More on Functions

Announcements

- Lab 5 posted; due Saturday
- Quiz 2 will be handed back Wednesday

Today’s plan

- Review Friday
- Go over shades.py program
- Re-examine functions, mutation, call stack
- functionWorksheet.py

Review

- Our graphics windows are a grid of pixels, where a pixel is a square of continuous color.

- We specify the size of the pixel grid in the **`GraphWin(title, width, height)`** constructor

- We can use one of the pre-defined colors, or define our own colors with the **`color_rgb(red, green, blue)`** function, where **`red`**, **`green`**, and **`blue`** are between 0 and 255.

Review

- A computer animation is a series of rapidly changing images.

- We can use the **`sleep(seconds)`** function from the **`time`** library to pause our program for a fraction of a second, before changing what is displayed in the graphics window—often with **`.move(dx, dy)`**

shades.py

- Nested for loops
- Randomly generating colors
- Avoiding hard coding
- Calling a function that calls a function

Recap

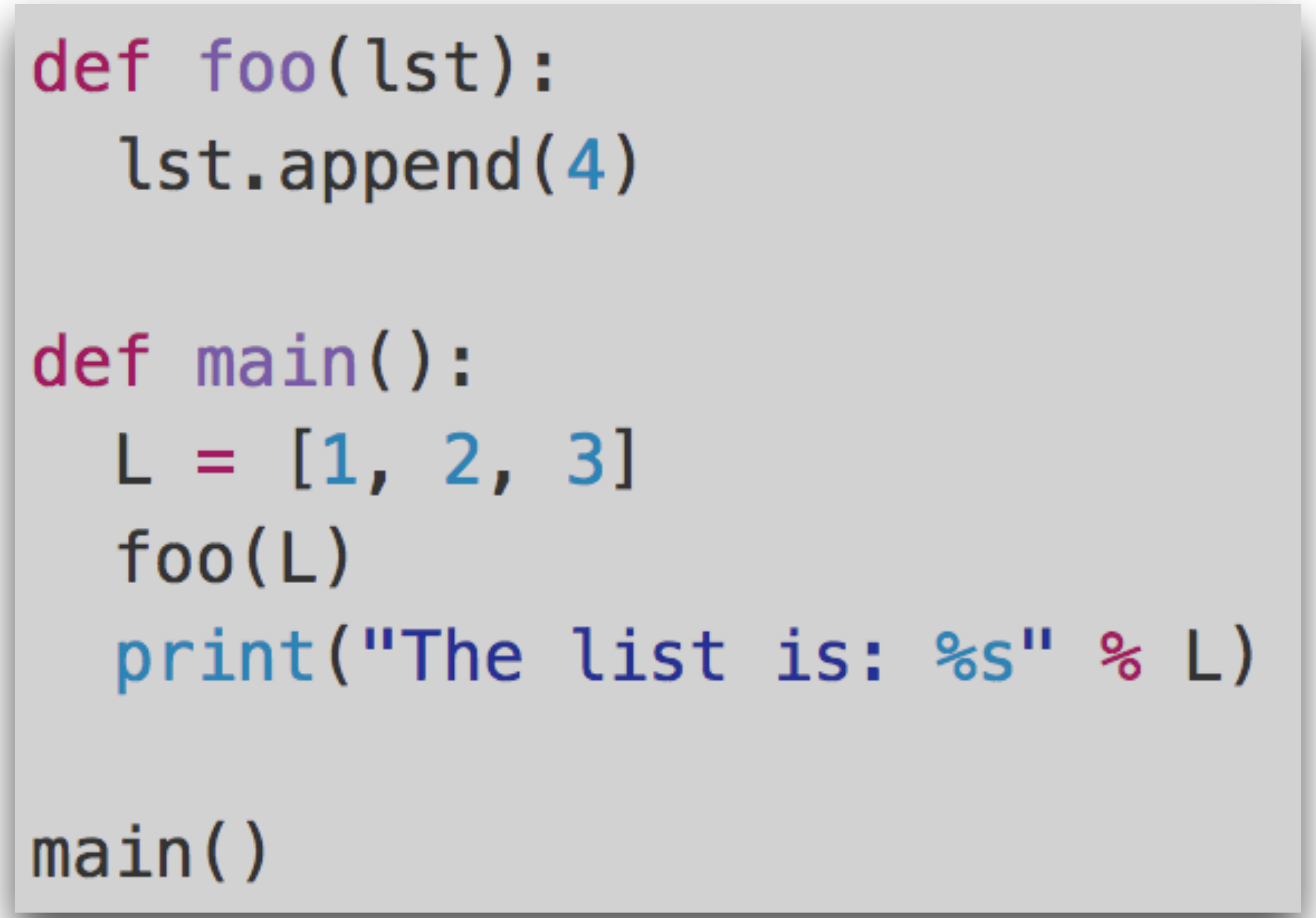
	Sequence?	Constructor?	Methods?	Mutable?
int	no	no	no	no
float	no	no	no	no
bool	no	no	no	no
string	yes	no	yes	**no**
list	yes	no	yes	yes
Object	usually no	yes	yes	yes

Use methods to mutate

- Lists and objects can be mutated through their methods.
  - `lst.append(4), lst.pop(), lst.reverse(), lst.sort()`
  - `p1.move(5, 5), circ.setFill("blue"), textObject.setText("Hello")`
- Lists can also be mutated at specific indices:
  - `L[2] = "new item"`
- Not all methods mutate:
  - `lst.count(), lst.index()`
  - `p1.getX(), circ.getRadius()`

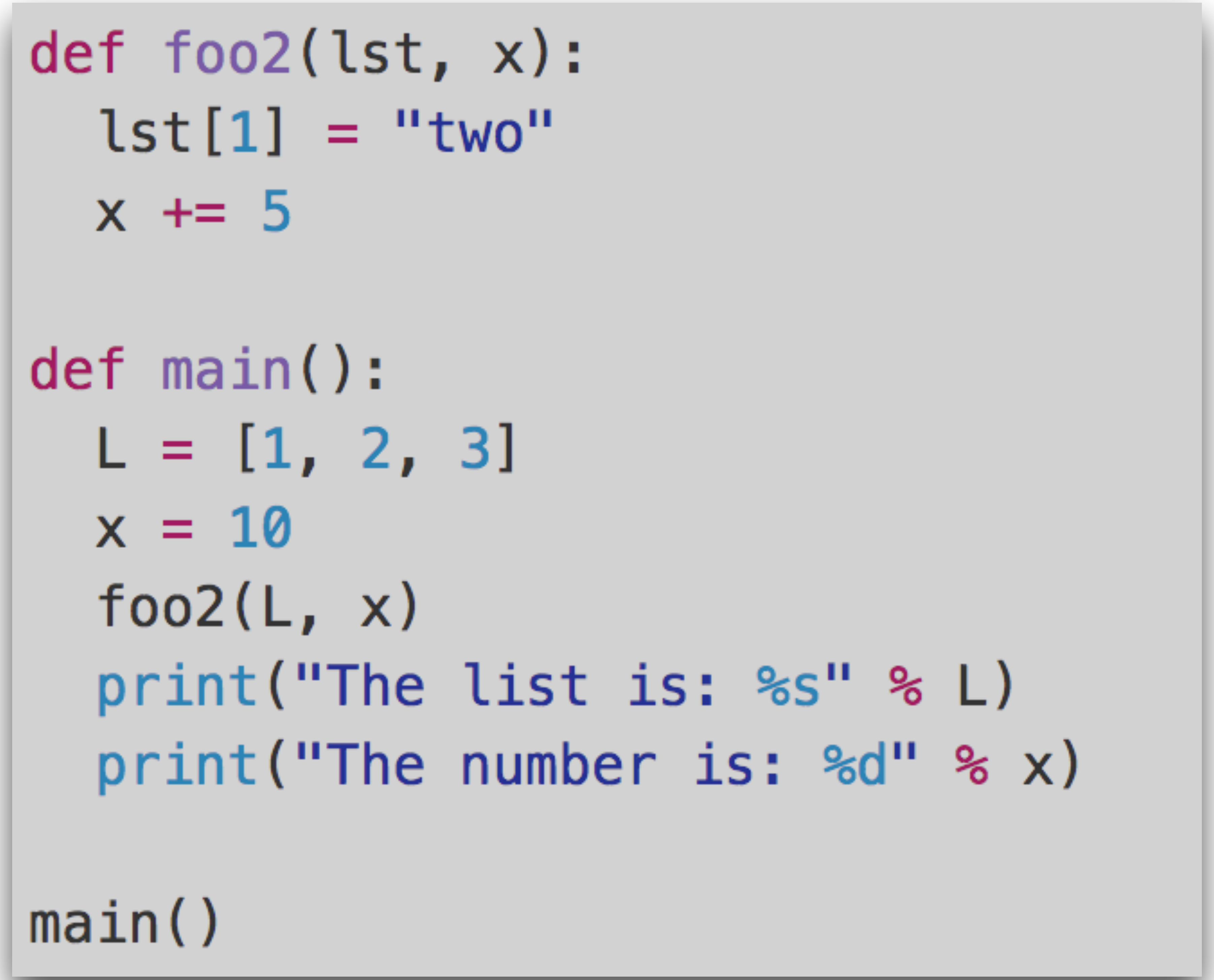
Mutating in a function

- When passed in as arguments to a function, lists and objects can be mutated within that function.



```python
def foo(lst):
  lst.append(4)

def main():
  L = [1, 2, 3]
  foo(L)
  print("The list is: %s" % L)

main()
```

Reassigning vs. Mutating



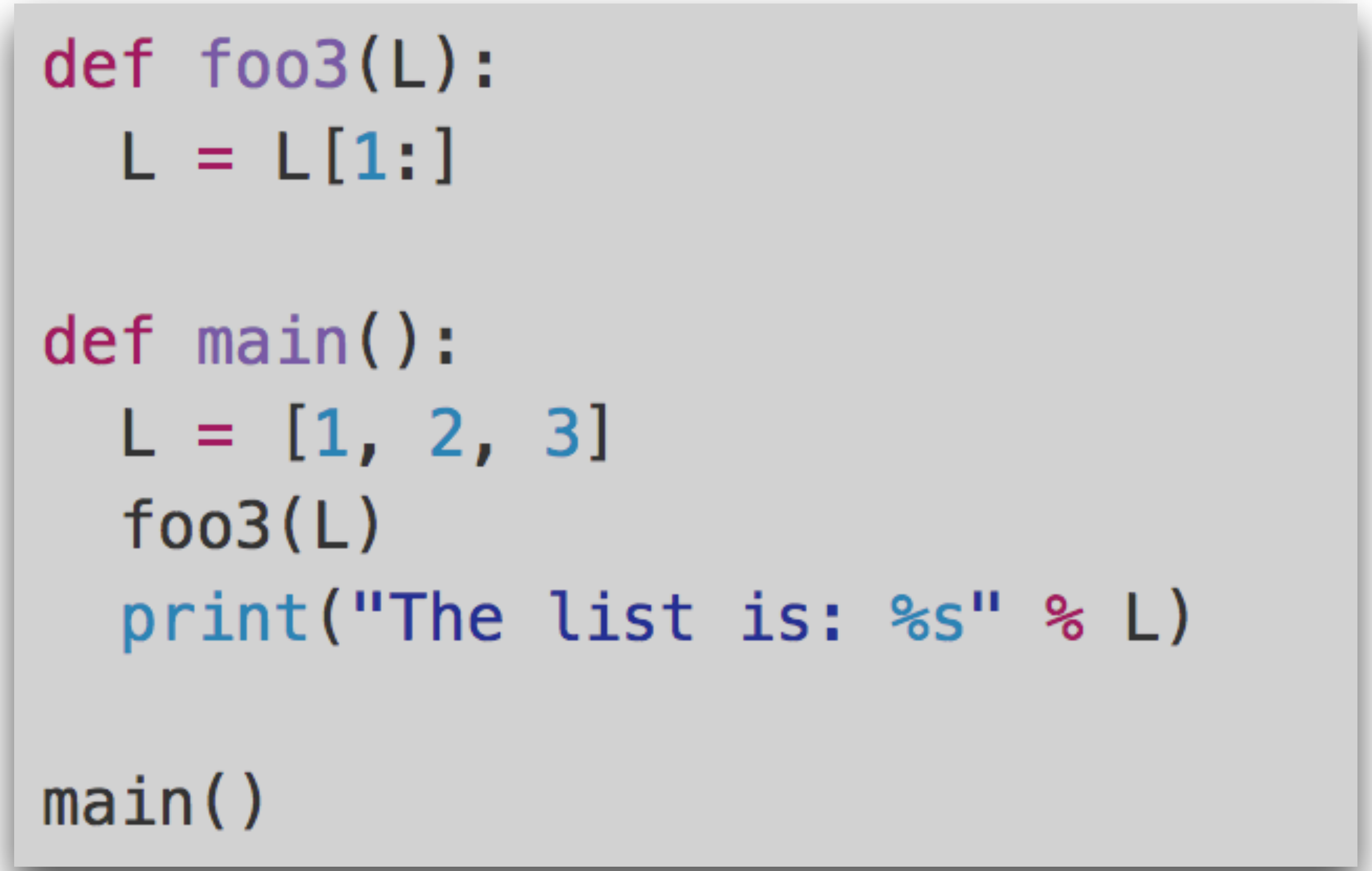
```python
def foo2(lst, x):
  lst[1] = "two"
  x += 5

def main():
  L = [1, 2, 3]
  x = 10
  foo2(L, x)
  print("The list is: %s" % L)
  print("The number is: %d" % x)

main()
```

Reassigning is not mutating

- If a variable, **x**, currently points to value **A** and we reassign it so that it points to value **B**, **A** is unchanged.

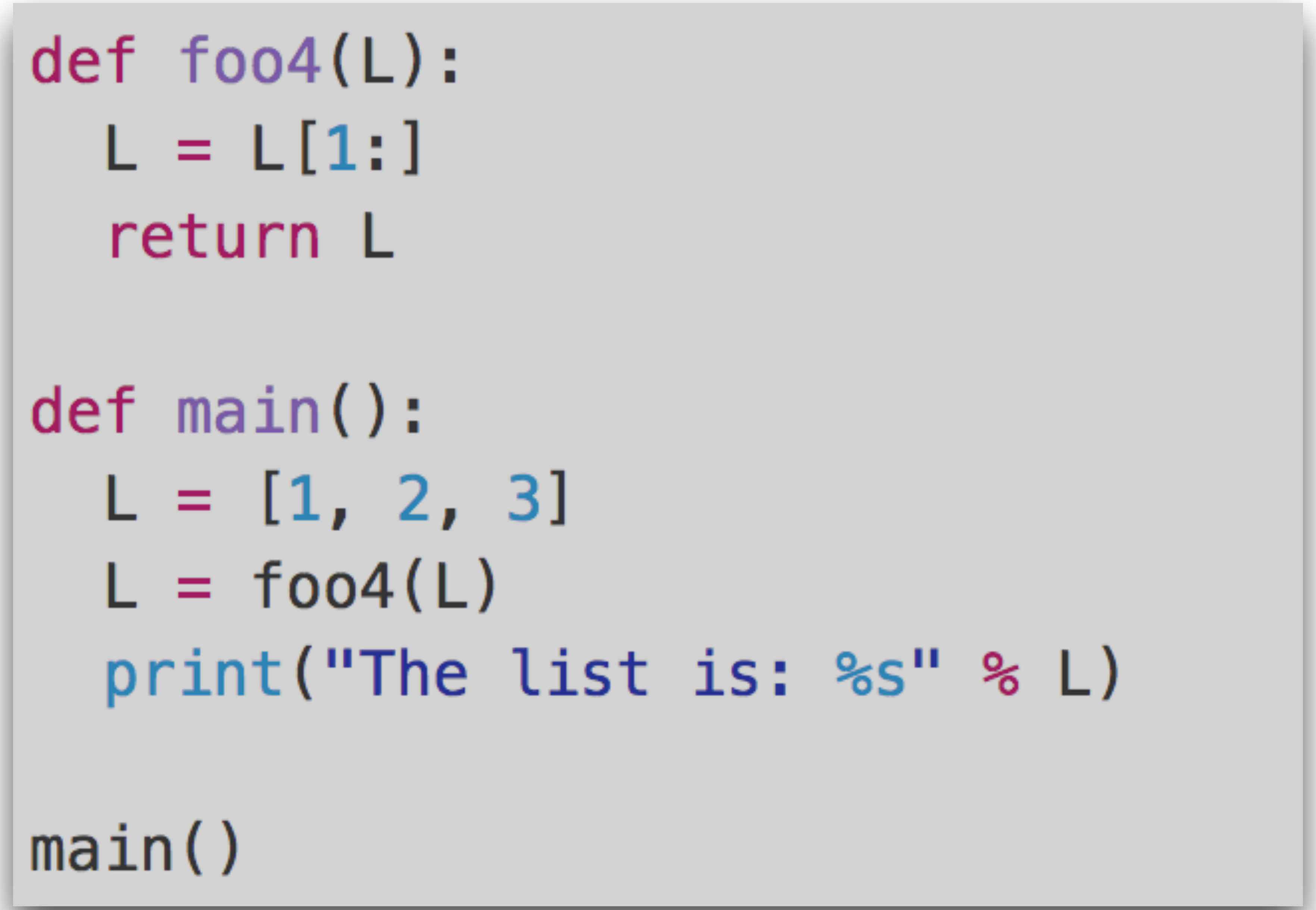
- If **x** points to an object/list and we mutate that object/list with a method or reassignment at an index, we haven’t reassigned **x**, but we have changed the contents of the **compound value** it points to.

Reassigning vs. Mutating



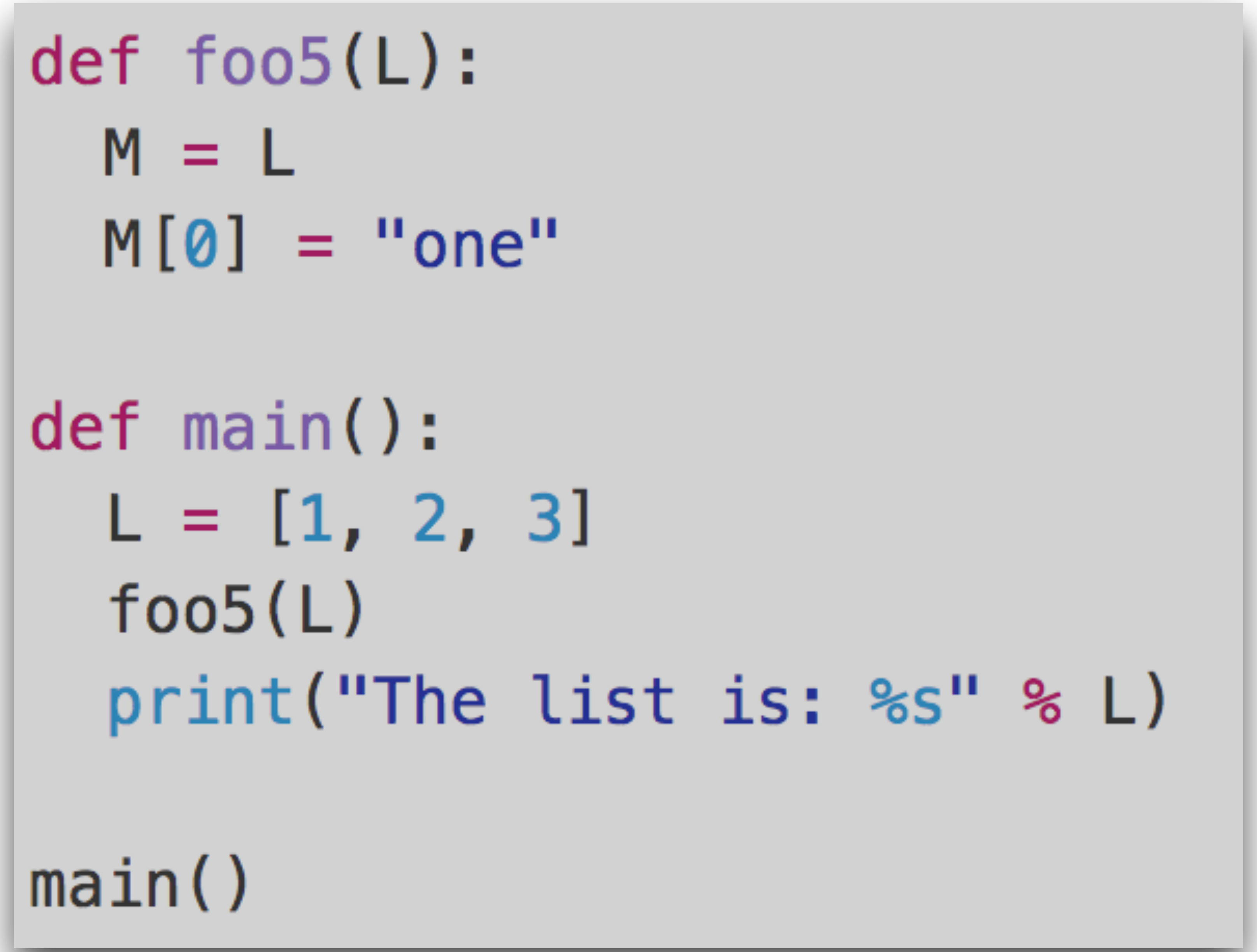
```python
def foo3(L):
  L = L[1:]

def main():
  L = [1, 2, 3]
  foo3(L)
  print("The list is: %s" % L)

main()
```

Reassigning vs. Mutating



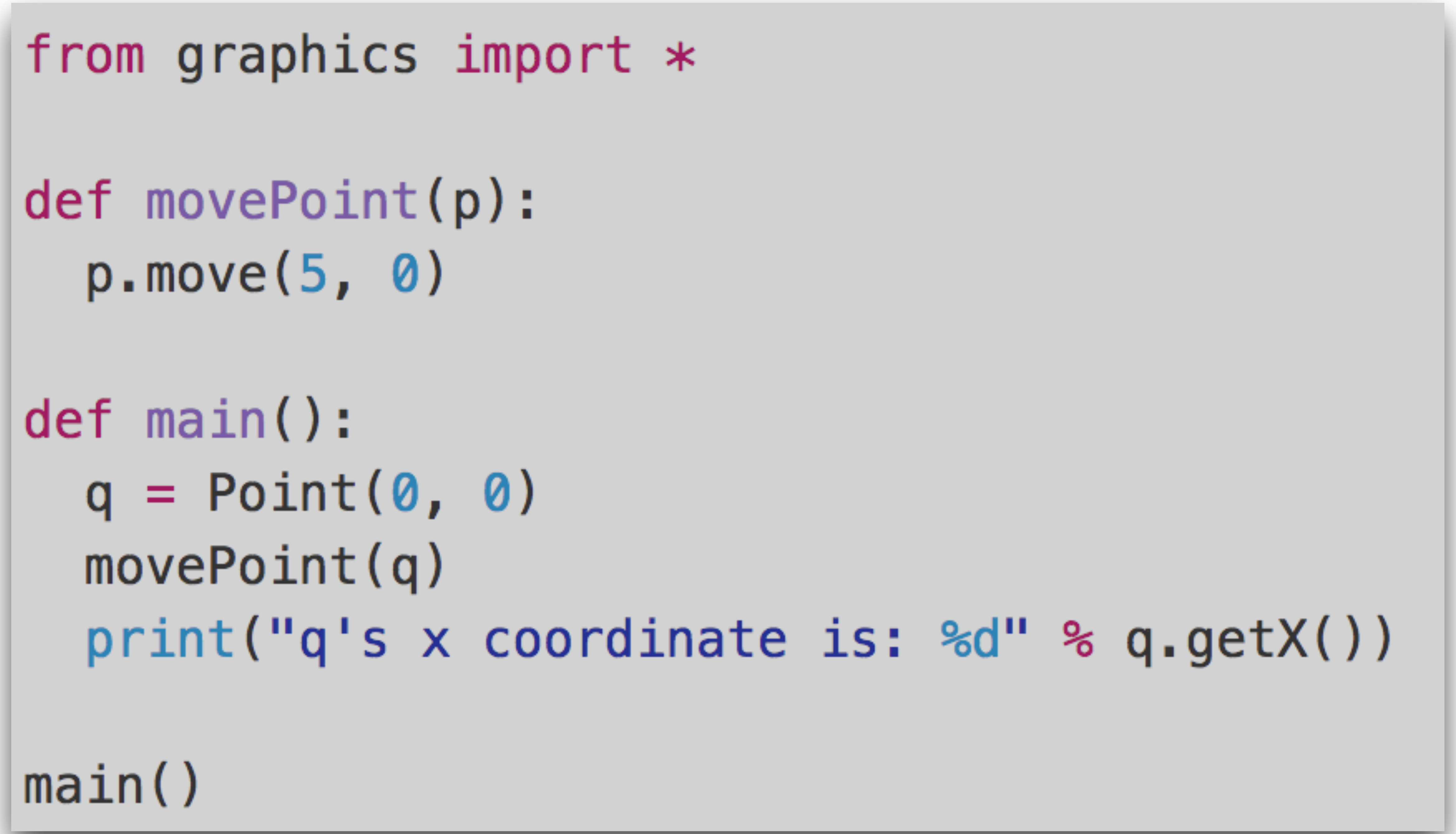
```python
def foo4(L):
  L = L[1:]
  return L

def main():
  L = [1, 2, 3]
  L = foo4(L)
  print("The list is: %s" % L)

main()
```

Reassigning vs. Mutating



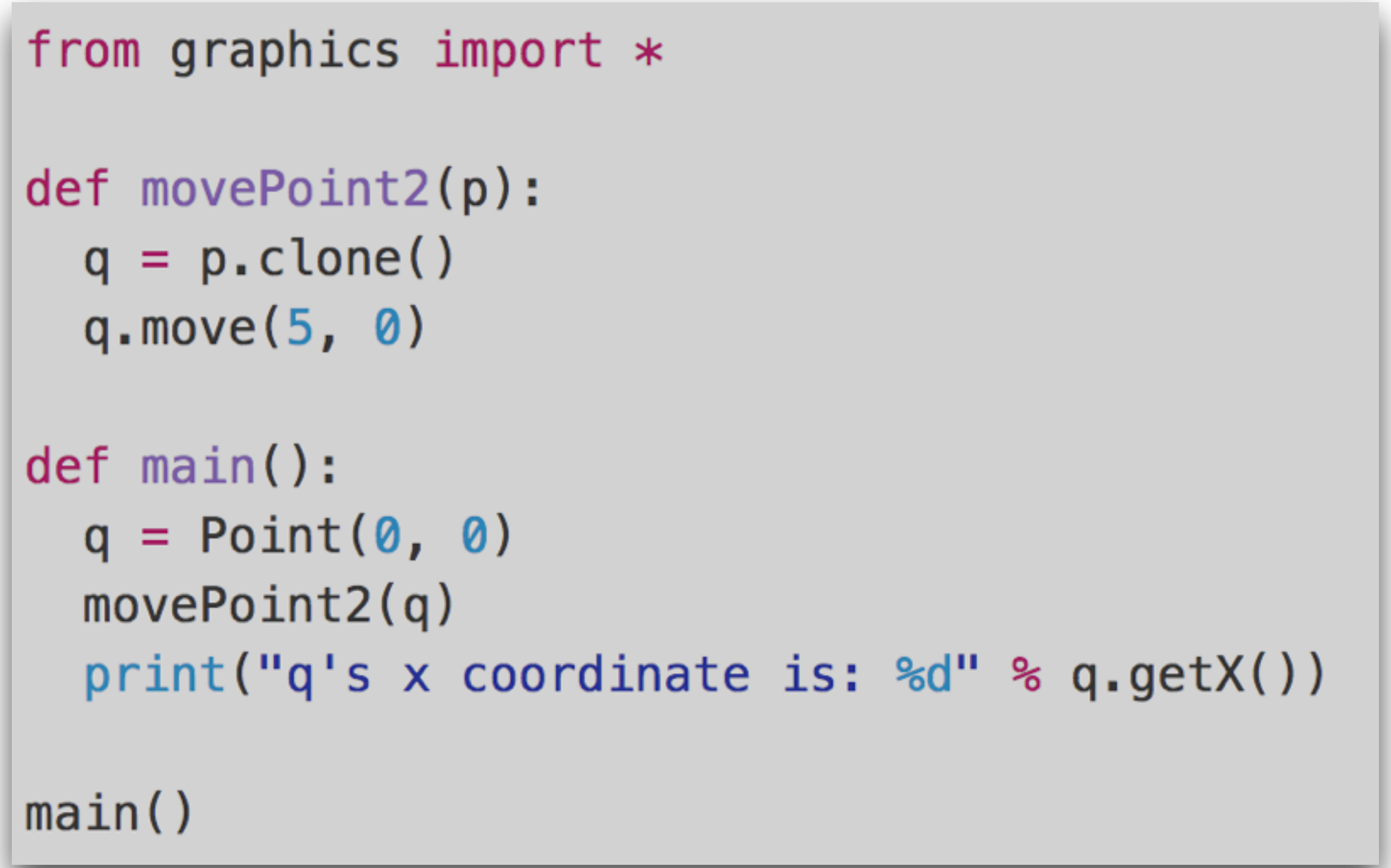
```
def foo5(L):
  M = L
  M[0] = "one"

def main():
  L = [1, 2, 3]
  foo5(L)
  print("The list is: %s" % L)

main()
```

Objects are also mutable



```python
from graphics import *

def movePoint(p):
  p.move(5, 0)

def main():
  q = Point(0, 0)
  movePoint(q)
  print("q's x coordinate is: %d" % q.getX())

main()
```

Creating a copy



```python
from graphics import *

def movePoint2(p):
  q = p.clone()
  q.move(5, 0)

def main():
  q = Point(0, 0)
  movePoint2(q)
  print("q's x coordinate is: %d" % q.getX())

main()
```

functionWorksheet.py