Tkinter for Python

Toolkit for Interfaces

GUI programming

- ***GUI*** (pronounced "gooey") stands for Graphical User Interface
- In GUI programming, the function of the "main" method, if present at all, is to create the graphical user interface
- Thereafter, everything that happens is controlled from the interface
- When the GUI is asked to do something (for example, by the user clicking a button), the GUI can call a function *with no parameters*

Setup

- Begin with this **`import`** statement:
  `from tkinter import *`
  - Note: In earlier versions of Python, this module was called **`Tkinter`**, not **`tkinter`**
- Then create an object of type **`Tk`**:
  `top = Tk()`
  - This is the top-level ***window*** of your GUI program
  - You can use any name for it; in these slides I use "**`top`**"
- Define the functions you are going to use
- Create ***widgets*** (graphical elements) and add them to the window
- Run the program by calling **`mainloop()`**

First example

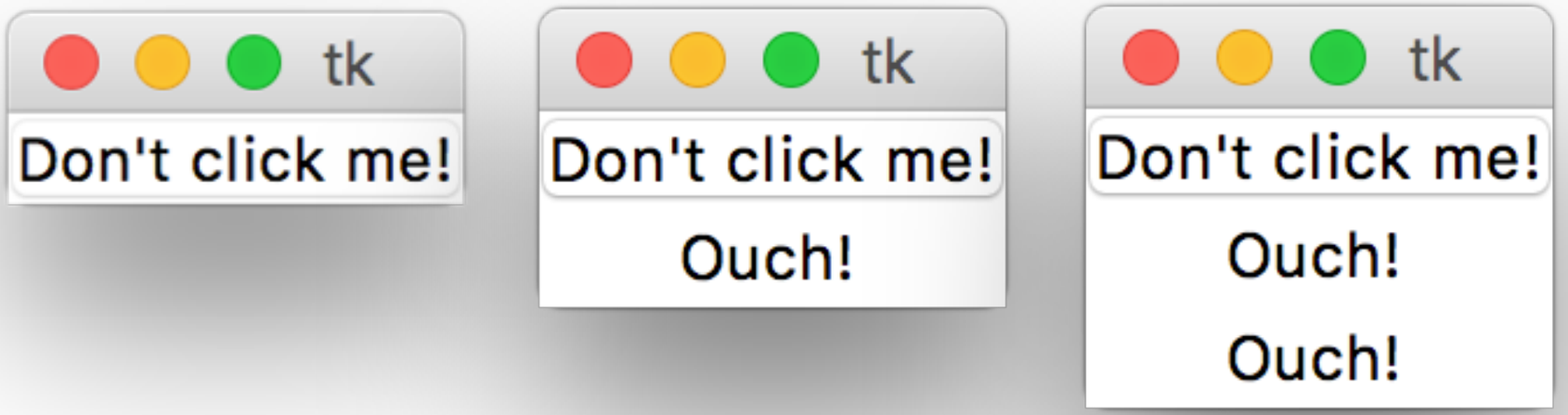
```
from tkinter import *

top = Tk()

def more():
    l = Label(top, text="Ouch!") # create label
    l.pack()                     # add to window

b = Button(top, text="Don't click me!", command=more)
b.pack()

mainloop()
```



Rearranging the example

- In Python, the code is executed as it is encountered
  - In the first example, the more function had to be defined before it could be referred to
- Encapsulating code in methods allows it to be arranged in any order
-

```
from tkinter import *
top = Tk()

def main():
    b = Button(top, text="Don't click me!", command=more)
    b.pack()
    mainloop()

def more():
    Label(top, text="Ouch!").pack()

main()
```

Building a GUI

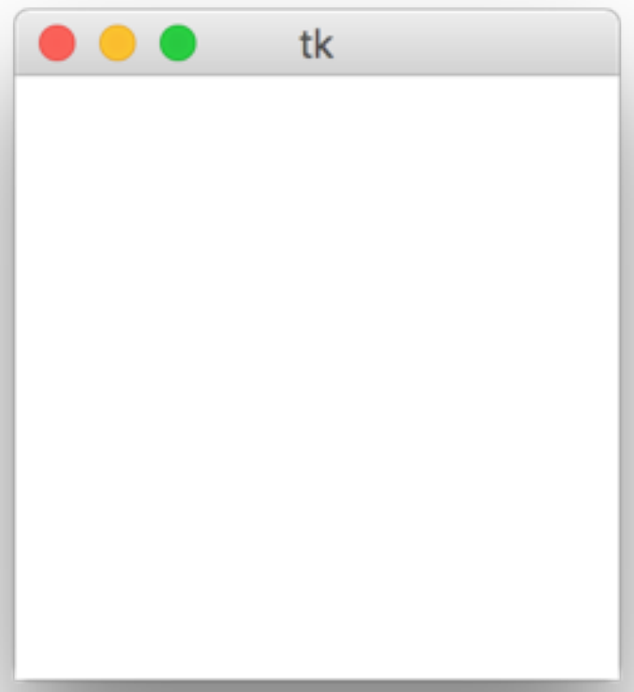
- Building a GUI requires:
  - Defining a number of widgets (easy)
  - Defining functions for the widgets to call (standard Python programming)
    - Don't use **`print`** statements, though!
  - Arranging the widgets in the window (can be difficult to get what you want)
- All the widgets, and the methods to arrange them, take a large number of parameters
  - Use *named* parameters--don't try to memorize the order!
  - **Example:** `Button(top, text="Don't click me!", command=more)`

Widgets I

- Here are some typical widgets, with typical parameters
- **`but = Button(top, text=`*`string`*`,`**
  `command=`*`function`*`)`
- **`lab = Label(top, text=`*`string`*`)`**
- **`chk = Checkbutton(top, text=`*`string`*`)`**
- **`ent = Entry(top, width=`*`n`*`)`**
- **`txt = Text(top, width=`*`num_characters`*`,`**
  `height=`*`num_lines`*`)`

Important advice

- **Build your GUI a little bit at a time, and run it after every little change!**
  - Why? You don't get runtime error messages!
  - Here's what you get for a runtime error:



When you see this, it's time to examine carefully the last code you added

Making widgets active

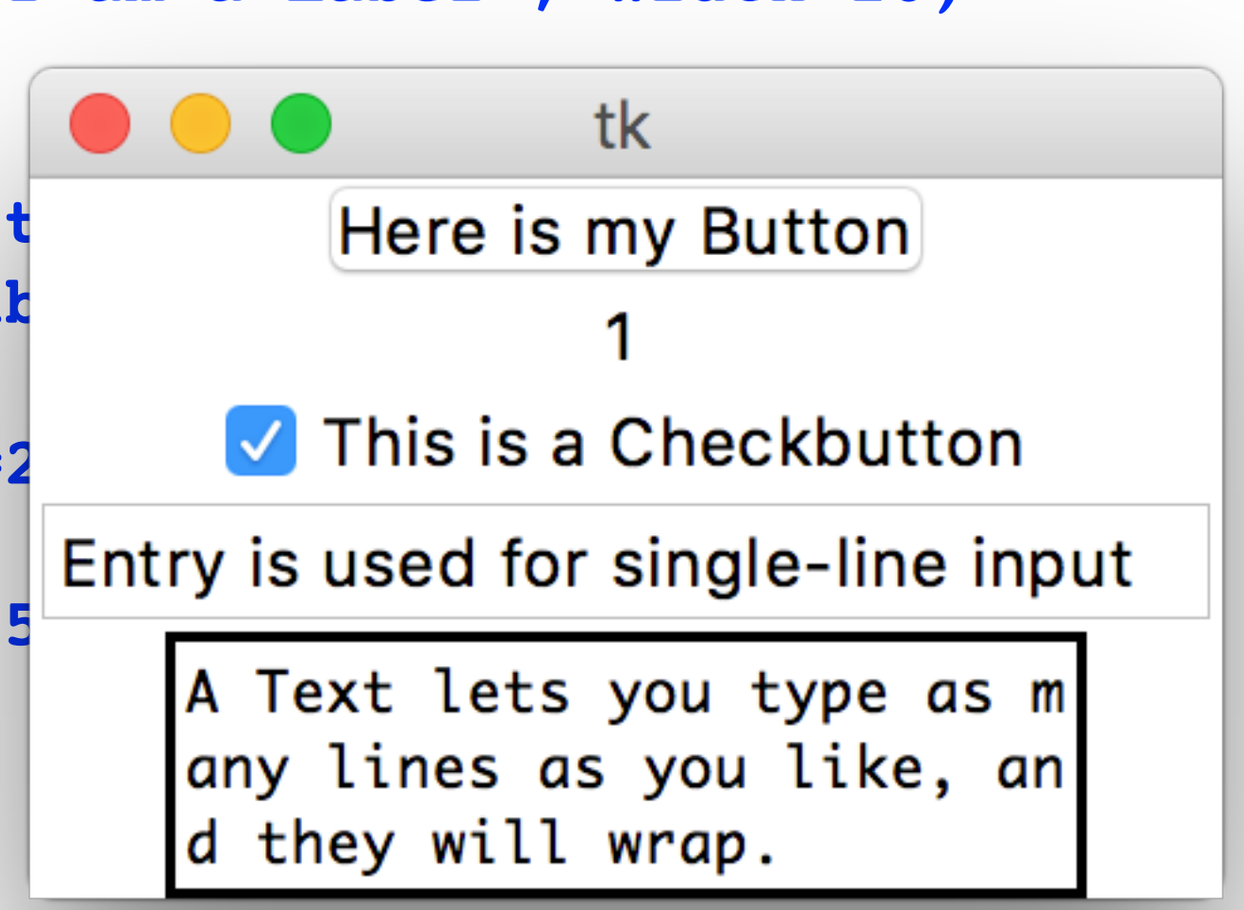
- With many of the widgets, you can add the parameter **`command=`***function*
- Some widgets, such as buttons and menu items, should do something when clicked
  - And the change should be visible to the user!!!
- Most widgets, such as text entry areas and checkboxes, should *not* do anything
  - Instead, the program should ask the widget for its value, if and when that value is needed
  - For example, both **`Entry`** and **`Text`** have a **`get`** method to return the text currently in them

Second example

```
def main():
    global lab, chk, chkvar, ent, txt
    Button(top, text="Here is my Button",\
           command=button).pack()
    lab = Label(top, text="I am a Label", width=20)
    lab.pack()
    chkvar = IntVar()
    chk = Checkbutton(top, text="This is a Checkbutton",\
                      variable=chkvar)
    chk.pack()
    ent = Entry(top, width=25)
    ent.pack()
    txt = Text(top, width=25, height=3)
    txt.pack()
    mainloop()
```

Second example

```
def main():
    global lab, chk, chkvar, ent, txt
    Button(top, text="Here is my Button",\
           command=button).pack()
    lab = Label(top, text="I am a Label", width=20)
    lab.pack()
    chkvar = IntVar()
    chk = Checkbutton(top, t
                      variab
    chk.pack()
    ent = Entry(top, width=2
    ent.pack()
    txt = Text(top, width=25
    txt.pack()
    mainloop()
```



Explanations I

- **`global lab, chk, chkvar, ent, txt`**
  - These widgets are made global so that I can refer to them outside of the **`main`** method
  - Of course, if they are not in a method, I don't need to do this
- **`Button(top, text="Here is my Button",\`**
  `command=button).pack()`
  - This **`Button`**, when clicked, will call my badly-named function **`button`**
  - I will never need to refer to this **`Button`**, so I don't bother assigning it to a variable

Explanations II

- **`lab = Label(top, text="I am a Label", width=20)`**
  `lab.pack()`
  - For a button I just said **`Button(...).pack()`**, because I didn't need to ever refer to the button again
  - However, the **`pack()`** method returns **`None`**, so **`lab = Label(...).pack()`** would assign **`None`** to **`lab`**
  - Therefore, I had to pack the label on a separate line
- **`chkvar = IntVar()`**
  `chk = Checkbutton(top, text="This is a Checkbutton",\`
  `variable=chkvar)`
  - This is how you find out whether a **`Checkbutton`** has been checked: **`chkvar.get()`**
  - The result is (by default) **`1`** if checked, **`0`** if not checked

Explanations III

- **`lab = Label(top, text="I am a Label", width=20)`**
  `lab.pack()`
  - For a button I just said **`Button(...).pack()`**, because I didn't need to ever refer to the button again
  - However, the **`pack()`** method returns None, so **`lab = Label(...).pack()`** would assign **`None`** to **`lab`**
  - Therefore, I had to pack the label on a separate line
- **`chkvar = IntVar()`**
  `chk = Checkbutton(top, text="This is a Checkbutton",\`
  `variable=chkvar)`
  - This is how you find out whether a **`Checkbutton`** has been checked: **`chkvar.get()`**
  - The result is (by default) **`1`** if checked, **`0`** if not checked

Explanations IV

- `ent = Entry(top, width=25)`
  `ent.pack()`

  `txt = Text(top, width=25, height=3)`
  `txt.pack()`
- To retrieve text from an **`Entry`**, use:
  `ent.get()`
- To retrieve text from a **`Text`**, use:
  `txt.get(1.0, END)`

Layout

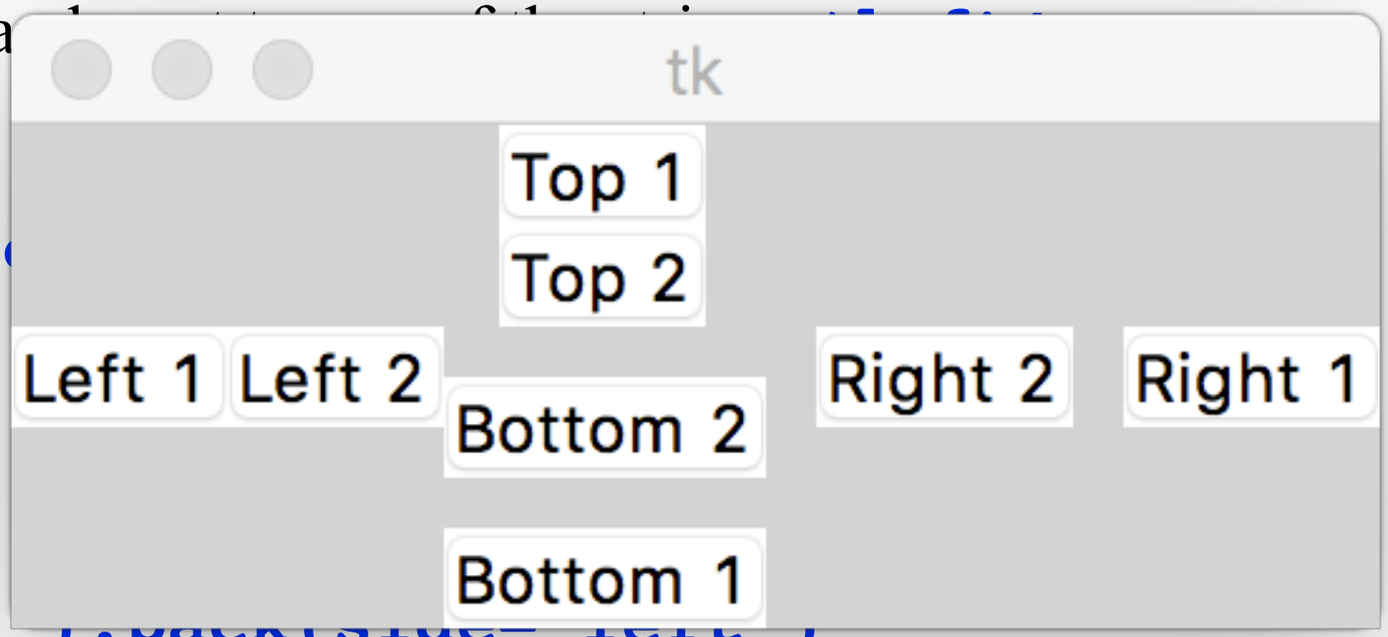
- A **`Frame`** is a widget whose purpose is to hold other widgets
  - All but the very simplest GUIs use frames, and often frames within frames
  - The program arranges the frames within the window, and arranges widgets within the frames
- There are three functions for inserting widgets into frames (or into windows): **`pack`**, **`grid`**, and **`place`**
  - I recommend against using **`place`**
  - I *strongly* recommend not using a mix of functions in any given frame (or window); they don't get along well

pack

- **pack** has a parameter side which can be set to one of the strings **'left'**, **'right'**, **'up'**, or **'down'**
- **pack** has parameters **padx** and **pady** that can be set to give padding (measured in pixels) around the widget
-
```
top['bg'] = 'light gray'
Button(top, text="Left 1").pack(side='left')
Button(top, text="Left 2").pack(side='left')
Button(top, text="Right 1").pack(side='right')
Button(top, text="Right 2").pack(side='right', padx=10)
Button(top, text="Top 1").pack(side='top')
Button(top, text="Top 2").pack(side='top')
Button(top, text="Bottom 1").pack(side='bottom')
Button(top, text="Bottom 2").pack(side='bottom', pady=10)
mainloop()
```

pack

- **pack** has a parameter side which ca
  'right', **'up'**, or **'down'**
- **pack** has parameters **padx** and **pa**
  pixels) around the widget
- **top['bg'] = 'light gray'**




```
Button(top, text="Left 1
Button(top, text="Left 2 ).pack(side='left')
Button(top, text="Right 1").pack(side='right')
Button(top, text="Right 2").pack(side='right', padx=10)
Button(top, text="Top 1").pack(side='top')
Button(top, text="Top 2").pack(side='top')
Button(top, text="Bottom 1").pack(side='bottom')
Button(top, text="Bottom 2").pack(side='bottom', pady=10)
mainloop()
```

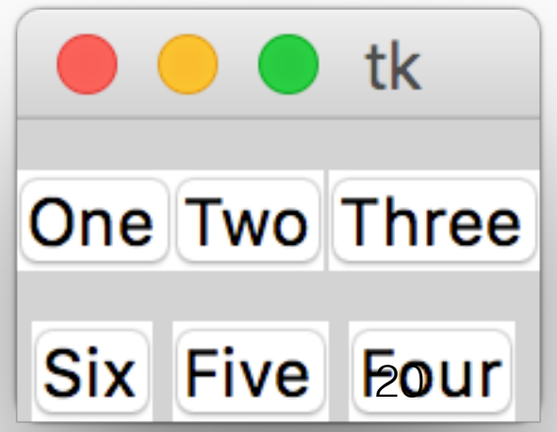
grid

- The **grid** function has parameters **row** and **column**, as well as **padx** and **pady**
-
```
top['bg'] = 'light gray'
Button(top, text="One").grid(row=0, column=0)
Button(top, text="Two").grid(row=0, column=1,
                             pady=10)
Button(top, text="Three").grid(row=0, column=2)
Button(top, text="Four").grid(row=1, column=2)
Button(top, text="Five").grid(row=1, column=1)
Button(top, text="Six").grid(row=1, column=0)
mainloop()
```

grid

- The **grid** function has parameters **row** and **column**, as well as **padx** and **pady**

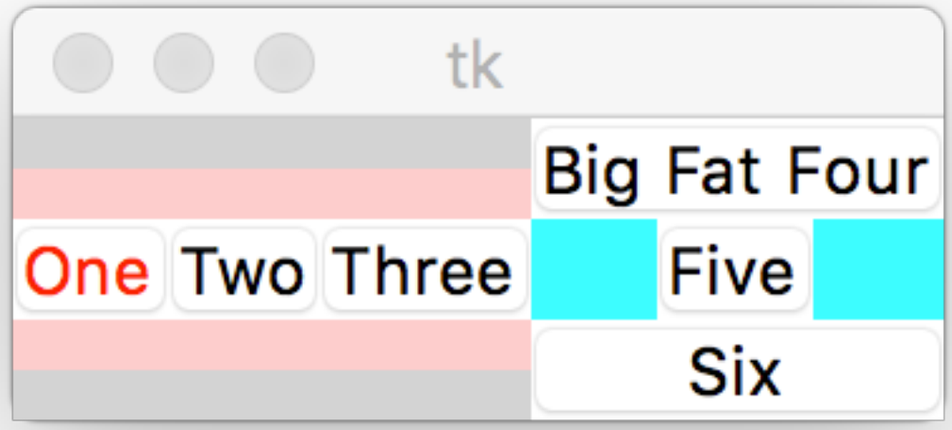
```
top['bg'] = 'light gray'
Button(top, text="One").grid(row=0, column=0)
Button(top, text="Two").grid(row=0, column=1,
                             pady=10)
Button(top, text="Three").grid(row=0, column=2)
Button(top, text="Four").grid(row=1, column=2)
Button(top, text="Five").grid(row=1, column=1)
Button(top, text="Six").grid(row=1, column=0)
mainloop()
```



Frame

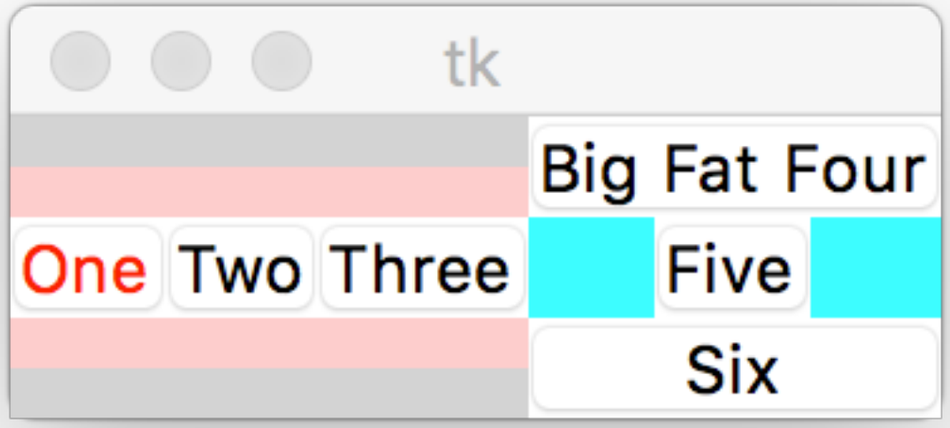
- Frames are used to hold and organize other widgets
- ```
  top['bg'] = 'light gray'
  frame1 = Frame(top, bg = '#FFCCCC')
  frame1.pack(side=LEFT)
  Button(frame1, text="One", fg='red').grid(row=0,
  column=0)
  Button(frame1, text="Two").grid(row=0, column=1, pady=10)
  Button(frame1, text="Three").grid(row=0, column=2)
  frame2 = Frame(top, bg='cyan')
  frame2.pack(side='right')
  Button(frame2, text="Big Fat Four").pack(side=TOP)
  Button(frame2, text="Five").pack(side='top')
  Button(frame2, text="Six").pack(side='top',fill=BOTH)
  mainloop()
  ```
  ```

Frame



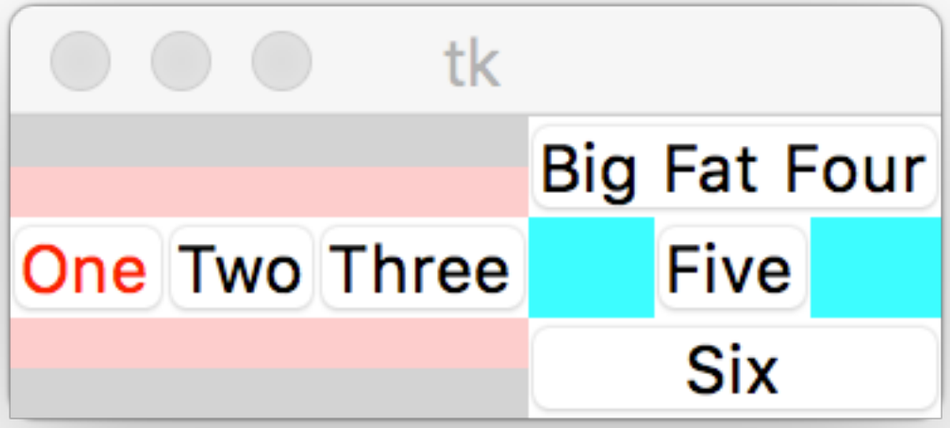
- Frames are used to hold and organize other widgets
-
```
top['bg'] = 'light gray'
frame1 = Frame(top, bg = '#FFCCCC')
frame1.pack(side=LEFT)
Button(frame1, text="One", fg='red').grid(row=0,
column=0)
Button(frame1, text="Two").grid(row=0, column=1, pady=10)
Button(frame1, text="Three").grid(row=0, column=2)
frame2 = Frame(top, bg='cyan')
frame2.pack(side='right')
Button(frame2, text="Big Fat Four").pack(side=TOP)
Button(frame2, text="Five").pack(side='top')
Button(frame2, text="Six").pack(side='top',fill=BOTH)
mainloop()
```

Explanations I



- `top['bg'] = 'light gray'`
  - Many widgets have **`fg`** (foreground) and **`bg`** (background) attributes
  - The available color names vary from system to system, but you can count on having **`'black'`**, **`'white'`**, **`'red'`**, **`'yellow'`**, **`'green'`**, **`'blue'`**, **`'cyan'`**, and **`'magenta'`**
- `frame1 = Frame(top, bg = '#FFCCCC')`
  - Color names can also be given as a hex string
- `Button(frame1, text="One", fg='red')...`
  - Setting the foreground usually means setting the color of text
  - On a Mac, setting the background color is legal but is ignored

Explanations II



- `Button(frame1, text="Two").grid(..., pady=10)`
  - This asks for padding above and below button "two"
  - The window background is light gray, but the frame background is pink, so the padding is pink
  - The other buttons in the row also get the padding
- `Button(frame2, text="Big Fat Four").pack(side=TOP)`
  `Button(frame2, text="Five", bg='blue').pack(side='top')`
  `Button(frame2, text="Six").pack(side='top',fill=BOTH)`
  - Some things can be represented in two ways, such as `'top'` and `TOP`
  - The "four" button is wider than the others, so the column is made that wide
  - Since the "five" button isn't as wide, we see the background on both sides
  - We ask the "six" button to fill the available space, `BOTH` in x and in y

Problems

- It's not hard to build a GUI, but you may get little or no help with errors
  - You can get a blank window, or no window at all
  - ***Really*** do it a little at a time, and test after every step!
- Did you forget to **`pack`** or **`grid`** your widget?
- `'NoneType' object does not support item assignment` -- Did you do **`w = SomeWidget(...).pack()`** and set **`w`** to **`None`**?
- Did you forget the **`mainloop()`**?
- Did you try to **`print`** when running a GUI?
- `'str' object has no attribute 'items'` -- Did you forget to put **`text=`** before a string?

References

- We have barely scratched the surface of what Tkinter can do
- There are 15 kinds of widgets, and each has lots of attributes
- https://www.tutorialspoint.com/python/python_gui_programming.htm is a good reference, but...
  - It can be really slow (because of Flash)
  - Some widget descriptions appear to be copied and pasted from other widget descriptions, and not edited
- http://www.python-course.eu/tkinter_buttons.php is a good tutorial

The End

```
def quit():
    top.destroy()
    exit()

quitButton = Button(top, text="Quit",
                    command=quit).pack()
```