2.5 Working with the Canvas

Canvas

Our last meeting is devoted to the `Canvas` – a widget that behaves like a... **canvas**. It's a flat, rectangular surface that you can cover with drawings, text, frames, and other widgets. Please treat this story as a basic introduction to the `Canvas` facilities. It can do much more for you – for example, it can scroll itself and react to many events – we hope you'll explore these issues on your own while we show you how to start your new adventure.

This will require neither palette nor easel – `Canvas` brings you all you need.

Let's start with a simple example.

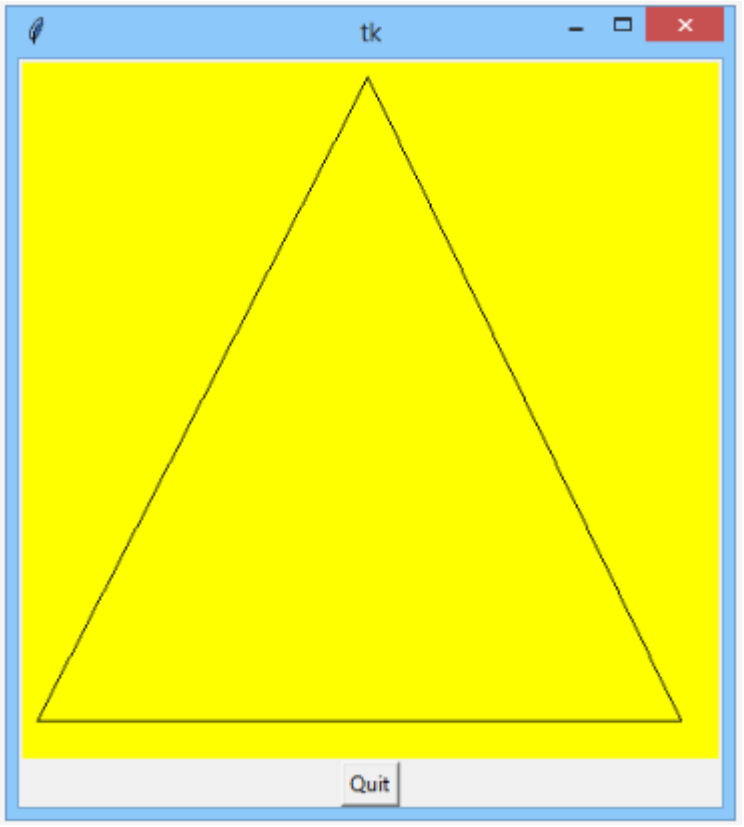
Take a look at the code.

```
import tkinter as tk


window = tk.Tk()
canvas = tk.Canvas(window, width=400, height=400, bg='yellow')
canvas.create_line(10, 380, 200, 10, 380, 380, 10, 380)
button = tk.Button(window, text="Quit", command=window.destroy)
canvas.grid(row=0)
button.grid(row=1)
window.mainloop()
```

It creates a 400 x 400-pixel **canvas** with a **yellow** background. Next, it draws a line (precisely: a polygonal **chain**) consisting of three line segments. The application can be terminated using the Quit button.

Can you find the parts of the code responsible for all these actions?



First, we'll show you how to create a canvas. This is done with a constructor named Canvas().

```
c = Canvas(master, options...)
```

Its first argument specifies the master widget (as usual). A set of keyword arguments specifies the properties of the canvas. The most usable of them are as follows:

Property name	Property role
`borderwidth`	canvas border's **width** in pixels (default: 2)
`background (bg)`	canvas border's **color** (default: the same as the underlying window's color)
`height`	canvas **height** (in pixels)
`width`	canvas **width** (in pixels)

An existing `Canvas` offers a set of methods designed to create different graphical constructs. To create a polygonal chain, you need to use the one named `create_line()`:

```
canvas.create_line(x0, y0, x1, y1, ..., xn, yn, option...)
```

The method draws a line connecting the points of specified coordinates (xi,yi), starting at (x0,y0) and ending at (xn,yn) – as you can see, each pair of positional arguments describes one point.

If you want to draw just one segment, you need to specify four values (i.e., the coordinates of two points).

The most interesting create_line() options are as follows:

Option name	Option meaning
`arrow`	normally, the chain ends aren't marked in any special way, but you may want them to be finished with **arrowheads**; setting the arrow option to `FIRST` results in drawing an arrowhead at the chain's beginning, `LAST` at the chain's end, `BOTH` at both sides of the chain.
`fill`	chain **color** (setting the option to an empty string causes the line to be transparent)
`smooth`	setting it to `True` rounds the chain's corners using a set of connected parabolas
`width`	line **width** (default: 1 pixel)

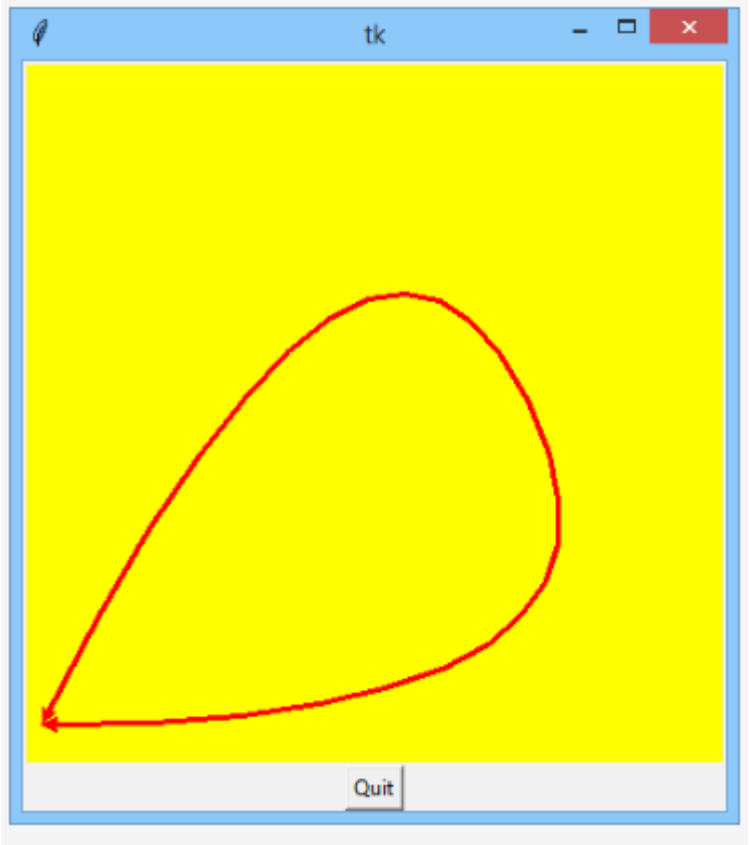
Let's see them in action.

```
import tkinter as tk

window = tk.Tk()
canvas = tk.Canvas(window, width=400, height=400, bg='yellow')
canvas.create_line(10, 380, 200, 10, 380, 380, 10, 380,
                   arrow=tk.BOTH, fill='red', smooth=True, width=3)
button = tk.Button(window, text="Quit", command=window.destroy)
canvas.grid(row=0)
button.grid(row=1)
window.mainloop()
```

Look at the sample code we've provided in the editor. We've drawn the same chain, but we've added some options to the `create_line()` invocation.

Can you predict what the result will look like?



Are you surprised? Of course, you are!

Drawing a rectangle can be done by the `create_rectangle()` method:

```
canvas.create_line(x0,y0,x1,y1, ...,xn,yn,option...)
```

The method draws a rectangle specified with two opposite vertices at the (x0,y0) and (x1,y1) points.

Some of the possible invocation options are:

Option name	Option meaning
`outline`	rectangle **edge color** (if specified as an empty string, the edge is transparent)
`fill`	rectangle **interior color**
`width`	rectangle **edge width** in pixels (default: 1)

Take a look at the code in the editor. This example's effect is easy to predict, isn't it?

```
import tkinter as tk

window = tk.Tk()
canvas = tk.Canvas(window, width=400, height=400, bg='black')
canvas.create_rectangle(200, 100, 300, 300, outline='white', width=5, fill='red')
button = tk.Button(window, text="Quit", command=window.destroy)
canvas.grid(row=0)
button.grid(row=1)
window.mainloop()
```

Drawing a **polygon** looks very similar to drawing a line, with the difference being that the last segment

(connecting the first and the last points) in the chain is drawn **automatically** (you don't need to specify the same point as the first and the last (x,y) pair:

```
canvas.create_polygon(x0, y0, x1, y1, xn, yn, option...)
```

The method uses the same set of options as `create_polygon()`.

Do you want to see it in action? Check out the code we've provided in the editor.

Analyze it and try to predict the shape it produces.

```
import tkinter as tk

window = tk.Tk()
canvas = tk.Canvas(window, width=400, height=400, bg='black')
canvas.create_polygon(20, 380, 200, 68, 380, 380, outline='red', width=5,
fill='yellow')
button = tk.Button(window, text="Quit", command=window.destroy)
canvas.grid(row=0)
button.grid(row=1)
window.mainloop()
```

Drawing an **ellipse** (and a **circle** is, in fact, a specific ellipse) needs a method named create_oval():

```
c.create_eclipse(x0,y0,x1,y1,xn,yn,option...)
```

The method draws an ellipse inscribed in a rectangle with vertices at the points (x0,y0) and (x1,y1).

If the rectangle is a **square**, the ellipse becomes a **circle**.

The options are the same as for `create_polygon()`.

Let's test it. Run the code we've provided in the editor.

```
import tkinter as tk

window = tk.Tk()
canvas = tk.Canvas(window, width=400, height=400, bg='blue')
canvas.create_oval(100, 100, 300, 200, outline='red', width=20, fill='white')
button = tk.Button(window, text="Quit", command=window.destroy)
canvas.grid(row=0)
button.grid(row=1)
window.mainloop()
```

If you want to draw an **arc** (a part of an ellipse) you'll use the `create_arc()` method:

```
canvas.create_arc(x0,y0,x1,y1,option...)
```

The method draws the arc of an ellipse inscribed inside a rectangle with vertices at points (x0,y0) and (x1,y1).

The options are the same as for `create_polygon()`, and define a set of three new ones, specific to the method:

Option name	Option meaning
`style`	can be set to one of the following: `PIESLICE` (default), `CHORD` and `ARC`; the **shape** of the resulting drawing is presented here: 
`start`	the **angle** (in degrees) of the arc's start relative to the X-axis (e.g., 90 means the highest point of the ellipse, while 0 is the right-most point. The default is 0)
`extent`	the arc's **span** (in degrees) relative to the start point; note: the span is calculated counter-clockwise. The default is 90 (a quarter of an ellipse)

Take a look at the code in the editor, this is how we've done it. Try to imagine what it looks like!

```
import tkinter as tk

window = tk.Tk()
canvas = tk.Canvas(window, width=400, height=400, bg='yellow')
canvas.create_arc(10, 100, 380, 300, outline='red', width=5)
canvas.create_arc(10, 100, 380, 300, outline='blue', width=5,
                  style=tk.CHORD, start=90, fill='white')
canvas.create_arc(10, 100, 380, 300, outline='green', width=5,
                  style=tk.ARC, start=180, extent=180)
button = tk.Button(window, text="Quit", command=window.destroy)
canvas.grid(row=0)
button.grid(row=1)
window.mainloop()
```

The `create_text()` method puts text on the `Canvas`. The text is placed inside a rectangle whose center is located at point (x,y):

```
c.create_text(x, y, option...)
```

The method makes use of the following options:

Option name	Option meaning
`fill`	text **color**
`font`	text **font**
`justify`	text **justification**: `LEFT` (default), `CENTER`, `RIGHT`
`text`	**text** to display (`\n` works as expected)
`width`	normally, the rectangle is as wide as the **longest text line**; using the width option forces the text to be aligned to that size

This is what the `create_text()` method can do for you (and much more as well).

```
import tkinter as tk

window = tk.Tk()
canvas = tk.Canvas(window, width=400, height=400, bg='blue')
canvas.create_text(200, 200, text="Mary\nhad\na\nlittle\nlamb",
                   font=("Arial","40","bold"),
                   justify=tk.CENTER,
                   fill='white')
button = tk.Button(window, text="Quit", command=window.destroy)
canvas.grid(row=0)
button.grid(row=1)
window.mainloop()
```

The `create_image()` method draws an image (a bitmap) on the Canvas. The image is placed inside a rectangle whose center is located at point `(x, y)`:

```
canvas.create_image(x, y, option...)
```

The method needs an image to display, and the image is passed as a keyword argument:

Option name	Option meaning
`image`	an object of the `PhotoImage` class containing the image itself; the `PhotoImage` class constructor needs a keyword argument named `file` pointing to a **bitmap file** (note: only GIF and PNG formats are accepted); the argument should specify the file's path

Let's see it inside our code.

```
import tkinter as tk

window = tk.Tk()
canvas = tk.Canvas(window, width=400, height=400, bg='yellow')
image = tk.PhotoImage(file='logo.png')
canvas.create_image(200, 200, image=image)
button = tk.Button(window, text="Quit", command=window.destroy)
canvas.grid(row=0)
button.grid(row=1)
window.mainloop()
```

If you want to use a **JPEG** bitmap, some additional steps are required – you need to:

- import the `Image` and `ImageTk` classes from the **PIL** (Python Image Library) module;
- build an object of the `Image()` class and use its `open()` method to fetch the bitmap from the file (the argument should specify the file's path)
- convert this object into a `PhotoImage` class object using an `ImageTk` function of the same name;
- continue as usual.

The example in the editor will tell you more.

This is how it works.

```
import tkinter as tk
```

```
import PIL

window = tk.Tk()
canvas = tk.Canvas(window, width=400, height=400, bg='red')
jpg = PIL.Image.open('logo.jpg')
image = PIL.ImageTk.PhotoImage(jpg)
canvas.create_image(200, 200, image=image)
button = tk.Button(window, text="Quit", command=window.destroy)
canvas.grid(row=0)
button.grid(row=1)
window.mainloop()
```