FEU Institute of Technology

(INTEGRATIVE PROGRAMMING AND TECHNOLOGIES)

EXERCISE

8

(GUI Development)

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Data Performed	Date Submitted

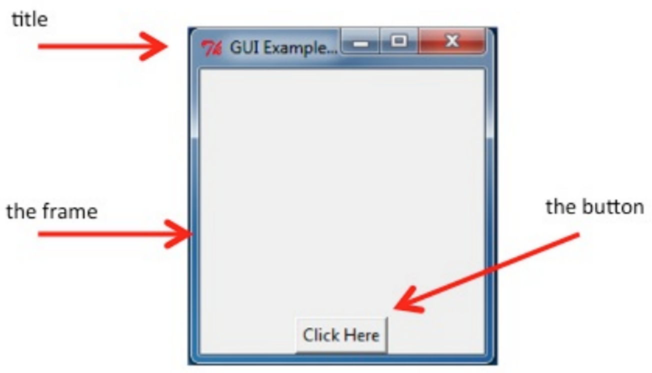
1 Exercise 1: A First GUI Program

The following program is available for download (called exercise1.py). Find the program, open it using IDLE and run it.

```
# Import the Tkinter package
#     Note in Python 3 it is all lowercase
from tkinter import *

# This method is called when the button is pressed
def clicked():
    print("Clicked")

# Create a main frame with
#      - a title
#      - size 200 by 200 pixels
app = Tk()
app.title("GUI Example 1")
app.geometry('200x200')

# Create the button with
#     - suitable text
#     - a command to call when the button is pressed
button1 = Button(app, text="Click Here", command=clicked)

# Make the button visible at the bottom of the frame
button1.pack(side='bottom')

# Start the application running
app.mainloop()
```

Exercise 1.1: Run the Program

Find the program (or type it in), open it using IDLE and run it. It should look like this:

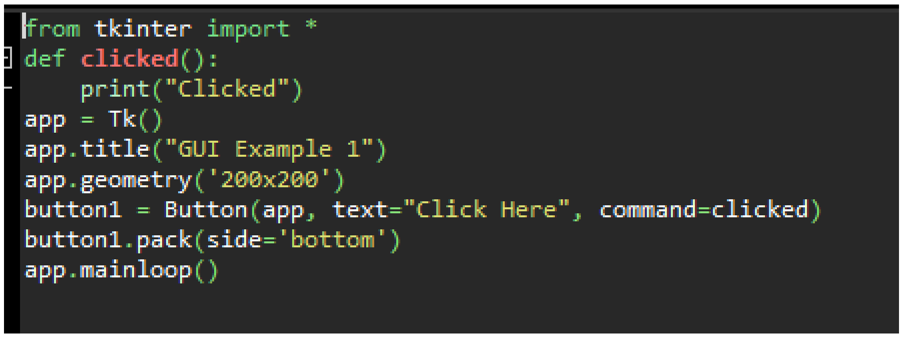


Also experiment with 'usual' windows operation such as resizing the window, minimising it and closing it.

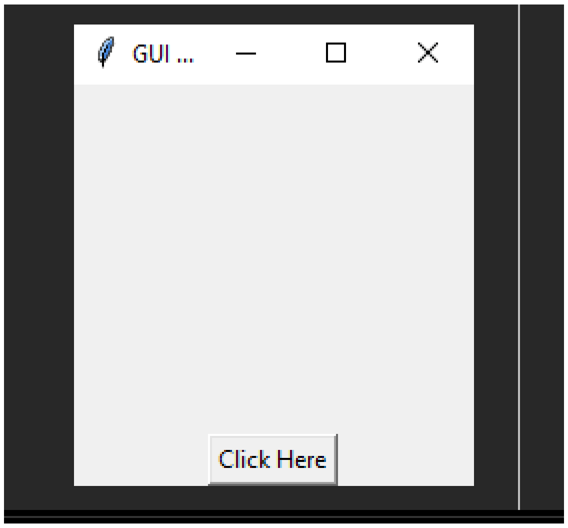
Exercise 1.2: Modify the Program

Although it has not been explained yet, see if you can figure out how to make the following modifications:

- Change the title
- Change the text in the button
- Change the text printed when the button is pressed
- Change the size (geometry) of the rectangular frame
- Move the button to the top of the frame



```
from tkinter import *
def clicked():
    print("Clicked")
app = Tk()
app.title("GUI Example 1")
app.geometry('200x200')
button1 = Button(app, text="Click Here", command=clicked)
button1.pack(side='bottom')
app.mainloop()
```

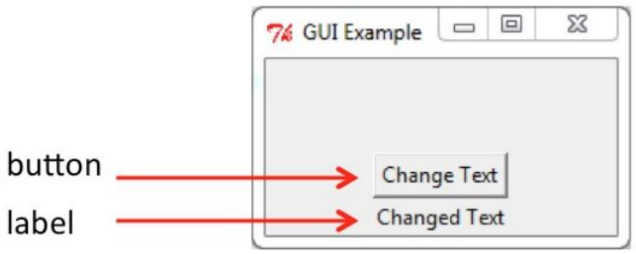


2 Exercise 2: Label Widget

This exercise:

- Introduces the label widget
- Practices getting and setting attributes.

Run the given program: exercise2.py. It should display the following:

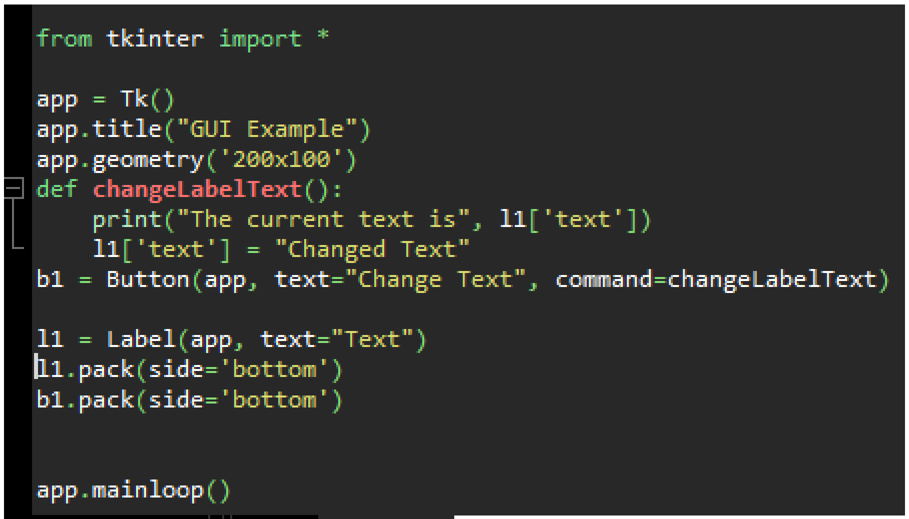


The widgets are:

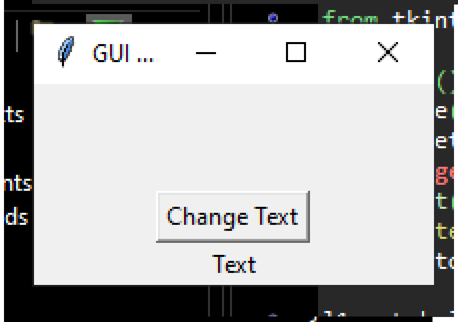
- Label: a single line text that is displayed
- Button: (see exercise 1)

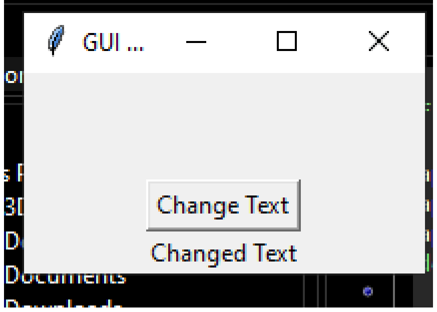
The intended behaviour is:

- Text is entered in entry widget



```
from tkinter import *

app = Tk()
app.title("GUI Example")
app.geometry('200x100')
def changeLabelText():
    print("The current text is", l1['text'])
    l1['text'] = "Changed Text"
b1 = Button(app, text="Change Text", command=changeLabelText)

l1 = Label(app, text="Text")
l1.pack(side='bottom')
b1.pack(side='bottom')


app.mainloop()
```





- When the button is pressed the text changes, toggling between two messages.

Exercise 2.1: Getting and Setting Attributes

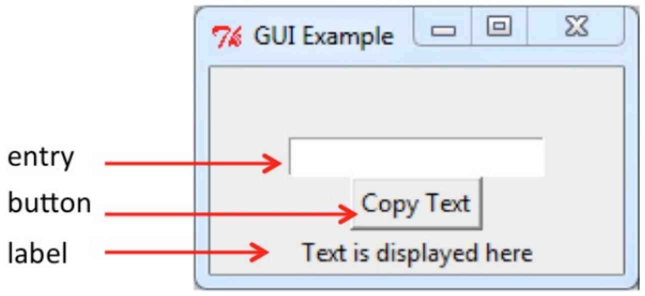
In the given code, pressing the button only changes the label text once. Change it so that it toggles, as described above.

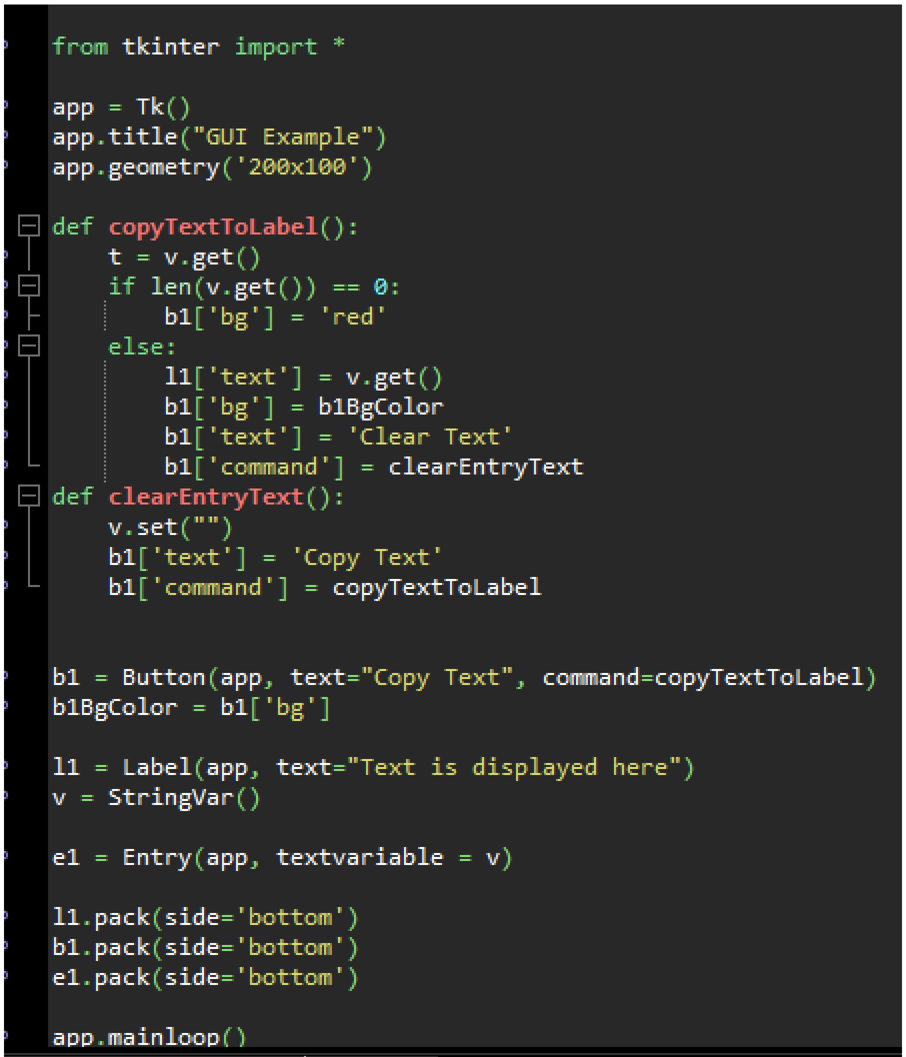
Exercise 2.2: Further Attributes

The background colour of the button is determined by an attribute ‘bg’ or ‘background’ (the two are equivalent). Further enhance the program to cycle the background colour of the button through 3 different colours, as well as changing the txt.

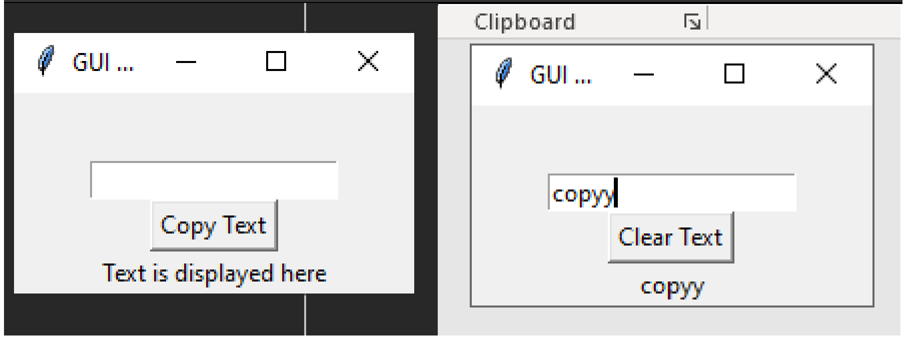
3 Exercise 3: Adding an Entry Widget

This exercise adds an ‘entry’ widget to the previous exercise. Run the given program exercise3.py, displaying:





```
from tkinter import *

app = Tk()
app.title("GUI Example")
app.geometry('200x100')

def copyTextToLabel():
    t = v.get()
    if len(v.get()) == 0:
        b1['bg'] = 'red'
    else:
        l1['text'] = v.get()
        b1['bg'] = b1BgColor
        b1['text'] = 'Clear Text'
        b1['command'] = clearEntryText
def clearEntryText():
    v.set("")
    b1['text'] = 'Copy Text'
    b1['command'] = copyTextToLabel


b1 = Button(app, text="Copy Text", command=copyTextToLabel)
b1BgColor = b1['bg']

l1 = Label(app, text="Text is displayed here")
v = StringVar()

e1 = Entry(app, textvariable = v)

l1.pack(side='bottom')
b1.pack(side='bottom')
e1.pack(side='bottom')

app.mainloop()
```



The widgets are:

- Label: a single line text that is displayed (see exercise 2)
- Button: (see exercise 1)
- Entry: a single line text that can be entered

The intended behaviour is:

- Text is entered in entry widget
- When the button is pressed the label text is updated with the entered text

<u>Exercise 3.1</u>: Complete Program

In the provided program, when you enter text in the box (the Entry widget) and press the button, it only prints the text from the entry. Complete it to give the intended behaviour described above.

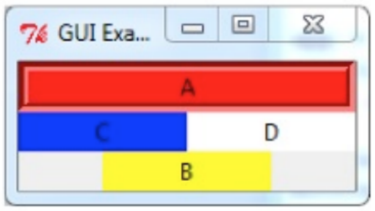
<u>Exercise 3.2</u>: Elaborations

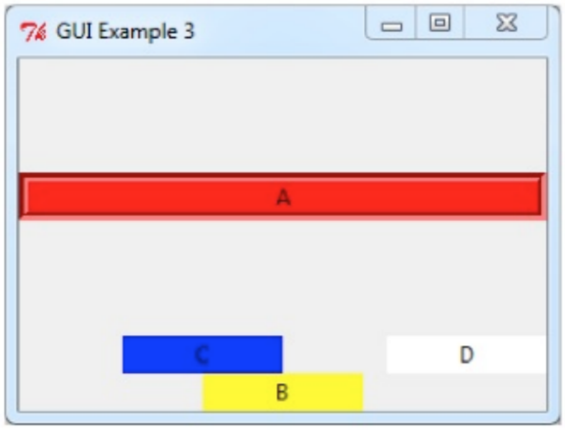
- When the button is pressed, check if the entered text is blank (i.e. has zero length). If so, do not copy it but instead set the background of the button red. Restore the original background colour when the button is pressed and some text has been entered.
- After the button has been pressed and the label changed, make the next press of the button clear the text in the entry widget. Change the button text so that the user understands what is happening.

4 Exercise 4: Managing Layout

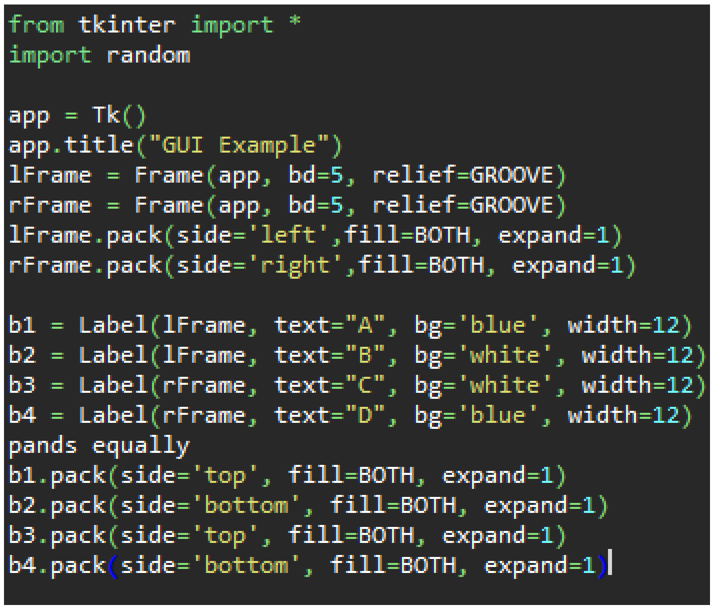
The aim of this exercise is to learn more about layout using the 'pack' layout manager. *The principles of packing are described in the additional notes at the end*.

The program exercise4.py displays the following (left hand picture shows the original display and the right hand side shows what happens when the window is resized):

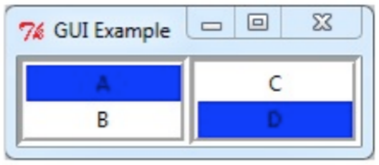


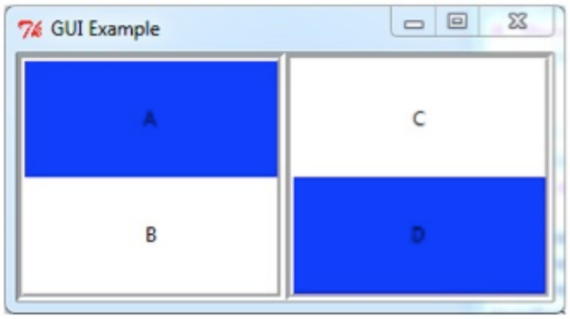


The desired behaviour is shown below. The four labels are positioned at the corners and the labels fill the space when the window is resized.



```
from tkinter import *
import random

app = Tk()
app.title("GUI Example")
lFrame = Frame(app, bd=5, relief=GROOVE)
rFrame = Frame(app, bd=5, relief=GROOVE)
lFrame.pack(side='left',fill=BOTH, expand=1)
rFrame.pack(side='right',fill=BOTH, expand=1)

b1 = Label(lFrame, text="A", bg='blue', width=12)
b2 = Label(lFrame, text="B", bg='white', width=12)
b3 = Label(rFrame, text="C", bg='white', width=12)
b4 = Label(rFrame, text="D", bg='blue', width=12)
pands equally
b1.pack(side='top', fill=BOTH, expand=1)
b2.pack(side='bottom', fill=BOTH, expand=1)
b3.pack(side='top', fill=BOTH, expand=1)
b4.pack(side='bottom', fill=BOTH, expand=1)
```



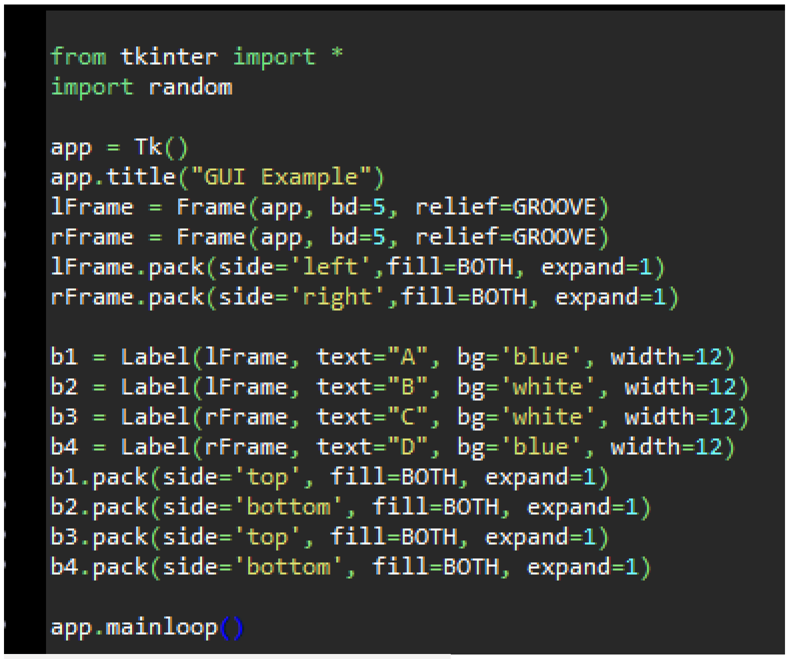


Exercise 4.1: Arrange the labels is a square grid

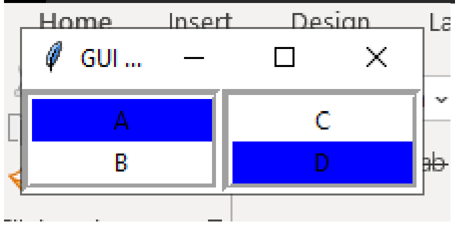
With the pack layout manager this means introduces extra frames so that the labels are in the frames and the frames are in the top-level window. In the diagram above, the frames have a border so they can be seen.

Exercise 4.2: Support resizing

Use the 'expand' and 'fill' attributes of the pack method to make the labels grow and expand into the available space. There is more guidance in code comments.



```
from tkinter import *
import random

app = Tk()
app.title("GUI Example")
lFrame = Frame(app, bd=5, relief=GROOVE)
rFrame = Frame(app, bd=5, relief=GROOVE)
lFrame.pack(side='left',fill=BOTH, expand=1)
rFrame.pack(side='right',fill=BOTH, expand=1)

b1 = Label(lFrame, text="A", bg='blue', width=12)
b2 = Label(lFrame, text="B", bg='white', width=12)
b3 = Label(rFrame, text="C", bg='white', width=12)
b4 = Label(rFrame, text="D", bg='blue', width=12)
b1.pack(side='top', fill=BOTH, expand=1)
b2.pack(side='bottom', fill=BOTH, expand=1)
b3.pack(side='top', fill=BOTH, expand=1)
b4.pack(side='bottom', fill=BOTH, expand=1)

app.mainloop()
```

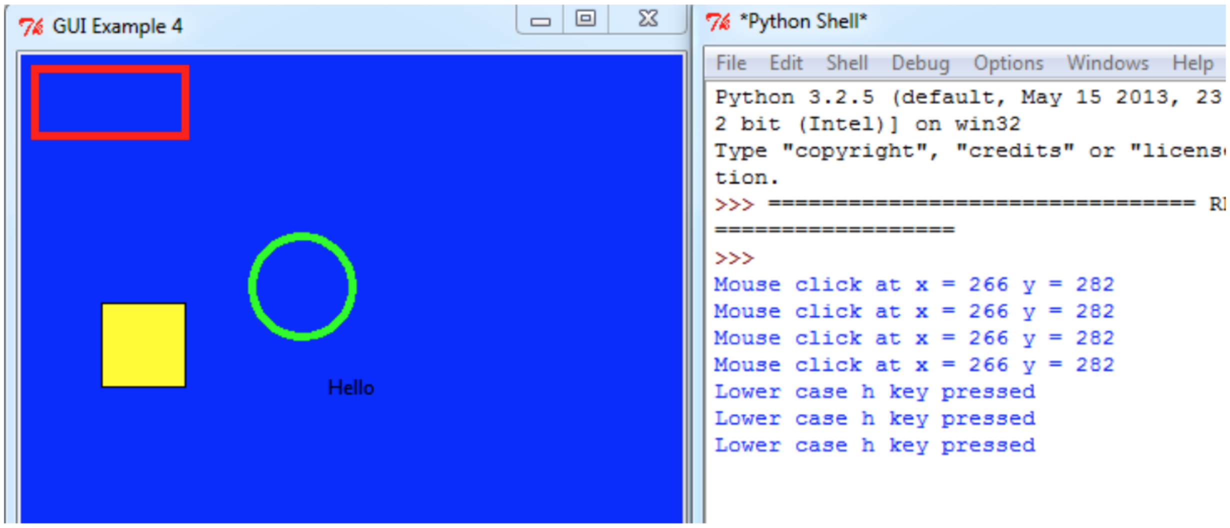


5 Exercise 5: The Drawing Canvas and Events

The aim of this exercise is to learn about the drawing canvas and also to use two new types of events:

1. Key press events
2. Mouse click events

The program exercise5.py displays a canvas with some shapes:



```
Python 3.2.5 (default, May 15 2013, 23
2 bit (Intel)] on win32
Type "copyright", "credits" or "licens
tion.
>>> ================================ RI
==================
>>>
Mouse click at x = 266 y = 282
Mouse click at x = 266 y = 282
Mouse click at x = 266 y = 282
Mouse click at x = 266 y = 282
Lower case h key pressed
Lower case h key pressed
Lower case h key pressed
```

In addition, two events are bound:

- Pressing the key 'h'
- Clicking the left mouse button

Exercise 5.1: Draw a Square where the mouse is clicked

Instead of always drawing the same shapes, use the mouse to draw a square: the top-left corner of the square goes where the mouse is clicked.

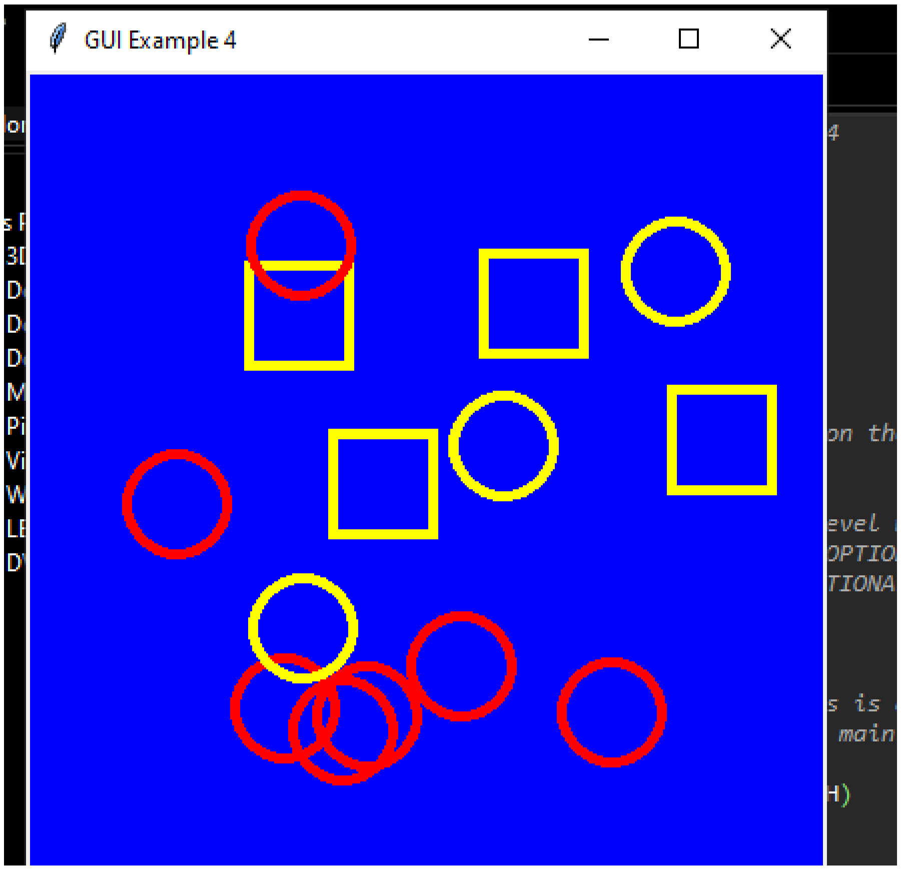
Exercise 5.2: Change the shape, colour and fill

Use keys to specify the shape, colour and whether the shape is filled. For example:

- Shape: 's' for square, 'c' for circle
- Filling: 'F' for filled, 'f' for unfilled
- Colour: 'y' for yellow, 'r' for red

Exercise 5.3: Interface Design

Using a pencil and paper, sketch some better interfaces to draw shapes. Consider either a) how to show what the current drawing options are or b) alternative ways to specify the shape, colour and filling, plus other features that could be useful.


GUI Example 4

Exercise 6.1: Add menu items

Add the new menu and menu items. At first, do not give a command.

Exercise 6.2: Implement Functions

Implement the functions to act on the command. You can use

- open(*filename, mode*) to open the file with mode 'r' and 'w'
- f.close(0 to close a file
- f.read() to read a whole file
- s.upper() to convert a string s to uppercase (returns a new string)
- f.write(*string*) to write a string to the file.

Exercise 6.3: Add checks

Add checks so that a) the program never crashes and b) the user does not lose work. The following table suggest which checks are needed. Display suitable messages in each case.

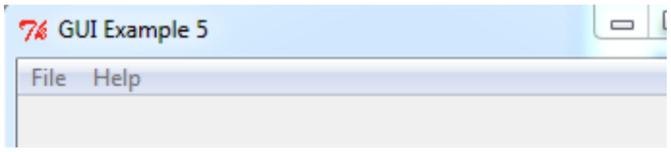
Command	Checks Needed
Open	Check for unsaved changes to the current file (Question)
Save	Check a file is open (Error) Check that changes need saving (Info)
Quit	Check for unsaved changes to the current file (Question)
Convert to upper	Check a file is open (Error)

6 Exercise 6: Dialogs and Menu

The aim of this exercise is to use dialogs and menus.

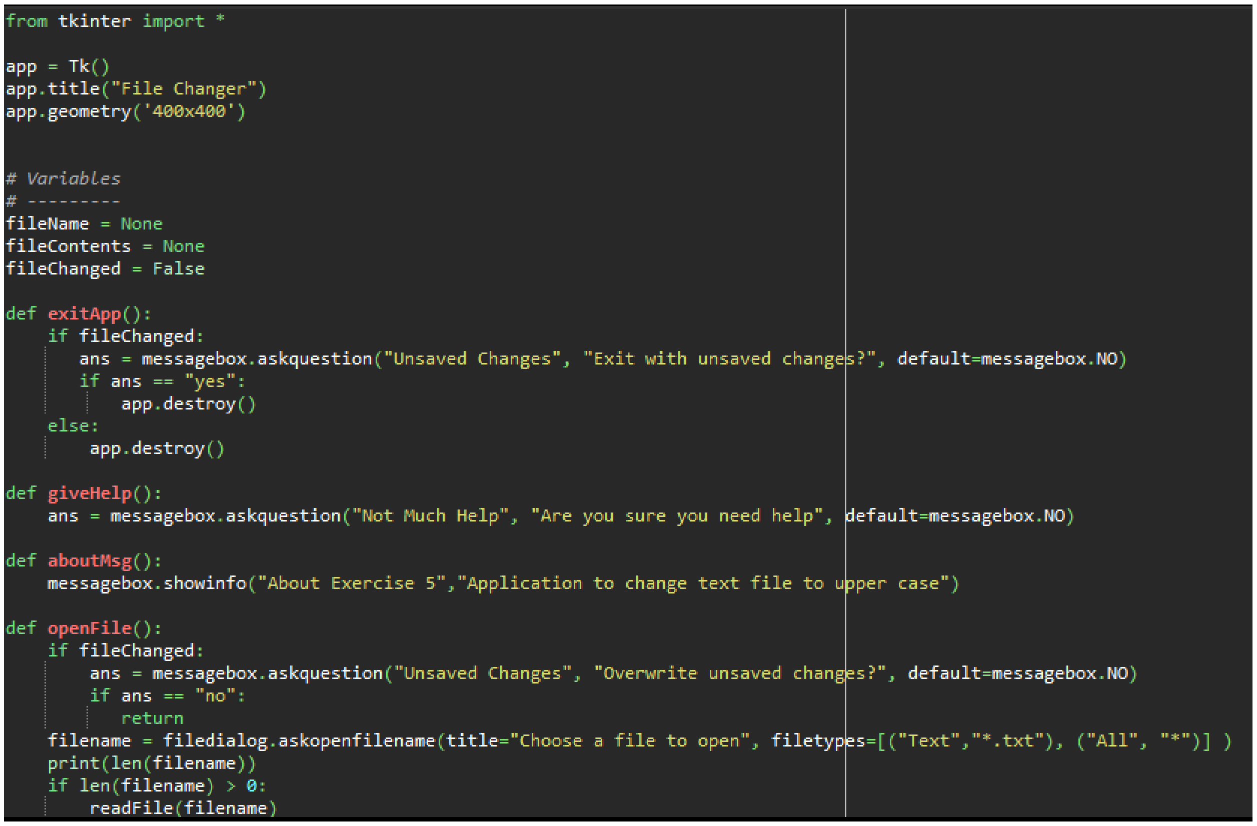
- A dialog displays a window requiring a response before the user can continue. We will look at message boxes and a file choosing dialog.
- A menu shows a menubar with menu items that expand when clicked to offer some command.

The program example6.py displays a frame, with two menu items.

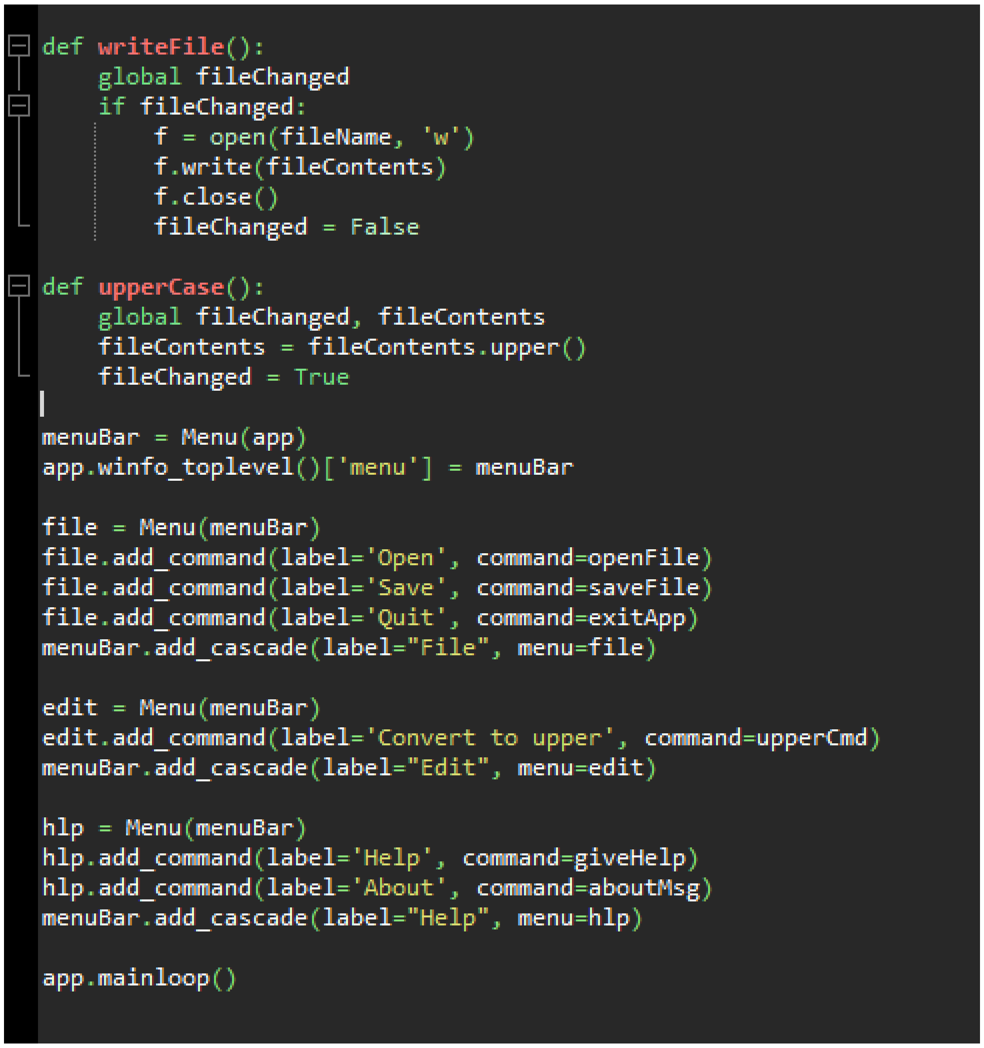


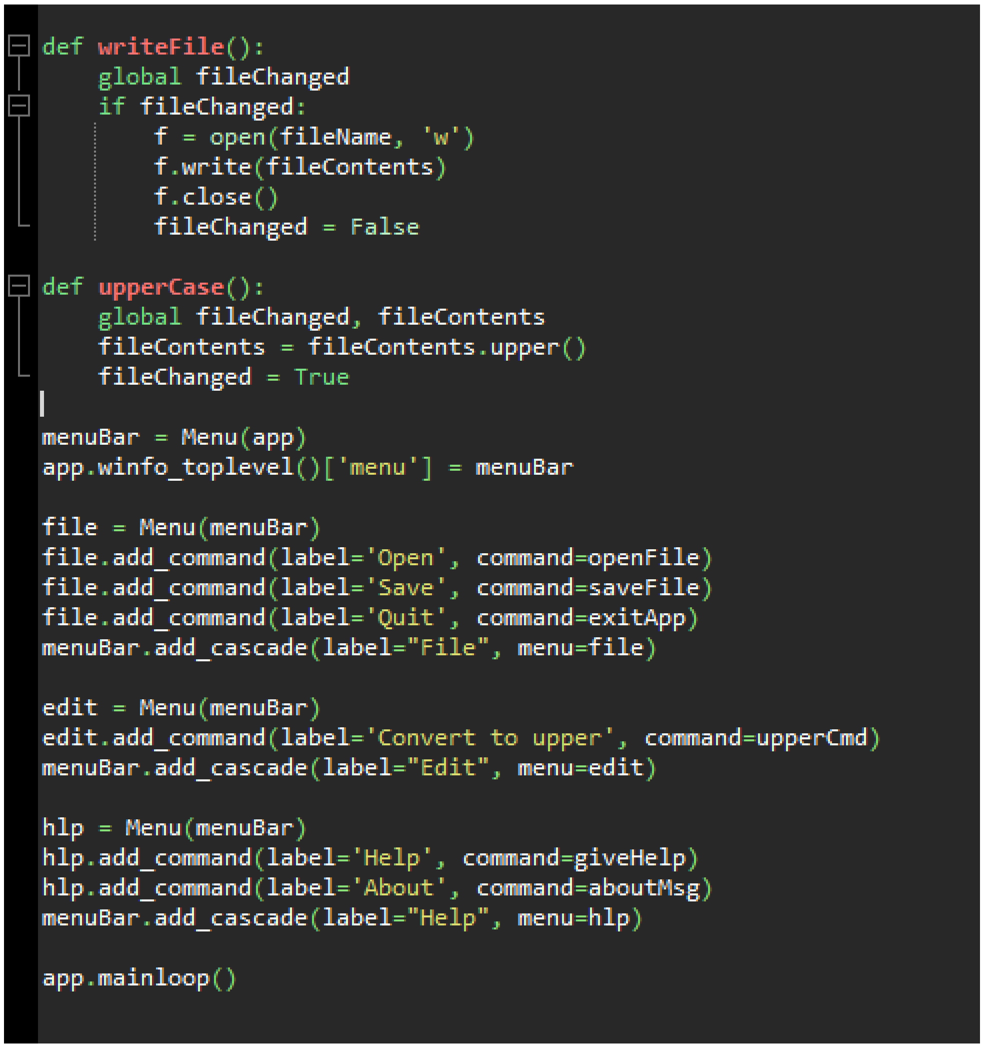
It does not do much yet! Change it to a simple application that can read a file, convert it to upper case and save it again. The commands are:

Menu	Command	Description
File	Open	Open a new file
	Save	Save the existing file
	Quit	Quit the application
Edit	Convert to upper	Convert the file contents to upper case
About	Help	Useful help
	About	Information about the application

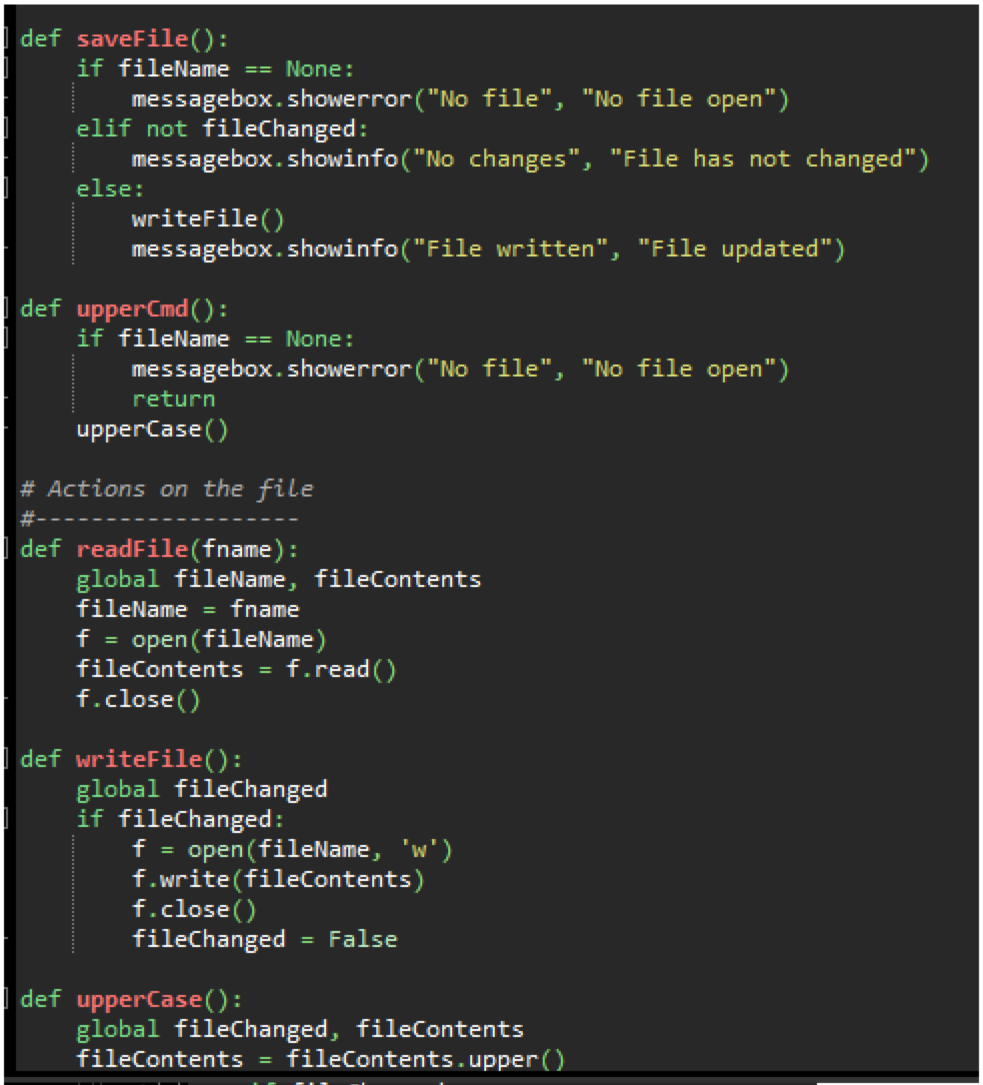


```python
from tkinter import *

app = Tk()
app.title("File Changer")
app.geometry('400x400')


# Variables
# ---------
fileName = None
fileContents = None
fileChanged = False

def exitApp():
    if fileChanged:
        ans = messagebox.askquestion("Unsaved Changes", "Exit with unsaved changes?", default=messagebox.NO)
        if ans == "yes":
            app.destroy()
    else:
        app.destroy()

def giveHelp():
    ans = messagebox.askquestion("Not Much Help", "Are you sure you need help", default=messagebox.NO)

def aboutMsg():
    messagebox.showinfo("About Exercise 5","Application to change text file to upper case")

def openFile():
    if fileChanged:
        ans = messagebox.askquestion("Unsaved Changes", "Overwrite unsaved changes?", default=messagebox.NO)
        if ans == "no":
            return
    filename = filedialog.askopenfilename(title="Choose a file to open", filetypes=[("Text","*.txt"), ("All", "*")] )
    print(len(filename))
    if len(filename) > 0:
        readFile(filename)
```

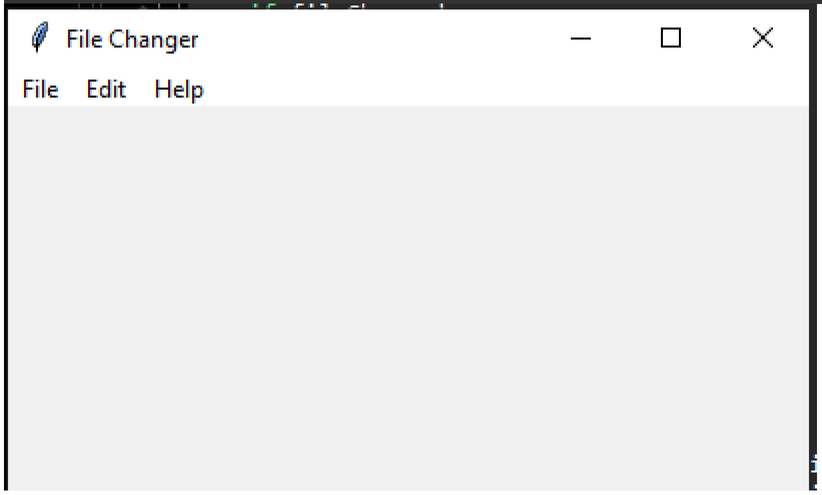

```
def writeFile():
    global fileChanged
    if fileChanged:
        f = open(fileName, 'w')
        f.write(fileContents)
        f.close()
        fileChanged = False

def upperCase():
    global fileChanged, fileContents
    fileContents = fileContents.upper()
    fileChanged = True

menuBar = Menu(app)
app.winfo_toplevel()['menu'] = menuBar

file = Menu(menuBar)
file.add_command(label='Open', command=openFile)
file.add_command(label='Save', command=saveFile)
file.add_command(label='Quit', command=exitApp)
menuBar.add_cascade(label="File", menu=file)

edit = Menu(menuBar)
edit.add_command(label='Convert to upper', command=upperCmd)
menuBar.add_cascade(label="Edit", menu=edit)

hlp = Menu(menuBar)
hlp.add_command(label='Help', command=giveHelp)
hlp.add_command(label='About', command=aboutMsg)
menuBar.add_cascade(label="Help", menu=hlp)

app.mainloop()
```



```python
def writeFile():
    global fileChanged
    if fileChanged:
        f = open(fileName, 'w')
        f.write(fileContents)
        f.close()
        fileChanged = False

def upperCase():
    global fileChanged, fileContents
    fileContents = fileContents.upper()
    fileChanged = True

menuBar = Menu(app)
app.winfo_toplevel()['menu'] = menuBar

file = Menu(menuBar)
file.add_command(label='Open', command=openFile)
file.add_command(label='Save', command=saveFile)
file.add_command(label='Quit', command=exitApp)
menuBar.add_cascade(label="File", menu=file)

edit = Menu(menuBar)
edit.add_command(label='Convert to upper', command=upperCmd)
menuBar.add_cascade(label="Edit", menu=edit)

hlp = Menu(menuBar)
hlp.add_command(label='Help', command=giveHelp)
hlp.add_command(label='About', command=aboutMsg)
menuBar.add_cascade(label="Help", menu=hlp)

app.mainloop()
```



```python
def saveFile():
    if fileName == None:
        messagebox.showerror("No file", "No file open")
    elif not fileChanged:
        messagebox.showinfo("No changes", "File has not changed")
    else:
        writeFile()
        messagebox.showinfo("File written", "File updated")

def upperCmd():
    if fileName == None:
        messagebox.showerror("No file", "No file open")
        return
    upperCase()

# Actions on the file
#-------------------
def readFile(fname):
    global fileName, fileContents
    fileName = fname
    f = open(fileName)
    fileContents = f.read()
    f.close()

def writeFile():
    global fileChanged
    if fileChanged:
        f = open(fileName, 'w')
        f.write(fileContents)
        f.close()
        fileChanged = False

def upperCase():
    global fileChanged, fileContents
    fileContents = fileContents.upper()
```

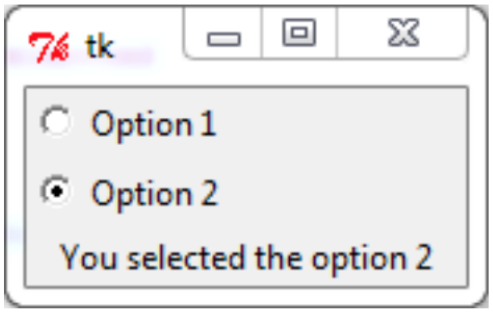


7 Exercise 7: Radio Button

The aim of this exercise is to use a radio button.

The program exercise7.py is shown below:

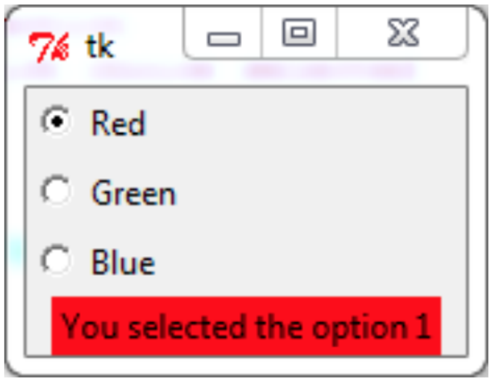
- There are two radio buttons
- Selecting one of the buttons changes the text of the label.



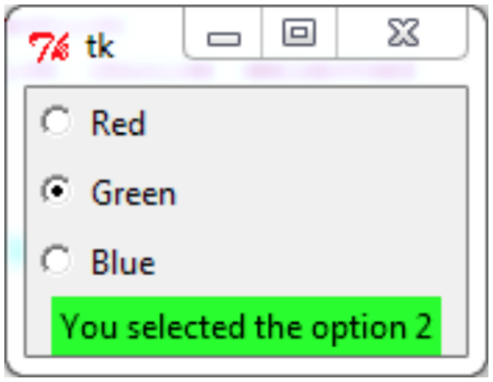
You selected the option 2

<u>Exercise 7.1</u>: Enhance the program

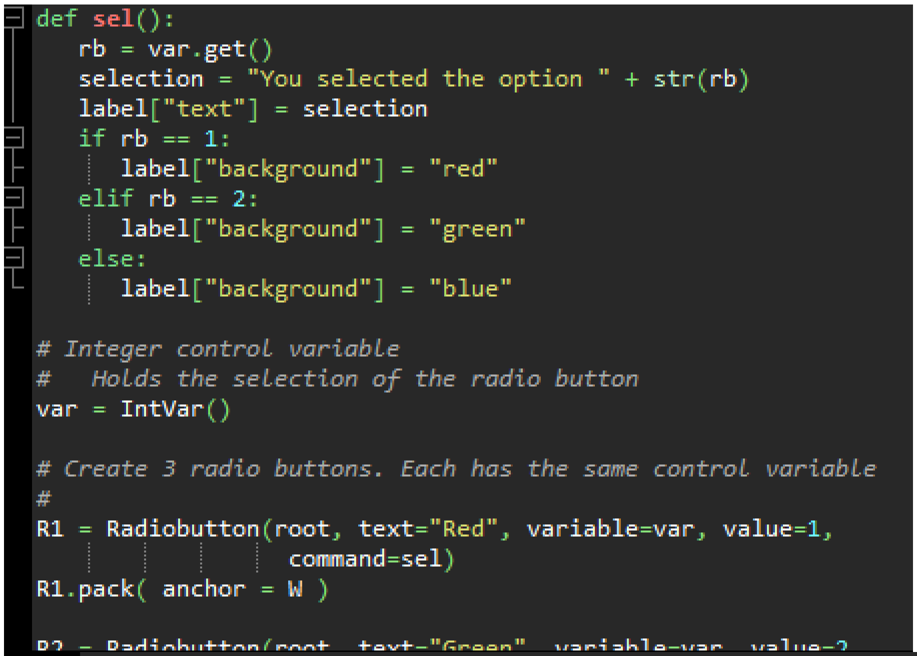
The complete program should change the colour of the button is well as the text, for a suitable choice of three (or more) colours.



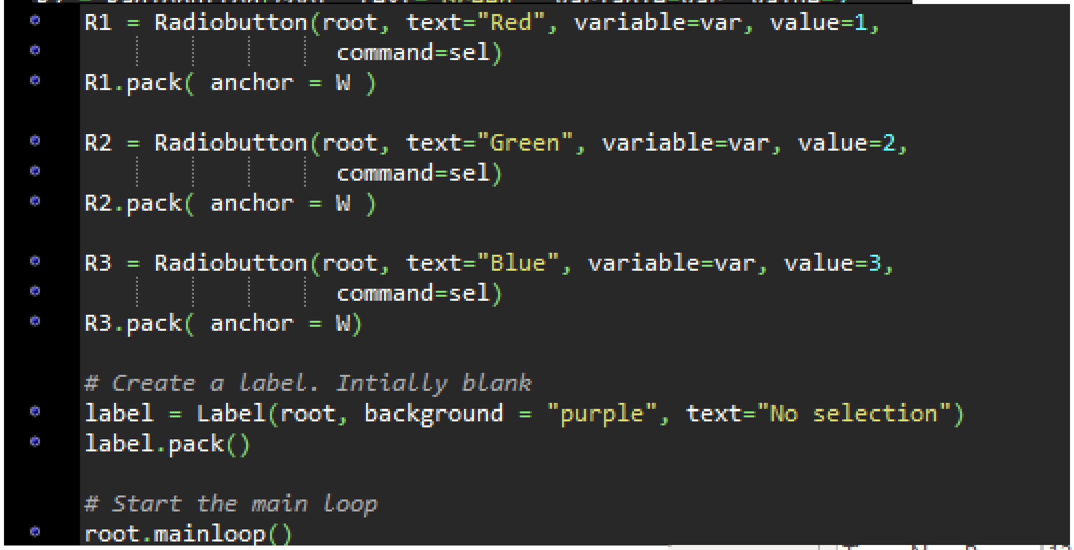
You selected the option 1



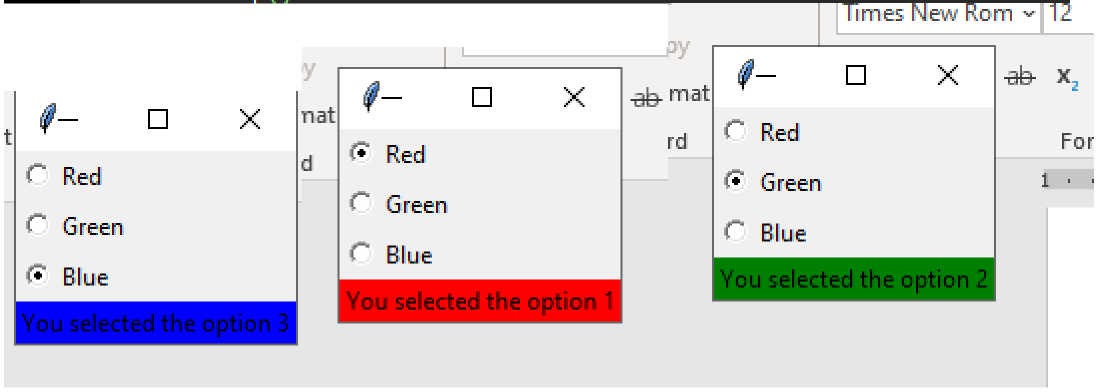
You selected the option 2



```
def sel():
    rb = var.get()
    selection = "You selected the option " + str(rb)
    label["text"] = selection
    if rb == 1:
        label["background"] = "red"
    elif rb == 2:
        label["background"] = "green"
    else:
        label["background"] = "blue"

# Integer control variable
#   Holds the selection of the radio button
var = IntVar()

# Create 3 radio buttons. Each has the same control variable
#
R1 = Radiobutton(root, text="Red", variable=var, value=1,
                 command=sel)
R1.pack( anchor = W )

R2 = Radiobutton(root, text="Green", variable=var, value=2
```



```
R1 = Radiobutton(root, text="Red", variable=var, value=1,
                 command=sel)
R1.pack( anchor = W )

R2 = Radiobutton(root, text="Green", variable=var, value=2,
                 command=sel)
R2.pack( anchor = W )

R3 = Radiobutton(root, text="Blue", variable=var, value=3,
                 command=sel)
R3.pack( anchor = W)

# Create a label. Intially blank
label = Label(root, background = "purple", text="No selection")
label.pack()

# Start the main loop
root.mainloop()
```



```
○ Red
○ Green
● Blue
You selected the option 3
```

```
● Red
○ Green
○ Blue
You selected the option 1
```

```
○ Red
● Green
○ Blue
You selected the option 2
```

8 Additional Notes

8.1 Layout

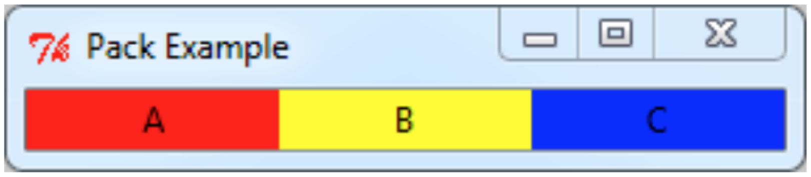
When a widget is created it needs to be positioned inside its parent. The positioning also needs to consider the possibility that the window may be resized. Layout is the responsibility of a layout manager: Tkinter offers a choice of layout managers.

These notes consider the 'pack' layout manager. It is simplest to get started with and also behaves ok for resizing. Other layout managers are 'place' and 'grid'; the latter is often recommended for more complex layouts.

The following two example program fragments illustrate the principles:

```
#
# Create three labels of given width
#
bA = Label(app, text="A", width=12, bg='red')
bB = Label(app, text="B", width=12, bg='yellow')
bC = Label(app, text="C", width=12, bg='blue')

# Pack horizontally
# -----------------
# Horizontal packing with
#   side = "left"
#   side = "right"
bA.pack(side='left')
bB.pack(side='left')
bC.pack(side='left')
```

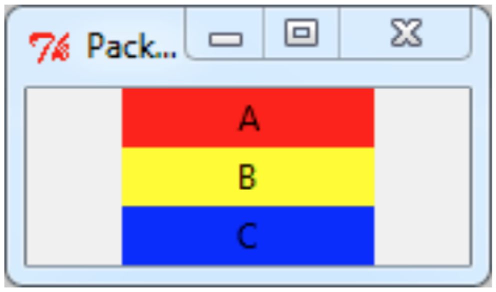
gives the display:



Whereas the vertical packing

```
# Pack vertically
# -----------------
# Vertical packing with
#   side = "top"
#   side = "bottom"
bA.pack(side='top')
bB.pack(side='top')
bC.pack(side='top')
```

displays:



There are two ways to control layout further using pack:

1. Create extra frames to hold widgets. For example, to position widget in the four quadrants of a square, create frames for the two and bottom halves and pack these vertically, then pack the widgets horizontally into the two frames.
2. Use the 'expand' and 'fill' attributes of pack.
    a. Fill (values X, Y, BOTH) determines the direction in which a widget can grow to fill available space.
    b. Expand (integer value) determines whether the containing frame gives more space to the widgets it contains. A zero value means no expansion. A positive value determine the relative expansion of each widget.

8.2 The Top-Level Window

A *top-level window* is a window that has an independent existence under the window manager. It has the standard icons for closing or minimizing the window, and can be moved and resized independently. Your application can use any number of top-level windows.

A top level window can conveniently be created

Attributes

bg or background	The background color of the window.
menu	To provide this window with a top-level menubar, supply a Menu widget as the value of this option.

Methods

.geometry(newGeometry=None)

Set the window geometry. For example:

- 200x400
- 200x400+10+20
- 200x400-10-20

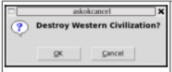
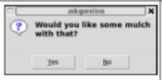
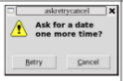
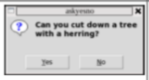
If the argument is omitted, the current geometry string is returned.

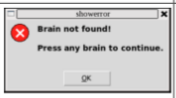
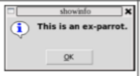
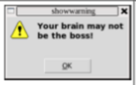
.title(text=None)

Set the window title. If the argument is omitted, returns the current title.

8.3 Message Dialogs

The following message dialogs are useful:

 askokcancel Destroy Western Civilization?	`.askokcancel(`*`title, message, options`*`)`
 askquestion Would you like some mulch with that?	`.askquestion(`*`title, message, options`*`)`
 askretrycancel Ask for a date one more time?	`.askretrycancel(`*`title, message, options`*`)`
 askyesno Can you cut down a tree with a herring?	`.askyesno(`*`title, message, options`*`)`

 showerror Brain not found! Press any brain to continue.	`.showerror(`*`title, message, options`*`)`
 showinfo This is an ex-parrot.	`.showinfo(`*`title, message, options`*`)`
 showwarning Your brain may not be the boss!	`.showwarning(`*`title, message, options`*`)`

On messages with a choice, the default choice is the first one. Use the default option

default = C

to change this where C = CANCEL, IGNORE, OK, NO, RETRY, or YES

Each of the "ask..." pop-up functions returns a value that depends on which button the user pushed to remove the pop-up.

- askokcancel, askretrycancel, and askyesno all return a bool value: True for "OK" or "Yes" choices, False for "No" or "Cancel" choices.
- askquestion returns u'yes' for "Yes", or u'no' for "No".

9 Recommended References and Sources

1. The most comprehensive summary is '*Tkinter* 8.5 reference: a GUI for Python', available from http://infohost.nmt.edu/tcc/help/pubs/tkinter/web/index.html either as a PDF or online.
2. A good online tutorial is http://www.python-course.eu/python_tkinter.php, part of a larger Python tutorial
3. This tutorial http://www.tutorialspoint.com/python/index.htm also has a section on Tkinter but I find it harder to navigate.