PROGRAMMING WITH PYTHON

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18. Python - GUI Programming (Tkinter)

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Python provides various options for developing graphical user interfaces (GUIs). Most important are listed below:

- **Tkinter**: Tkinter is the Python interface to the Tk GUI toolkit shipped with Python. We would look this option in this tutorial.
- **wxPython**: This is an open-source Python interface for wxWindows http://wxpython.org.
- **JPython**: JPython is a Python port for Java, which gives Python scripts seamless access to Java class libraries on the local machine http://www.jython.org.

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

```
import Tkinter

top = Tkinter.Tk()

# Code to add widgets will go here...

top.mainloop()
```

Python - Tkinter Button

The Button widget is used to add buttons in a Python application. These buttons can display text or images that convey the purpose of the buttons. You can attach a function or a method to a button, which is called automatically when you click the button.

Syntax:

```
w = Button ( master, option=value, ... )
```

Parameters:

- master: This represents the parent window.
- options: Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:

```
import Tkinter

import tkMessageBox

top = Tkinter.Tk()

def helloCallBack():

        tkMessageBox.showinfo( "Hello Python", "Hello World")

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

B.pack()

top.mainloop()
```

Python - Tkinter Canvas

The Canvas is a **rectangular area** intended for drawing pictures or other complex layouts. You can place graphics, text, widgets, or frames on a Canvas.

Syntax:

```
w = Canvas ( master, option=value, ... )
```

Parameters:

- master: This represents the parent window.
- options: Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

The Canvas widget can support the following standard items:

- arc . Creates an arc item.

  coord = 10, 50, 240, 210

  arc = canvas.create_arc(coord, start=0, extent=150, fill="blue")

- image . Creates an image item, which can be an instance of either the BitmapImage or the PhotoImage classes.

  filename = PhotoImage(file = "sunshine.gif")

  image = canvas.create_image(50, 50, anchor=NE, image=filename)

The Canvas widget can support the following standard items:

- line . Creates a line item.

  line = canvas.create_line(x0, y0, x1, y1, ..., xn, yn, options)

- oval . Creates a circle or an ellipse at the given coordinates.

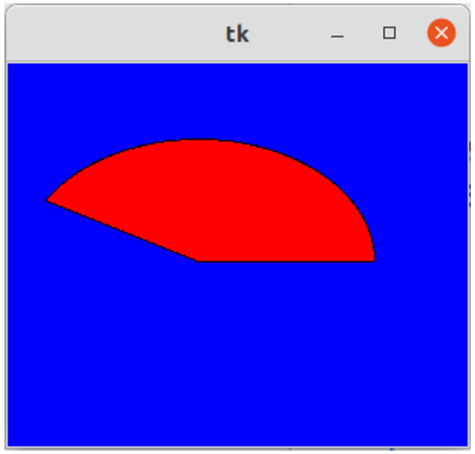
  oval = canvas.create_oval(x0, y0, x1, y1, options)

- polygon . Creates a polygon item that must have at least three vertices.

  polygon = canvas.create_polygon(x0, y0, x1, y1,...xn, yn, options)

Example:

```
import tkinter

import tkinter.messagebox

top = tkinter.Tk()

C = tkinter.Canvas(top, bg="blue", height=250, width=300)

coord = 10, 50, 240, 210

arc = C.create_arc(coord, start=0, extent=150, fill="red")

C.pack()

top.mainloop()
```



Python - tkinter Checkbutton

The Checkbutton widget is used to display a number of options to a user as toggle buttons. The user can then select one or more options by clicking the button corresponding to each option.

You can also display images in place of text.

Syntax:

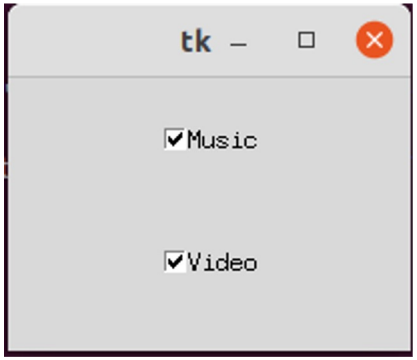
w = Checkbutton (master, option, ...)

Parameters:

- master: This represents the parent window.
- options: Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:

```
from tkinter import *

import tkinter.messagebox

import tkinter

top = tkinter.Tk()

CheckVar1 = IntVar()

CheckVar2 = IntVar()

C1 = Checkbutton(top, text = "Music", variable
= CheckVar1, \

    onvalue = 1, offvalue = 0, height=5, width =
20)

C2 = Checkbutton(top, text = "Video", variable
= CheckVar2, \

    onvalue = 1, offvalue = 0, height=5, width =
20)

C1.pack()

C2.pack()

top.mainloop()
```



Python - Tkinter Entry:

- The Entry widget is used to accept single-line text strings from a user.
- If you want to display multiple lines of text that can be edited, then you should usethe Text widget.
- If you want to display one or more lines of text that cannot be modified by the user then you should use the Label widget.

Syntax:

Here is the simple syntax to create this widget:

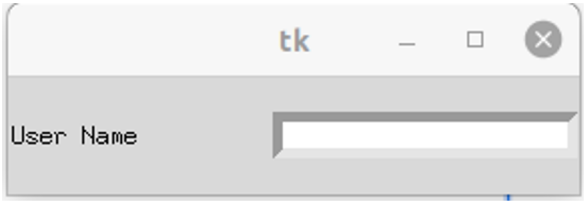
w = Entry(master, option, ...)

Parameters:

- master: This represents the parent window.
- options: Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:

```
from tkinter import *

top = Tk()

L1 = Label(top, text="User Name")

L1.pack( side = LEFT)

E1 = Entry(top, bd =5)

E1.pack(side = RIGHT)

top.mainloop()
```



Python - Tkinter Frame

The Frame widget is very important for the process of grouping and organizing other widgets in a somehow friendly way. It works like a container, which is responsible for arranging the position of other widgets.

It uses rectangular areas in the screen to organize the layout and to provide padding of these widgets. A frame can also be used as a foundation class to implement complex widgets.

Python - Tkinter Frame

Syntax:

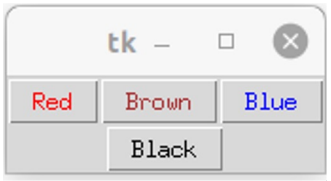
Here is the simple syntax to create this widget:

w = Frame (master, option, ...)

Parameters:

- master: This represents the parent window.
- options: Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:




```
from tkinter import *

root = Tk()

frame = Frame(root)

frame.pack()

bottomframe = Frame(root)

bottomframe.pack( side = BOTTOM )

redbutton = Button(frame, text="Red",
fg="red")

redbutton.pack( side = LEFT)

greenbutton = Button(frame, text="Brown",
fg="brown")

greenbutton.pack( side = LEFT )

bluebutton = Button(frame, text="Blue",
fg="blue")

bluebutton.pack( side = LEFT )

blackbutton = Button(bottomframe,
text="Black", fg="black")

blackbutton.pack( side = BOTTOM)

root.mainloop()
```

Python - Tkinter Label

This widget implements a display box where you can place text or images. The text displayed by this widget can be updated at any time you want.

It is also possible to underline part of the text (like to identify a keyboard shortcut), and span the text across multiple lines.

Syntax: Here is the simple syntax to create this widget:

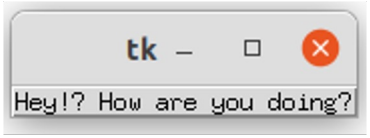
w = Label (master, option, ...)

Parameters:

- **master**: This represents the parent window.
- **options**: Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:

```
from tkinter import *

root = Tk()

var = StringVar()

label = Label( root, textvariable=var, relief=RAISED )

var.set("Hey!? How are you doing?")

label.pack()

root.mainloop()
```



Python - Tkinter Listbox

The Listbox widget is used to display a list of items from which a user can select a number of items

Syntax: Here is the simple syntax to create this widget:

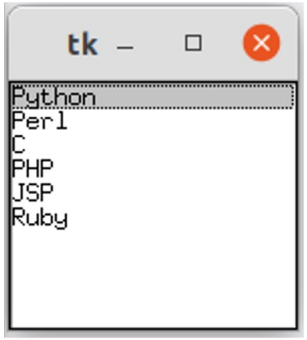
```
w = Listbox ( master, option, ... )
```

Parameters:

- master: This represents the parent window.
- options: Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:

```
from tkinter import *
import tkinter.messagebox
import tkinter
top = Tk()
Lb1 = Listbox(top)
Lb1.insert(1, "Python")
Lb1.insert(2, "Perl")
Lb1.insert(3, "C")
Lb1.insert(4, "PHP")
Lb1.insert(5, "JSP")
Lb1.insert(6, "Ruby")
Lb1.pack()
top.mainloop()
```



Python - Tkinter Menubutton

A menubutton is the part of a drop-down menu that stays on the screen all the time. Every menubutton is associated with a Menu widget that can display the choices for that menubutton when the user clicks on it.

Syntax: Here is the simple syntax to create this widget:

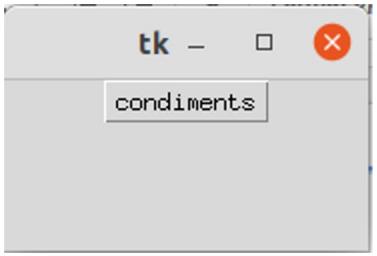
w = Menubutton (master, option, ...)

Parameters:

- **master**: This represents the parent window.
- **options**: Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:

```
from tkinter import *

import tkinter.messagebox

import tkinter

top = Tk()

mb=  Menubutton ( top,
text="condiments", relief=RAISED )

mb.grid()

mb.menu  =  Menu ( mb, tearoff = 0 )

mb["menu"]  =  mb.menu

mayoVar  = IntVar()

ketchVar = IntVar()

mb.menu.add_checkbutton (
label="mayo", variable=mayoVar )

mb.menu.add_checkbutton (
label="ketchup",
variable=ketchVar )

mb.pack()

top.mainloop()
```



Python - Tkinter Message

- This widget provides a multiline and noneditable object that displays texts, automatically breaking lines and justifying their contents.
- Its functionality is very similar to the one provided by the Label widget, except that it can also automatically wrap the text, maintaining a given width or aspect ratio.

Syntax: Here is the simple syntax to create this widget:

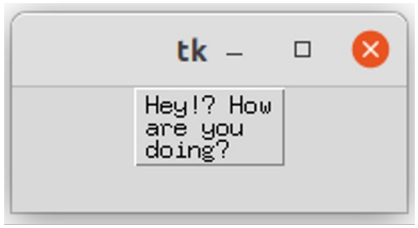
```
w = Message ( master, option, ... )
```

Parameters:

- master: This represents the parent window.
- options: Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example

```
from tkinter import *

root = Tk()

var = StringVar()

label = Message( root, textvariable=var, relief=RAISED )

var.set("Hey!? How are you doing?")

label.pack()

root.mainloop()
```



Python - Tkinter Radiobutton

- This widget implements a multiple-choice button, which is a way to offer many possible selections to the user, and let user choose only one of them.
- In order to implement this functionality, each group of radiobuttons must be associated to the same variable, and each one of the buttons must symbolize a single value. You can use the Tab key to switch from one radionbutton to another.

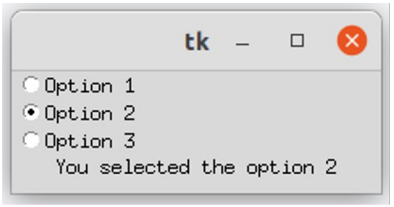
Syntax: Here is the simple syntax to create this widget:

```
w = Radiobutton ( master, option, ... )
```

Parameters:

- **master:** This represents the parent window.
- **options:** Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:




```
from tkinter import *

def sel():

   selection = "You selected the option " +
str(var.get())

   label.config(text = selection)

root = Tk()

var = IntVar()

R1 = Radiobutton(root, text="Option 1",
variable=var, value=1, command=sel)

R1.pack( anchor = W )

R2 = Radiobutton(root, text="Option 2",
variable=var, value=2,command=sel)

R2.pack( anchor = W )

R3 = Radiobutton(root, text="Option 3",
variable=var, value=3,command=sel)

R3.pack( anchor = W)

label = Label(root)

label.pack()

root.mainloop()
```

Python - Tkinter Scale

The Scale widget provides a graphical slider object that allows you to select values from a specific scale.

Syntax: Here is the simple syntax to create this widget:

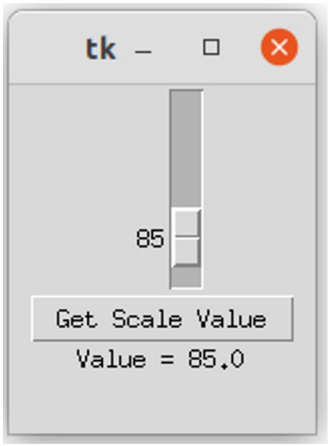
w = Scale (master, option, ...)

Parameters:

- **master:** This represents the parent window.
- **options:** Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:

```
from tkinter import *

def sel():
   selection = "Value = " + str(var.get())
   label.config(text = selection)
```




```
root = Tk()

var = DoubleVar()

scale = Scale( root, variable = var )

scale.pack(anchor=CENTER)

button = Button(root, text="Get Scale Value",
command=sel)

button.pack(anchor=CENTER)

label = Label(root)

label.pack()

root.mainloop()
```

Python - Tkinter Scrollbar

This widget provides a slide controller that is used to implement vertical scrolled widgets, such as Listbox, Text, and Canvas. Note that you can also create horizontal scrollbars on Entry widgets.

Syntax: Here is the simple syntax to create this widget:

w = Scrollbar (master, option, ...)

Parameters:

- **master:** This represents the parent window.
- **options:** Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:


```
from tkinter import *

root = Tk()

scrollbar = Scrollbar(root)

scrollbar.pack( side = RIGHT, fill=Y )

mylist = Listbox(root, yscrollcommand
= scrollbar.set )

for line in range(100):

    mylist.insert(END, "This is line
    number " + str(line))

mylist.pack( side = LEFT, fill = BOTH )

scrollbar.config( command =
mylist.yview )

mainloop()
```

Python - Tkinter Text

- Text widgets provide advanced capabilities that allow you to edit a multiline text and format the way it has to be displayed, such as changing its color and font.
- You can also use elegant structures like tabs and marks to locate specific sections of the text, and apply changes to those areas. Moreover, you can embed windows and images in the text because this widget was designed to handle both plain and formatted text.

Syntax: Here is the simple syntax to create this widget:

w = Text (master, option, ...)

Parameters:

- **master**: This represents the parent window.
- **options**: Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:


```
from tkinter import *

def onclick():
        pass

root = Tk()

text = Text(root)

text.insert(INSERT, "Hello.....")

text.insert(END, "Bye Bye.....")

text.pack()

text.tag_add("here", "1.0", "1.4")

text.tag_add("start", "1.8", "1.13")

text.tag_config("here", background="yellow",
foreground="blue")

text.tag_config("start", background="black",
foreground="green")

root.mainloop()
```

Python - Tkinter Toplevel

- Toplevel widgets work as windows that are directly managed by the window manager. They do not necessarily have a parent widget on top of them.
- Your application can use any number of top-level windows.

Syntax: Here is the simple syntax to create this widget:

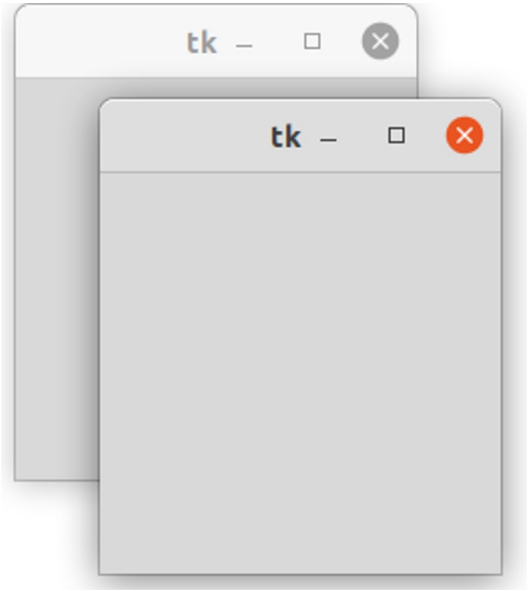
w = Toplevel (option, ...)

Parameters:

- **options:** Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:

```
from tkinter import *

root = Tk()

top = Toplevel()

top.mainloop()
```



Python - Tkinter 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.

Syntax:

Here is the simple syntax to create this widget:

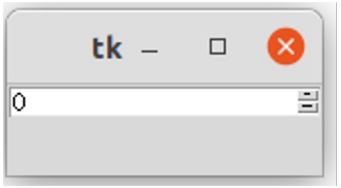
w = Spinbox(master, option, ...)

Parameters:

- **master:** This represents the parent window.
- **options:** Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:

```
from tkinter import *

master = Tk()

w = Spinbox(master, from_=0, to=10)

w.pack()

mainloop()
```



Python - Tkinter PanedWindow

- A PanedWindow is a container widget that may contain any number of panes, arranged horizontally or vertically.
- Each pane contains one widget, and each pair of panes is separated by a moveable (via mouse movements) sash. Moving a sash causes the widgets on either side of the sash to be resized.

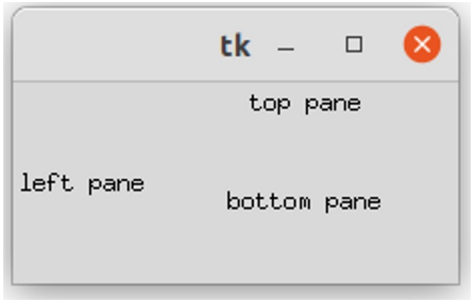
Syntax: Here is the simple syntax to create this widget:

w = PanedWindow(master, option, ...)

Parameters:

- **master:** This represents the parent window.
- **options:** Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:




```
from tkinter import *

m1 = PanedWindow()

m1.pack(fill=BOTH, expand=1)

left = Label(m1, text="left pane")

m1.add(left)

m2 = PanedWindow(m1, orient=VERTICAL)

m1.add(m2)

top = Label(m2, text="top pane")

m2.add(top)

bottom = Label(m2, text="bottom pane")

m2.add(bottom)

mainloop()
```

Python - Tkinter LabelFrame

- A labelframe is a simple container widget. Its primary purpose is to act as a spacer or container for complex window layouts.
- This widget has the features of a frame plus the ability to display a label.

Syntax: Here is the simple syntax to create this widget:

```
w = LabelFrame( master, option, ... )
```

Parameters:

- **master:** This represents the parent window.
- **options:** Here is the list of most commonly used options for this widget. These options can be used as key-value pairs separated by commas.

Example:


```
from tkinter import *

root = Tk()

labelframe = LabelFrame(root, text="This is a LabelFrame")

labelframe.pack(fill="both", expand="yes")

left = Label(labelframe, text="Inside the LabelFrame")

left.pack()

root.mainloop()
```

17. Python Exceptions Handling

17. Python Exceptions Handling

Python provides two very important features to handle any unexpected error in your Python programs and to add debugging capabilities in them:

- **Exception Handling:** This would be covered in this tutorial.
- **Assertions:** This would be covered in Assertions in Python tutorial.

What is Exception?

- An exception is an event, which occurs during the execution of a program, that disrupts the normal flow of the program's instructions.
- In general, when a Python script encounters a situation that it can't cope with, it raises an exception. An exception is a Python object that represents an error.
- When a Python script raises an exception, it must either handle the exception immediately otherwise it would terminate and come out.

Handling an exception:

If you have some suspicious code that may raise an exception, you can defend your program by placing the suspicious code in a try: block.

After the **try:** block, include an **except:** statement, followed by a block of code which handles the problem as elegantly as possible.

Syntax:

```
try:
        You do your operations here;
        ......................
except Exception I:
        If there is Exception I, then execute this
block.
except Exception II:
        If there is Exception II, then execute this
block.
        ......................
else:
        If there is no exception then execute this
block.
```

Here are few important points above the above mentioned syntax:

- A single try statement can have multiple except statements. This is useful when the try block contains statements that may throw different types of exceptions.
- You can also provide a generic except clause, which handles any exception.
- After the except clause(s), you can include an else-clause. The code in the else-block executes if the code in the try: block does not raise an exception.
- The else-block is a good place for code that does not need the try: block's protection.

Example:

```
try:
        fh = open("testfile", "w")
        fh.write("This is my test file for exception handling!!")
except IOError: print("Error: can\'t find file or read data")
else: print "Written content in the file successfully"
fh.close()
```

This will produce following result:

```
Written content in the file successfully
```

The except clause with no exceptions:

You can also use the except statement with no exceptions defined as follows:

try:

    You do your operations here;

    ……..

except:

    If there is any exception, then execute this block. ……..

else:

    If there is no exception then execute this block.

This kind of a **try-except** statement catches all the exceptions that occur. Using this kind of try-except statement is not considered a good programming practice, though, because it catches all exceptions but does not make the programmer identify the root cause of the problem that may occur.

The except clause with multiple exceptions:

You can also use the same except statement to handle multiple exceptions as follows:

try:

    You do your operations here;

    ....

except(Exception1[, Exception2[,...ExceptionN]]]):

    If there is any exception from the given exception list, then execute this block

    ....

else:

    If there is no exception then execute this block.

Standard Exceptions:

Here is a list standard Exceptions available in Python: Standard Exceptions

The try-finally clause:

You can use a finally: block along with a try: block. The finally block is a place to put any code that must execute, whether the try-block raised an exception or not. The syntax of the try-finally statement is this:

try:

You do your operations here;

.....

Due to any exception, this may be skipped.

finally:

This would always be executed.

.....

Note that you can provide except clause(s), or a finally clause, but not both. You can not use else clause as well along with a finally clause.

Example:

```
try:
        fh = open("testfile", "w")
        fh.write("This is my test file for exception handling!!")
finally:
        print("Error: can\'t find file or read data")
```

If you do not have permission to open the file in writing mode then this will produce following result:

```
Error: can't find file or read data
```

Reading and Writing Files:

The ***file*** object provides a set of access methods to make our lives easier. We would see how to use read() and write() methods to read and write files.

The write() Method:

- The write() method writes any string to an open file. It is important to note that Python strings can have binary data and not just text.
- The write() method does not add a newline character ('\n') to the end of the string.

Syntax:

fileObject.write(string);

Argument of an Exception:

An exception can have an argument, which is a value that gives additional information about the problem. The contents of the argument vary by exception. You capture an exception's argument by supplying a variable in the except clause as follows:

try:

    You do your operations here;

    ……..

except *ExceptionType*, *Argument*:

    You can print value of Argument here...

Argument of an Exception:

If you are writing the code to handle a single exception, you can have a variable follow the name of the exception in the except statement. If you are trapping multiple exceptions, you can have a variable follow the tuple of the exception.

This variable will receive the value of the exception mostly containing the cause of the exception. The variable can receive a single value or multiple values in the form of a tuple. This tuple usually contains the error string, the error number, and an error location.

Example:

Following is an example for a single exception:

```
def temp_convert(var):
        try:
                return int(var)
        except ValueError, Argument:
                print("The argument does not contain numbers\n", Argument)

temp_convert("xyz");
```

This would produce following result:

```
The argument does not contain numbers
invalid literal for int() with base 10: 'xyz'
```

Raising an exceptions:

You can raise exceptions in several ways by using the raise statement. The general syntax for the raise statement.

Syntax:

raise [Exception [, args [, traceback]]]

- Here Exception is the type of exception (for example, NameError) and argument is a value for the exception argument. The argument is optional; if not supplied, the exception argument is None.
- The final argument, traceback, is also optional (and rarely used in practice), and, if present, is the traceback object used for the exception

Example:

```
def functionName( level ):
        if level < 1:
        raise "Invalid level!", level
        # The code below to this would not be executed
        # if we raise the exception
```

Note: In order to catch an exception, an "except" clause must refer to the same exception thrown either class object or simple string. For example to capture above exception we must write our except clause as follows:

```
try:
        Business Logic here...
except "Invalid level!":
        Exception handling here...
else:
        Rest of the code here...
```

User-Defined Exceptions:

- Python also allows you to create your own exceptions by deriving classes from the standard built-in exceptions.
- Here is an example related to RuntimeError. Here a class is created that is subclassed from RuntimeError. This is useful when you need to display more specific information when an exception is caught.
- In the try block, the user-defined exception is raised and caught in the except block. The variable e is used to create an instance of the class Networkerror.

```
class Networkerror(RuntimeError):
        def __init__(self, arg):
                self.args = arg
```

So once you defined above class, you can raise your exception as follows:

```
try:
        raise Networkerror("Bad hostname")
except Networkerror,e:
        print(e.args)
```