Graphics

15-110 – Bonus Content

Tkinter Starter Code – Top-Level Version

In order to create graphics, we need to take a few preliminary steps. These will be provided to you as starter code.

First, **create a new window**- that's the thing that pops up on the screen.

Second, **create a new canvas**- that's the thing we can draw graphics on.

Next, **pack the canvas into the window**- that tells the canvas to fill the whole window.

We'll do all our drawing here.

Finally, the last line will tell the window to stay open until we press the X button.

```
import tkinter

root = tkinter.Tk()
canvas = tkinter.Canvas(root,
                        height=400,
                        width=400)
canvas.configure(bd=0,
                 highlightthickness=0)
canvas.pack()

# write your code here

root.mainloop()
```

Tkinter Starter Code – Function Version

Once you've learned about function definitions, you can also write Tkinter code inside of functions!

We'll move the setup code into `makeCanvas`, then call your graphics function from `makeCanvas`.

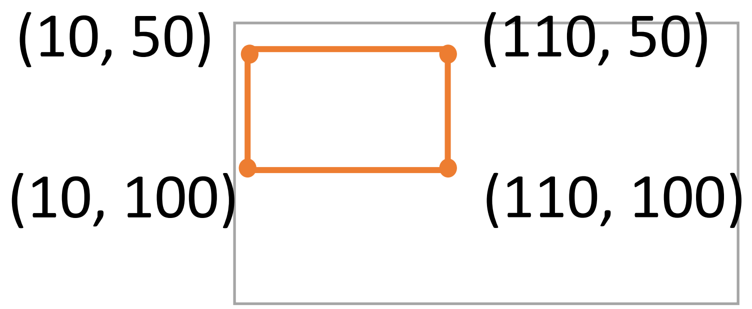
We have to pass in `canvas` as an argument, but you can still use it the same way as before.

```
import tkinter as tk # shorten library name
def draw(canvas):
    pass

def makeCanvas(w, h):
    root = tk.Tk()
    canvas = tk.Canvas(root, width=w, height=h)
    canvas.configure(bd=0,
                     highlightthickness=0)
    canvas.pack()
    draw(canvas)
    root.mainloop()

makeCanvas(400, 400)
```

Drawing a Rectangle

To draw a rectangle, we use the function `create_rectangle` in our `draw` function. This function takes four required parameters: the x and y coordinates of the **left-top** corner, and the x and y coordinates of the **right-bottom** corner. The rectangle will then be drawn between those two points.

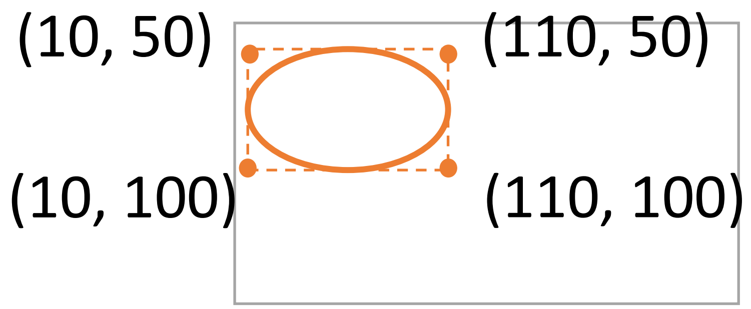
```
canvas.create_rectangle(10, 50, 110, 100)
```



Drawing an Oval

We can draw more shapes than just rectangles. To draw an oval, use `create_oval`. This function uses the same parameters as `create_rectangle`, where the coordinates mark the oval's **bounding box**.

```
canvas.create_oval(10, 50, 110, 100)
```



Drawing Squares/Circles

If you want to draw a square or a circle, you need to ensure that the width of the shape equals the height.

How can you do that? Make sure that (right - left) is equal to (bottom - top)!

```
canvas.create_rectangle(50, 100, 150, 200)
```

Keyword Arguments Add Variety

With the basic parameters, we can only draw outlines of shapes. By adding **keyword arguments**, we can change the properties of these shapes.

A keyword argument is an argument is associated with a specific name instead of a position in the call. We can put keyword arguments in any order we like as long as they occur after the main arguments.

Keyword arguments can have **default values**, which is why we don't need to include them in every graphics call. To change that default value, include the keyword, followed by `=`, followed by the new value in the function call.

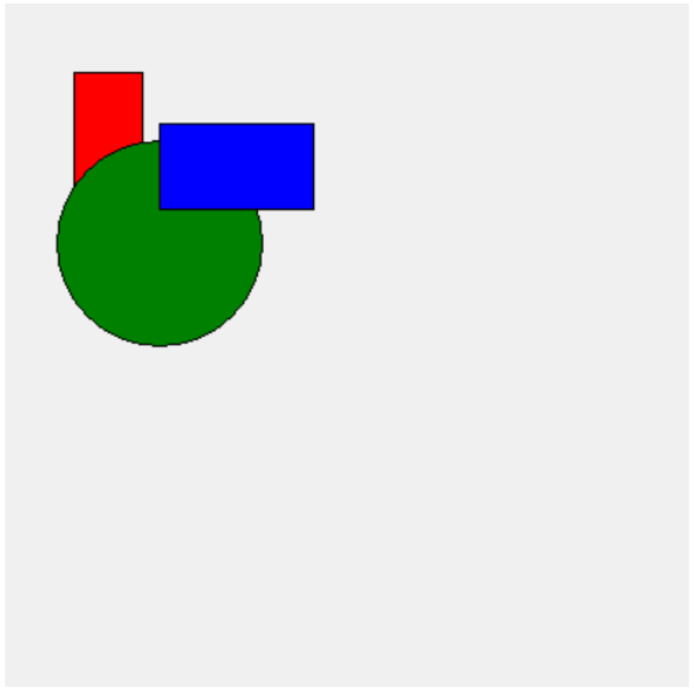
```
canvas.create_rectangle(50, 100, 150, 200, fill="green")
```

Keyword Argument - fill

The `fill` argument can be used on any shape. It uses a string (the name of the color) to change the color of the shape.

```
canvas.create_rectangle(40, 40, 80, 140, fill="red")

canvas.create_oval(30, 80, 150, 200, fill="green")

canvas.create_rectangle(90, 70, 180, 120, fill="blue")
```

Note that when we draw shapes on top of each other, the one on top is the **last one called**. Order matters!



Sidebar: Hexadecimal Numbers For Colors

What if we want to define our own colors, by using the RGB system we discussed in the Data Representation system? Python lets us do this, but we'll need to represent the RGB values in a new number system.

We use the **hexadecimal** number system to represent a byte with just two digits. This number system uses base **16**. In comparison, normal decimal uses base **10** and binary uses base **2**.

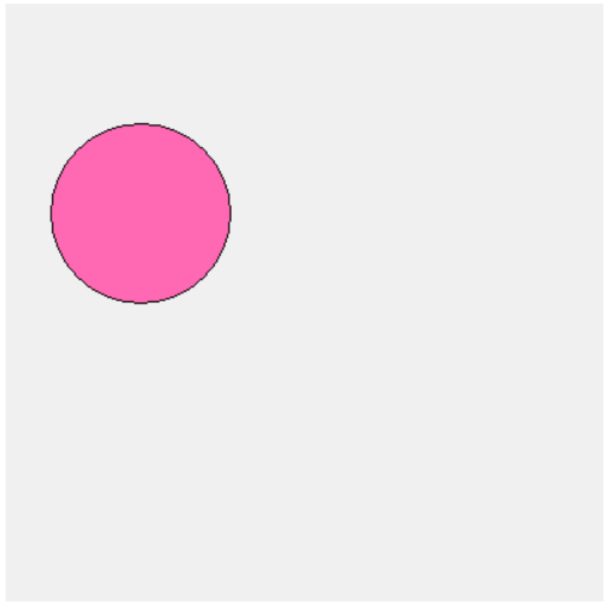
The digits of hexadecimal are : 0123456789**ABCDEF**

Example: 01111011 = 7B, because 0111 is 7 and 1011 is 11 (B).

Making New Colors

To define a new color, make a string "#RRGGBB", where you replace RR with the red value in hex, GG with green, and BB with blue. `"#FF69B4"` is hot pink!

```
canvas.create_oval(30, 80, 150, 200, fill="#FF69B4")
```

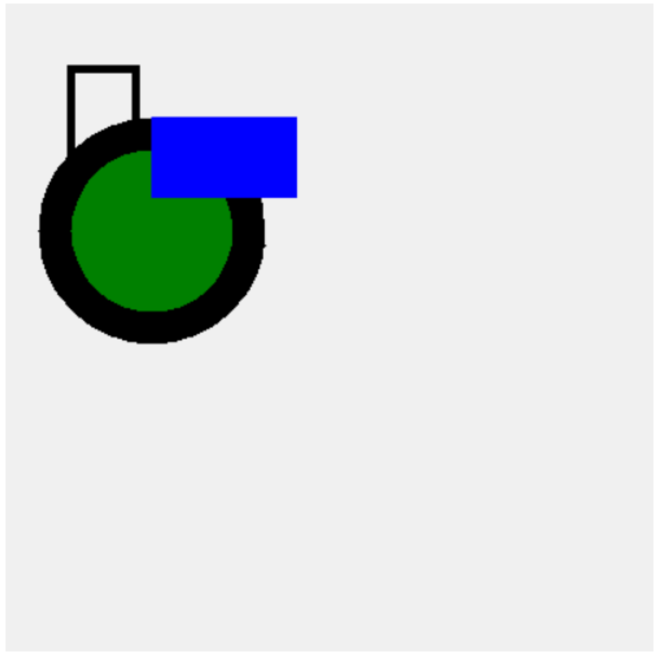


Interested in finding more Tkinter color names? There's a whole databank!
https://wiki.tcl-lang.org/page/Color+Names%2C+running%2C+all+screens

Keyword Argument - width

Another keyword argument is `width`, which specifies how many pixels wide the border of the shape should be.

```
canvas.create_rectangle(40, 40, 80, 140, width=5)

canvas.create_oval(30, 80, 150, 200,
                   width=20, fill="green")

canvas.create_rectangle(90, 70, 180, 120,
                        fill="blue", width=0)
```



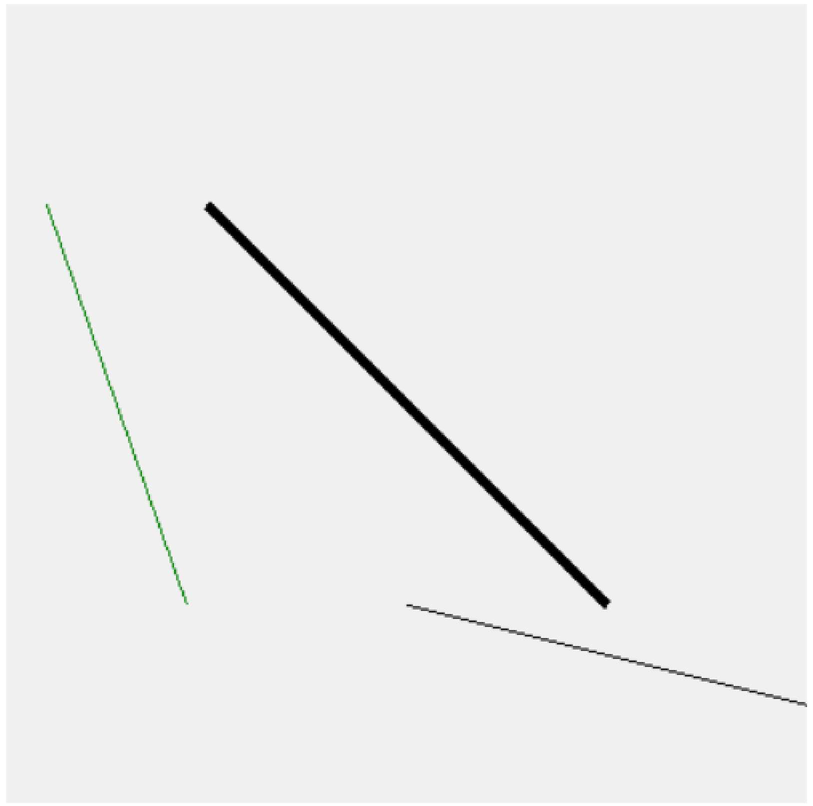
Note that setting `width` to `0` removes the border completely.

Drawing Lines

To draw a line on the screen, you specify the two endpoints of the line.

```
canvas.create_line(200, 300, 400, 350)

canvas.create_line(20, 100, 90, 300, fill="green")

canvas.create_line(100, 100, 300, 300, width=5)
```

Again, we can use `fill` and `width` to modify the lines.



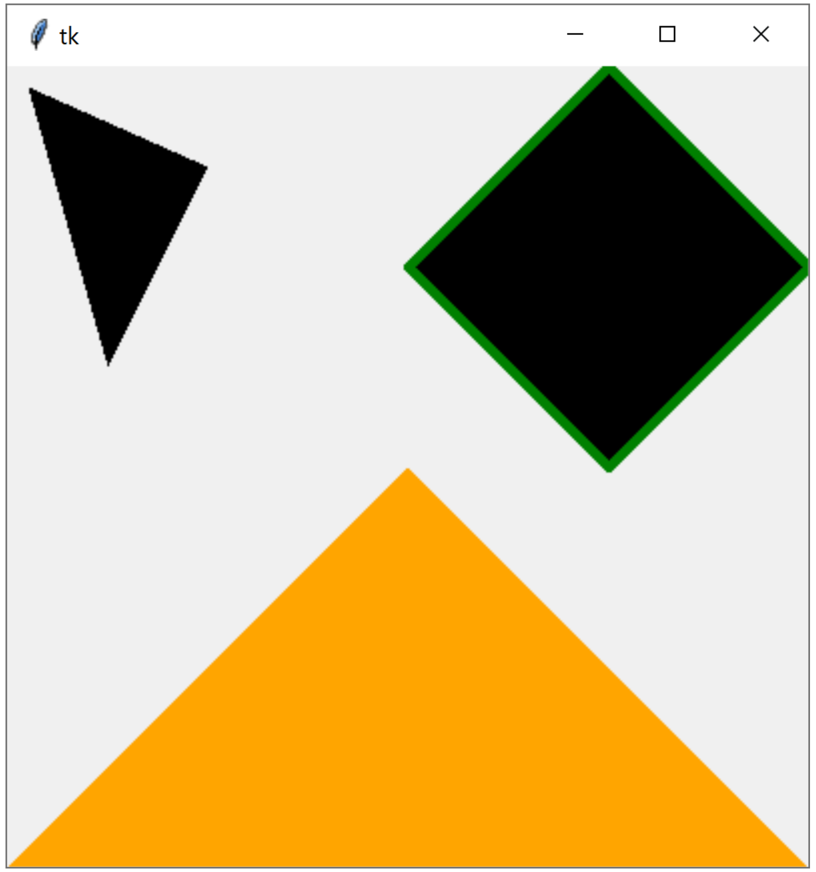
Drawing Polygons

To draw a polygon, you need to specify the coordinates of **each of the polygon's points as an x, y coordinate, in perimeter order**.

The polygon can have as many points as needed but will need at least three points to appear.

```
canvas.create_polygon(10, 10, 50, 150, 100, 50)
canvas.create_polygon(200, 200, 400, 400, 0, 400,
                      fill="orange")
canvas.create_polygon(200, 100, 300, 0,
                      400, 100, 300, 200,
                      outline="green", width=5)
```

Note here that we've also added a new keyword argument – **outline**, which specifies the color of the shape's outline.



Drawing Text

Drawing text on the canvas works a bit differently from drawing rectangles, ovals, lines, and polygons. We specify only one coordinate – the pixel where the **center** of text will be drawn.

```
canvas.create_text(200, 200, text="Hello World")
```

Although `text` is keyword argument and technically optional, `text` is required in order to draw text at all.

Keyword Argument - font

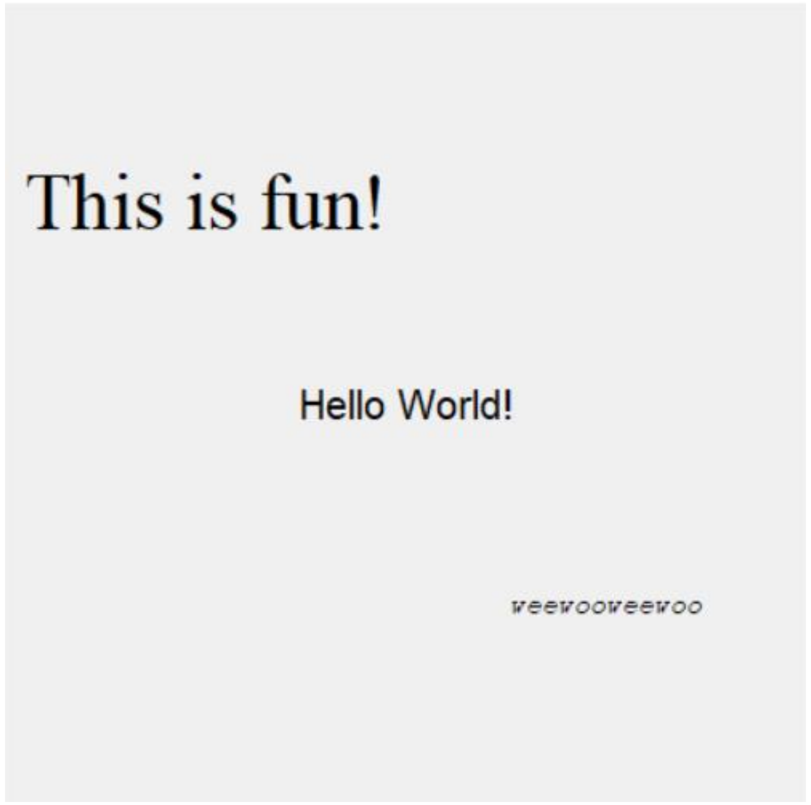
When drawing text, we can use the keyword argument `font` to change the appearance of the text.

The font parameters takes a string with one to three pieces of information – the font name, the font size, and the font type.

```
canvas.create_text(200, 200, text="Hello World!",
                   font="Arial")

canvas.create_text(100, 100, text="This is fun!",
                   font="Times 30")

canvas.create_text(300, 300, text="weewooweewoo",
                   font="Courier 10 italic")
```

You can find a full list of fonts and types here:

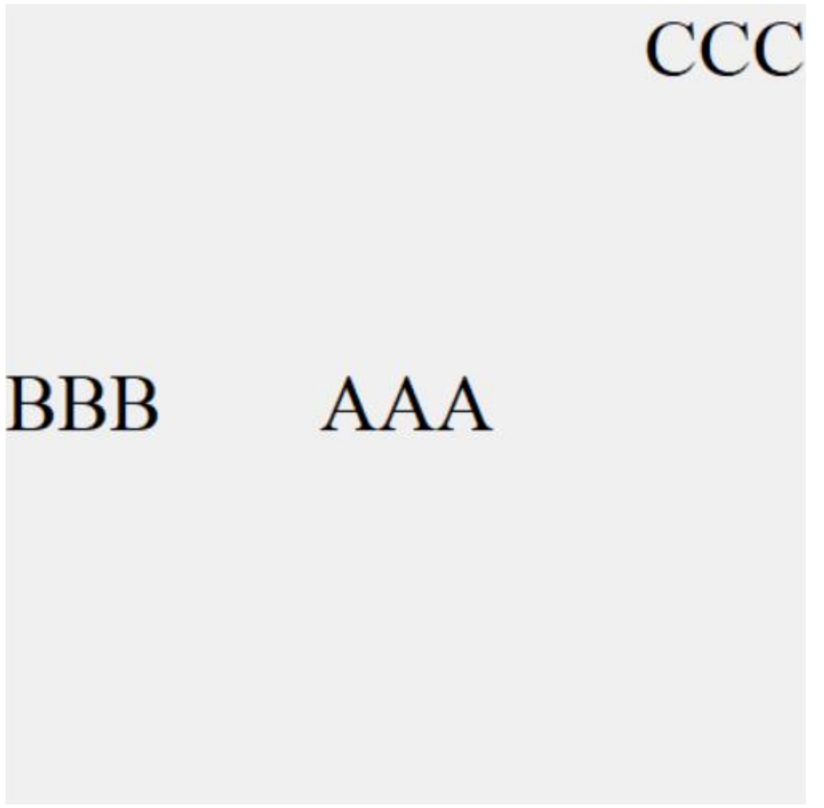
https://anzeljg.github.io/rin2/book2/2405/docs/tkinter/fonts.html



Keyword Argument - anchor

The point used in the `canvas.create_text` call is actually an **anchor** for the text, to describe where it is drawn from. That anchor defaults to the center of the text box, but we can change it to be any compass point instead.

```
canvas.create_text(200, 200, text="AAA",
                   font="Times 30", anchor="center")

canvas.create_text(0, 200, text="BBB",
                   font="Times 30", anchor="w")

canvas.create_text(400, 0, text="CCC",
                   font="Times 30", anchor="ne")
```



Note that the anchor describes the **point on the text box** that will correspond to the (x, y) coordinate. Since CCC's anchor is `"ne"` (north-east), the upper-right corner of the text box is placed at (400, 0).

Drawing images

If we want to use a pre-made image in Tkinter, we can load one in as a PhotoImage. This can be created with:

```
img = tkinter.PhotoImage(file="sample.gif")
```

We can resize the image if needed, using **subsample** to make it smaller and **zoom** to make it bigger.

```
img = img.subsample(5) # make the image 5 times smaller
img = img.zoom(2) # make the image twice as large
```

Unfortunately, PhotoImages can only be .pgm, .ppm, and .gif files. For more filetypes, use the external module Pillow (we'll learn about external modules later in the course).

Drawing images

Once you've created an image, you can draw it with `create_image`. This method takes the x, y coordinates of the image and can have other optional parameters:

```
# the image to be displayed. not really optional...
canvas.create_image(200, 100, image=imageVar)

# the anchor point of the coordinate.
# Same as for text, default "center"
canvas.create_image(200, 100, image=imageVar, anchor="n")
```

Tkinter Can Do Even More!

There's plenty of things Tkinter can draw and plenty of additional keyword arguments that we haven't covered here.

If you're interested in learning more, check out the Tkinter documentation:
https://anzeljg.github.io/rin2/book2/2405/docs/tkinter/index.html