was introduced in 1996 as an alternative to pack. Though **grid is easier to learn** and to use and produces nicer layouts, lots of developers keep using pack.
- **Grid** is in many cases **the best choice for general use**. While pack is sometimes not sufficient for changing details in the layout, **place** gives you **complete control of positioning each element**, but this makes it a lot more complex than pack and grid.
- The **Grid** geometry manager **places the widgets in a 2-dimensional table**, which consists of a number of rows and columns. **The position** of a widget is defined by **a row and a column number**.

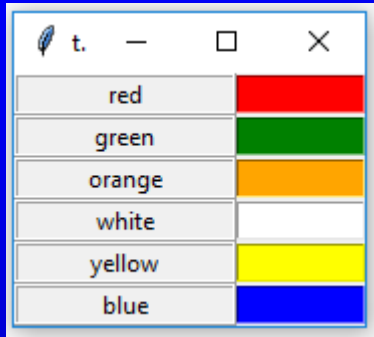


grid() Method

- This geometry manager organizes widgets in a table-like structure in the parent widget.
- Syntax : `widget.grid(grid_options)`
- Here is the list of possible options –
 - **column** – The column to put widget in; default 0 (leftmost column).
 - **columnspan** – How many columns widget occupies; default 1.
 - **ipadx, ipady** – How many pixels to pad widget, horizontally and vertically, inside widget's borders.
 - **padx, pady** – How many pixels to pad widget, horizontally and vertically, outside v's borders.
 - **row** – The row to put widget in; default the first row that is still empty.
 - **rowspan** – How many rows widget occupies; default 1.
 - **sticky** – What to do if the cell is larger than widget. By default, with `sticky=""`, widget is centered in its cell. `sticky` may be the string concatenation of zero or more of N, E, S, W, NE, NW, SE, and SW, compass directions indicating the sides and corners of the cell to which widget sticks.



Example 1 with grid



- ❑ Places Labels in positions $(0,0),(1,0),(2,0),(3,0),(4,0),(5,0)$: First Column
- ❑ Places Entries in positions $(0,1),(1,1),(2,1),(3,1),(4,1),(5,1)$: Second Column

```
import tkinter as tk
```

```
colours = ['red','green','orange','white','yellow','blue']
```

```
r = 0
```

```
for c in colours:
```

```
    tk.Label(text=c, relief=tk.RIDGE, width=15).grid(row=r,column=0)
```

```
    tk.Entry(bg=c, relief=tk.SUNKEN, width=10).grid(row=r,column=1)
```

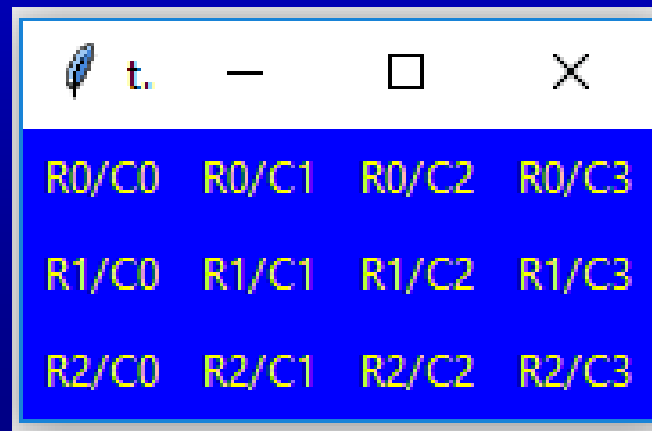
```
    r = r + 1
```

```
tk.mainloop()
```



Example 2 with grid

```
import tkinter
root = tkinter.Tk( )
for r in range(3):
    for c in range(4):
        tkinter.Label(root, text='R%s/C%s'%(r,c), borderwidth=3, padx=3, pady=3, fg="yellow", \
            bg="blue" ).grid(row=r,column=c)
root.mainloop()
```



place() Method

- This geometry manager organizes widgets by placing them in a specific position in the parent widget.
- Syntax: `widget.place(place_options)`
- Here is the list of possible options –
 - **anchor** – The exact spot of widget other options refer to: may be N, E, S, W, NE, NW, SE, or SW, compass directions indicating the corners and sides of widget; default is NW (the upper left corner of widget)
 - **bordermode** – INSIDE (the default) to indicate that other options refer to the parent's inside (ignoring the parent's border); OUTSIDE otherwise.
 - **height, width** – Height and width in pixels.
 - **relheight, relwidth** – Height and width as a float between 0.0 and 1.0, as a fraction of the height and width of the parent widget.
 - **relx, rely** – Horizontal and vertical offset as a float between 0.0 and 1.0, as a fraction of the height and width of the parent widget.
 - **x, y** – Horizontal and vertical offset in pixels



Example 1 with place

```
import tkinter
```

```
from tkinter import messagebox
```

```
top = tkinter.Tk()
```

```
top.geometry("300x400") #Width x Height
```

```
def helloCallBack():
```

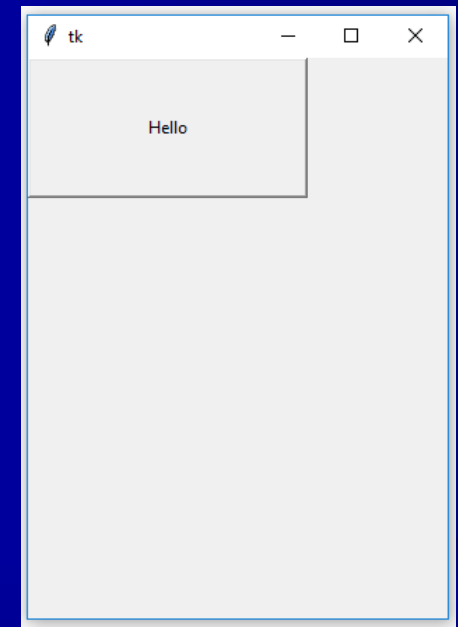
```
    messagebox.showinfo( "Hello Python", "Hello World")
```

```
B = tkinter.Button(top, text ="Hello", command = helloCallBack)
```

```
B.pack()
```

```
B.place(bordermode="outside", height=100, width=200)
```

```
top.mainloop()
```



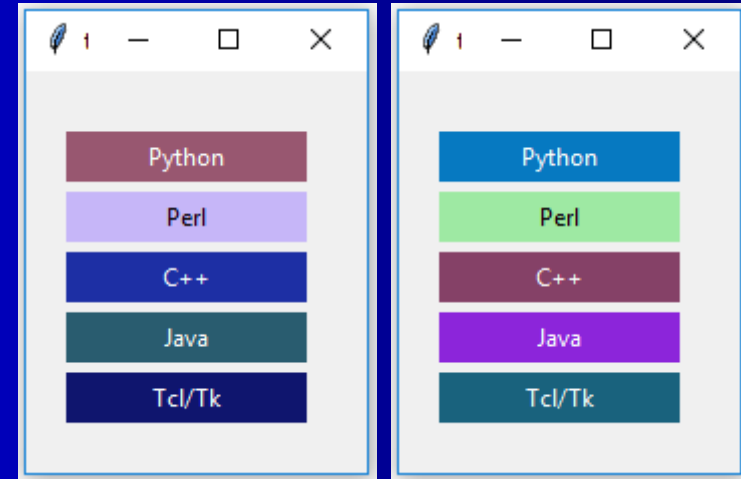
Example 2 with place

```
import tkinter as tk
import random

root = tk.Tk()
# width x height + x_offset + y_offset:
# geometry("window width x window height + position right + position down")
# position the top left corner of the window right 300 pixels and down 300 pixels.
root.geometry("170x200+30+230")

languages = ['Python', 'Perl', 'C++', 'Java', 'Tcl/Tk']
labels = range(5)
for i in range(5):
    ct = [random.randrange(256) for x in range(3)]
    brightness = int(round(0.299 * ct[0] + 0.587 * ct[1] + 0.114 * ct[2]))
    ct_hex = "%02x%02x%02x" % tuple(ct)
    bg_colour = '#' + "".join(ct_hex)
    l = tk.Label(root,
                 text=languages[i],
                 fg='White' if brightness < 120 else 'Black',
                 bg=bg_colour)
    l.place(x=20, y=30 + i * 30, width=120, height=25)

root.mainloop()
```



- we assign to every label a different colour, which we randomly create using the randrange method of the random module. We calculate the brightness (grey value) of each colour. If the brightness is less than 120, we set the foreground colour (fg) of the label to White otherwise to black, so that the text can be easier read.

Binding Functions

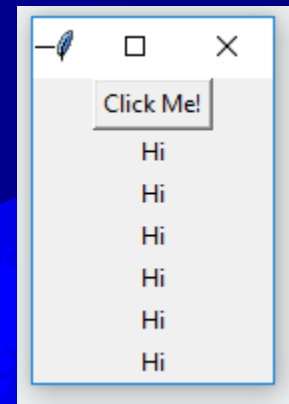
- Calling functions whenever an event occurs refers to a binding function.
 - In the below example, when you click the button, it calls a function called `say_hi`.
 - Function `say_hi` creates a new label with the text `Hi`.

```
import tkinter
```

```
window = tkinter.Tk()  
window.title("GUI")
```

```
# creating a function called say_hi()  
def say_hi():  
    tkinter.Label(window, text = "Hi").pack()
```

```
# 'command' is executed when you click the button  
# in this above case we're calling the function 'say_hi'.  
tkinter.Button(window, text = "Click Me!", command =  
say_hi).pack()  
window.mainloop()
```



Binding Functions

- Another way to bind functions is using events. Events are something like mousemove, mouseover, clicking, scrolling, etc....
- Example on the next slide has clicking events are of 3 different types namely leftClick, middleClick, and rightClick.
- <Button-1>' parameter of bind method is the left clicking event, i.e., when you click the left button the bind method call the function associated with it.
 - <Button-1> for left click
 - <Button-2> for middle click
 - <Button-3> for right click



Binding Functions

```
import tkinter

window = tkinter.Tk()
window.title("GUI")

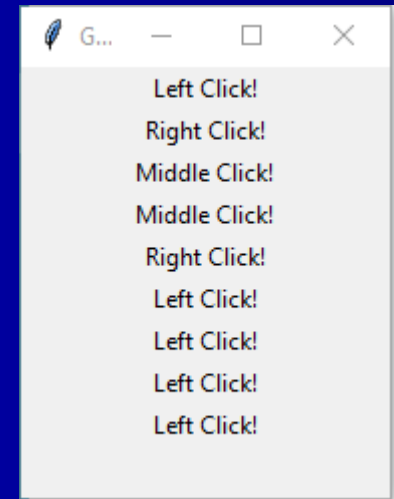
#creating 3 different functions for 3 events
def left_click(event):
    tkinter.Label(window, text = "Left Click!").pack()

def middle_click(event):
    tkinter.Label(window, text = "Middle Click!").pack()

def right_click(event):
    tkinter.Label(window, text = "Right Click!").pack()

window.bind("<Button-1>", left_click)
window.bind("<Button-2>", middle_click)
window.bind("<Button-3>", right_click)

window.mainloop()
```



GUI with Classes

- **You can use GUI Classes** using root window when you're developing a large software or something that's big.

```
import tkinter
```

```
class GeeksBro:
```

```
    def __init__(self, window):
```

```
        # create a button to call a function called 'say_hi'
```

```
        self.text_btn = tkinter.Button(window, text = "Click Me!", command = self.say_hi)
```

```
        self.text_btn.pack()
```

```
        # closing the 'window' when you click the button
```

```
        self.close_btn = tkinter.Button(window, text = "Close", command = window.quit)
```

```
        self.close_btn.pack()
```

```
    def say_hi(self):
```

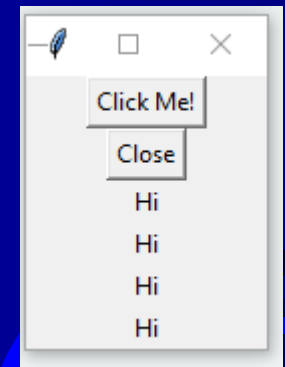
```
        tkinter.Label(window, text = "Hi").pack()
```

```
window = tkinter.Tk()
```

```
window.title("GUI")
```

```
geeks_bro = GeeksBro(window)
```

```
window.mainloop()
```



Examples from textbook: Getting Started with Tkinter

Getting started with Tkinter with a simple example.



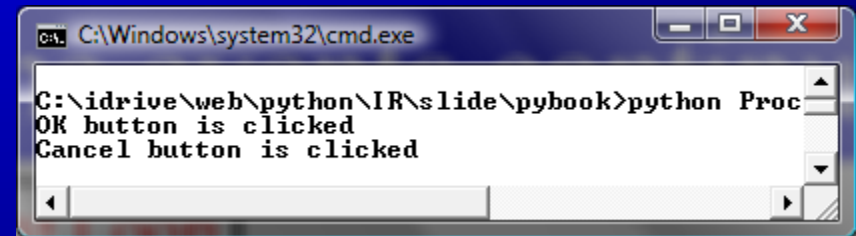
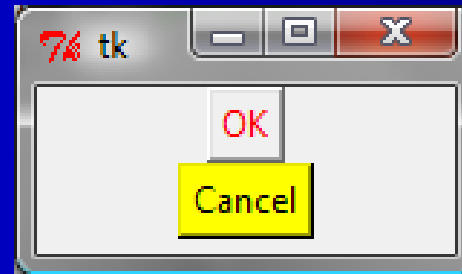
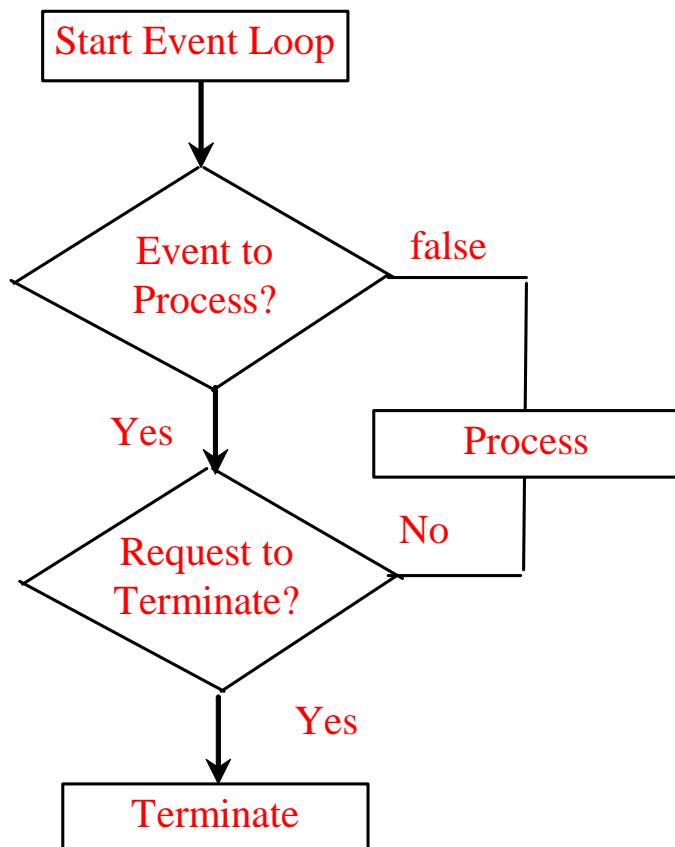
SimpleGUI

Run

Processing Events

`window.mainloop()` # Create an event loop

The statement creates an event loop. The event loop processes the events continuously.



ProcessButtonEvent

Run

The Widget Classes

| Widget Class | Description |
|---------------------|--|
| Button | A simple button, used to execute a command. |
| Checkbutton | Clicking a check button toggles between the values. |
| Radiobutton | Clicking a radio button sets the variable to that value, and clears all other radio buttons associated with the same variable. |
| Entry | A text entry field, a.k.a a text field or a text box. |
| Frame | A container widget for containing other widgets. |
| Menu | A menu pane, used to implement pull down and popup menus. |
| Menubutton | A menu button, used to implement pull down menus. |
| Label | Displays a text or an image. |
| Message | Displays a text. Similar to the label widget, but can automatically wrap text to a given width or aspect ratio. |
| Text | Formatted text display. Allows you to display and edit text with various styles and attributes. Also supports embedded images and windows. |
| Scale | Allows you to set a numerical value by dragging a "slider". |
| Canvas | Structured graphics, used to draw graphs and plots, create graphics editors, and to implement custom widgets. |
| Toplevel | A container widget displayed as a separate, top-level window. |

Color and Font

- To specify a color, you can either use
 - a color name such as red, yellow, green, blue, white, black, purple, etc,
 - or explicitly specify the red, green, and blue (RGB) color components using a string #RRGGBB, where RR, GG, BB are hexadecimal representations of the red, green and blue values, respectively.
- You can specify a font in a string that includes the font name, size, and style. Here are
Some examples:

"Times 10 bold"

"Helvetica 10 bold italic"

"Courier New 20 bold italic"

"Courier New 20 bold italic over strike underline"



Text Formatting

- The text in a label and a button is centered by default.
- You can change it by using the justify option with values LEFT, CENTER, or RIGHT.
- You can also display the text in multiple lines by inserting the newline character \n to separate texts.



Mouse Cursor

You can set a mouse cursor by using the cursor option with values such as

- "arrow" (default),
- "circle",
- "cross"
- "plus", etc.



Change Properties

- When you construct a widget, you can specify its properties such as fg, bg, font, cursor, text, and command in the constructor.
- Later in the program, you can change the widget's properties by using the following syntax:

```
widgetName["propertyName"] = newPropertyValue
```

Examples:

```
btShowOrHide = Button(window, text = "Show", bg = "white")
```

```
btShowOrHide["text"] = "Hide"
```

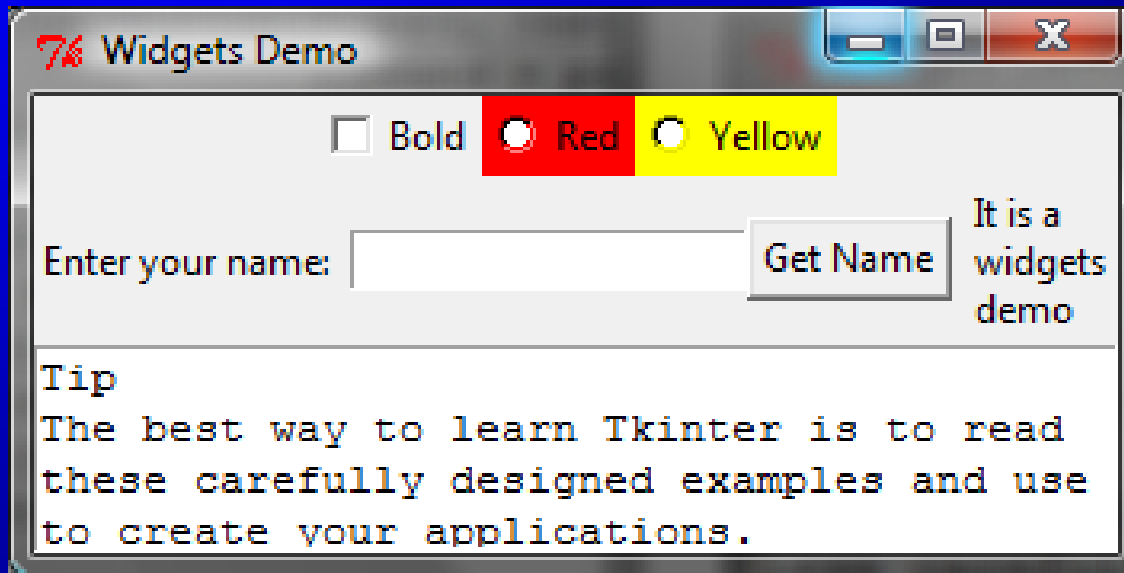
```
btShowOrHide["bg"] = "red"
```

```
btShowOrHide["fg"] = "#AB84F9" # Change fg color to #AB84F9
```

```
btShowOrHide["cursor"] = "plus" # Change mouse cursor to plus
```



Widget Demo

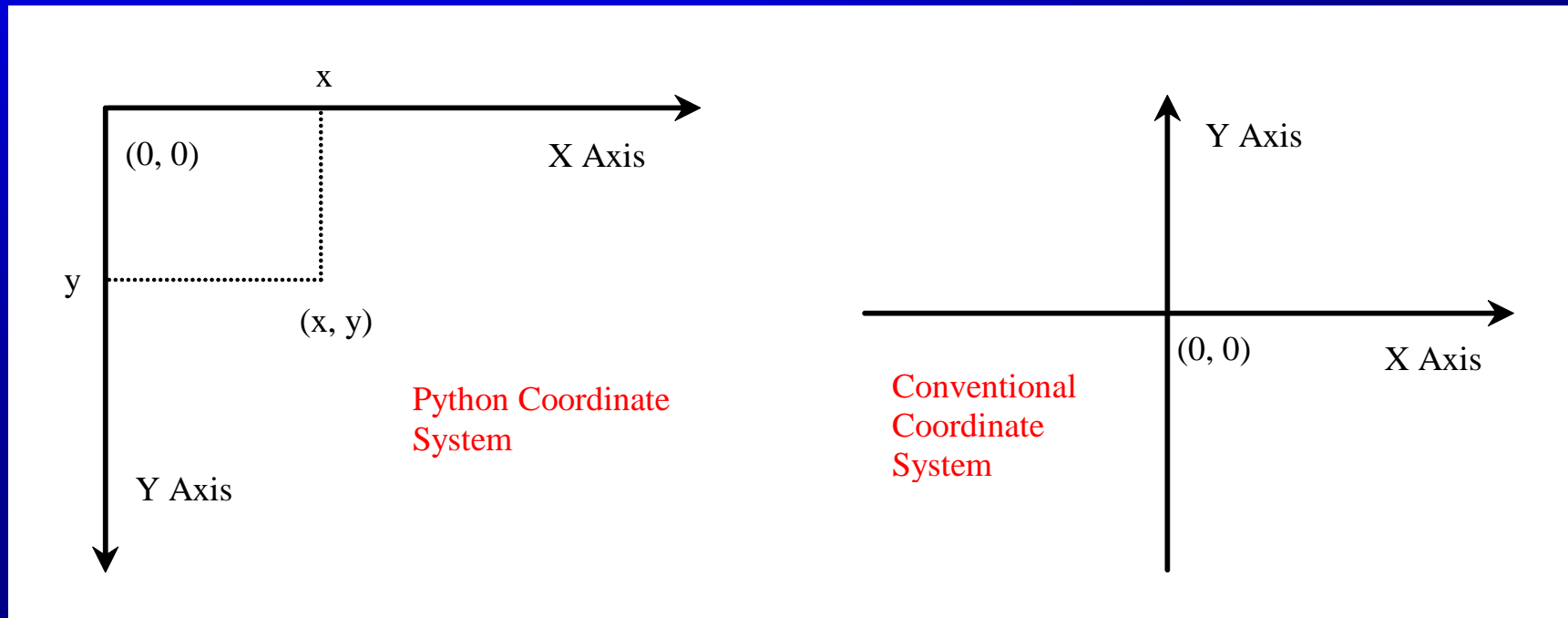


[WidgetsDemo](#)

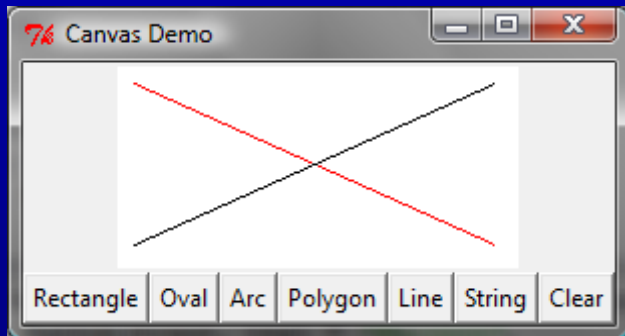
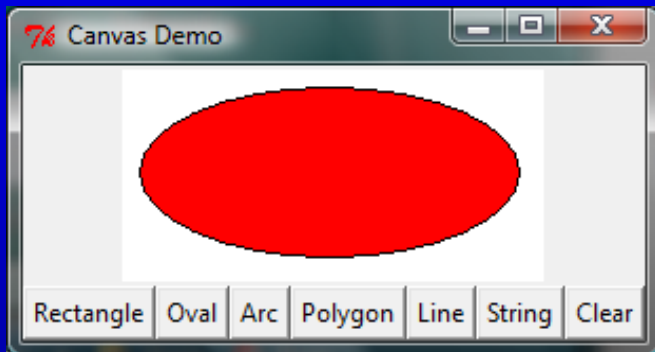
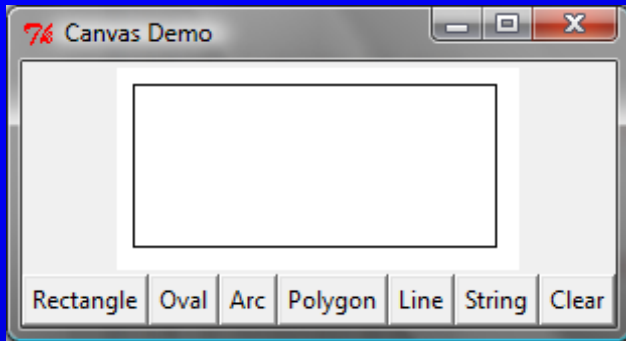
Run

Canvas

- Canvas can be used to display shapes.
- You can use the method such as `create_rectangle`, `create_oval`, `create_arc`, `create_polygon`, and `create_line` to draw a rectangle, oval, arc, polygon, and line on a canvas.



Canvas Demo



CanvasDemo

Run

Drawing Methods

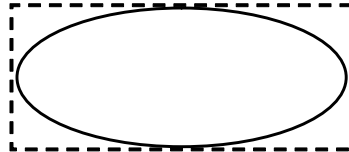
(x1, y1)



(x2, y2)

`canvas.create_rectangle(x1, y1, x2, y2)`

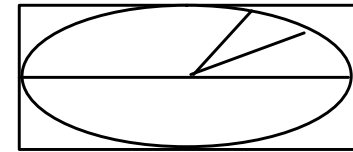
(x1, y1)



(x2, y2)

`canvas.create_oval(x1, y1, x2, y2)`

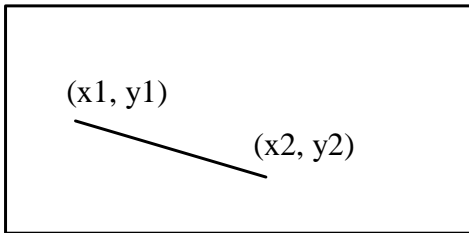
(x1, y1)



(x2, y2)

`canvas.create_arc(x1, y1, x2, y2, start, extent)`

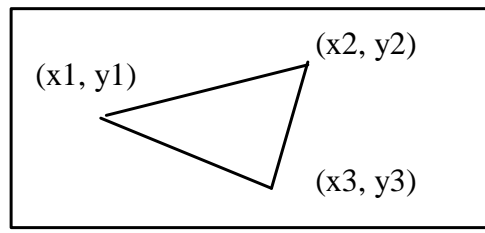
(x1, y1)



(x2, y2)

`canvas.create_line(x1, y1, x2, y2)`

(x1, y1)



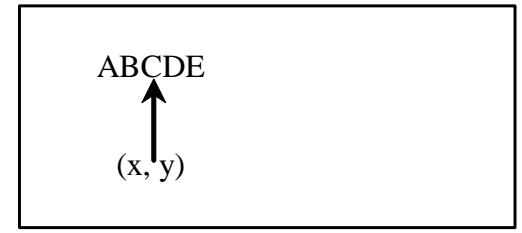
(x2, y2)

(x3, y3)

`canvas.create_oval(x1, y1, x2, y2, x3, y3)`

ABCDE

(x, y)



`canvas.create_text(x, y, text = "ABCDE")`

Geometry Managers

Grid Manager

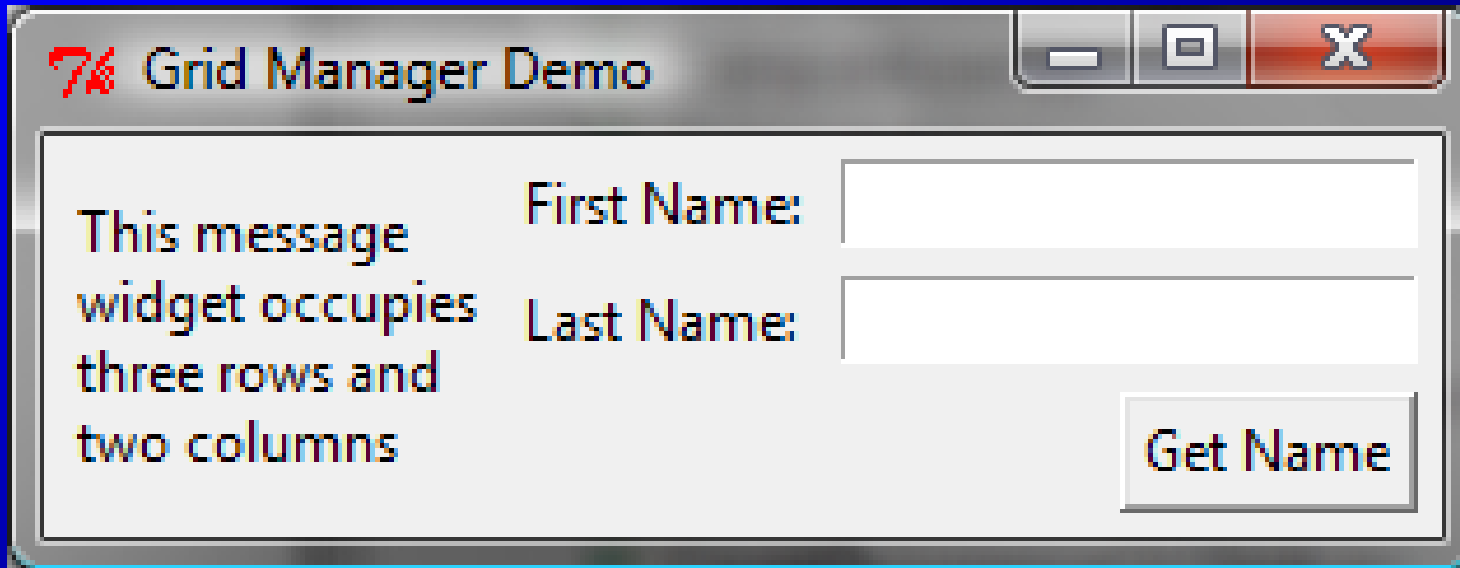
Pack Manager

Place Manager

Since each manager has its own style of placing the widget, it is not a good practice to mix the managers for the widgets in the same container. You can use a frame as a subcontainer to achieve desired layout.



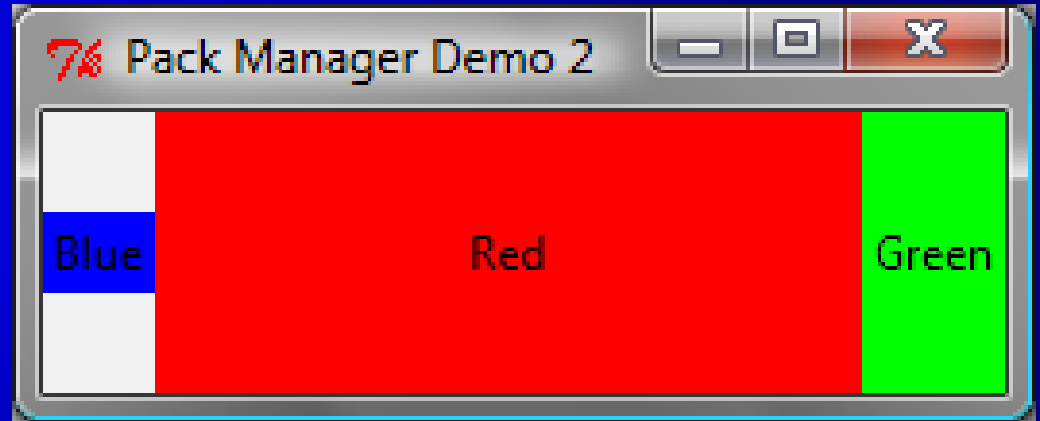
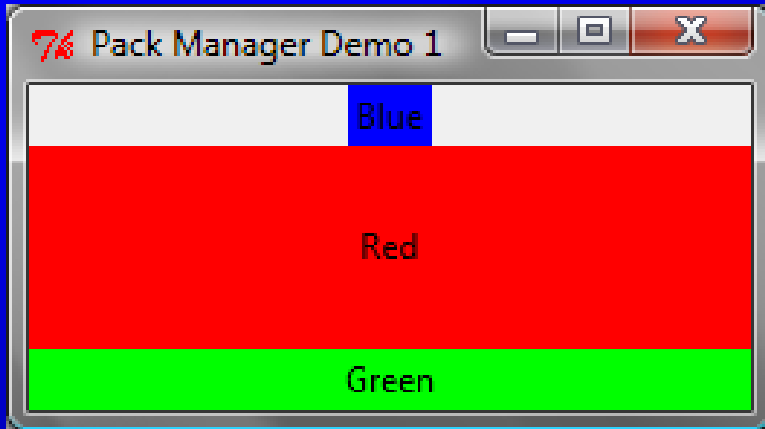
Grid Managers



[GridManagerDemo](#)

Run

Pack Managers



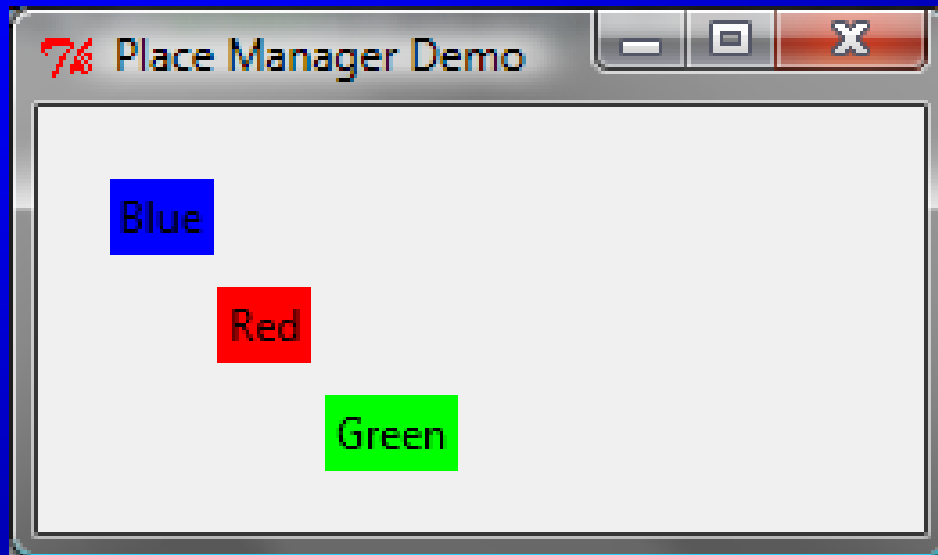
PackManagerDemo1

Run

PackManagerDemo2

Run

Place Managers



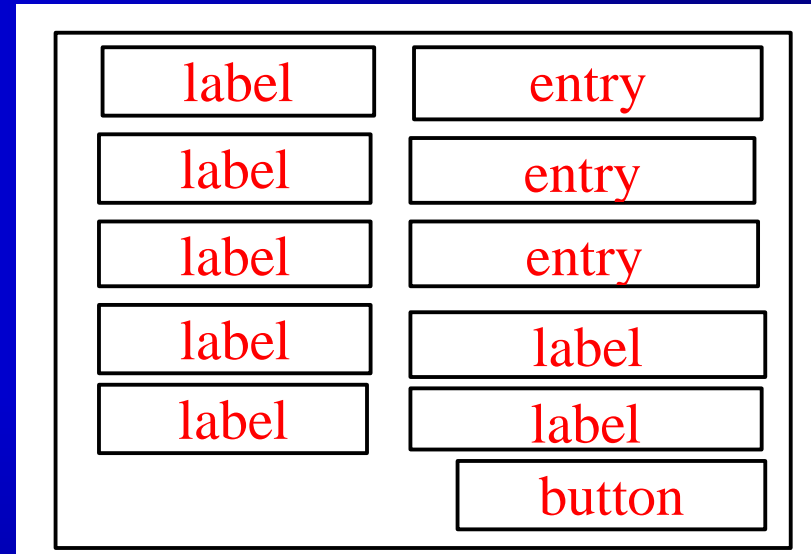
PlaceManagerDemo

Run

Case Study: Loan Calculator

| | |
|----------------------|---------|
| Annual Interest Rate | 4.5 |
| Number of Years | 4 |
| Loan Amount | 5000 |
| Monthly Payment | 114.02 |
| Total Payment | 5472.96 |

Compute Payment



LoanCalculator

Run

Display Images

You can add an image in a label, button, check button, and radio button. To create an image, use the `PhotoImage` class as follows:

```
photo = PhotoImage(file = imagefilename)
```

The image file must be GIF. You can use a conversion utility to convert image files in other format into GIF.



Image Example

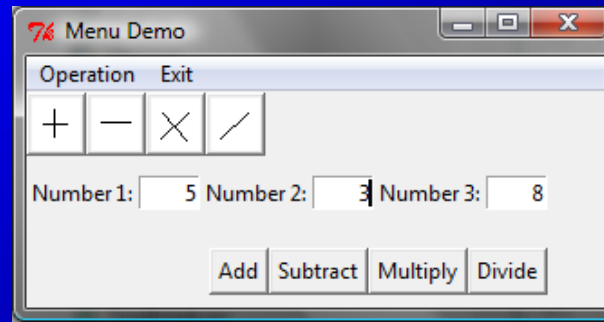
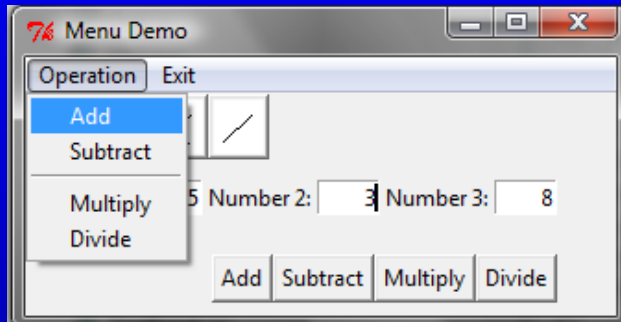


[ImageDemo](#)

Run

Menus

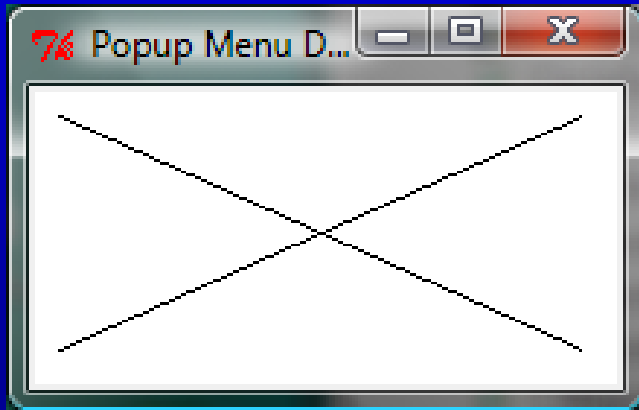
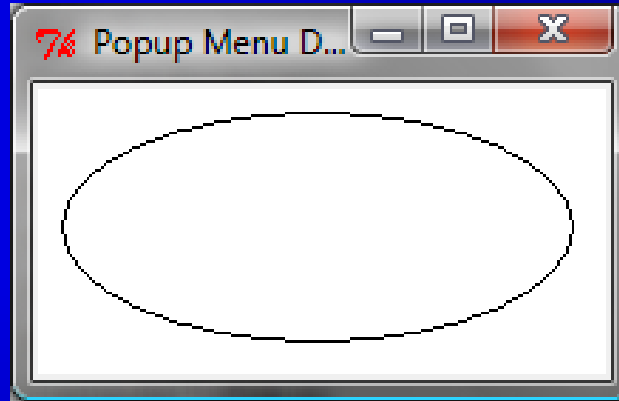
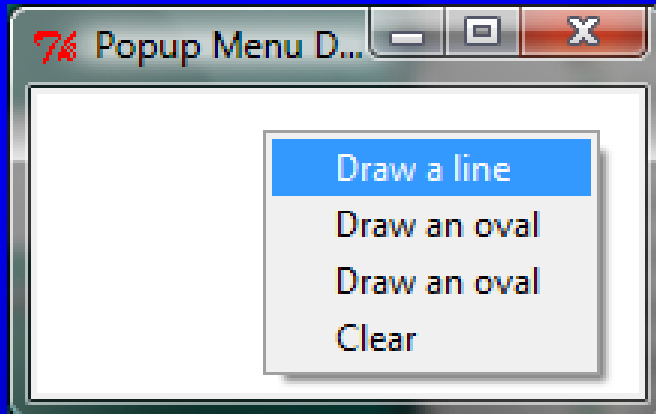
Tkinter provides a comprehensive solution for building graphical user interfaces.



MenuDemo

Run

Popup Menus



[PopupMenuDemo](#)

Run

Mouse and Key Events

```
widget.bind(event, handler)
```

```
def popup(event):  
    menu.post(event.x_root, event.y_root)
```



Events

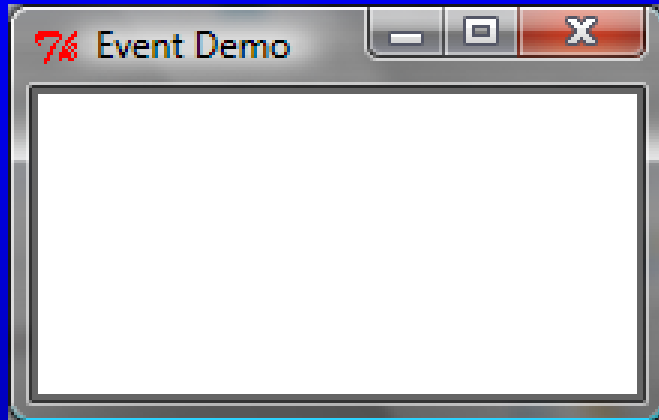
| Event | Description |
|-----------------------------|--|
| <Button- <i>i</i> > | Button-1, Button-2, and Button-3 are for left, middle, or right buttons. When a mouse button is pressed over the widget, Tkinter automatically grabs the mouse pointer location. ButtonPressed- <i>i</i> is synonymous to Button- <i>i</i> . |
| <Bi-Motion> | An event occurs, when a mouse button is moved while being held down on the widget. |
| <ButtonReleased- <i>i</i> > | An event occurs, when a mouse button is released. |
| <Double-Button- <i>i</i> > | An event occurs, when a mouse button is double-clicked. |
| <Triple-Button- <i>i</i> > | An event occurs, when a mouse button is triple-clicked. |
| <Enter> | An event occurs, when a mouse pointer enters the widget. |
| <Leave> | An event occurs, when a mouse pointer leaves the widget. |
| <Return> | An event occurs, when the Enter key is pressed. You can bind any key such as <A>, , <Up>, <Down>, <Left>, <Right> in the keyboard with an event. |
| <Key> | An event occurs, when a key is pressed. |
| <Shift-A> | An event occurs, when the Shift+A keys are pressed. You use Alt, Shift, and Control to combine with other keys. |

Event Properties

| Event | Description |
|---|--|
| <code>widget</code> | The widget object that fires this event. |
| <code>x</code> and <code>y</code> | The current mouse location in the widget pixels. |
| <code>x__root</code> and <code>y__root</code> | The current mouse position relative to the upper left corner of the screen, in pixels. |
| <code>num</code> | The button number (1, 2, 3), indicating which mouse button was clicked. |
| <code>char</code> | The char entered from the keyboard for key events. |
| <code>keysym</code> | The key symbol for the key entered from the keyboard for key events. |
| <code>keycode</code> | The key code for the key entered from the keyboard for key events. |



Mouse Key Event Demo

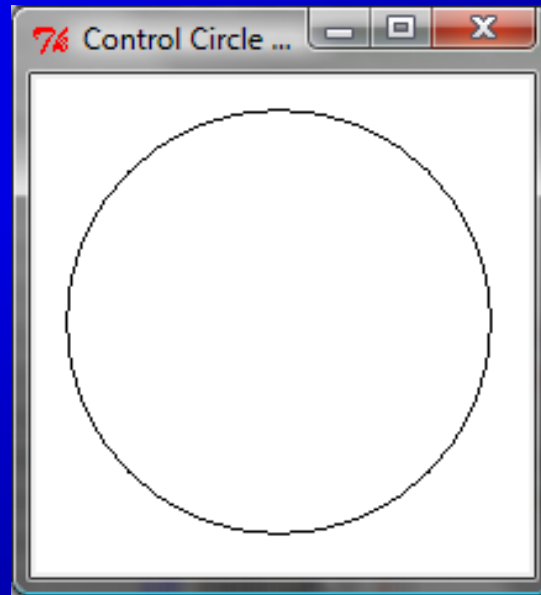
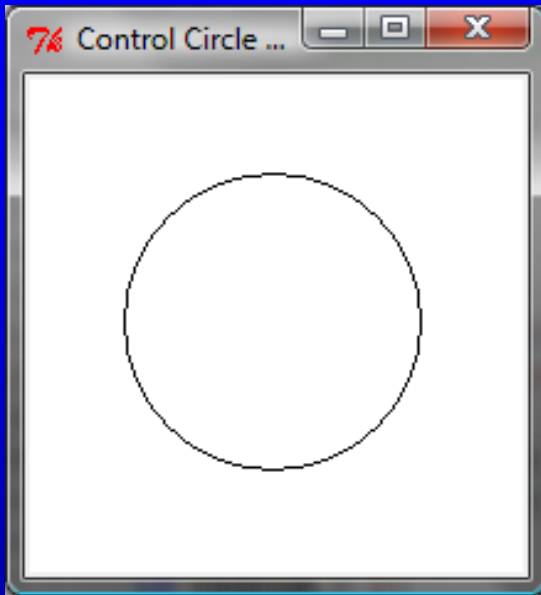


```
Administrator: Command Prompt - python MouseKeyEventDemo.py
c:\pybook>python MouseKeyEventDemo.py
clicked at 138 72
Position in the screen 376 330
Which button is clicked? 1
clicked at 107 78
Position in the screen 345 336
Which button is clicked? 1
keysym? g
char? g
keycode? 71
keysym? Return
char?
keycode? 13
```

MouseKeyEventDemo

Run

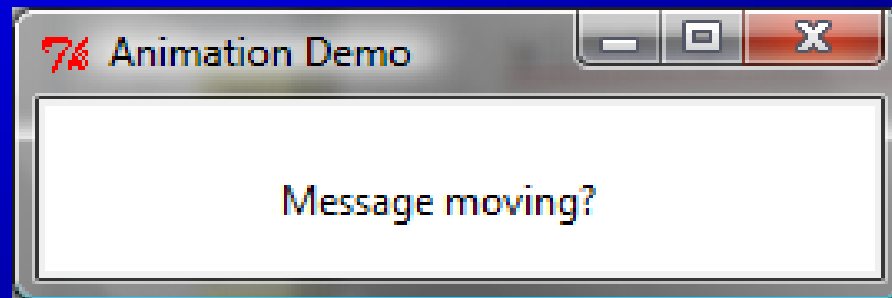
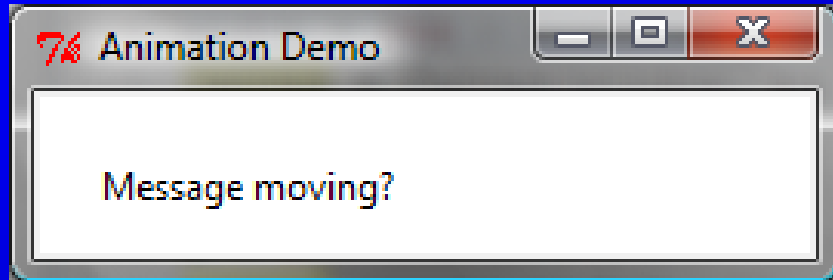
Control Circle Demo



ControlCircle

Run

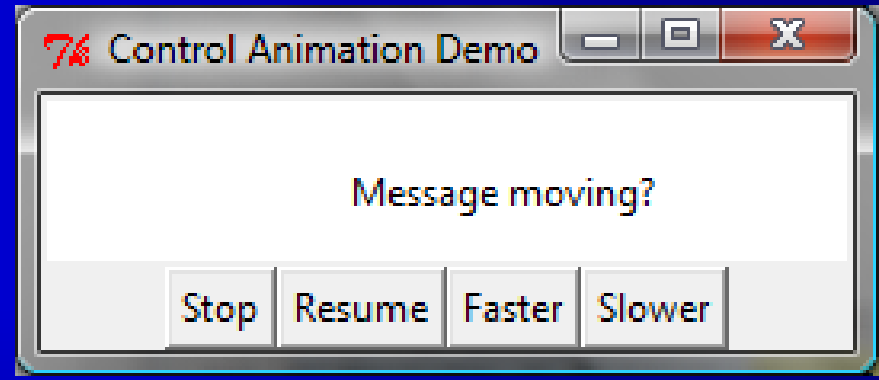
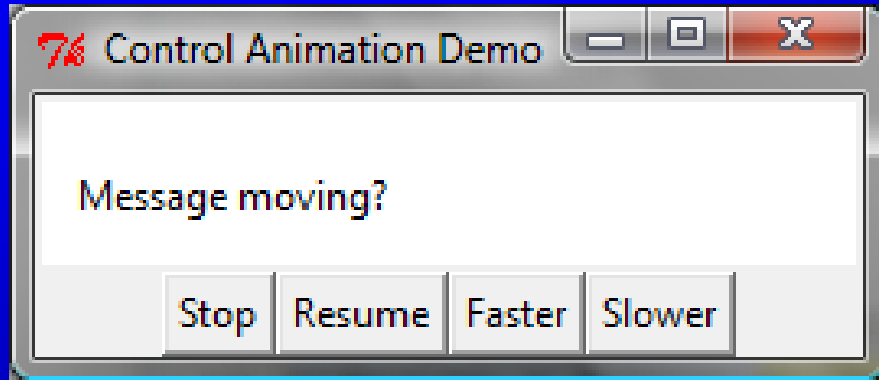
Animations



Animation Demo

Run

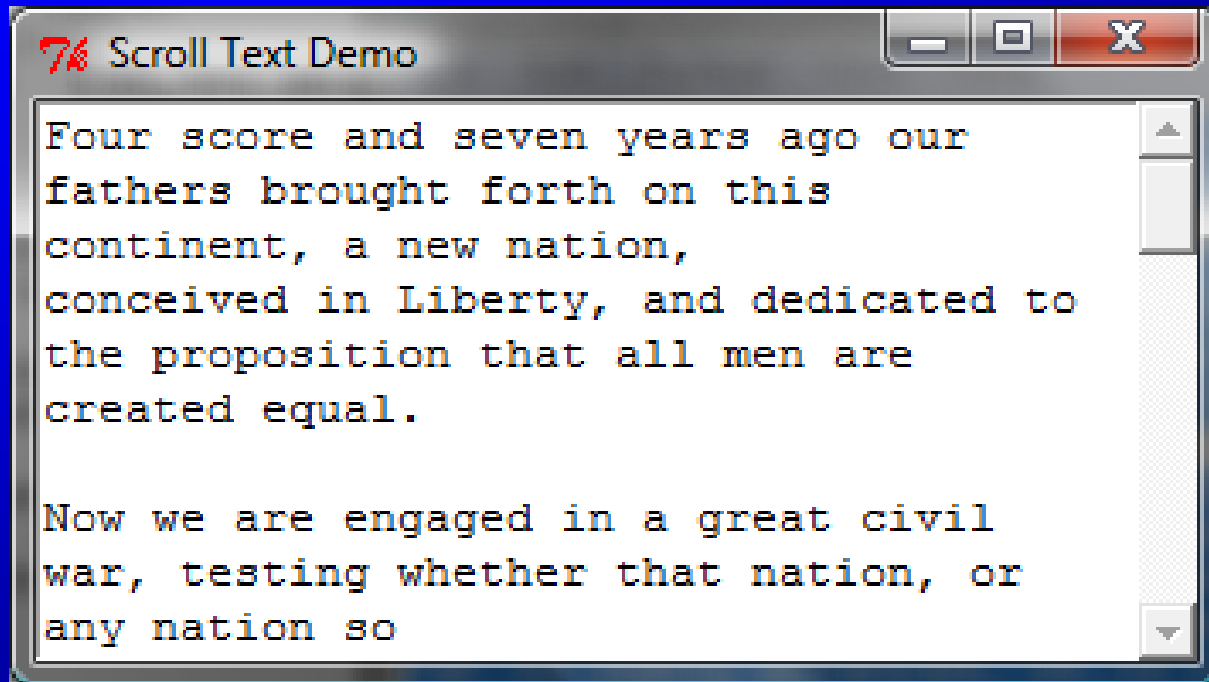
Control Animations



ControlAnimation

Run

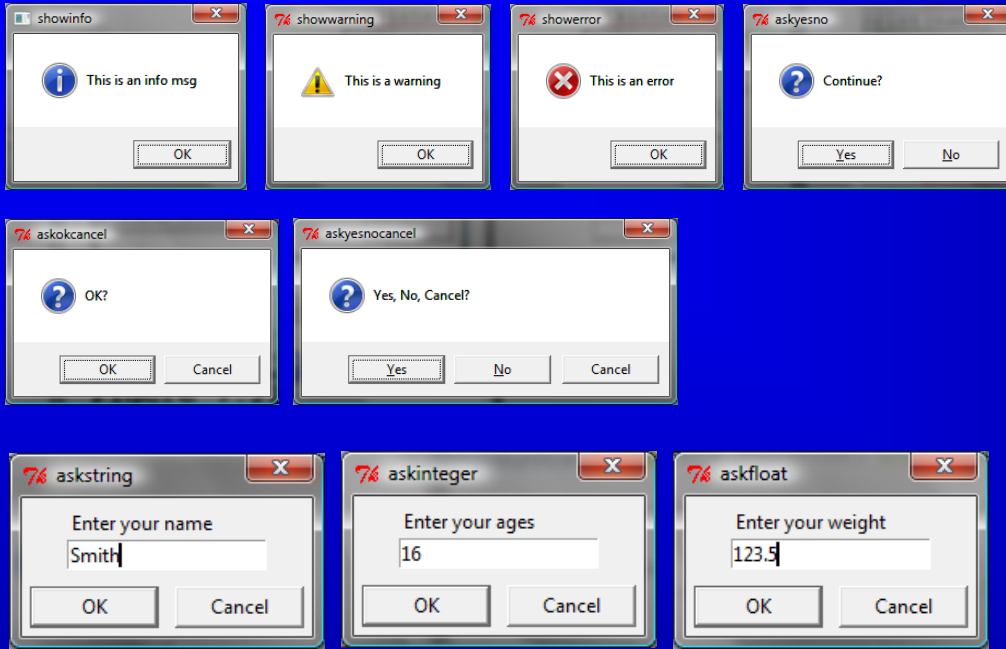
Scrollbar



ScrollText

Run

Standard Dialogs



DialogDemo

Run