Tkinter Module

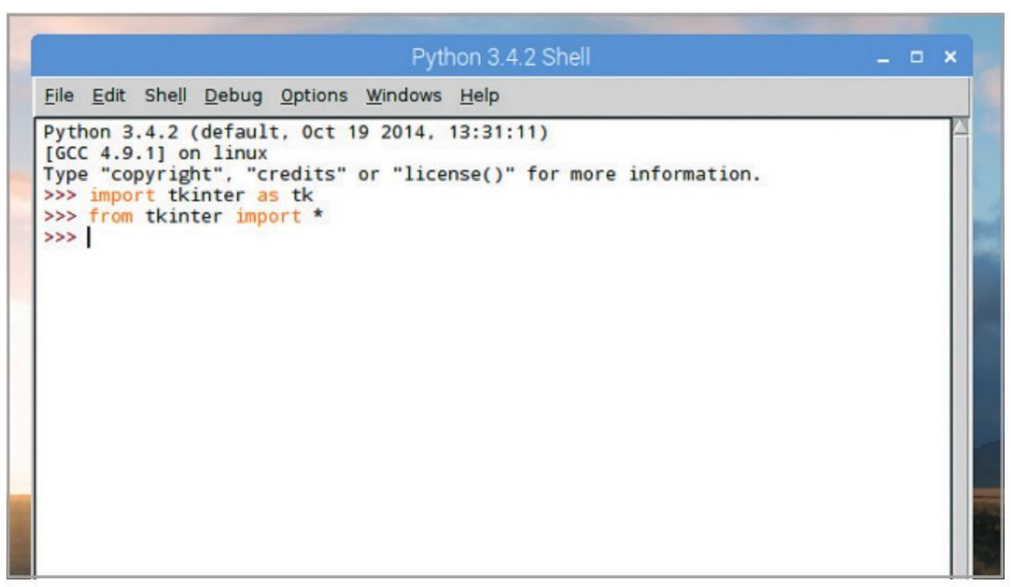
While running your code from the command line, or even in the Shell, is perfectly fine, Python is capable of so much more. The Tkinter module enables the programmer to set up a Graphical User Interface to interact with the user, and it's surprisingly powerful too.

GETTING GUI

Tkinter is easy to use but there's a lot more you can do with it. Let's start by seeing how it works and getting some code into it. Before long you will discover just how powerful this module really is.

STEP 1 Tkinter is usually built into Python 3. However, if it's available when you enter: `import tkinter`, then you need to `pip install tkinter` from the command prompt. We can start to import modules differently than before, to save on typing and by importing all their contents:

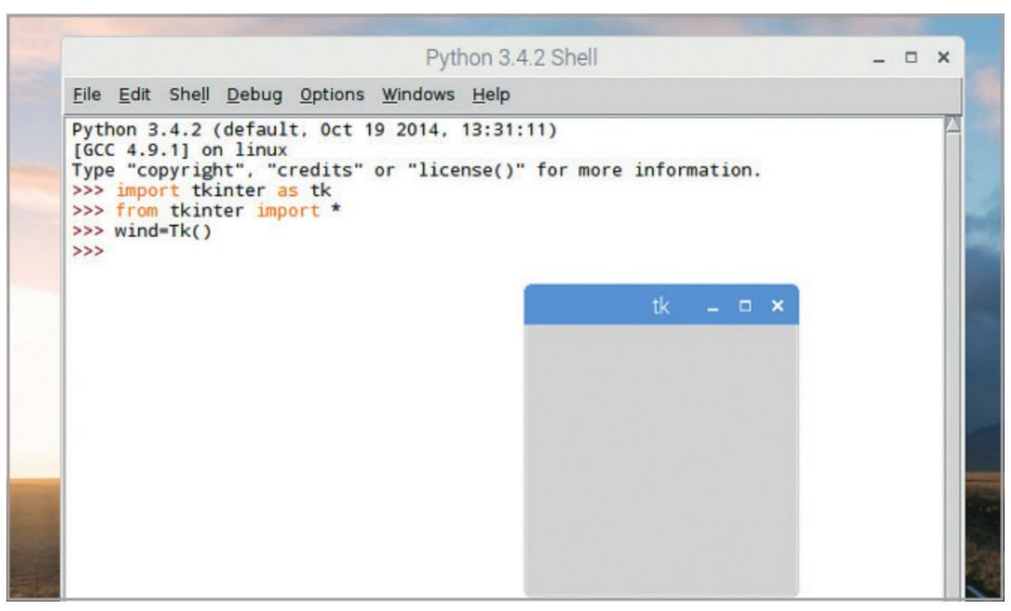
```
import tkinter as tk
from tkinter import *
```



STEP 2 It's not recommended to import everything from a module using the asterisk but it won't do any harm normally. Let's begin by creating a basic GUI window, enter:

```
wind=Tk()
```

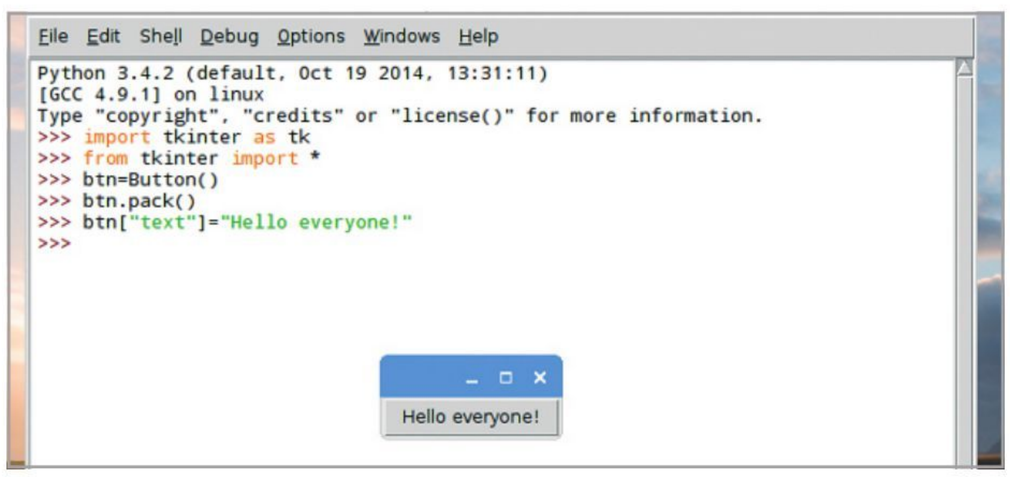
This creates a small, basic window. There's not much else to do at this point but click the X in the corner to close the window.



STEP 3 The ideal approach is to add mainloop() into the code to control the Tkinter event loop, but we'll get to that soon. You've just created a Tkinter widget and there are several more we can play around with:

```
btn=Button()
btn.pack()
btn["text"]="Hello everyone!"
```

The first line focuses on the newly created window. Click back into the Shell and continue the other lines.

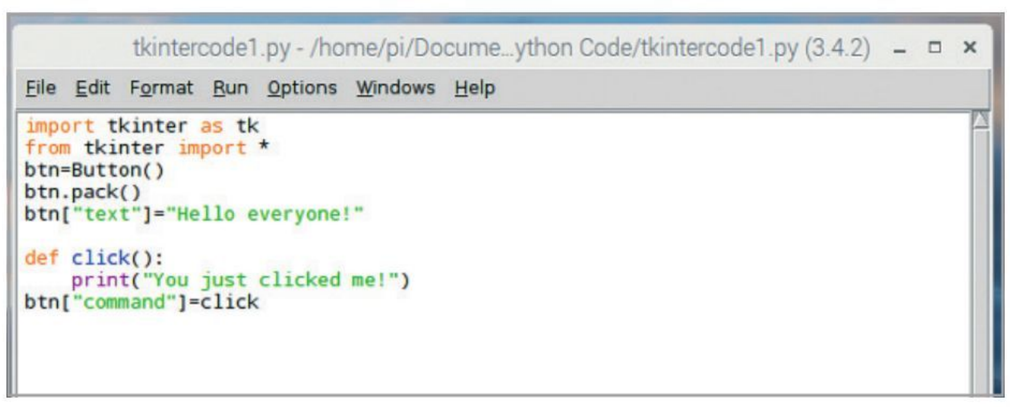


STEP 4 You can combine the above into a New File:

```
import tkinter as tk
from tkinter import *
btn=Button()
btn.pack()
btn["text"]="Hello everyone!"
```

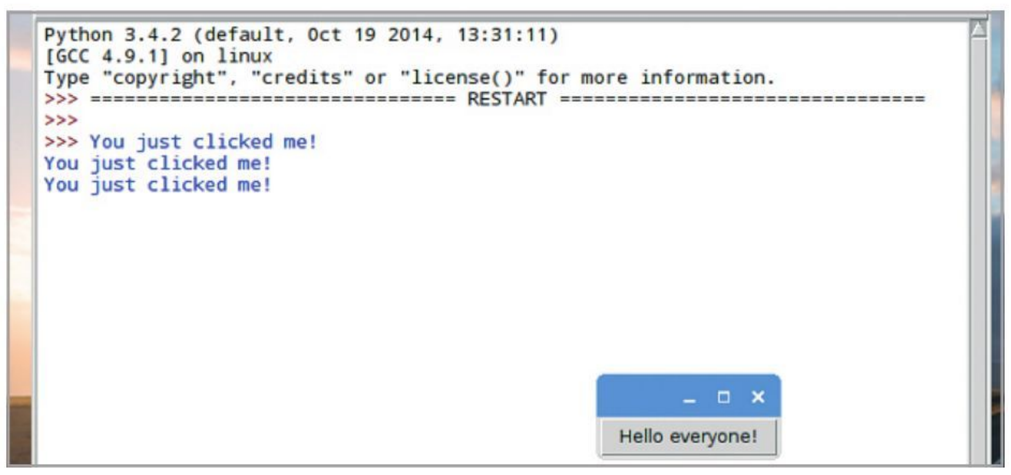
Then add some button interactions:

```
def click():
  print("You just clicked me!")
btn["command"]=click
```



STEP 5

Save and execute the code from Step 5 and a window appears with 'Hello everyone!' inside. If you click the Hello everyone! button, the Shell will output the text 'You just clicked me!'. It's simple but shows you what can be achieved with a few lines of code.



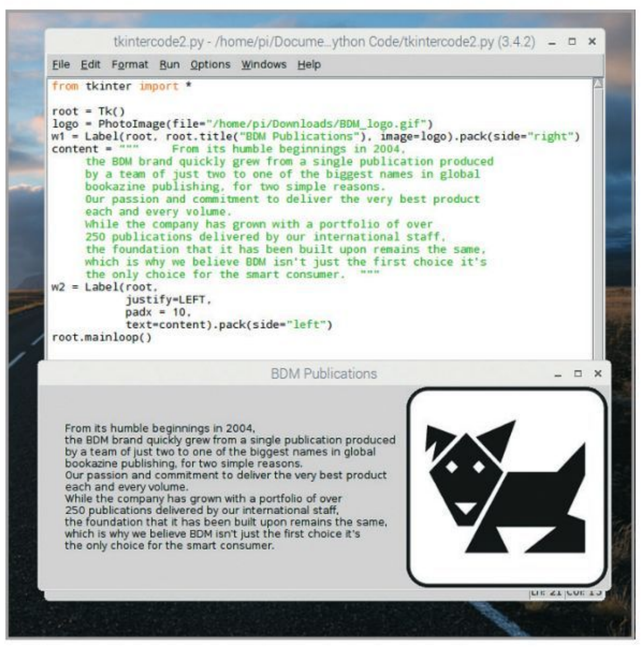
STEP 6

You can also display both text and images within a Tkinter window. However, only GIF, PGM or PPM formats are supported. So find an image and convert it before using the code. Here's an example using the BDM Publishing logo:

```
from tkinter import *

root = Tk()
logo = PhotoImage(file="/home/pi/Downloads/BDM_
logo.gif")
w1 = Label(root, root.title("BDM Publications"),
image=logo).pack(side="right")
content = """  From its humble beginnings in 2004,
the BDM brand quickly grew from a single publication
produced by a team of just two to one of the biggest
names in global bookazine publishing, for two simple
reasons. Our passion and commitment to deliver the
very best product each and every volume. While
the company has grown with a portfolio of over 250
publications delivered by our international staff,
the foundation that it has been built upon remains
the same, which is why we believe BDM isn't just
the first choice it's the only choice for the smart
consumer.  """
w2 = Label(root,
    justify=LEFT,
    padx = 10,
    text=content).pack(side="left")
root.mainloop()
```

STEP 7

The previous code is quite weighty, mostly due to the content variable holding a part of BDM's About page from the company website. You can obviously change the content, the root.title and the image to suit your needs.



STEP 8

You can create radio buttons too. Try:

```
from tkinter import *

root = Tk()

v = IntVar()

Label(root, root.title("Options"), text="""Choose
a preferred language:""",
  justify = LEFT, padx = 20).pack()
Radiobutton(root,
    text="Python",
    padx = 20,
    variable=v,
    value=1).pack(anchor=W)
Radiobutton(root,
    text="C++",
    padx = 20,
    variable=v,
    value=2).pack(anchor=W)

mainloop()
```

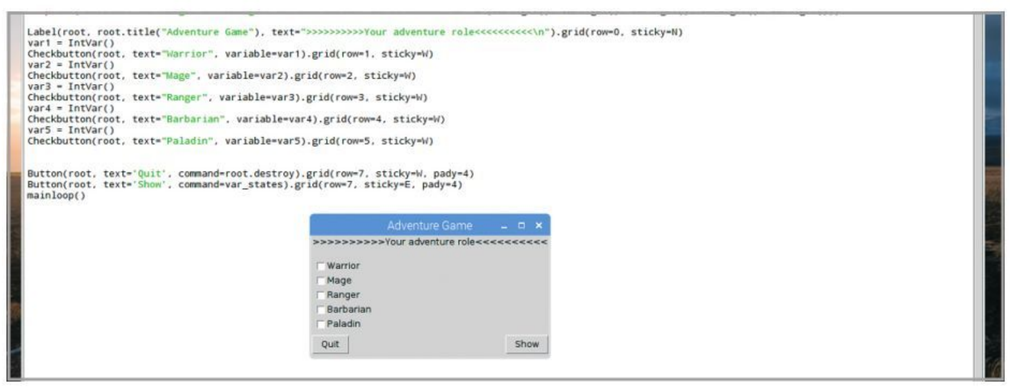
STEP 9

You can also create check boxes, with buttons and output to the Shell:

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

def var_states():
  print("Warrior: %d,\nMage: %d" % (var1.get(),
var2.get()))

Label(root, root.title("Adventure Game"),
text=">>>>>>>>>>Your adventure role<<<<<<<<<<").
grid(row=0, sticky=N)
var1 = IntVar()
Checkbutton(root, text="Warrior", variable=var1).
grid(row=1, sticky=W)
var2 = IntVar()
Checkbutton(root, text="Mage", variable=var2).
grid(row=2, sticky=W)
Button(root, text='Quit', command=root.destroy).
grid(row=3, sticky=W, pady=4)
Button(root, text='Show', command=var_states).
grid(row=3, sticky=E, pady=4)

mainloop()
```

STEP 10

The code from Step 9 introduced some new geometry elements into Tkinter. Note the sticky=N, E and W arguments. These describe the locations of the check boxes and buttons (North, East, South and West). The row argument places them on separate rows. Have a play around and see what you get.



Pygame Module

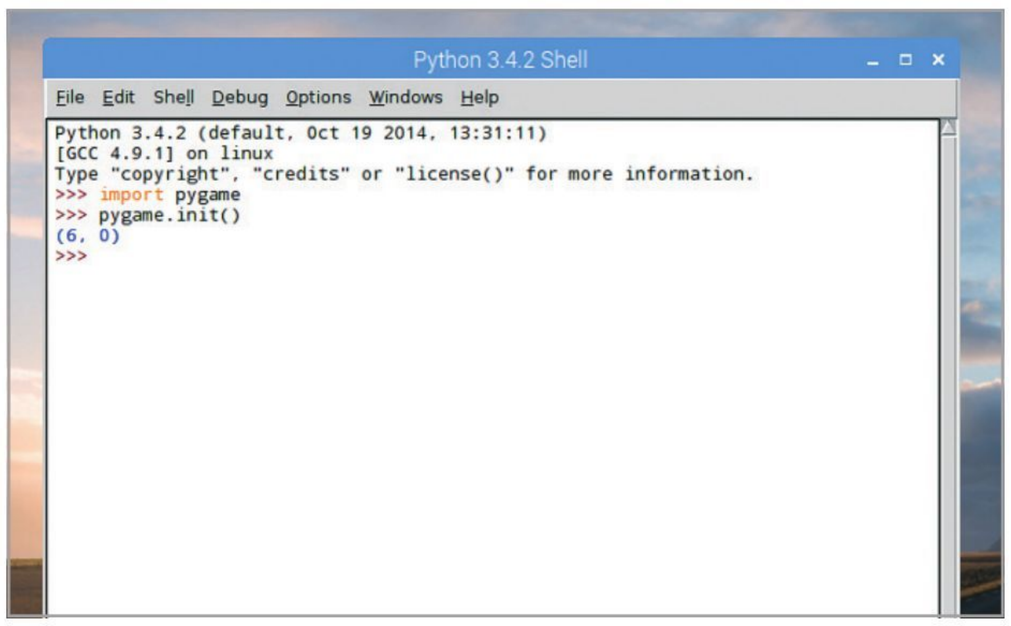
We've had a brief look at the Pygame module already but there's a lot more to it that needs exploring. Pygame was developed to help Python programmers create either graphical or text-based games.

PYGAMING

Pygame isn't an inherent module to Python but those using the Raspberry Pi will already have it installed. Everyone else will need to use: pip install pygame from the command prompt.

STEP 1 Naturally you need to load up the Pygame modules into memory before you're able to utilise them. Once that's done Pygame requires the user to initialise it prior to any of the functions being used:

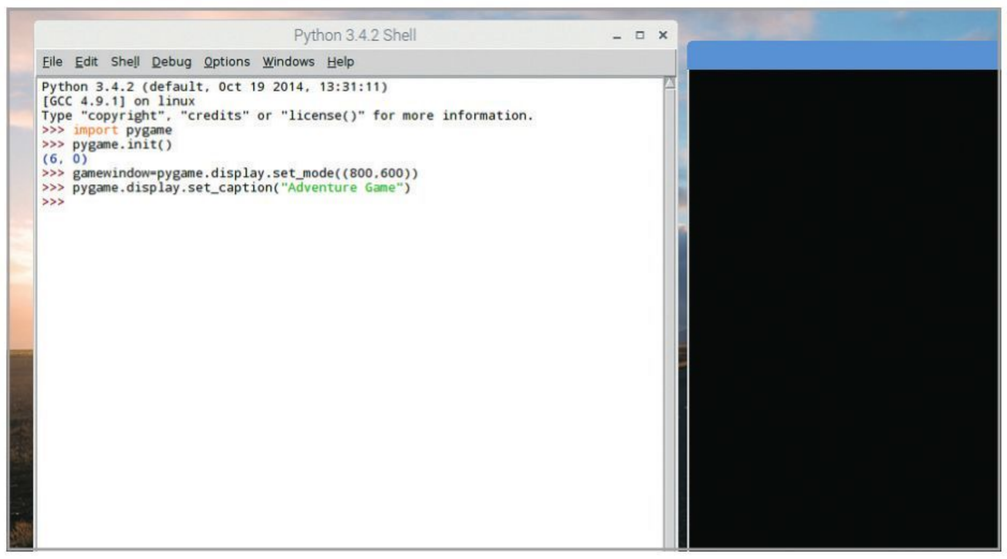
```
import pygame
pygame.init()
```



STEP 2 Let's create a simple game ready window, and give it a title:

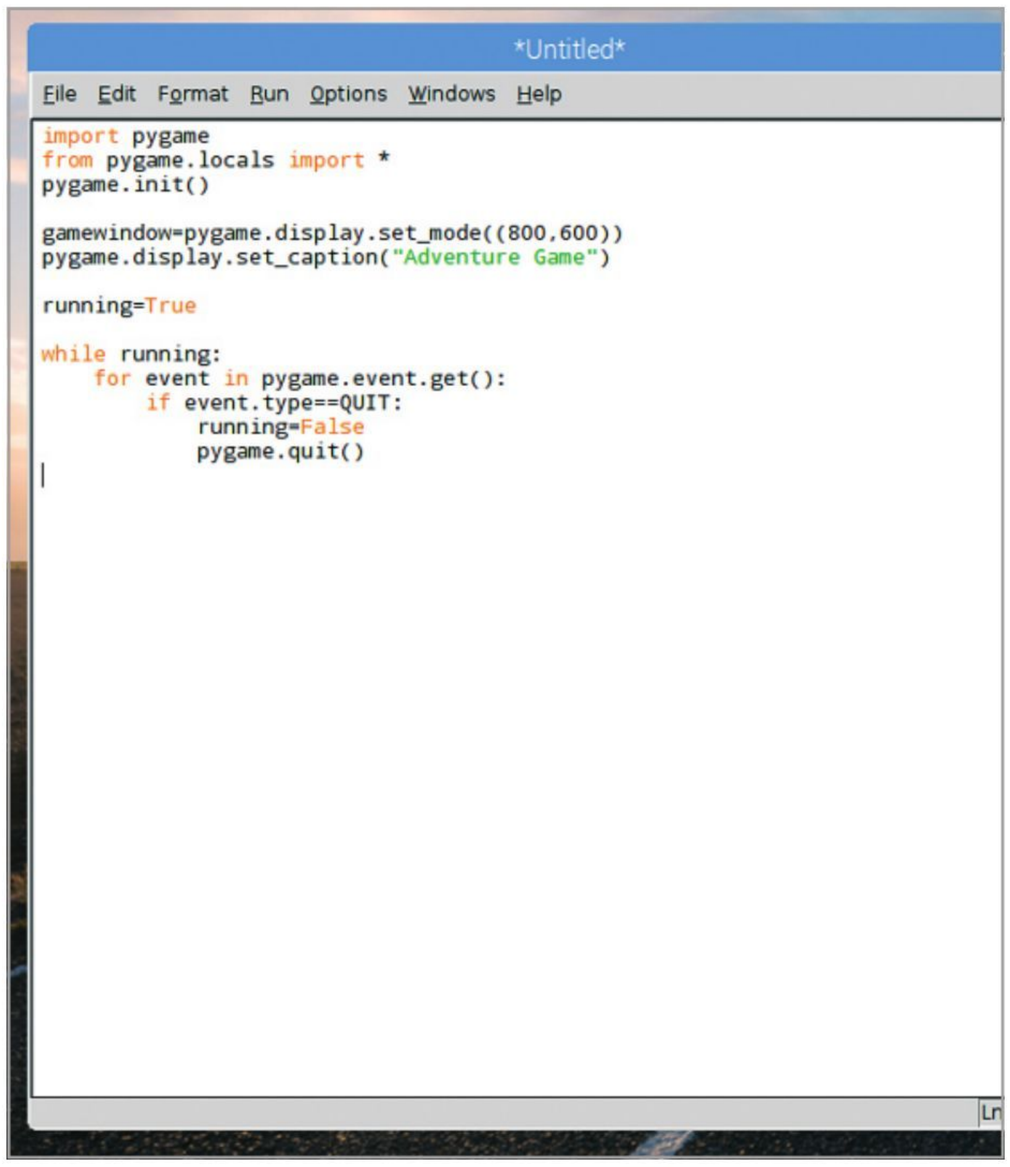
```
gamewindow=pygame.display.set_mode((800,600))
pygame.display.set_caption("Adventure Game")
```

You can see that after the first line is entered, you need to click back into the IDLE Shell to continue entering code; also, you can change the title of the window to anything you like.



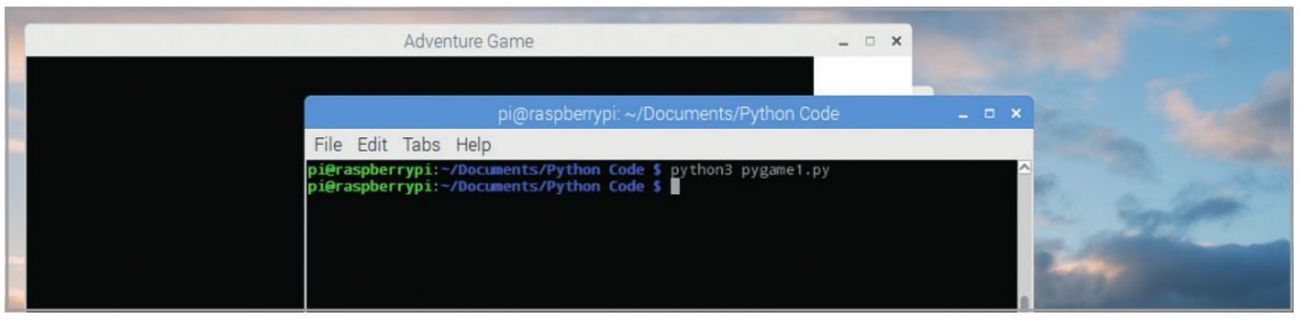
STEP 3 Sadly you can't close the newly created Pygame window without closing the Python IDLE Shell, which isn't very practical. For this reason, you need to work in the editor (New > File) and create a True/False while loop:

```
import pygame
from pygame.locals import *
pygame.init()

gamewindow=pygame.display.set_mode((800,600))
pygame.display.set_caption("Adventure Game")

running=True

while running:
  for event in pygame.event.get():
    if event.type==QUIT:
      running=False
      pygame.quit()
```



STEP 4

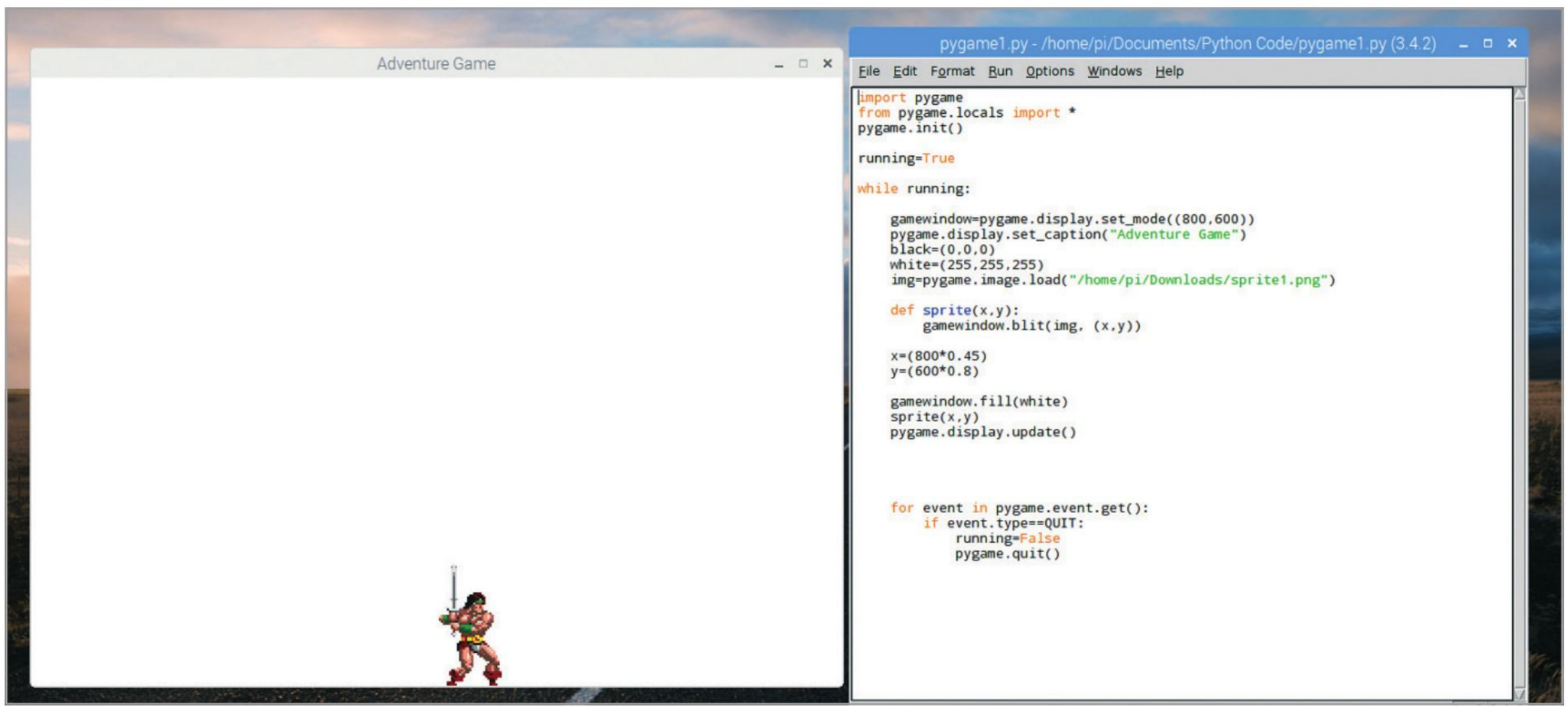
If the Pygame window still won't close don't worry, it's just a discrepancy between the IDLE (which is written with Tkinter) and the Pygame module. If you run your code via the command line, it closes perfectly well.



STEP 5

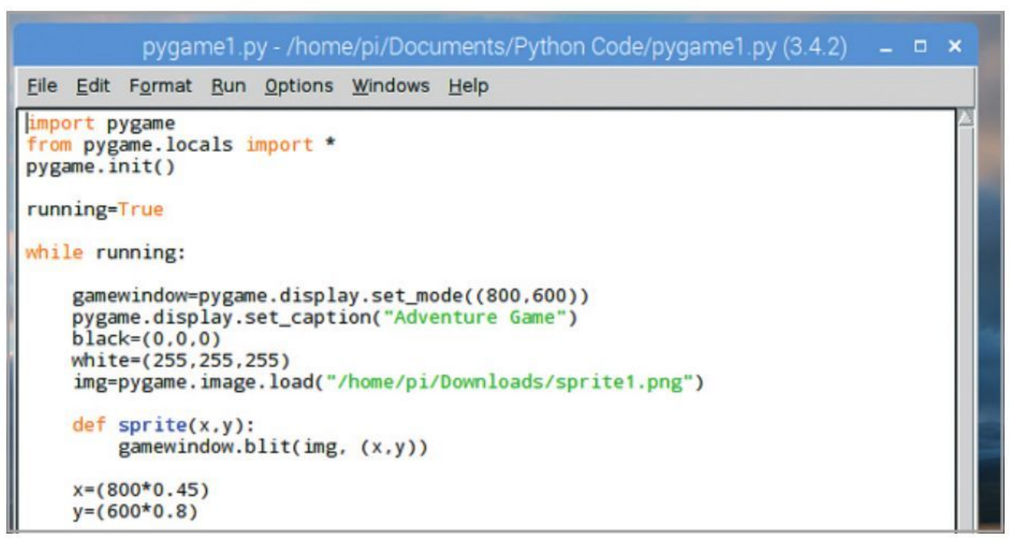
You're going to shift the code around a bit now, running the main Pygame code within a while loop; it makes it neater and easier to follow. We've downloaded a graphic to use and we need to set some parameters for pygame:

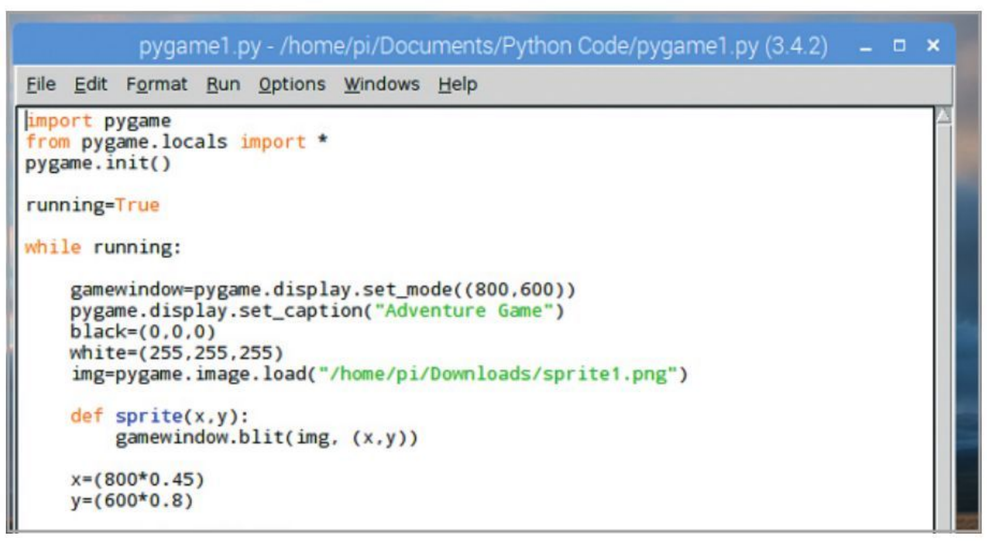
```
import pygame
pygame.init()
running=True
while running:
  gamewindow=pygame.display.set_mode((800,600))
  pygame.display.set_caption("Adventure Game")
  black=(0,0,0)
  white=(255,255,255)
  img=pygame.image.load("/home/pi/Downloads/sprite1.png")
  def sprite(x,y):
    gamewindow.blit(img, (x,y))
  x=(800*0.45)
  y=(600*0.8)
  gamewindow.fill(white)
  sprite(x,y)
  pygame.display.update()
  for event in pygame.event.get():
    if event.type==pygame.QUIT:
      running=False
```



STEP 6

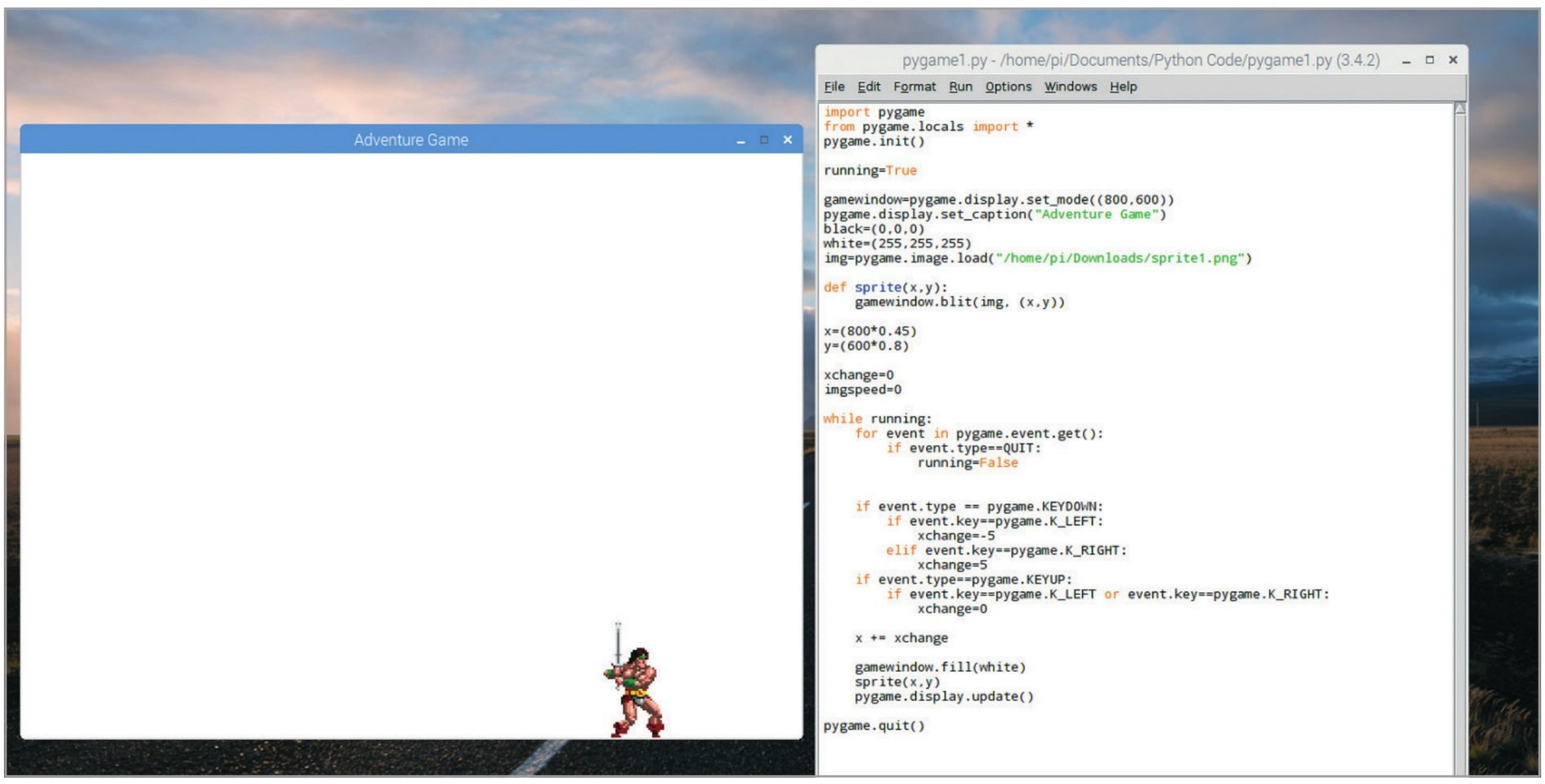
Let's quickly go through the code changes. We've defined two colours, black and white together with their respective RGB colour values. Next we've loaded the downloaded image called sprite1.png and allocated it to the variable img; and also defined a sprite function and the Blit function will allow us to eventually move the image.



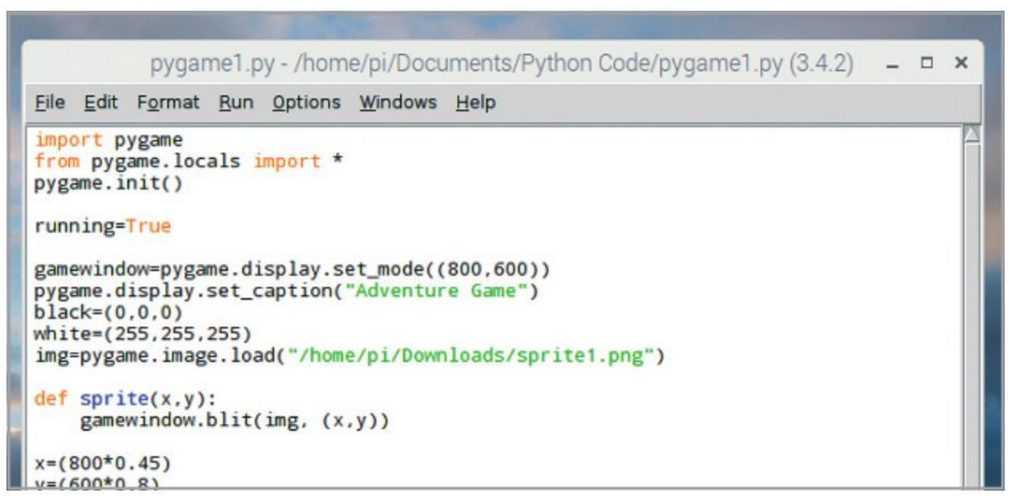


STEP 7 Now we can change the code around again, this time containing a movement option within the while loop, and adding the variables needed to move the sprite around the screen:

```
import pygame
from pygame.locals import *
pygame.init()

running=True

gamewindow=pygame.display.set_mode((800,600))
pygame.display.set_caption("Adventure Game")
black=(0,0,0)
white=(255,255,255)
img=pygame.image.load("/home/pi/Downloads/
sprite1.png")

def sprite(x,y):
  gamewindow.blit(img, (x,y))

x=(800*0.45)
y=(600*0.8)

xchange=0
imgspeed=0

while running:
  for event in pygame.event.get():
    if event.type==QUIT:
      running=False

  if event.type == pygame.KEYDOWN:
    if event.key==pygame.K_LEFT:
      xchange=-5
    elif event.key==pygame.K_RIGHT:
      xchange=5
  if event.type==pygame.KEYUP:
    if event.key==pygame.K_LEFT or event
key==pygame.K_RIGHT:
      xchange=0
  x += xchange

  gamewindow.fill(white)
  sprite(x,y)
  pygame.display.update()

pygame.quit()
```

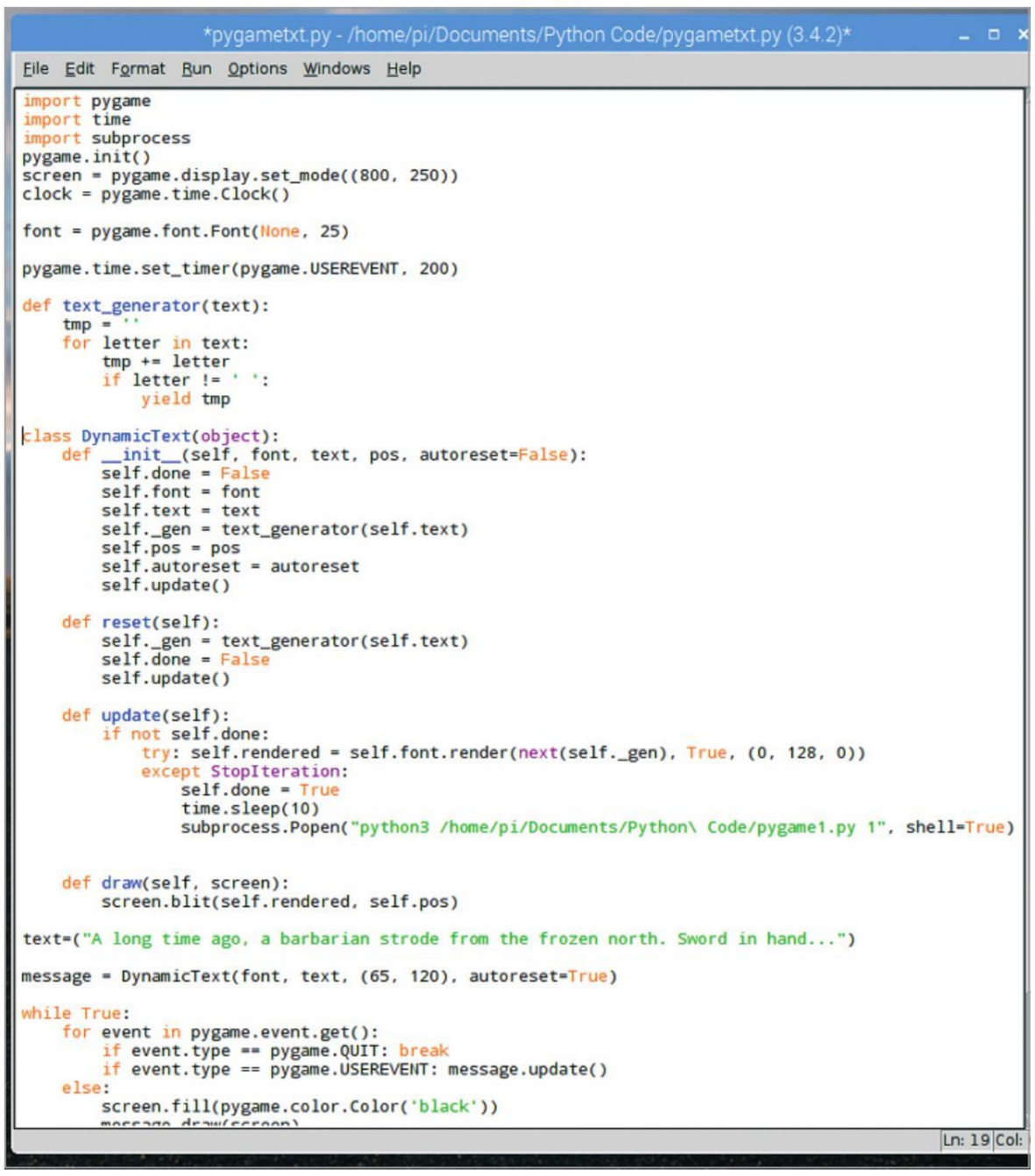


STEP 8 Copy the code down and using the left and right arrow keys on the keyboard you can move your sprite across the bottom of the screen. Now, it looks like you have the makings of a classic arcade 2D scroller in the works.

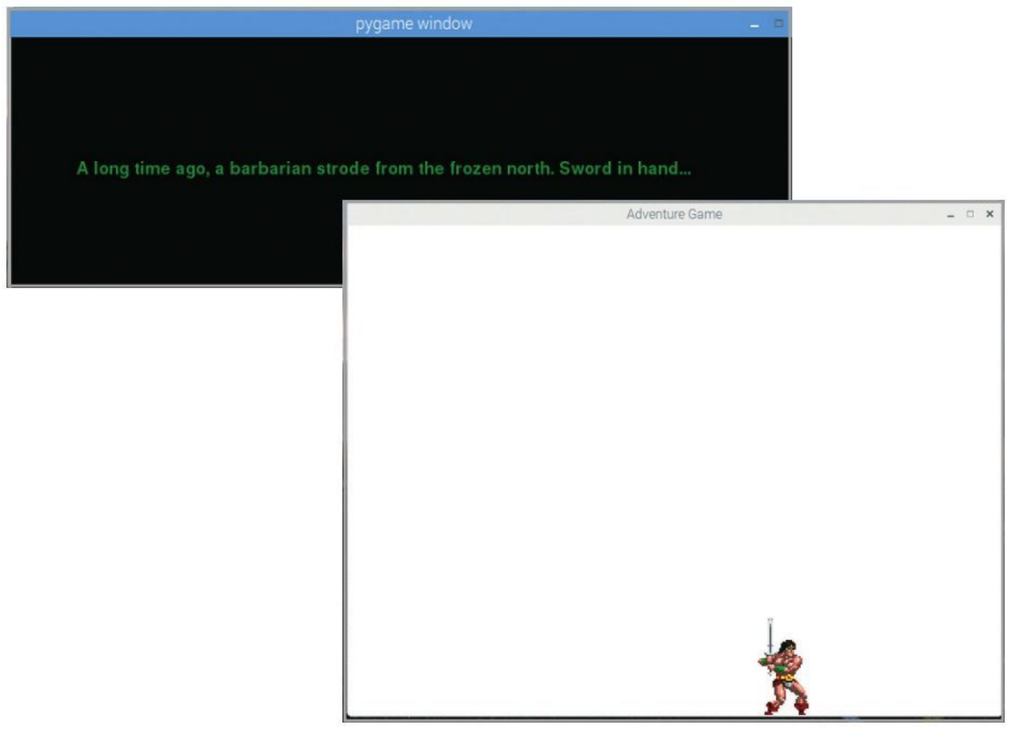


STEP 9 You can now implement a few additions and utilise some previous tutorial code. The new elements are the Subprocess module, of which one function allows us to launch a second Python script from within another; and we're going to create a New File called pygametxt.py:

```
import pygame
import time
import subprocess
pygame.init()
screen = pygame.display.set_mode((800, 250))
clock = pygame.time.Clock()

font = pygame.font.Font(None, 25)

pygame.time.set_timer(pygame.USEREVENT, 200)

def text_generator(text):
  tmp = ‘’
  for letter in text:
    tmp += letter
    if letter != ‘ ‘:
      yield tmp

class DynamicText(object):
  def __init__(self, font, text, pos,
autoreset=False):
    self.done = False
    self.font = font
    self.text = text
    self._gen = text_generator(self.text)
    self.pos = pos
    self.autoreset = autoreset
    self.update()

  def reset(self):
    self._gen = text_generator(self.text)
    self.done = False
    self.update()

  def update(self):
    if not self.done:
      try: self.rendered = self.font.
render(next(self._gen), True, (0, 128, 0))
      except StopIteration:
        self.done = True
        time.sleep(10)
        subprocess.Popen(“python3 /home/pi/Documents/
Python\ Code/pygame1.py 1”, shell=True)

  def draw(self, screen):
    screen.blit(self.rendered, self.pos)

text=(“A long time ago, a barbarian strode from the
frozen north. Sword in hand...”)

message = DynamicText(font, text, (65, 120),
autoreset=True)

while True:
  for event in pygame.event.get():
    if event.type == pygame.QUIT: break
    if event.type == pygame.USEREVENT:
message.update()
  else:
    screen.fill(pygame.color.Color(‘black’))
    message.draw(screen)
    pygame.display.flip()
    clock.tick(60)
    continue
  break

pygame.quit()
```



STEP 10 When you run this code it will display a long, narrow Pygame window with the intro text scrolling to the right. After a pause of ten seconds, it then launches the main game Python script where you can move the warrior sprite around. Overall the effect is quite good but there's always room for improvement.



Basic Animation

Python's modules make it relatively easy to create shapes, or display graphics and animate them accordingly. Animation though, can be a tricky element to get right in code. There are many different ways of achieving the same end result and we'll show you one such example here.

LIGHTS, CAMERA, ACTION

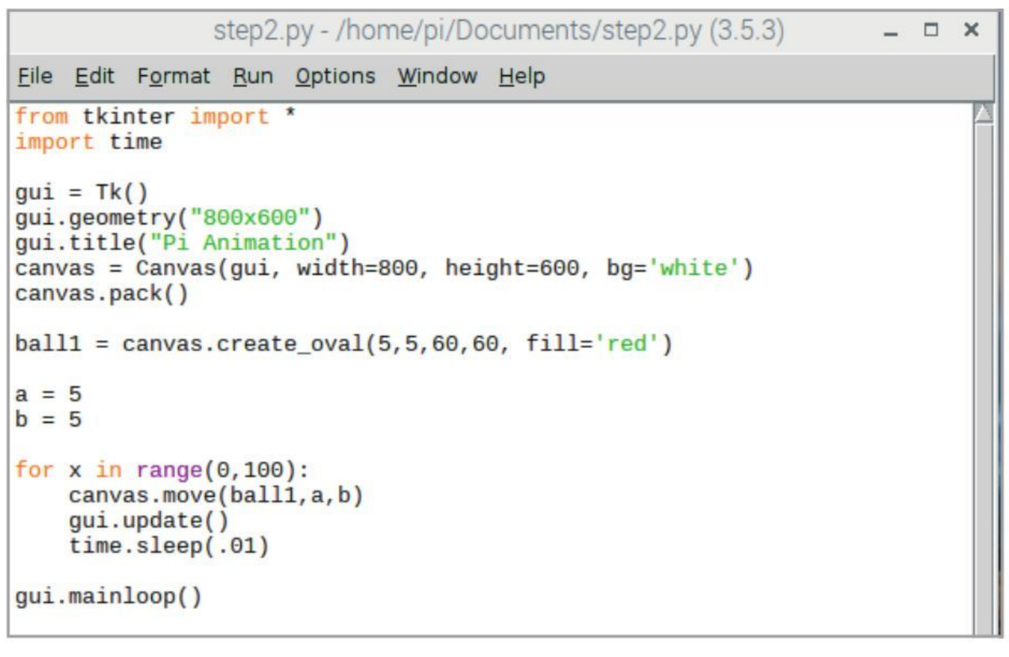
The Tkinter module is an ideal starting point for learning animation within Python. Naturally, there are better custom modules out there, but Tkinter does the job well enough to get a grasp on what's needed.

STEP 1 Let's make a bouncing ball animation. First, we will need to create a canvas (window) and the ball to animate:

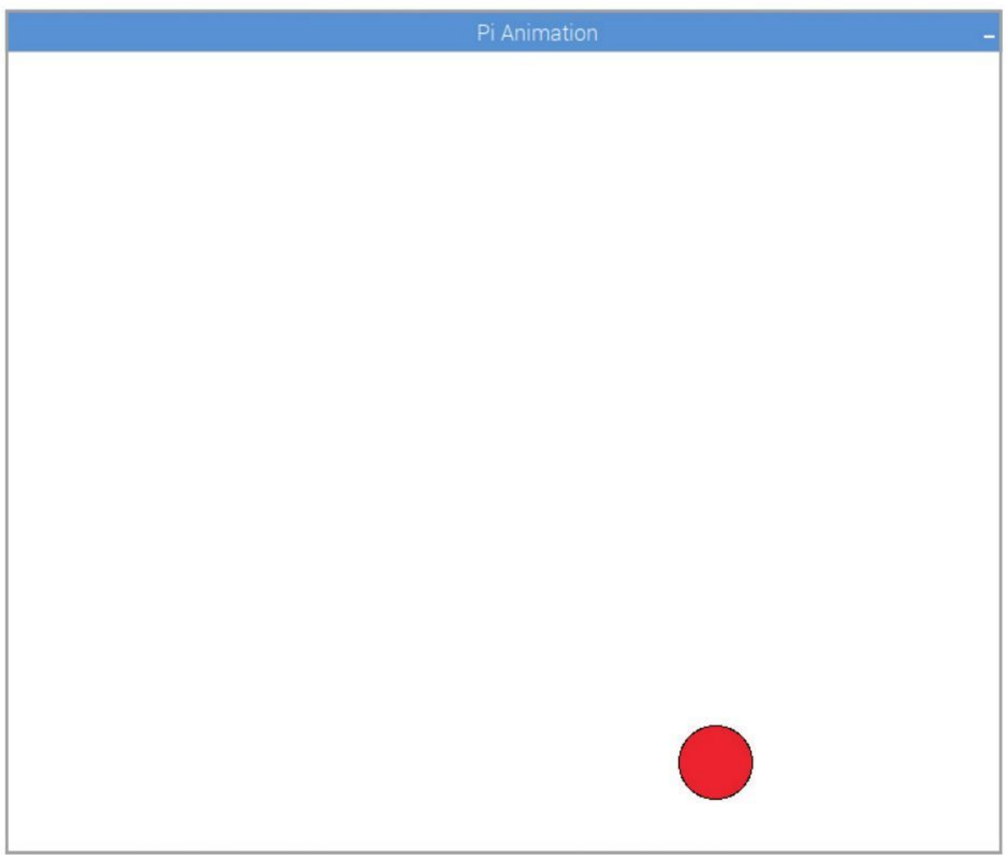
```
from tkinter import *
import time

gui = Tk()
gui.geometry("800x600")
gui.title("Pi Animation")
canvas = Canvas(gui,
width=800,height=600,bg='white')
canvas.pack()

ball1 = canvas.create_oval(5,5,60,60, fill='red')

gui.mainloop()
```

STEP 2 Save and Run the code. You will see a blank window appear, with a red ball sitting in the upper left corner of the window. While this is great, it's not very animated. Let's add the following code:

```
a = 5
b = 5

for x in range(0,100):
        canvas.move(ball1,a,b)
        gui.update()
        time.sleep(.01)
```



STEP 3 Insert the new code between the `ball1 = canvas.create_oval(5,5,60,60, fill='red')` line and the `gui.mainloop()` line. Save it and Run. You will now see the ball move from the top left corner of the animation window, down to the bottom right corner. You can alter the speed in which the ball traverses the window by altering the `time.sleep(.01)` line. Try (.05).



STEP 4 The `canvas.move(ball1,a,b)` line is the part that moves the ball from one corner to the other; obviously with both a and b equalling 5. We can change things around a bit already, such as the size and colour of the ball, with the line: `ball1 = canvas.create_oval(5,5,60,60, fill='red')` and we can change the values of a and b to something else.

```
ball1 = canvas.create_oval(7,7,60,60, fill='red')

a = 8
b = 3

for x in range(0,100):
    canvas.move(ball1,a,b)
    gui.update()
    time.sleep(.05)
```

STEP 5

Let's see if we can animate the ball so that it bounces around the window until you close the program.

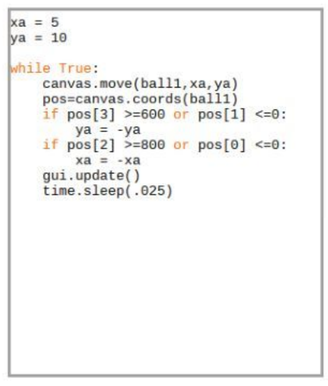
```
xa = 5
ya = 10

while True:
        canvas.move(ball1,xa,ya)
        pos=canvas.coords(ball1)
       if pos[3] >=600 or pos[1] <=0:
            ya = -ya
        if pos[2] >=800 or pos[0] <=0:
            xa = -xa
        gui.update()
       time.sleep(.025)
```

STEP 6

Remove the code you entered in Step 2 and insert the code from Step 5 in its place; again, between the `ball1 = canvas.create_oval(5,5,60,60, fill='red')` and the `gui.mainloop()` lines. Save the code and Run it as normal. If you've entered the code correctly, then you will see the red ball bounce off the edges of the window until you close the program.

STEP 7

The bouncing animation takes place within the `While True` loop. First, we have the values of xa and xy before the loop, both of 5 and 10. The `pos=canvas.coords(ball1)` line takes the value of the ball's location in the window. When it reaches the limits of the window, 800 or 600, it will make the values negative; moving the ball around the screen.



STEP 8

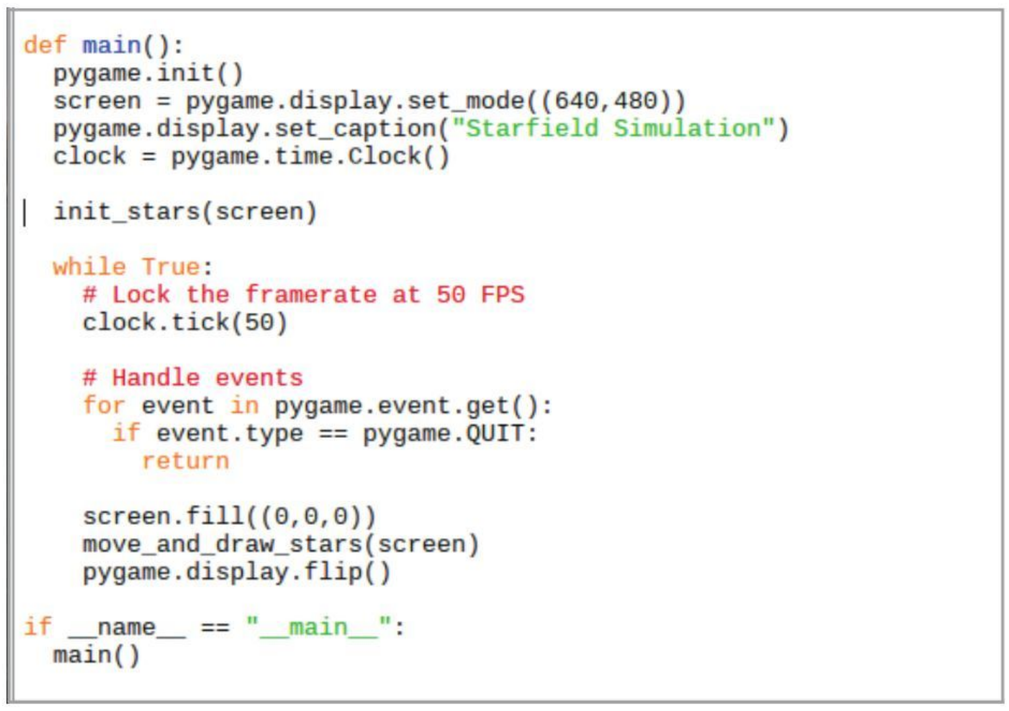
Pygame, however, is a much better module at producing higher-end animations. Begin by creating a New File and entering:

```
import pygame
from random import randrange

MAX_STARS  = 250
STAR_SPEED = 2

def init_stars(screen):
  """ Create the starfield """
  global stars
  stars = []
  for i in range(MAX_STARS):
    # A star is represented as a list with this
format: [X,Y]
    star = [randrange(0,screen.get_width() - 1),
            randrange(0,screen.get_height() - 1)]
    stars.append(star)

def move_and_draw_stars(screen):
  """ Move and draw the stars """
  global stars
  for star in stars:
    star[1] += STAR_SPEED
    if star[1] >= screen.get_height():
      star[1] = 0
      star[0] = randrange(0,639)

    screen.set_at(star,(255,255,255))
```

STEP 9

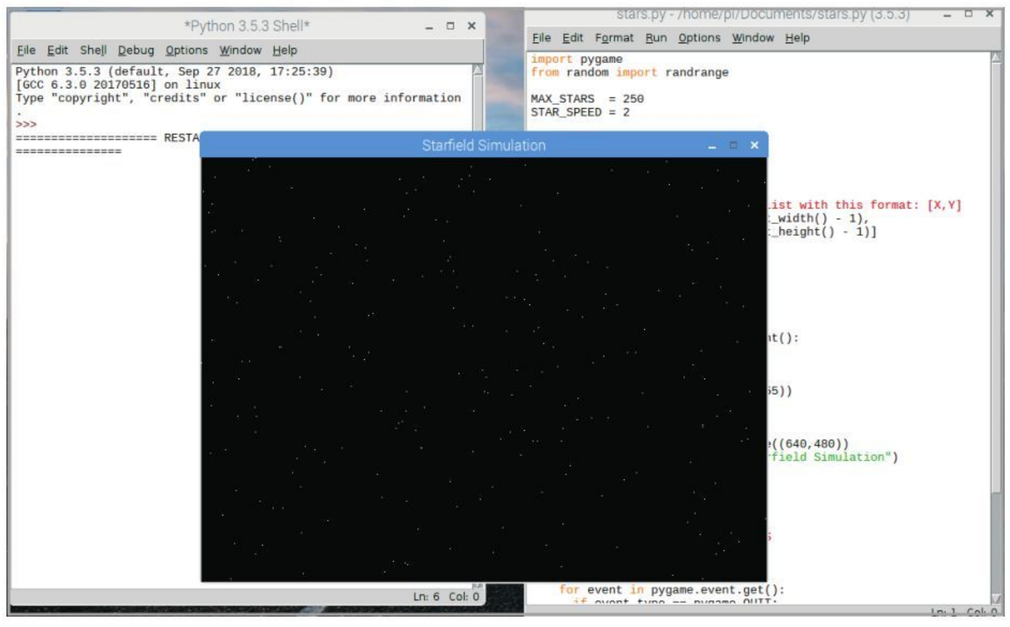
Now add the following:

```
def main():
  pygame.init()
  screen = pygame.display.set_mode((640,480))
  pygame.display.set_caption("Starfield
Simulation")
  clock = pygame.time.Clock()

  init_stars(screen)

  while True:
    # Lock the framerate at 50 FPS
    clock.tick(50)

    # Handle events
    for event in pygame.event.get():
      if event.type == pygame.QUIT:
        return

    screen.fill((0,0,0))
    move_and_draw_stars(screen)
    pygame.display.flip()

if __name__ == "__main__":
  main()
```



STEP 10

Save and Run the code. You will agree that the simulated starfield code looks quite impressive. Imagine this as the beginning of some game code, or even the start to a presentation? Using a combination of Pygame and Tkinter, your Python animations will look fantastic.



Create Your Own Modules

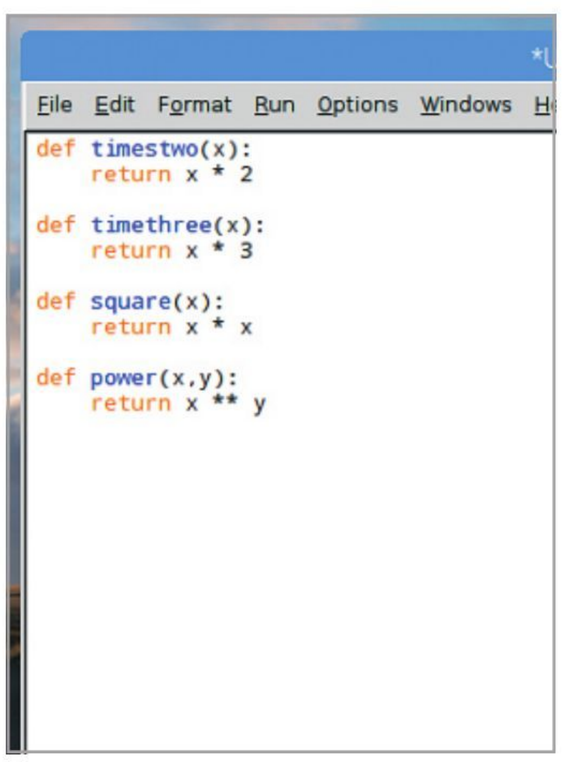
Large programs can be much easier to manage if you break them up into smaller parts and import the parts you need as modules. Learning to build your own modules also makes it easier to understand how they work.

BUILDING MODULES

Modules are Python files, containing code, that you save using a .py extension. These are then imported into Python using the now familiar import command.

STEP 1 Let's start by creating a set of basic Mathematics functions. Multiply a number by two, three and square or raise a number to an exponent (power). Create a New File in the IDLE and enter:

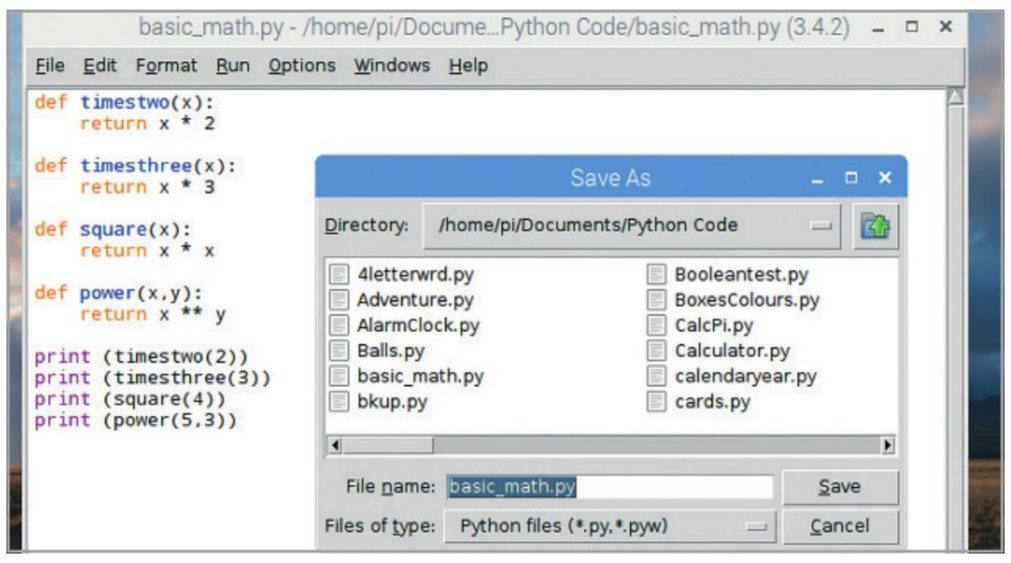
```
def timestwo(x):
        return x * 2

def timesthree(x):
        return x * 3

def square(x):
        return x * x

def power(x,y):
        return x ** y
```



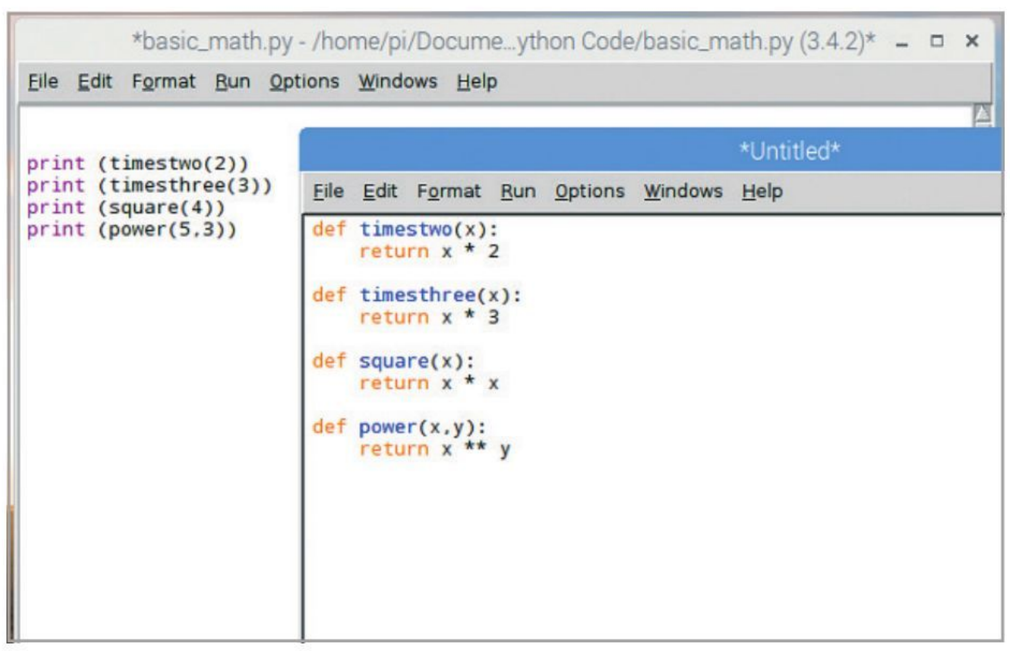
STEP 2 Under the above code, enter functions to call the code:

```
print (timestwo(2))
print (timesthree(3))
print (square(4))
print (power(5,3))
```

Save the program as basic_math.py and execute it to get the results.



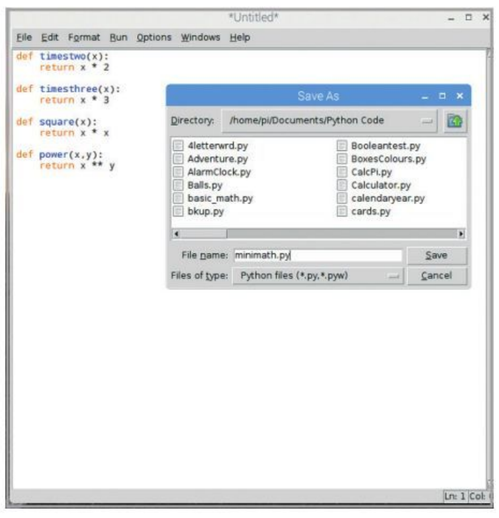
STEP 3 Now you're going to take the function definitions out of the program and into a separate file. Highlight the function definitions and choose Edit > Cut. Choose File > New File and use Edit > Paste in the new window. You now have two separate files, one with the function definitions, the other with the function calls.



STEP 4 If you now try and execute the basic_math.py code again, the error **'NameError: name 'timestwo' is not defined'** will be displayed. This is due to the code no longer having access to the function definitions.

```
Traceback (most recent call last):
  File "/home/pi/Documents/Python Code/basic_math.py", line 3, in <module>
    print (timestwo(2))
NameError: name 'timestwo' is not defined
>>>
```

STEP 5 Return to the newly created window containing the function definitions, and click File > Save As. Name this **minimath.py** and save it in the same location as the original **basic_math.py** program. Now close the minimath.py window, so the basic_math.py window is left open.

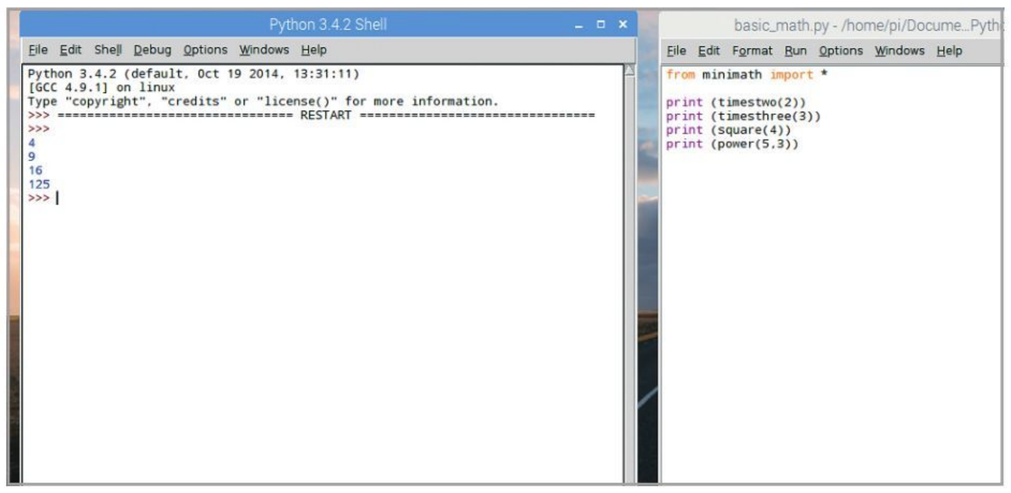


STEP 6

Back to the basic_math.py window: at the top of the code enter:

```
from minimath import *
```

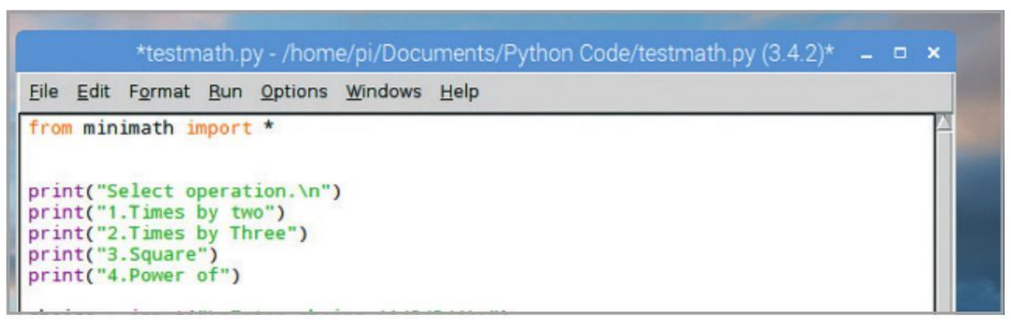
This will import the function definitions as a module. Press F5 to save and execute the program to see it in action.



STEP 7

You can now use the code further to make the program a little more advanced, utilising the newly created module to its full. Include some user interaction. Start by creating a basic menu the user can choose from:

```
print(“Select operation.\n”)
print(“1.Times by two”)
print(“2.Times by Three”)
print(“3.Square”)
print(“4.Power of”)

choice = input(“\nEnter choice (1/2/3/4):”)
```

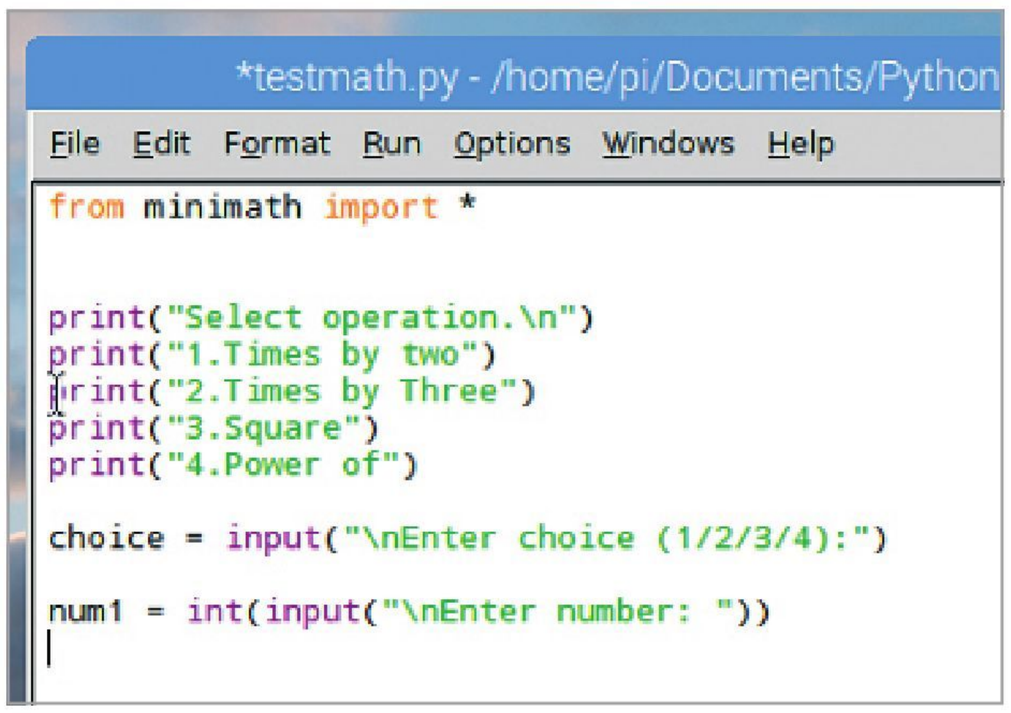


STEP 8

Now we can add the user input to get the number the code will work on:

```
num1 = int(input(“\nEnter number: “))
```

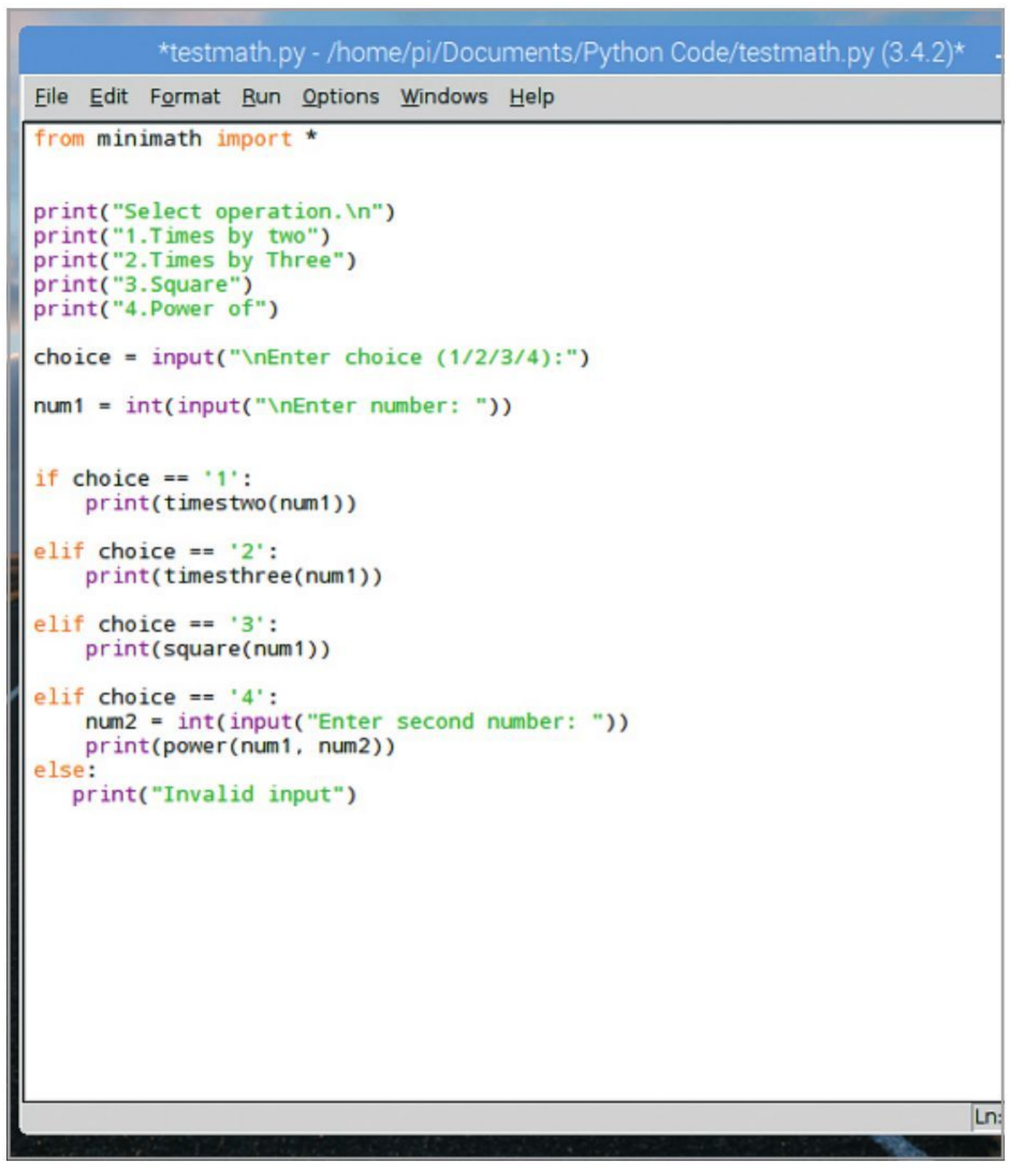
This will save the user-entered number as the variable num1.



STEP 9

Finally, you can now create a range of if statements to determine what to do with the number and utilise the newly created function definitions:

```
if choice == ‘1’:
    print(timestwo(num1))

elif choice == ‘2’:
    print(timesthree(num1))

elif choice == ‘3’:
    print(square(num1))

elif choice == ‘4’:
    num2 = int(input(“Enter second number: “))
    print(power(num1, num2))
else:
   print(“Invalid input”)
```



STEP 10

Note that for the last available options, the Power of choice, we’ve added a second variable, num2. This passes a second number through the function definition called power. Save and execute the program to see it in action.