

Python GUI Programming With Tkinter

by David Amos 80 Comments basics gui python

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```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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However, Tkinter is lightweight and relatively painless to use compared to other frameworks. This makes it a compelling choice for building GUI applications in Python, especially for applications where a modern sheen is unnecessary, and the top priority is to build something that's functional and cross-platform quickly.

In this tutorial, you'll learn how to:

- **Get started** with Tkinter with a “Hello, World!” application
- **Work** with widgets, such as buttons and text boxes
- **Control** your application layout with geometry managers
- **Make** your applications interactive by associating button clicks to Python functions

Once you've mastered these skills by working through the exercises at the end of each section, you'll tie everything together by building two applications. The first is a temperature converter, and the second is a text editor. It's time to dive right in and see how to build an application with Tkinter!

Note: This tutorial is adapted from the chapter “Graphical User Interfaces” of [Python Basics: A Practical Introduction to Python 3](#).

The book uses Python's built-in [IDLE](#) editor to create and edit Python files and interact with the Python shell. In this tutorial, references to IDLE have been removed in favor of more general language.

The bulk of the material in this tutorial has been left unchanged, and you should have no problems running the example code from the editor and environment of your choice.

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Building Your First Python GUI Application With Tkinter

The foundational element of a Tkinter GUI is the **window**. Windows are the containers in which all other GUI elements live. These other GUI elements, such as text boxes, labels, and buttons, are known as **widgets**. Widgets are contained inside of windows.

First, create a window that contains a single widget. Start up a new [Python shell](#) session and follow along!

Note: The code examples in this tutorial have all been tested on Windows, macOS, and Ubuntu Linux 18.04 with Python versions 3.6, 3.7, and 3.8.

If you've [installed Python](#) with the official installers available for [Windows](#) and [macOS](#) from python.org, then

If you haven't installed Python with the official installers, or there's no official distribution for your system, then

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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version of Python with the correct Tcl/Tk version:

Shell

```
$ sudo add-apt-repository ppa:deadsnakes/ppa
$ sudo apt-get update
$ sudo apt-get install python3.8 python3-tk
```

The first two commands add the deadsnakes PPA to your system's repository list, and the last command installs Python 3.8 and the Python GUI Tkinter module.

Ubuntu Linux 18.04:

You can install the latest version of Python with the correct Tcl/Tk version from the Universe repository with the following command:

Shell

```
$ sudo apt-get install python3.8 python3-tk
```

This installs Python 3.8, as well as the Python GUI Tkinter module.

Other Linux Flavors:

If you're unable to get a working Python installation on your flavor of Linux, then you can build Python with the correct version of Tcl/Tk from the source code. For a step-by-step walkthrough of this process, check out the [Python 3 Installation & Setup Guide](#).

With your Python shell open, the first thing you need to do is import the Python GUI Tkinter module:

Python

>>>

```
>>> import tkinter as tk
```

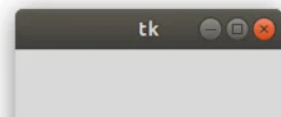
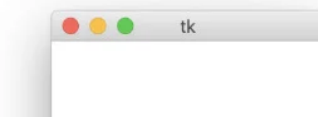
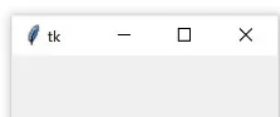
A **window** is an instance of Tkinter's Tk class. Go ahead and create a new window and assign it to the [variable](#) window:

Python

>>>

```
>>> window = tk.Tk()
```

When you execute the above code, a new window pops up on your screen. How it looks depends on your operating system:



```
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6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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Label widget with the text `hello, tkinter` and assign it to a variable called `greeting`.

Python

>>>

```
>>> greeting = tk.Label(text="Hello, Tkinter")
```

The window you created earlier doesn't change. You just created a `Label` widget, but you haven't added it to the window yet. There are several ways to add widgets to a window. Right now, you can use the `Label` widget's `.pack()` method:

Python

>>>

```
>>> greeting.pack()
```

The window now looks like this:

When you `.pack()` a widget into a window, Tkinter sizes the window as small as it can while still fully encompassing the widget. Now execute the following:

Python

>>>

```
>>> window.mainloop()
```

Nothing seems to happen, but notice that a new prompt does not appear in the shell.

`window.mainloop()` tells Python to run the Tkinter **event loop**. This method listens for events, such as button clicks or keypresses, and **blocks** any code that comes after it from running until the window it's called on is closed. Go ahead and close the window you've created, and you'll see a new prompt displayed in the shell.

Warning: When you work with Tkinter from a Python REPL, updates to windows are applied as each line is executed. This is **not the case** when a Tkinter program is executed from a Python file!

If you don't include `window.mainloop()` at the end of a program in a Python file, then the Tkinter application will never run, and nothing will be displayed.

Creating a window with Tkinter only takes a couple of lines of code. But blank windows aren't very useful! In the next section, you'll learn about some of the widgets available in Tkinter, and how you can customize them to meet your application's needs.

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Check Your Understanding

```
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8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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When you're ready, you can move on to the next section.

Working With Widgets

Widgets are the bread and butter of the Python GUI framework Tkinter. They are the elements through which users interact with your program. Each **widget** in Tkinter is defined by a class. Here are some of the widgets available:

Widget Class	Description
Label	A widget used to display text on the screen
Button	A button that can contain text and can perform an action when clicked
Entry	A text entry widget that allows only a single line of text
Text	A text entry widget that allows multiline text entry
Frame	A rectangular region used to group related widgets or provide padding between widgets

You'll see how to work with each of these in the following sections. Note that Tkinter has many more widgets than the ones listed here. For a full list, check out [Basic Widgets](#) and [More Widgets](#) in the [TkDocs](#) tutorial. For now, take a closer look at the Label widget.

Displaying Text and Images With Label Widgets

Label widgets are used to **display text or images**. The text displayed by a Label widget can't be edited by the user. It's for display purposes only. As you saw in the example at the beginning of this tutorial, you can create a Label widget by instantiating the Label class and passing a [string](#) to the text parameter:

Python

```
label = tk.Label(text="Hello, Tkinter")
```

Label widgets display text with the default system text color and the default system text background color. These are typically black and white, respectively, but you may see different colors if you have changed these settings in your operating system.

You can control Label text and background colors using the foreground and background parameters:

Python

```
label = tk.Label(
    text="Hello, Tkinter",
    foreground="white", # Set the text color to white
    background="black" # Set the background color to black
)
```

- "red"

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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You can also specify a color using [hexadecimal values](#):

Python

```
label = tk.Label(text="Hello, Tkinter", background="#34A2FE")
```

This sets the label background to a nice, light blue color. Hexadecimal RGB values are more cryptic than named colors, but they're also more flexible. Fortunately, there are [tools](#) available that make getting hexadecimal color codes relatively painless.

If you don't feel like typing out foreground and background all the time, then you can use the shorthand fg and bg parameters to set the foreground and background colors:

Python

```
label = tk.Label(text="Hello, Tkinter", fg="white", bg="black")
```

You can also control the width and height of a label with the width and height parameters:

Python

```
label = tk.Label(
    text="Hello, Tkinter",
    fg="white",
    bg="black",
    width=10,
    height=10
)
```

Here's what this label looks like in a window:

It may seem strange that the label in the window isn't square even though the width and height are both set to 10.

This is because the width and height are measured in **text units**. One horizontal text unit is determined by the width

the height of the character "0".

```
1# How to merge two dicts
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6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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Displaying Clickable Buttons With Button Widgets

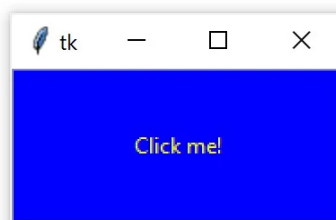
Button widgets are used to display **clickable buttons**. They can be configured to call a function whenever they're clicked. You'll cover how to call functions from button clicks in the next section. For now, take a look at how to create and style a **Button**.

There are many similarities between **Button** and **Label** widgets. In many ways, a **Button** is just a **Label** that you can click! The same keyword arguments you use to create and style a **Label** will work with **Button** widgets. For example, the following code creates a **Button** with a blue background and yellow text. It also sets the width and height to 25 and 5 text units, respectively:

Python

```
button = tk.Button(
    text="Click me!",
    width=25,
    height=5,
    bg="blue",
    fg="yellow",
)
```

Here's what the button looks like in a window:



Pretty nifty! The next two widgets you'll see are used to collect text input from a user.

Getting User Input With Entry Widgets

When you need to get a little bit of text from a user, like a name or an email address, use an **Entry** widget. They display a **small text box** that the user can type some text into. Creating and styling an **Entry** widget works pretty much exactly like **Label** and **Button** widgets. For example, the following code creates a widget with a blue background, some yellow text, and a width of 50 text units:

Python

The interesting bit about Entry widgets isn't how to style them, though. It's how to use them to **get input from a user**. There are three main operations that you can perform with Entry widgets:

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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Now create a Label and an Entry widget:

Python

>>>

```
>>> label = tk.Label(text="Name")
>>> entry = tk.Entry()
```

The Label describes what sort of text should go in the Entry widget. It doesn't enforce any sort of requirements on the Entry, but it tells the user what your program expects them to put there. You need to `.pack()` the widgets into the window so that they're visible:

Python

>>>

```
>>> label.pack()
>>> entry.pack()
```

Here's what that looks like:

Notice that Tkinter automatically centers the Label above the Entry widget in the window. This is a feature of `.pack()`, which you'll learn more about in later sections.

Click inside the Entry widget with your mouse and type "Real Python":

Now you've got some text entered into the Entry widget, but that text hasn't been sent to your program yet. You can use `.get()` to retrieve the text and assign it to a variable called name:

Python

>>>

```
>>> name = entry.get()
>>> name
'Real Python'
```

You can `.delete()` text as well. This method takes an integer argument that tells Python which character to remove. For example, the code block below shows how `.delete(0)` deletes the first character from the Entry:

Python

>>>

The text remaining in the widget is now "ea1 Python":

```
1# How to merge two dicts
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6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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the entry:

Python

>>>

```
>>> entry.delete(0, 4)
```

The remaining text now reads "Python":

`Entry.delete()` works just like [string slicing](#). The first argument determines the starting index, and the deletion continues up to **but not including** the index passed as the second argument. Use the special constant `tk.END` for the second argument of `.delete()` to remove all text in an `Entry`:

Python

>>>

```
>>> entry.delete(0, tk.END)
```

You'll now see a blank text box:

On the opposite end of the spectrum, you can also `.insert()` text into an `Entry` widget:

Python

>>>

```
>>> entry.insert(0, "Python")
```

The window now looks like this:

The first argument tells `.insert()` where to insert the text. If there is no text in the `Entry`, then the new text will always be inserted at the beginning of the widget, no matter what value you pass as the first argument. For example, calling `.insert()` with 100 as the first argument instead of 0, as you did above, would have generated the same output.

If an `Entry` already contains some text, then `.insert()` will insert the new text at the specified position and shift all

```

1# How to merge two dicts
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6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}

```

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single line, they're not ideal for gathering large amounts of text. That's where Text widgets come in!

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Getting Multiline User Input With Text Widgets

Text widgets are used for entering text, just like Entry widgets. The difference is that Text widgets may contain **multiple lines of text**. With a Text widget, a user can input a whole paragraph or even several pages of text! Just like Entry widgets, there are three main operations you can perform with Text widgets:

1. **Retrieve text** with `.get()`
2. **Delete text** with `.delete()`
3. **Insert text** with `.insert()`

Although the method names are the same as the Entry methods, they work a bit differently. It's time to get your hands dirty by creating a Text widget and seeing what all it can do.

Note: Do you still have the window from the previous section open?

If so, then you can close it by executing the following:

Python

>>>

```
>>> window.destroy()
```

You can also close it manually by clicking the *Close* button.

In your Python shell, create a new blank window and `.pack()` a `Text()` widget into it:

Python

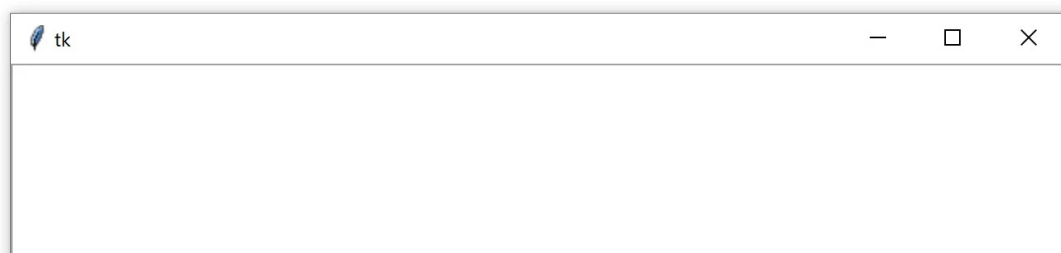
>>>

```

>>> window = tk.Tk()
>>> text_box = tk.Text()
>>> text_box.pack()

```

Text boxes are much larger than Entry widgets by default. Here's what the window created above looks like:



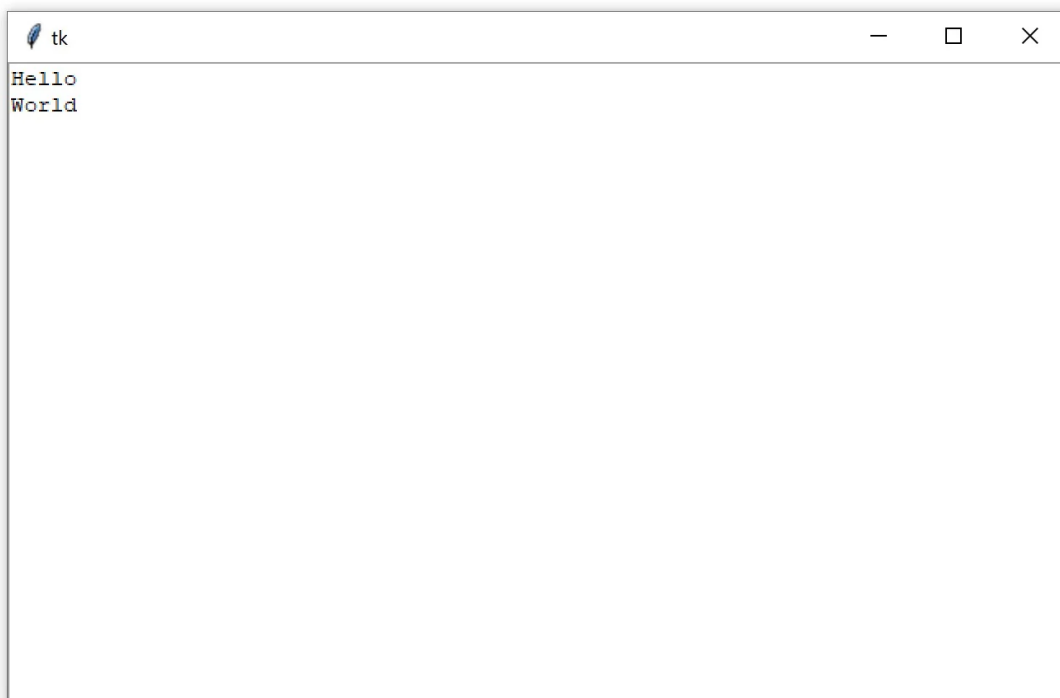
```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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Click anywhere inside the window to activate the text box. Type in the word "Hello". Then press and type "World" on the second line. The window should now look like this:



Just like Entry widgets, you can retrieve the text from a Text widget using `.get()`. However, calling `.get()` with no arguments doesn't return the full text in the text box like it does for Entry widgets. It raises an [exception](#):

Python

>>>

```
>>> text_box.get()
Traceback (most recent call last):
  File "<pyshell#4>", line 1, in <module>
    text_box.get()
TypeError: get() missing 1 required positional argument: 'index1'
```

Entry widgets. Since Text widgets can have several lines of text, an index must contain two pieces of information:

```
1# How to merge two dicts
2# in Python 3.5+
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4>>> x = {'a': 1, 'b': 2}
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6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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'H'

There are five letters in the word "Hello", and the character number of o is 4, since character numbers start from 0, and the word "Hello" starts at the first position in the text box. Just like Python string slices, in order to get the entire word "Hello" from the text box, the end index must be one more than the index of the last character to be read.

So, to get the word "Hello" from the text box, use "1.0" for the first index and "1.5" for the second index:

Python

>>>

```
>>> text_box.get("1.0", "1.5")
'Hello'
```

To get the word "World" on the second line of the text box, change the line numbers in each index to 2:

Python

>>>

```
>>> text_box.get("2.0", "2.5")
'World'
```

To get all of the text in a text box, set the starting index in "1.0" and use the special `tk.END` constant for the second index:

Python

>>>

```
>>> text_box.get("1.0", tk.END)
'Hello\nWorld\n'
```

Notice that text returned by `.get()` includes any newline characters. You can also see from this example that every line in a Text widget has a newline character at the end, including the last line of text in the text box.

`.delete()` is used to delete characters from a text box. It work just like `.delete()` for Entry widgets. There are two ways to use `.delete()`:

1. With a **single argument**
2. With **two arguments**

Using the single-argument version, you pass to `.delete()` the index of a single character to be deleted. For example, the following deletes the first character H from the text box:

Python

>>>

```
>>> text_box.delete("1.0")
```

The first line of text in the window now reads "ello":

 tk

— □ ×

```
1# How to merge two dicts
2# in Python 3.5+
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4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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With the two-argument version, you pass two indices to delete a range of characters starting at the first index and up to, but not including, the second index.

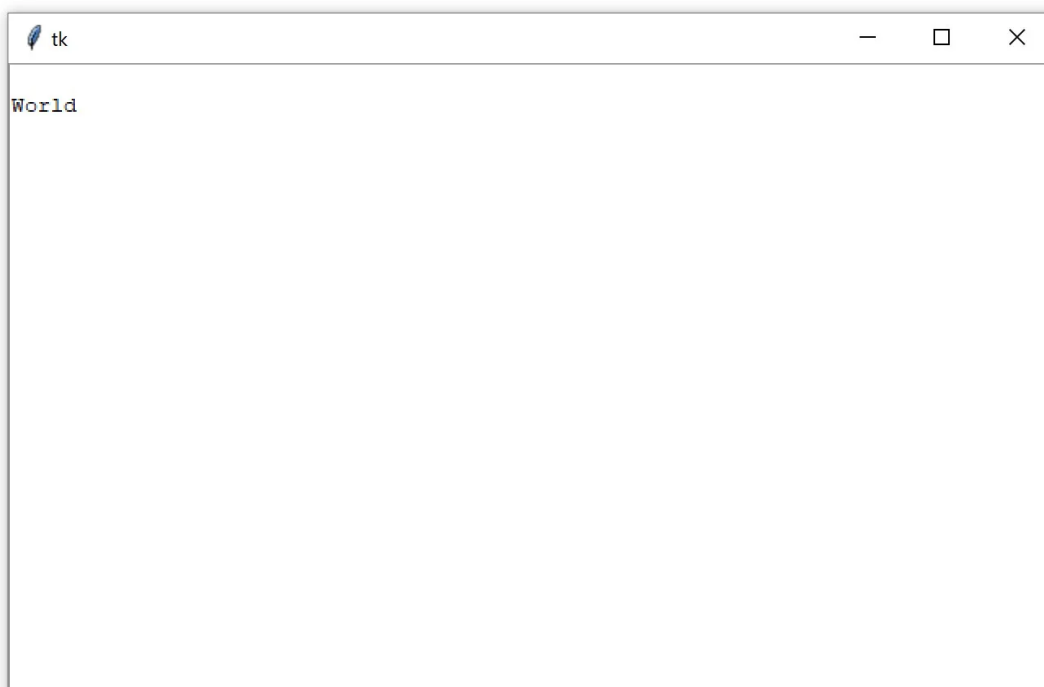
For example, to delete the remaining "ello" on the first line of the text box, use the indices "1.0" and "1.4":

Python

>>>

```
>>> text_box.delete("1.0", "1.4")
```

Notice that the text is gone from the first line. This leaves a blank line followed the word World on the second line:



Even though you can't see it, there's still a character on the first line. It's a newline character! You can verify this using `.get()`:

Python

>>>

```
>>> text_box.get("1.0")
'\n'
```

Python

>>>

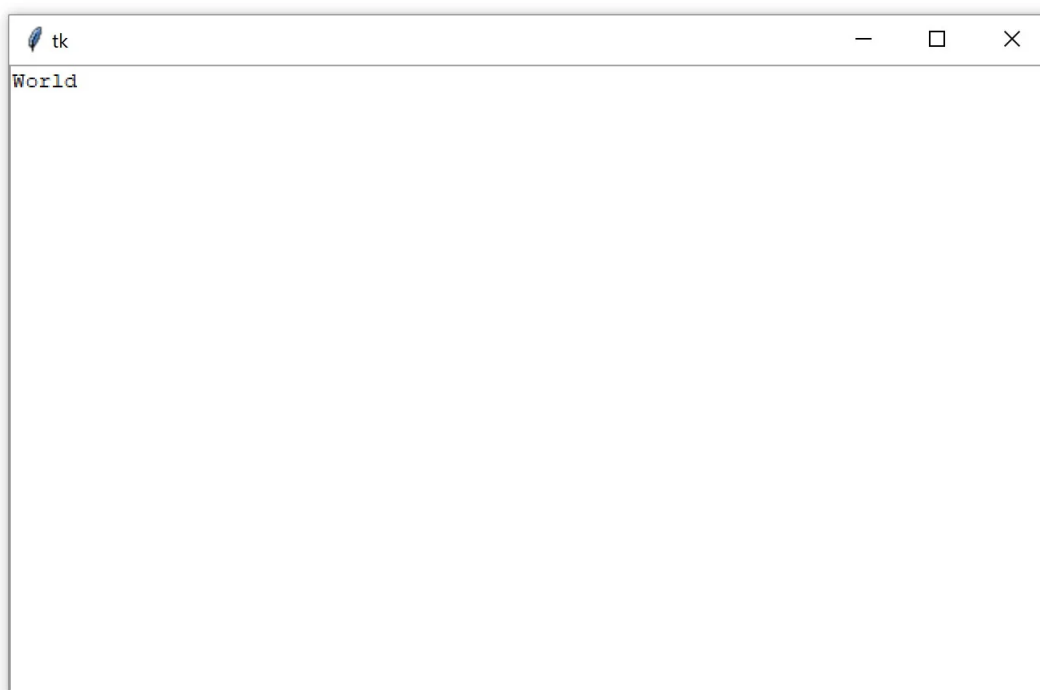
```
>>> text_box.delete("1.0")
```

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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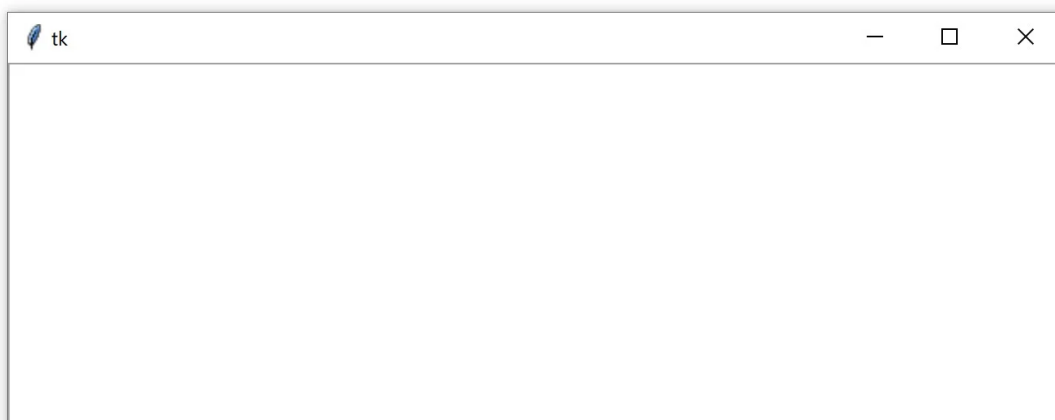
Try to clear out the rest of the text in the text box. Set "1.0" as the start index and use tk.END for the second index:

Python

>>>

```
>>> text_box.delete("1.0", tk.END)
```

The text box is now empty:



```
1# How to merge two dicts
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9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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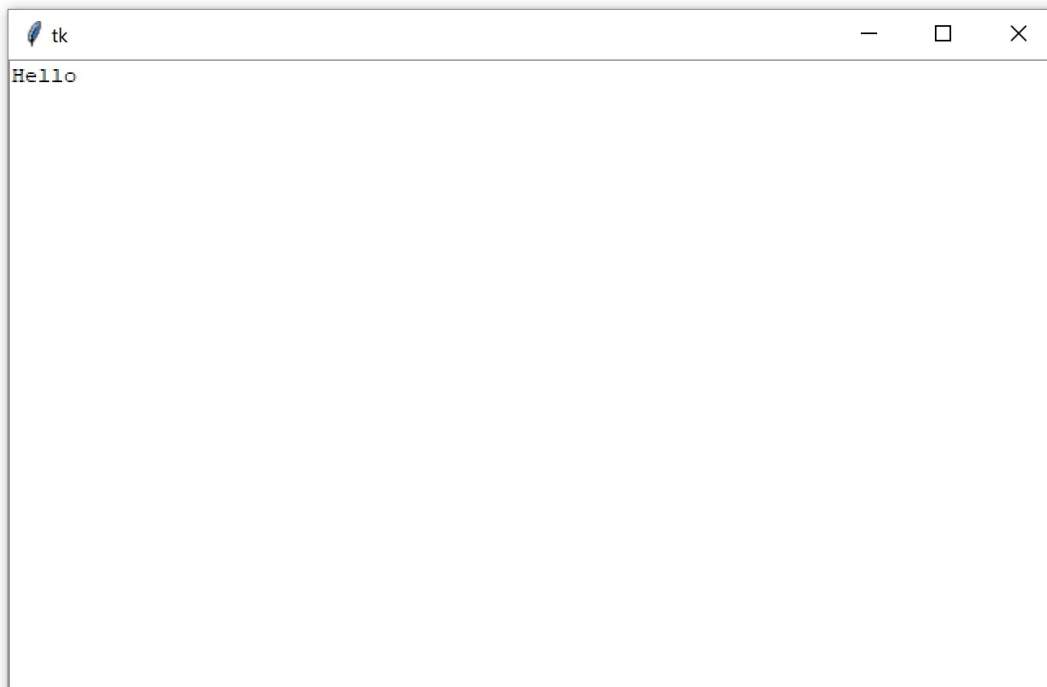
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Python

```
>>> text_box.insert("1.0", "Hello")
```

This inserts the word "Hello" at the beginning of the text box, using the same "<line>.<column>" format used by `.get()` to specify the insertion position:



Check out what happens if you try to insert the word "World" on the second line:

Python

```
>>> text_box.insert("2.0", "World")
```

Instead of inserting the text on the second line, the text is inserted at the end of the first line:

```
1# How to merge two dicts
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5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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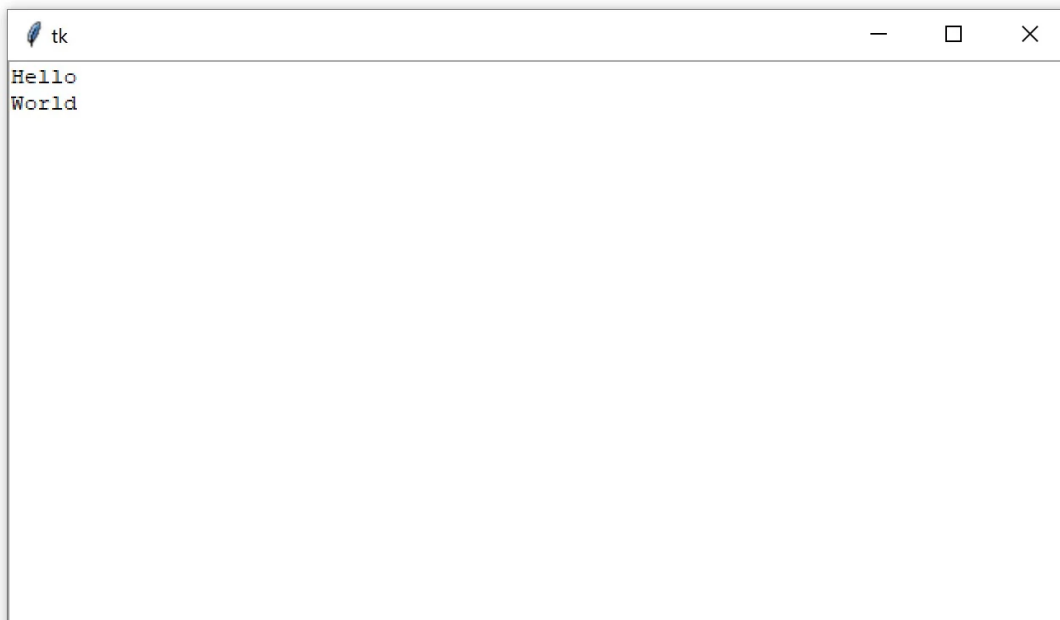
If you want to insert text onto a new line, then you need to insert a newline character manually into the string being inserted:

Python

>>>

```
>>> text_box.insert("2.0", "\nWorld")
```

Now "World" is on the second line of the text box:




```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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Don't forget to include the newline character (`\n`) at the beginning of the text if you want to put it on a new line:

Python

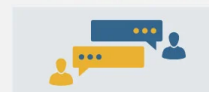
```
text_box.insert(tk.END, "\nPut me on a new line!")
```

Label, Button, Entry, and Text widgets are just a few of the widgets available in Tkinter. There are several others, including widgets for checkboxes, radio buttons, scroll bars, and progress bars. For more information on all of the available widgets, see the Additional Widgets list in the [Additional Resources](#) section.

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Assigning Widgets to Frames With Frame Widgets

In this tutorial, you're going to work with only five widgets. These are the four you've seen so far plus the Frame widget. **Frame** widgets are important for **organizing the layout of your widgets** in an application.

Before you get into the details about laying out the visual presentation of your widgets, take a closer look at how Frame widgets work, and how you can assign other widgets to them. The following script creates a blank Frame widget and assigns it to the main application window:

Python

```
import tkinter as tk

window = tk.Tk()
frame = tk.Frame()
frame.pack()

window.mainloop()
```

`frame.pack()` packs the frame into the window so that the window sizes itself as small as possible to encompass the frame. When you run the above script, you get some seriously uninteresting output:

An empty Frame widget is practically invisible. Frames are best thought of as **containers** for other widgets. You can assign a widget to a frame by setting the widget's `master` attribute:

Python

```
frame = tk.Frame()
label = tk.Label(master=frame)
```

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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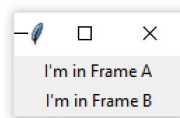
```
label_a = tk.Label(master=frame_a, text="I'm in Frame A")
label_a.pack()

label_b = tk.Label(master=frame_b, text="I'm in Frame B")
label_b.pack()

frame_a.pack()
frame_b.pack()

window.mainloop()
```

Note that frame_a is packed into the window before frame_b. The window that opens shows the label in frame_a above the label in frame_b:



Now see what happens when you swap the order of frame_a.pack() and frame_b.pack():

```
Python

import tkinter as tk

window = tk.Tk()

frame_a = tk.Frame()
label_a = tk.Label(master=frame_a, text="I'm in Frame A")
label_a.pack()

frame_b = tk.Frame()
label_b = tk.Label(master=frame_b, text="I'm in Frame B")
label_b.pack()

# Swap the order of `frame_a` and `frame_b`
frame_b.pack()
frame_a.pack()

window.mainloop()
```

The output looks like this:

Now label_b is on top. Since label_b is assigned to frame_b, it moves to wherever frame_b is positioned.

organizing other widgets in a logical manner. Related widgets can be assigned to the same frame so that, if the frame is ever moved in the window, then the related widgets stay together.

```
1 # How to merge two dicts
2 # in Python 3.5+
3
4 >>> x = {'a': 1, 'b': 2}
5 >>> y = {'b': 3, 'c': 4}
6
7 >>> z = {**x, **y}
8
9 >>> z
10 {'c': 4, 'a': 1, 'b': 3}
```

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- **tk.RAISED:** Creates a raised effect.
- **tk.GROOVE:** Creates a grooved border effect.
- **tk.RIDGE:** Creates a ridged effect.

To apply the border effect, you must set the `borderwidth` attribute to a value greater than 1. This attribute adjusts the width of the border in pixels. The best way to get a feel for what each effect looks like is to see them for yourself. Here's a script that packs five Frame widgets into a window, each with a different value for the `relief` argument:

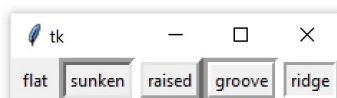
Python

```
1 import tkinter as tk
2
3 border_effects = {
4     "flat": tk.FLAT,
5     "sunken": tk.SUNKEN,
6     "raised": tk.RAISED,
7     "groove": tk.GROOVE,
8     "ridge": tk.RIDGE,
9 }
10
11 window = tk.Tk()
12
13 for relief_name, relief in border_effects.items():
14     frame = tk.Frame(master=window, relief=relief, borderwidth=5)
15     frame.pack(side=tk.LEFT)
16     label = tk.Label(master=frame, text=relief_name)
17     label.pack()
18
19 window.mainloop()
```

Here's a breakdown of this script:

- **Lines 3 to 9** create a [dictionary](#) whose keys are the names of the different relief effects available in Tkinter. The values are the corresponding Tkinter objects. This dictionary is assigned to the `border_effects` variable.
- **Line 13** starts a [for loop](#) to loop over each item in the `border_effects` dictionary.
- **Line 14** creates a new Frame widget and assigns it to the window object. The `relief` attribute is set to the corresponding relief in the `border_effects` dictionary, and the `border` attribute is set to 5 so that the effect is visible.
- **Line 15** packs the Frame into the window using `.pack()`. The `side` keyword argument tells Tkinter in which direction to pack the frame objects. You'll see more about how this works in the next section.
- **Lines 16 and 17** create a Label widget to display the name of the relief and pack it into the frame object you just created.

The window produced by the above script looks like this:



- `tk.FLAT` creates a frame that appears to be flat.

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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Understanding Widget Naming Conventions

When you create a widget, you can give it any name you like, as long as it's a **valid Python identifier**. It's usually a good idea to include the name of the widget class in the variable name you assign to the widget instance. For example, if a `Label` widget is used to display a user's name, then you might name the widget `label_user_name`. An `Entry` widget used to collect a user's age might be called `entry_age`.

When you include the widget class name in the variable name, you help yourself (and anyone else that needs to read your code) to understand what type of widget the variable name refers to. However, using the full name of the widget class can lead to long variable names, so you may want to adopt a shorthand for referring to each widget type. For the rest of this tutorial, you'll use the following shorthand prefixes to name widgets:

Widget Class	Variable Name Prefix	Example
<code>Label</code>	<code>lbl</code>	<code>lbl_name</code>
<code>Button</code>	<code>btn</code>	<code>btn_submit</code>
<code>Entry</code>	<code>ent</code>	<code>ent_age</code>
<code>Text</code>	<code>txt</code>	<code>txt_notes</code>
<code>Frame</code>	<code>frm</code>	<code>frm_address</code>

In this section, you learned how to create a window, use widgets, and work with frames. At this point, you can make some plain windows that display messages, but you've yet to create a full-blown application. In the next section, you'll learn how to control the layout of your applications using Tkinter's powerful geometry managers.

Check Your Understanding

Expand the code block below for an exercise to check your understanding:

Exercise: Create an `Entry` widget and insert some text

Show/Hide

You can expand the code block below to see a solution:

Solution: Create an `Entry` widget and insert some text

Show/Hide

When you're ready, you can move on to the next section.

Controlling Layout With Geometry Managers

what exactly this method does. Let's clear things up: Application layout in Tkinter is controlled with **geometry managers**. While `.pack()` is an example of a geometry manager, it isn't the only one. Tkinter has two others:

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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packing algorithm has two primary steps.

1. **Compute a rectangular area** called a **parcel** that's just tall (or wide) enough to hold the widget and fills the remaining width (or height) in the window with blank space.
2. **Center the widget in the parcel** unless a different location is specified.

`.pack()` is powerful, but it can be difficult to visualize. The best way to get a feel for `.pack()` is to look at some examples. See what happens when you `.pack()` three `Label` widgets into a `Frame`:

Python

```
import tkinter as tk

window = tk.Tk()

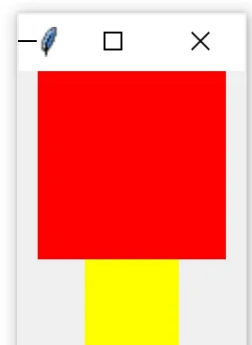
frame1 = tk.Frame(master=window, width=100, height=100, bg="red")
frame1.pack()

frame2 = tk.Frame(master=window, width=50, height=50, bg="yellow")
frame2.pack()

frame3 = tk.Frame(master=window, width=25, height=25, bg="blue")
frame3.pack()

window.mainloop()
```

`.pack()` places each `Frame` below the previous one by default, in the order that they're assigned to the window:



```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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Python

```
import tkinter as tk

window = tk.Tk()

frame1 = tk.Frame(master=window, height=100, bg="red")
frame1.pack(fill=tk.X)

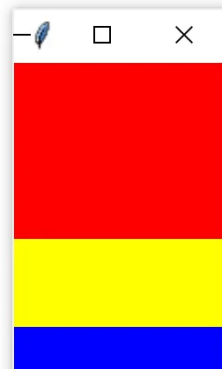
frame2 = tk.Frame(master=window, height=50, bg="yellow")
frame2.pack(fill=tk.X)

frame3 = tk.Frame(master=window, height=25, bg="blue")
frame3.pack(fill=tk.X)

window.mainloop()
```

Notice that the width is not set on any of the Frame widgets. width is no longer necessary because each frame sets .pack() to fill horizontally, overriding any width you may set.

The window produced by this script looks like this:



One of the nice things about filling the window with .pack() is that the fill is responsive to window resizing. Try widening the window generated by the previous script to see how this works. As you widen the window, the width of the three Frame widgets grow to fill the window:

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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- tk.BOTTOM
- tk.LEFT
- tk.RIGHT

If you don't set side, then `.pack()` will automatically use `tk.TOP` and place new widgets at the top of the window, or at the top-most portion of the window that isn't already occupied by a widget. For example, the following script places three frames side-by-side from left to right and expands each frame to fill the window vertically:

Python

```
import tkinter as tk

window = tk.Tk()

frame1 = tk.Frame(master=window, width=200, height=100, bg="red")
frame1.pack(fill=tk.Y, side=tk.LEFT)

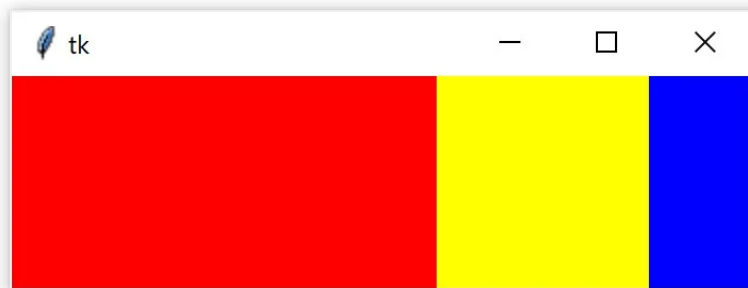
frame2 = tk.Frame(master=window, width=100, bg="yellow")
frame2.pack(fill=tk.Y, side=tk.LEFT)

frame3 = tk.Frame(master=window, width=50, bg="blue")
frame3.pack(fill=tk.Y, side=tk.LEFT)

window.mainloop()
```

This time, you have to specify the `height` keyword argument on at least one of the frames to force the window to have some height.

The resulting window looks like this:



Just like when you set `fill=tk.X` to make the frames responsive when you resized the window horizontally, you can set `fill=tk.Y` to make the frames responsive when you resize the window vertically:

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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To make the layout truly responsive, you can set an initial size for your frames using the width and height attributes. Then, set the fill keyword argument of `.pack()` to `tk.BOTH` and set the expand keyword argument to `True`:

Python

```
import tkinter as tk

window = tk.Tk()

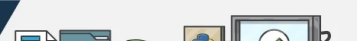
frame1 = tk.Frame(master=window, width=200, height=100, bg="red")
frame1.pack(fill=tk.BOTH, side=tk.LEFT, expand=True)

frame2 = tk.Frame(master=window, width=100, bg="yellow")
frame2.pack(fill=tk.BOTH, side=tk.LEFT, expand=True)

frame3 = tk.Frame(master=window, width=50, bg="blue")
frame3.pack(fill=tk.BOTH, side=tk.LEFT, expand=True)

window.mainloop()
```

When you run the above script, you'll see a window that initially looks the same as the one you generated in the previous example. The difference is that now you can resize the window however you want and the frames will expand and fill the window responsively:



```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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Keep in mind that the origin (where x and y are both 0) is the top-left corner of the Frame or window. So, you can think of the y argument of `.place()` as the number of pixels from the top of the window, and the x argument as the number of pixels from the left of the window.

Here's an example of how the `.place()` geometry manager works:

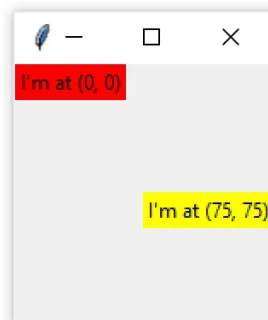
Python

```
1 import tkinter as tk
2
3 window = tk.Tk()
4
5 frame = tk.Frame(master=window, width=150, height=150)
6 frame.pack()
7
8 label1 = tk.Label(master=frame, text="I'm at (0, 0)", bg="red")
9 label1.place(x=0, y=0)
10
11 label2 = tk.Label(master=frame, text="I'm at (75, 75)", bg="yellow")
12 label2.place(x=75, y=75)
13
14 window.mainloop()
```

Here's how this code works:

- **Lines 5 and 6** create a new Frame widget called frame1, one that's 150 pixels wide and 150 pixels tall, and pack it into the window with `.pack()`.
- **Lines 8 and 9** create a new Label called label1 with a yellow background and place it in frame1 at position (0, 0).
- **Lines 11 and 12** create a second Label called label2 with a red background and place it in frame1 at position (75, 75).

Here's the window the code produces:



`.place()` is not used often. It has two main drawbacks:

1. **Layout can be difficult to manage with `.place()`.** This is especially true if your application has lots of widgets.
2. **Layouts created with `.place()` are not responsive.** They don't change as the window is resized.

platform they are viewed on, and `.place()` is a poor choice for making responsive and cross-platform layouts.

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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The geometry manager you'll likely use most often is `.grid()`, which provides all the power of `.pack()` in a format that's easier to understand and maintain.

`.grid()` works by splitting a window or Frame into rows and columns. You specify the location of a widget by calling `.grid()` and passing the row and column indices to the `row` and `column` keyword arguments, respectively. Both row and column indices start at 0, so a row index of 1 and a column index of 2 tells `.grid()` to place a widget in the third column of the second row.

The following script creates a 3×3 grid of frames with Label widgets packed into them:

Python

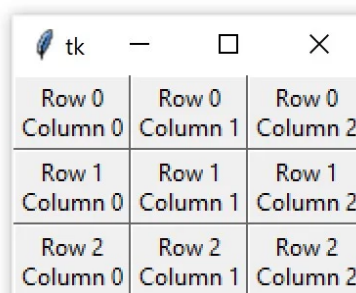
```
import tkinter as tk

window = tk.Tk()

for i in range(3):
    for j in range(3):
        frame = tk.Frame(
            master=window,
            relief=tk.RAISED,
            borderwidth=1
        )
        frame.grid(row=i, column=j)
        label = tk.Label(master=frame, text=f"Row {i}\nColumn {j}")
        label.pack()

window.mainloop()
```

Here's what the resulting window looks like:



geometry manager:

Python

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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```
label = tk.Label(master=frame, text=f"Row {i}\nColumn {j}")
label.pack()

window.mainloop()
```

Each label is attached to its master Frame with `.pack()`:

Python

```
import tkinter as tk

window = tk.Tk()

for i in range(3):
    for j in range(3):
        frame = tk.Frame(
            master=window,
            relief=tk.RAISED,
            borderwidth=1
        )
        frame.grid(row=i, column=j)
        label = tk.Label(master=frame, text=f"Row {i}\nColumn {j}")
        label.pack()

window.mainloop()
```

The important thing to realize here is that even though `.grid()` is called on each Frame object, the geometry manager applies to the window object. Similarly, the layout of each frame is controlled with the `.pack()` geometry manager.

The frames in the previous example are placed tightly next to one another. To add some space around each Frame, you can set the padding of each cell in the grid. **Padding** is just some blank space that surrounds a widget and separates it visually from its contents.

The two types of padding are **external** and **internal padding**. External padding adds some space around the outside of a grid cell. It's controlled with two keyword arguments to `.grid()`:

1. **padx** adds padding in the horizontal direction.
2. **pady** adds padding in the vertical direction.

Both `padx` and `pady` are measured in pixels, not text units, so setting both of them to the same value will create the same amount of padding in both directions. Try to add some padding around the outside of the frames in the previous example:

Python

```
window = tk.Tk()
```

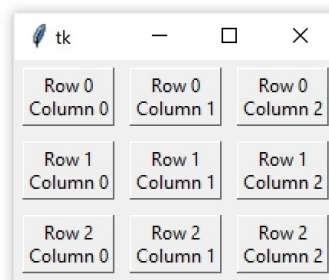
```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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Here's the resulting window:



`.pack()` also has `padx` and `pady` parameters. The following code is nearly identical to the previous code, except that you add 5 pixels of additional padding around each `Label` in both the `x` and `y` directions:

Python

```
import tkinter as tk

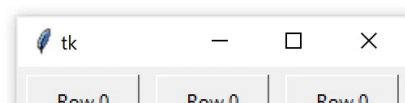
window = tk.Tk()

for i in range(3):
    for j in range(3):
        frame = tk.Frame(
            master=window,
            relief=tk.RAISED,
            borderwidth=1
        )
        frame.grid(row=i, column=j, padx=5, pady=5)

        label = tk.Label(master=frame, text=f"Row {i}\nColumn {j}")
        label.pack(padx=5, pady=5)

window.mainloop()
```

The extra padding around the `Label` widgets gives each cell in the grid a little bit of breathing room between the `Frame` border and the text in the `Label`:



Row 1 Column 0	Row 1 Column 1	Row 1 Column 2
-------------------	-------------------	-------------------

```

1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}

```

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The whole grid stays at the top-left corner as the window expands.

You can adjust how the rows and columns of the grid grow as the window is resized using `.columnconfigure()` and `.rowconfigure()` on the window object. Remember, the grid is attached to window, even though you're calling `.grid()` on each Frame widget. Both `.columnconfigure()` and `.rowconfigure()` take three essential arguments:

1. **The index of the grid column or row** that you want to configure (or a list of indices to configure multiple rows or columns at the same time)
2. **A keyword argument called `weight`** that determines how the column or row should respond to window resizing, relative to the other columns and rows
3. **A keyword argument called `minsize`** that sets the minimum size of the row height or column width in pixels

`weight` is set to 0 by default, which means that the column or row doesn't expand as the window resizes. If every column and row is given a weight of 1, then they all grow at the same rate. If one column has a weight of 1 and another a weight of 2, then the second column expands at twice the rate of the first. Adjust the previous script to better handle window resizing:

Python

```

import tkinter as tk

window = tk.Tk()

for i in range(3):
    window.columnconfigure(i, weight=1, minsize=75)
    window.rowconfigure(i, weight=1, minsize=50)

```

```
frame = tk.Frame(  
    master=window,  
    relief=tk.RAISED
```

```
1# How to merge two dicts  
2# in Python 3.5+  
3  
4>>> x = {'a': 1, 'b': 2}  
5>>> y = {'b': 3, 'c': 4}  
6  
7>>> z = {**x, **y}  
8  
9>>> z  
10{'c': 4, 'a': 1, 'b': 3}
```

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On each iteration of the loop, the *i*-th column and row are configured to have a weight of 1. This ensures that each row and column expands at the same rate whenever the window is resized. The `minsize` argument is set to 75 for each column and 50 for each row. This makes sure the `Label` widget always displays its text without chopping off any

characters, even if the window size is extremely small.

The result is a grid layout that expands and contracts smoothly as the window is resized:

Try it yourself to get a feel for how it works! Play around with the `weight` and `minsize` parameters to see how they affect the grid.

By default, widgets are centered in their grid cells. For example, the following code creates two `Label` widgets and places them in a grid with one column and two rows:

Python

```
import tkinter as tk  
  
window = tk.Tk()  
window.columnconfigure(0, minsize=250)  
window.rowconfigure([0, 1], minsize=100)  
  
label1 = tk.Label(text="A")  
label1.grid(row=0, column=0)  
  
label2 = tk.Label(text="B")  
label2.grid(row=1, column=0)  
  
window.mainloop()
```

Each grid cell is 250 pixels wide and 100 pixels tall. The labels are placed in the center of each cell, as you can see in the following figure:



```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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- "e" or "E" to align to the right-center side of the cell
- "s" or "S" to align to the bottom-center part of the cell
- "w" or "W" to align to the left-center side of the cell

The letters "n", "s", "e", and "w" come from the cardinal directions north, south, east, and west. Setting sticky to "n" on both Labels in the previous code positions each Label at the top-center of its grid cell:

Python

```
import tkinter as tk

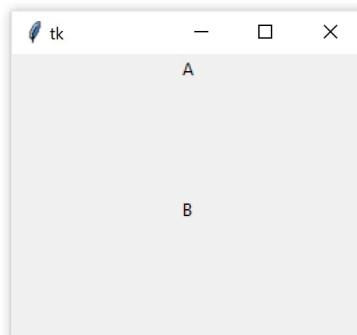
window = tk.Tk()
window.columnconfigure(0, minsize=250)
window.rowconfigure([0, 1], minsize=100)

label1 = tk.Label(text="A")
label1.grid(row=0, column=0, sticky="n")

label2 = tk.Label(text="B")
label2.grid(row=1, column=0, sticky="n")

window.mainloop()
```

Here's the output:



You can combine multiple letters in a single string to position each Label in the corner of its grid cell:

Python

```
import tkinter as tk

window = tk.Tk()
window.columnconfigure(0, minsize=250)
window.rowconfigure([0, 1], minsize=100)

label1 = tk.Label(text="A")
label1.grid(row=0, column=0, sticky="ne")

label2 = tk.Label(text="B")
label2.grid(row=1, column=0, sticky="sw")
```

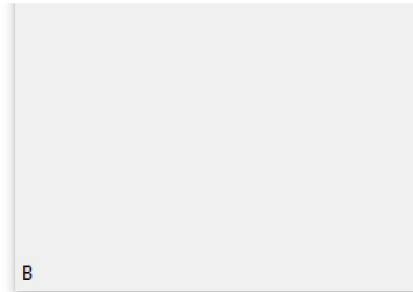
In this example, the sticky parameter of label1 is set to "ne" which places the label at the top-right corner of its grid

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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When a widget is positioned with sticky, the size of the widget itself is just big enough to contain any text and other contents inside of it. It won't fill the entire grid cell. In order to fill the grid, you can specify "ns" to force the widget to fill the cell in the vertical direction, or "ew" to fill the cell in the horizontal direction. To fill the entire cell, set sticky to "nsew". The following example illustrates each of these options:

Python

```
import tkinter as tk

window = tk.Tk()

window.rowconfigure(0, minsize=50)
window.columnconfigure([0, 1, 2, 3], minsize=50)

label1 = tk.Label(text="1", bg="black", fg="white")
label2 = tk.Label(text="2", bg="black", fg="white")
label3 = tk.Label(text="3", bg="black", fg="white")
label4 = tk.Label(text="4", bg="black", fg="white")

label1.grid(row=0, column=0)
label2.grid(row=0, column=1, sticky="ew")
label3.grid(row=0, column=2, sticky="ns")
label4.grid(row=0, column=3, sticky="nsew")

window.mainloop()
```

Here's what the output looks like:



What the above example illustrates is that the `.grid()` geometry manager's sticky parameter can be used to achieve the same effects as the `.pack()` geometry manager's fill parameter. The correspondence between the sticky and fill parameters is summarized in the following table:


```
.grid()
sticky="ns"
```

```
.pack()
fill=tk.Y
```

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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geometry manager.

Note: `.grid()` offers much more flexibility than you've seen here. For example, you can configure cells to span multiple rows and columns. For more information, check out the [Grid Geometry Manager section of the TkDocs tutorial](#).

Now that you've got the fundamentals of geometry managers down for the Python GUI framework Tkinter, the next step is to assign actions to buttons to bring your applications to life.

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Expand the code block below for an exercise to check your understanding:

Exercise: Create an address entry form

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You can expand the code block below to see a solution:

Solution: Create an address entry form

Show/Hide

When you're ready, you can move on to the next section.

Making Your Applications Interactive

By now, you have a pretty good idea of how to create a window with Tkinter, add some widgets, and control the application layout. That's great, but applications shouldn't just look good—they actually need to do something! In this section, you'll learn how to bring your applications to life by performing actions whenever certain **events** occur.

Using Events and Event Handlers

When you create a Tkinter application, you must call `window.mainloop()` to start the **event loop**. During the event loop, your application checks if an event has occurred. If so, then some code can be executed in response.

The event loop is provided for you with Tkinter, so you don't have to write any code that checks for events yourself. However, you do have to write the code that will be executed in response to an event. In Tkinter, you write functions called **event handlers** for the events that you use in your application.

Note: An **event** is any action that occurs during the event loop that might trigger some behavior in the application, such as when a key or mouse button is pressed.

event is instantiated. You don't need to worry about creating these classes yourself. Tkinter will create instances of event classes for you automatically.

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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```
# Assume that this list gets updated automatically
events_list = []

# Run the event loop
while True:
    # If events_list is empty, then no events have occurred and you
    # can skip to the next iteration of the loop
    if events_list == []:
        continue

    # If execution reaches this point, then there is at least one
    # event object in events_list
    event = events_list[0]
```

Right now, the event loop you've created doesn't do anything with event. Let's change that. Suppose your application needs to respond to keypresses. You need to check that event was generated by a user pressing a key on their keyboard, and, if so, pass event to an event handler function for key presses.

Assume that event has a `.type` attribute set to the string "keypress" if the event is a keypress event object, and a `.char` attribute containing the character of the key that was pressed. Create a new function `handle_keypress()` and update your event loop code:

```
Python

events_list = []

# Create an event handler
def handle_keypress(event):
    """Print the character associated to the key pressed"""
    print(event.char)

while True:
    if events_list == []:
        continue
    event = events_list[0]

    # If event is a keypress event object
    if event.type == "keypress":
        # Call the keypress event handler
        handle_keypress(event)
```

When you call `window.mainloop()`, something like the above loop is run for you. This method takes care of two parts of the loop for you:

1. **It maintains a list of events** that have occurred.
2. **It runs an event handler** any time a new event is added to that list.

Update your event loop to use `window.mainloop()` instead of your own event loop:

```
import tkinter as tk
```

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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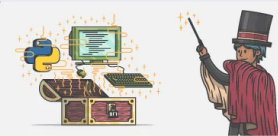
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when to use `handle_keypress()`? Tkinter widgets have a method called `.bind()` for just this purpose.

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Using `.bind()`

To call an event handler whenever an event occurs on a widget, use `.bind()`. The event handler is said to be **bound** to the event because it's called every time the event occurs. You'll continue with the keypress example from the previous section and use `.bind()` to bind `handle_keypress()` to the keypress event:

Python

```
import tkinter as tk

window = tk.Tk()

def handle_keypress(event):
    """Print the character associated to the key pressed"""
    print(event.char)

# Bind keypress event to handle_keypress()
window.bind("<Key>", handle_keypress)

window.mainloop()
```

Here, the `handle_keypress()` event handler is bound to a "<Key>" event using `window.bind()`. Whenever a key is pressed while the application is running, your program will print the character of the key pressed.

Note: The output of the above program is **not** printed in the Tkinter application window. It is printed to `stdout`.

If you run the program in IDLE, you'll see the output in the interactive window. If you run the program from a terminal, you should see the output in your terminal.

`.bind()` always takes at least two arguments:

1. **An event** that's represented by a string of the form "<event_name>", where `event_name` can be any of Tkinter's events
2. **An event handler** that's the name of the function to be called whenever the event occurs

The event handler is bound to the widget on which `.bind()` is called. When the event handler is called, the event object is passed to the event handler function.

In the example above, the event handler is bound to the window itself, but you can bind an event handler to any widget in your application. For example, you can bind an event handler to a `Button` widget that will perform some action whenever the button is pressed:

```
def handle_click(event):
    print("The button was clicked!")
```

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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...For a list of commonly used events, see the [Events](#) section of the [Tkinter GUIs Toolkit](#).

You can bind any event handler to any kind of widget with `.bind()`, but there's an easier way to bind event handlers to button clicks using the `Button` widget's `command` attribute.

Using command

Every `Button` widget has a `command` attribute that you can assign to a function. Whenever the button is pressed, the function is executed.

Take a look at an example. First, you'll create a window with a `Label` widget that holds a numerical value. You'll put buttons on the left and right side of the label. The left button will be used to decrease the value in the `Label`, and the right one will increase the value. Here's the code for the window:

Python

```
import tkinter as tk

window = tk.Tk()

window.rowconfigure(0, minsize=50, weight=1)
window.columnconfigure([0, 1, 2], minsize=50, weight=1)

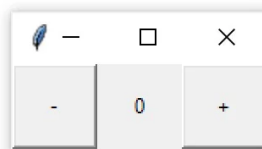
btn_decrease = tk.Button(master=window, text="-")
btn_decrease.grid(row=0, column=0, sticky="nsew")

lbl_value = tk.Label(master=window, text="0")
lbl_value.grid(row=0, column=1)

btn_increase = tk.Button(master=window, text="+")
btn_increase.grid(row=0, column=2, sticky="nsew")

window.mainloop()
```

The window looks like this:



With the app layout defined, you can bring it to life by giving the buttons some commands. Start with the left button. When this button is pressed, it should decrease the value in the label by 1. There are two things you need to know how to do in order to do this:

1. How do you get the text in a `Label`?
2. How do you update the text in a `Label`?

accessing the text attribute with a dictionary-style subscript notation:

Python

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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Python

```
def increase():
    value = int(lbl_value["text"])
    lbl_value["text"] = f"{value + 1}"
```

`increase()` gets the text from `lbl_value` and converts it to an integer with `int()`. Then, it increases this value by 1 and sets the label's text attribute to this new value.

You'll also need `decrease()` to decrease the value in `value_label` by 1:

Python

```
def decrease():
    value = int(lbl_value["text"])
    lbl_value["text"] = f"{value - 1}"
```

Put `increase()` and `decrease()` in your code just after the `import` statement.

To connect the buttons to the functions, assign the function to the button's `command` attribute. You can do this when you instantiate the button. For example, to assign `increase()` to `increase_button`, update the line that instantiates the button to the following:

Python

```
btn_increase = tk.Button(master=window, text="+", command=increase)
```

Now assign `decrease()` to `decrease_button`:

Python

```
btn_decrease = tk.Button(master=window, text="-", command=decrease)
```

That's all you need to do to bind the buttons to `increase()` and `decrease()` and make the program functional. Try saving your changes and running the application! Click the buttons to increase and decrease the value in the center of the window:

Here's the full application code for your reference:

This app is not particularly useful, but the skills you learned here apply to every app you'll make:

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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Expand the code block below for an exercise to check your understanding:

Exercise: Simulate rolling a six-sided die

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You can expand the code block below to see a solution:

Solution: Simulate rolling a six-sided die

Show/Hide

When you're ready, you can move on to the next section.

Building a Temperature Converter (Example App)

In this section, you'll build a **temperature converter application** that allows the user to input temperature in degrees Fahrenheit and push a button to convert that temperature to degrees Celsius. You'll walk through the code step by step. You can also find the full source code at the end of this section for your reference.

Note: To get the most out of this section, follow along in a [Python shell](#).

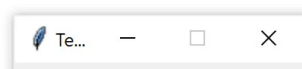
Before you start coding, you'll first design the app. You need three elements:

1. **An Entry widget** called `ent_temperature` to enter the Fahrenheit value
2. **A Label widget** called `lbl_result` to display the Celsius result
3. **A Button widget** called `btn_convert` that reads the value from the Entry widget, converts it from Fahrenheit to Celsius, and sets the text of the Label widget to the result when clicked

You can arrange these in a grid with a single row and one column for each widget. That gets you a minimally working application, but it isn't very user-friendly. Everything needs to have **labels**.

You'll put a label directly to the right of the `ent_temperature` widget containing the Fahrenheit symbol (°F) so that the user knows that the value `ent_temperature` should be in degrees Fahrenheit. To do this, set the label text to `"\N{DEGREE FAHRENHEIT}"`, which uses Python's named [Unicode character support](#) to display the Fahrenheit symbol.

You can give `btn_convert` a little flair by setting its text to the value `"\N{RIGHTWARDS BLACK ARROW}"`, which displays a black arrow pointing to the right. You'll also make sure that `lbl_result` always has the Celsius symbol (°C) following the label text `"\N{DEGREE CELSIUS}"` to indicate that the result is in degrees Celsius. Here's what the final window will look like:



Now that you know what widgets you need and what the window is going to look like, you can start coding it up! First

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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assigned to a frame widget called `frm_entry`.

Python

```
frm_entry = tk.Frame(master=window)
ent_temperature = tk.Entry(master=frm_entry, width=10)
lbl_temp = tk.Label(master=frm_entry, text="\N{DEGREE FAHRENHEIT}")
```

`ent_temperature` is where the user will enter the Fahrenheit value. `lbl_temp` is used to label `ent_temperature` with the Fahrenheit symbol. `frm_entry` is a container that groups `ent_temperature` and `lbl_temp` together.

You want `lbl_temp` to be placed directly to the right of `ent_temperature`. You can lay them out in the `frm_entry` using the `.grid()` geometry manager with one row and two columns:

Python

```
ent_temperature.grid(row=0, column=0, sticky="e")
lbl_temp.grid(row=0, column=1, sticky="w")
```

You've set the `sticky` parameter to "e" for `ent_temperature` so that it always sticks to the right-most edge of its grid cell. You also set `sticky` to "w" for `lbl_temp` to keep it stuck to the left-most edge of its grid cell. This ensures that `lbl_temp` is always located immediately to the right of `ent_temperature`.

Now, make the `btn_convert` and the `lbl_result` for converting the temperature entered into `ent_temperature` and displaying the results:

Python

```
btn_convert = tk.Button(
    master=window,
    text="\N{RIGHTWARDS BLACK ARROW}"
)
lbl_result = tk.Label(master=window, text="\N{DEGREE CELSIUS}")
```

Like `frm_entry`, both `btn_convert` and `lbl_result` are assigned to `window`. Together, these three widgets make up the three cells in the main application grid. Use `.grid()` to go ahead and lay them out now:

Python

```
frm_entry.grid(row=0, column=0, padx=10)
btn_convert.grid(row=0, column=1, pady=10)
lbl_result.grid(row=0, column=2, padx=10)
```

Finally, run the application:

Python

```
window.mainloop()
```

That looks great! But the button doesn't do anything just yet. At the top of your script file, just below the `import` line, add a function called `fahrenheit_to_celsius()`:

Python

```
convert the value for fahrenheit to celsius and insert the
result into lbl_result.
"""
```

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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```
master = window,
text="\N{RIGHTWARDS BLACK ARROW}",
command=fahrenheit_to_celsius # <--- Add this line
)
```

That's it! You've created a fully functional temperature converter app in just 26 lines of code! Pretty cool, right?

You can expand the code block below to see the full script:

Temperature Converter Full Source Code

Show/Hide

It's time to kick things up a notch! Read on to learn how to build a text editor.

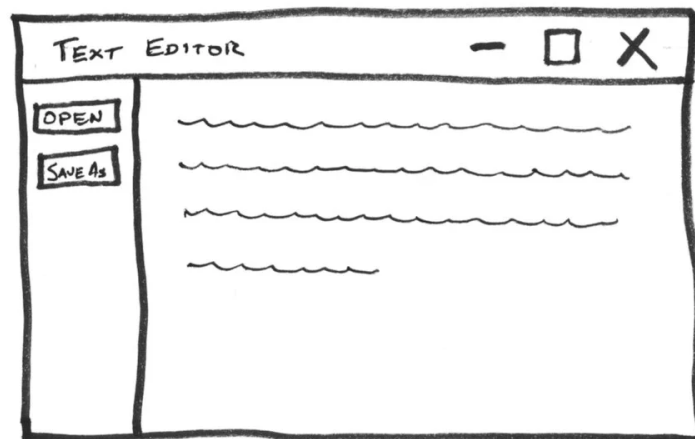
Building a Text Editor (Example App)

In this section, you'll build a **text editor application** that can create, open, edit, and save text files. There are three essential elements in the application:

1. A **Button widget** called `btn_open` for opening a file for editing
2. A **Button widget** called `btn_save` for saving a file
3. A **TextBox widget** called `txt_edit` for creating and editing the text file

The three widgets will be arranged so that the two buttons are on the left-hand side of the window, and the text box is on the right-hand side. The whole window should have a minimum height of 800 pixels, and `txt_edit` should have a minimum width of 800 pixels. The whole layout should be responsive so that if the window is resized, then `txt_edit` is resized as well. The width of the Frame holding the buttons should not change, however.

Here's a sketch of how the window will look:



You can achieve the desired layout using the `.grid()` geometry manager. The layout contains a single row and two columns:

1. A **narrow column** on the left for the buttons

To set the minimum sizes for the window and `txt_edit`, you can set the `minsize` parameters of the window methods `.rowconfigure()` and `.columnconfigure()` to 800. To handle resizing, you can set the `weight` parameters of these

```
1 # How to merge two dicts
2 # in Python 3.5+
3
4 >>> x = {'a': 1, 'b': 2}
5 >>> y = {'b': 3, 'c': 4}
6
7 >>> z = {**x, **y}
8
9 >>> z
10 {'c': 4, 'a': 1, 'b': 3}
```

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```
1 import tkinter as tk
2
3 window = tk.Tk()
4 window.title("Simple Text Editor")
5
6 window.rowconfigure(0, minsize=800, weight=1)
7 window.columnconfigure(1, minsize=800, weight=1)
8
9 txt_edit = tk.Text(window)
10 fr_buttons = tk.Frame(window)
11 btn_open = tk.Button(fr_buttons, text="Open")
12 btn_save = tk.Button(fr_buttons, text="Save As...")
```

Here's a breakdown of this code:

- **Line 1** imports `tkinter`.
- **Lines 3 and 4** create a new window with the title "Simple Text Editor".
- **Lines 6 and 7** set the row and column configurations.
- **Lines 9 to 12** create the four widgets you'll need for the text box, the frame, and the open and save buttons.

Take a look at line 6 more closely. The `minsize` parameter of `.rowconfigure()` is set to 800 and `weight` is set to 1:

Python

```
window.rowconfigure(0, minsize=800, weight=1)
```

The first argument is 0, which sets the height of the first row to 800 pixels and makes sure that the height of the row grows proportionally to the height of the window. There's only one row in the application layout, so these settings apply to the entire window.

Let's also take a closer look at line 7. Here, you use `.columnconfigure()` to set the width and `weight` attributes of the column with index 1 to 800 and 1, respectively:

Python

```
window.columnconfigure(1, minsize=800, weight=1)
```

Remember, row and column indices are zero-based, so these settings apply only to the second column. By configuring just the second column, the text box will expand and contract naturally when the window is resized, while the column containing the buttons will remain at a fixed width.

Now you can work on the application layout. First, assign the two buttons to the `fr_buttons` frame using the `.grid()` geometry manager:

Python

```
btn_open.grid(row=0, column=0, sticky="ew", padx=5, pady=5)
btn_save.grid(row=1, column=0, sticky="ew", padx=5)
```

and btn_save have their master attribute set to fr_buttons. btn_open is put in the first row and btn_save in the second row so that btn_open appears above btn_save in the layout, just you planned in your sketch.

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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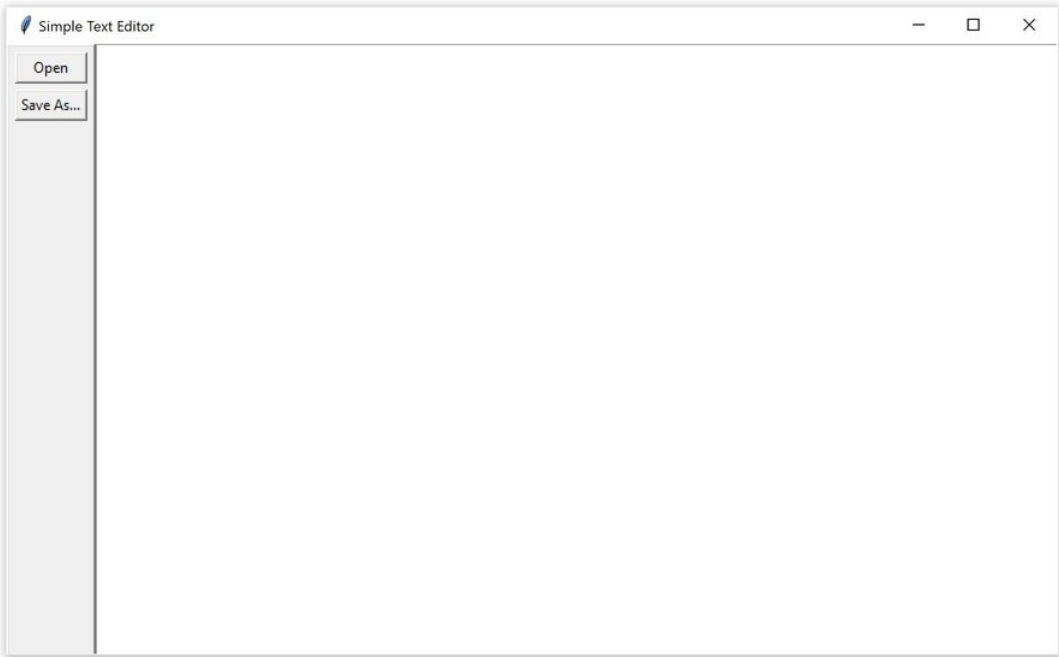
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```
fr_buttons.grid(row=0, column=0, sticky="ns",
txt_edit.grid(row=0, column=1, sticky="nsew")
```

These two lines of code **create a grid** with one row and two columns for window. You place fr_buttons in the first column and txt_edit in the second column so that fr_buttons appears to the left of txt_edit in the window layout.

The sticky parameter for fr_buttons is set to "ns", which forces the whole frame to **expand vertically** and fill the entire height of its column. txt_edit fills its entire grid cell because you set its sticky parameter to "nsew", which forces it to **expand in every direction**.

Now that the application layout is complete, add window.mainloop() to the bottom of the program and save and run the file. The following window is displayed:



That looks great! But it doesn't do anything just yet, so you need to start writing the commands for the buttons. btn_open needs to show a **file open dialog** and allow the user to select a file. It then needs to open that file and set the text of txt_edit to the contents of the file. Here's a function open_file() that does just this:

```
Python
1 def open_file():
```

```

4         askopenfilename(
5             filetypes=[("Text Files", "*.txt"), ("All Files", "*.")]
6         )

```

```

1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}

```

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- **Lines 6 and 7** check to see if the user closes the dialog box or clicks the *Cancel* button. If so, then `filepath` will be `None`, and the function will return without executing any of the code to read the file and set the text of `txt_edit`.
- **Line 8** clears the current contents of `txt_edit` using `.delete()`.
- **Lines 9 and 10** open the selected file and `.read()` its contents before storing the text as a string.
- **Line 11** assigns the string text to `txt_edit` using `.insert()`.
- **Line 12** sets the title of the window so that it contains the path of the open file.

Now you can update the program so that `btn_open` calls `open_file()` whenever it's clicked. There are a few things you need to do to update the program. First, import `askopenfilename()` from `tkinter.filedialog` by adding the following import to the top of your program:

Python

```

import tkinter as tk
from tkinter.filedialog import askopenfilename

window = tk.Tk()
window.title("Simple Text Editor")

window.rowconfigure(0, minsize=800, weight=1)
window.columnconfigure(1, minsize=800, weight=1)

txt_edit = tk.Text(window)
fr_buttons = tk.Frame(window)
btn_open = tk.Button(fr_buttons, text="Open")
btn_save = tk.Button(fr_buttons, text="Save As...")

```

Next, add the definition of `open_file()` just below the import statements:

Python

```

import tkinter as tk
from tkinter.filedialog import askopenfilename

def open_file():
    """Open a file for editing."""
    filepath = askopenfilename(
        filetypes=[("Text Files", "*.txt"), ("All Files", "*.")]
    )
    if not filepath:
        return
    txt_edit.delete("1.0", tk.END)
    with open(filepath, "r") as input_file:
        text = input_file.read()
        txt_edit.insert(tk.END, text)
    window.title(f"Simple Text Editor - {filepath}")

window = tk.Tk()
window.title("Simple Text Editor")

```

```
txt_edit = tk.Text(window)
```

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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Python

```
import tkinter as tk
from tkinter.filedialog import askopenfilename

def open_file():
    """Open a file for editing."""
    filepath = askopenfilename(
        filetypes=[("Text Files", "*.txt"), ("All Files", "*.*)"]
    )
    if not filepath:
        return
    txt_edit.delete("1.0", tk.END)
    with open(filepath, "r") as input_file:
        text = input_file.read()
        txt_edit.insert(tk.END, text)
    window.title(f"Simple Text Editor - {filepath}")

window = tk.Tk()
window.title("Simple Text Editor")

window.rowconfigure(0, minsize=800, weight=1)
window.columnconfigure(1, minsize=800, weight=1)

txt_edit = tk.Text(window)
fr_buttons = tk.Frame(window)
btn_open = tk.Button(fr_buttons, text="Open", command=open_file)
btn_save = tk.Button(fr_buttons, text="Save As...")
```

Save the file and run it to check that everything is working. Then try opening a text file!

With `btn_open` working, it's time to work on the function for `btn_save`. This needs to open a **save file dialog box** so that the user can choose where they would like to save the file. You'll use the `asksaveasfilename` dialog in the `tkinter.filedialog` module for this. This function also needs to extract the text currently in `txt_edit` and write this to a file at the selected location. Here's a function that does just this:

Python

```
1 def save_file():
2     """Save the current file as a new file."""
3     filepath = asksaveasfilename(
4         defaultextension=".txt",
```

```

7 | if not filepath:
8 |     return
9 | with open(filepath, "w") as output_file:

```

```

1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}

```

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- **Line 9** creates a new file at the selected file path.
- **Line 10** extracts the text from `txt_edit` with `.get()` method and assigns it to the variable `text`.
- **Line 11** writes text to the output file.
- **Line 12** updates the title of the window so that the new file path is displayed in the window title.

Now you can update the program so that `btn_save` calls `save_file()` when it's clicked. Again, there are a few things you need to do in order to update the program. First, import `asksaveasfilename()` from `tkinter.filedialog` by updating the import at the top of your script, like so:

Python

```

import tkinter as tk
from tkinter.filedialog import askopenfilename, asksaveasfilename

def open_file():
    """Open a file for editing."""
    filepath = askopenfilename(
        filetypes=[("Text Files", "*.txt"), ("All Files", "*.")]
    )
    if not filepath:
        return
    txt_edit.delete(1.0, tk.END)
    with open(filepath, "r") as input_file:
        text = input_file.read()
    txt_edit.insert(tk.END, text)
    window.title(f"Simple Text Editor - {filepath}")

window = tk.Tk()
window.title("Simple Text Editor")
window.rowconfigure(0, minsize=800, weight=1)
window.columnconfigure(1, minsize=800, weight=1)

txt_edit = tk.Text(window)
fr_buttons = tk.Frame(window, relief=tk.RAISED, bd=2)
btn_open = tk.Button(fr_buttons, text="Open", command=open_file)
btn_save = tk.Button(fr_buttons, text="Save As...")

btn_open.grid(row=0, column=0, sticky="ew", padx=5, pady=5)
btn_save.grid(row=1, column=0, sticky="ew", padx=5)

fr_buttons.grid(row=0, column=0, sticky="ns")
txt_edit.grid(row=0, column=1, sticky="nsew")

window.mainloop()

```

Next, add the definition of `save_file()` just below the `open_file()` definition:

```

1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}

```

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Python

```

import tkinter as tk
from tkinter.filedialog import askopenfilename, asksaveasfilename

def open_file():
    """Open a file for editing."""
    filepath = askopenfilename(
        filetypes=[("Text Files", "*.txt"), ("All Files", "*.")]
    )
    if not filepath:
        return
    txt_edit.delete(1.0, tk.END)
    with open(filepath, "r") as input_file:
        text = input_file.read()
    txt_edit.insert(tk.END, text)
    window.title(f"Simple Text Editor - {filepath}")

def save_file():
    """Save the current file as a new file."""
    filepath = asksaveasfilename(
        defaultextension="txt",
        filetypes=[("Text Files", "*.txt"), ("All Files", "*.")],
    )
    if not filepath:
        return
    with open(filepath, "w") as output_file:
        text = txt_edit.get(1.0, tk.END)
        output_file.write(text)
    window.title(f"Simple Text Editor - {filepath}")

window = tk.Tk()
window.title("Simple Text Editor")
window.rowconfigure(0, minsize=800, weight=1)
window.columnconfigure(1, minsize=800, weight=1)

txt_edit = tk.Text(window)
fr_buttons = tk.Frame(window, relief=tk.RAISED, bd=2)
btn_open = tk.Button(fr_buttons, text="Open", command=open_file)
btn_save = tk.Button(fr_buttons, text="Save As...")

btn_open.grid(row=0, column=0, sticky="ew", padx=5, pady=5)
btn_save.grid(row=1, column=0, sticky="ew", padx=5)

fr_buttons.grid(row=0, column=0, sticky="ns")
txt_edit.grid(row=0, column=1, sticky="nsew")

window.mainloop()

```

Finally, set the command attribute of btn_save to save_file:

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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Python

```
import tkinter as tk
from tkinter.filedialog import askopenfilename, asksaveasfilename

def open_file():
    """Open a file for editing."""
    filepath = askopenfilename(
        filetypes=[("Text Files", "*.txt"), ("All Files", "*.")]
    )
    if not filepath:
        return
    txt_edit.delete(1.0, tk.END)
    with open(filepath, "r") as input_file:
        text = input_file.read()
    txt_edit.insert(tk.END, text)
    window.title(f"Simple Text Editor - {filepath}")

def save_file():
    """Save the current file as a new file."""
    filepath = asksaveasfilename(
        defaultextension=".txt",
        filetypes=[("Text Files", "*.txt"), ("All Files", "*.")],
    )
    if not filepath:
        return
    with open(filepath, "w") as output_file:
        text = txt_edit.get(1.0, tk.END)
        output_file.write(text)
    window.title(f"Simple Text Editor - {filepath}")

window = tk.Tk()
window.title("Simple Text Editor")
window.rowconfigure(0, minsize=800, weight=1)
window.columnconfigure(1, minsize=800, weight=1)

txt_edit = tk.Text(window)
fr_buttons = tk.Frame(window, relief=tk.RAISED, bd=2)
btn_open = tk.Button(fr_buttons, text="Open", command=open_file)
btn_save = tk.Button(fr_buttons, text="Save As...", command=save_file)

btn_open.grid(row=0, column=0, sticky="ew", padx=5, pady=5)
btn_save.grid(row=1, column=0, sticky="ew", padx=5)

fr_buttons.grid(row=0, column=0, sticky="ns")
txt_edit.grid(row=0, column=1, sticky="nsew")

window.mainloop()
```

Save the file and run it. You've now got a minimal yet fully-functional text editor!

You can expand the code block below to see the full script:

[Text Editor Application Full Source Code](#)

[Show/Hide](#)

tutorial. That's no small achievement, so take some time to feel good about what you've done. You're now ready to tackle some applications on your own!

```
1# How to merge two dicts
2# in Python 3.5+
3
4>>> x = {'a': 1, 'b': 2}
5>>> y = {'b': 3, 'c': 4}
6
7>>> z = {**x, **y}
8
9>>> z
10{'c': 4, 'a': 1, 'b': 3}
```

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- How to make your applications **interactive**
- How to use five basic Tkinter **widgets** (Label, Button, Entry, Text, and Frame)

Now that you've mastered the foundations of Python GUI programming with Tkinter, the next step is to build some of your own applications. What will you create? Share your fun projects down in the comments below!

Additional Resources

In this tutorial, you touched on just the foundations of creating Python GUI applications with Tkinter. There are a number of additional topics that aren't covered here. In this section, you'll find some of the best resources available to help you continue on your journey.

Tkinter References

Here are some official resources to check out:

- The [official Python Tkinter tutorial](#) covers Python's Tkinter module in moderate depth. It's written for more advanced Python developers and is not the best resource for beginners.
- [Tkinter 8.5 reference: a GUI for Python](#) is an extensive reference covering the majority of the Tkinter module. It's exhaustive, but it's written in the reference style without commentary or examples.
- The [Tk Commands](#) reference is the definitive guide to commands in the Tk library. It's written for the Tcl language, but it answers a lot of questions about why things work the way they do in Tkinter. The official Python docs have a [section](#) on mapping basic Tk into Tkinter that's indispensable when you're reading the Tk Commands doc.

Additional Widgets

In this tutorial, you learned about the Label, Button, Entry, Text, and Frame widgets. There are several other widgets in Tkinter, all of which are essential for building real-world applications. Here are some resources to continue learning about widgets:

- The [TkDocs Tkinter Tutorial](#) is a fairly comprehensive guide for Tk, the underlying code library used by Tkinter. Examples are presented in Python, Ruby, Perl, and Tcl. You can find several examples of widgets beyond those covered here in two sections:
 - [Basic Widgets](#) covers the same widgets as this tutorial, plus a few more.
 - [More Widgets](#) covers several additional widgets.
- The official Python docs have three sections covering additional widgets:
 - [ttk themed widgets](#) covers the Tk themed widget set.
 - [Extension widgets for Tk](#) covers widgets in the Tk Interface Extension set.
 - [Scrolled Text Widget](#) details a Text widget combined with a vertical scroll bar.

Application Distribution

Once you've created an application with Tkinter, you probably want to distribute that to your colleagues and friends. Here are some tutorials to get you going with that process:

- [Using PyInstaller to Easily Distribute Python Applications](#)