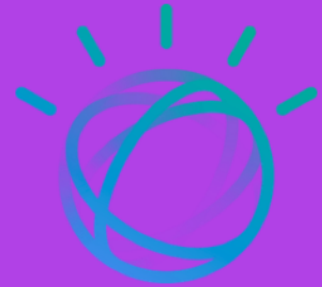


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Classes and Objects in Python

Welcome! Objects in programming are like objects in real life. Like life, there are different classes of objects. In this notebook, we will create two classes called Circle and Rectangle. By the end of this notebook, you will have a better idea about :

- what a class is
- what an attribute is
- what a method is

Don't worry if you don't get it the first time, as much of the terminology is confusing. Don't forget to do the practice tests in the notebook.

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Estimated time needed: **40 min**

Introduction to Classes and Objects

Creating a Class

The first part of creating a class is giving it a name: In this notebook, we will create two classes, Circle and Rectangle. We need to determine all the data that make up that class, and we call that an attribute. Think about this step as creating a blue print that we will use to create objects. In figure 1 we see two classes, circle and rectangle. Each has their attributes, they are variables. The class circle has the attribute radius and color, while the rectangle has the attribute height and width. Let's use the visual examples of these shapes before we get to the code, as this will help you get accustomed to the vocabulary.

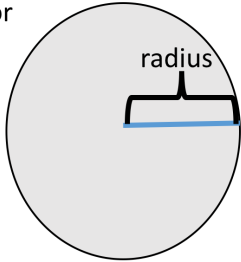
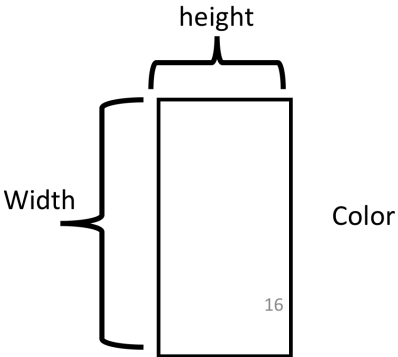
Class Circle	Class Rectangle
Attributes: radius, Color	Attributes: Color, height and Width
<div> <div>Color</div>  </div>	<div>  </div>

Figure 1: Classes circle and rectangle, and each has their own attributes. The class circle has the attribute radius and colour, the rectangle has the attribute height and width.

Instances of a Class: Objects and Attributes

An instance of an object is the realisation of a class, and in Figure 2 we see three instances of the class circle. We give each object a name: red circle, yellow circle and green circle. Each object has different attributes, so let's focus on the attribute of colour for each object.

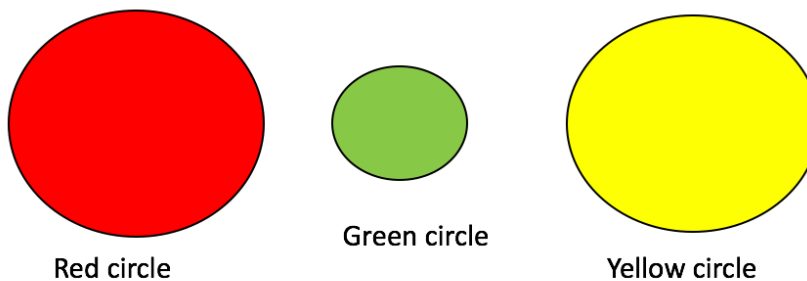


Figure 2: Three instances of the class circle or three objects of type circle.

The colour attribute for the red circle is the colour red, for the green circle object the colour attribute is green, and for the yellow circle the colour attribute is yellow.

Methods

Methods give you a way to change or interact with the object; they are functions that interact with objects. For example, let's say we would like to increase the radius by a specified amount of a circle. We can create a method called **add_radius(r)** that increases the radius by **r**. This is shown in figure 3, where after applying the method to the "orange circle object", the radius of the object increases accordingly. The "dot" notation means to apply the method to the object, which is essentially applying a function to the information in the object.

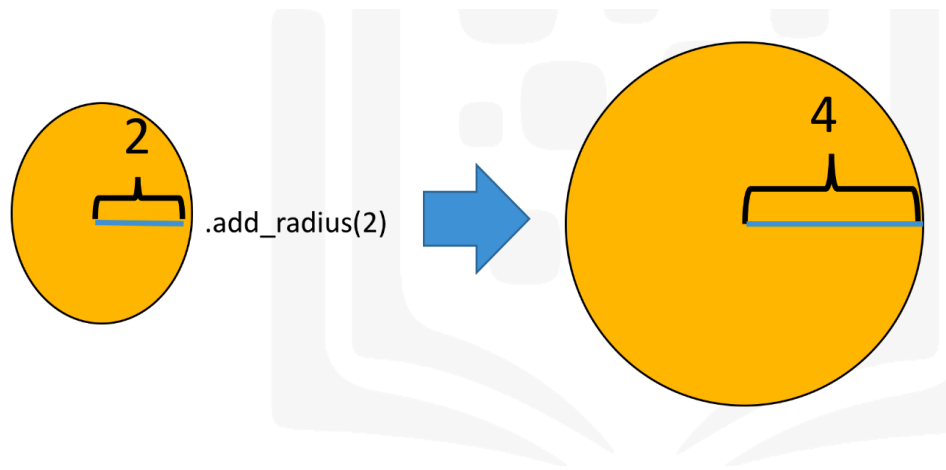


Figure 3: Applying the method “add_radius” to the object orange circle object.

Creating a Class

Now we are going to create a class circle, but first, we are going to import a library to draw the objects:

In [1]:

```
# Import the library  
  
import matplotlib.pyplot as plt  
%matplotlib inline
```

The first step in creating your own class is to use the `class` keyword, then the name of the class as shown in Figure 4. In this course the class parent will always be object:

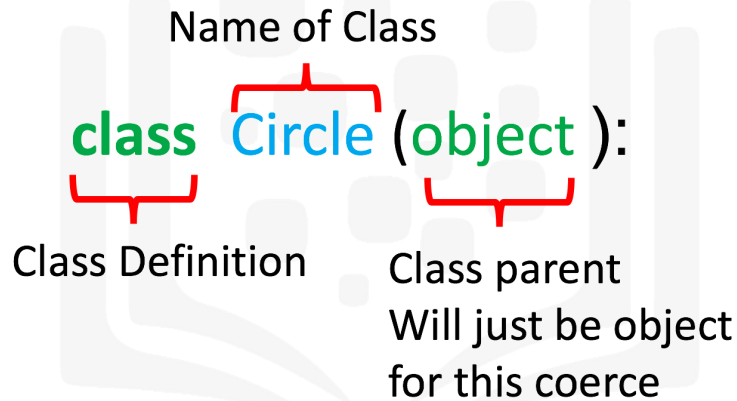
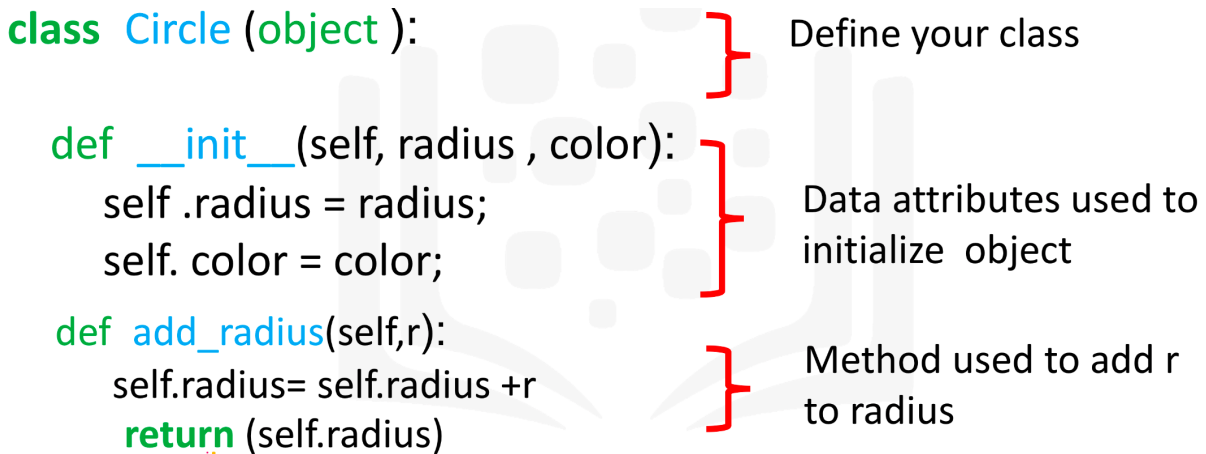


Diagram illustrating the syntax of a class definition: `class Circle(object):`. The word `class` is labeled "Class Definition". The word `Circle` is labeled "Name of Class". The word `(object)` is labeled "Class parent" and "Will just be object for this coerce".

Figure 4: Three instances of the class circle or three objects of type circle.

The next step is a special method called a constructor `__init__`, which is used to initialize the object. The input are data attributes. The term `self` contains all the attributes in the set. For example the `self.color` gives the value of the attribute `color` and `self.radius` will give you the radius of the object. We also have the method `add_radius()` with the parameter `r`, the method adds the value of `r` to the attribute `radius`. To access the radius we use the syntax `self.radius`. The labeled syntax is summarized in Figure 5:



```
class Circle(object):
    def __init__(self, radius, color):
        self.radius = radius;
        self.color = color;
    def add_radius(self,r):
        self.radius= self.radius +r
        return (self.radius)
```

Annotations for Figure 5:

- `class Circle(object):` Define your class
- `def __init__(self, radius, color):` Data attributes used to initialize object
- `def add_radius(self,r):` Method used to add r to radius

Figure 5: Labeled syntax of the object circle.

The actual object is shown below. We include the method `drawCircle` to display the image of a circle. We set the default radius to 3 and the default colour to blue:

In [2]:

```
# Create a class Circle

class Circle(object):

    # Constructor
    def __init__(self, radius=3, color='blue'):
        self.radius = radius
        self.color = color

    # Method
    def add_radius(self, r):
        self.radius = self.radius + r
        return(self.radius)

    # Method
    def drawCircle(self):
        plt.gca().add_patch(plt.Circle((0, 0), radius=self.radius, fc=self.color))
        plt.axis('scaled')
        plt.show()
```

Creating an instance of a class Circle

Let's create the object `RedCircle` of type `Circle` to do the following:

In [3]:

```
# Create an object RedCircle

RedCircle = Circle(10, 'red')
```

We can use the `dir` command to get a list of the object's methods. Many of them are default Python methods.

In [4]:

```
# Find out the methods can be used on the object RedCircle
```

```
dir(RedCircle)
```

Out[4]:

```
['_class_',  
'_delattr_',  
'_dict_',  
'_dir_',  
'_doc_',  
'_eq_',  
'_format_',  
'_ge_',  
'_getattribute_',  
'_gt_',  
'_hash_',  
'_init_',  
'_init_subclass_',  
'_le_',  
'_lt_',  
'_module_',  
'_ne_',  
'_new_',  
'_reduce_',  
'_reduce_ex_',  
'_repr_',  
'_setattr_',  
'_sizeof_',  
'_str_',  
'_subclasshook_',  
'_weakref_',  
'add_radius',  
'color',  
'drawCircle',  
'radius']
```

We can look at the data attributes of the object:

In [5]:

```
# Print the object attribute radius
```

```
RedCircle.radius
```

Out[5]:

10

In [6]:

```
# Print the object attribute color
```

```
RedCircle.color
```

Out[6]:

'red'

We can change the object's data attributes:

In [7]:

```
# Set the object attribute radius
```

```
RedCircle.radius = 1  
RedCircle.radius
```

Out[7]:

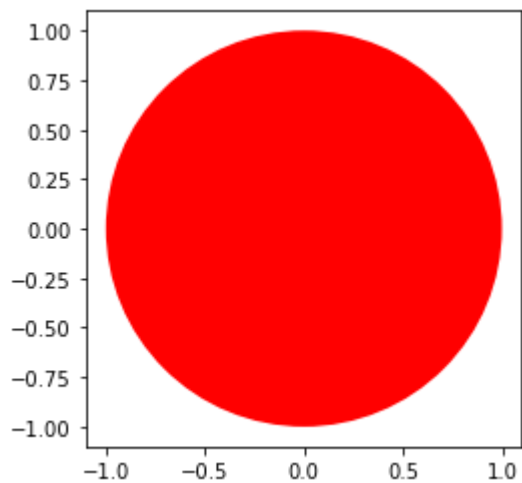
1

We can draw the object by using the method `drawCircle()` :

In [8]:

```
# Call the method drawCircle
```

```
RedCircle.drawCircle()
```



We can increase the radius of the circle by applying the method `add_radius()` . Let increases the radius by 2 and then by 5:

In [9]:

```
# Use method to change the object attribute radius

print('Radius of object:',RedCircle.radius)
RedCircle.add_radius(2)
print('Radius of object of after applying the method add_radius(2):',RedCircle.radius)
RedCircle.add_radius(5)
print('Radius of object of after applying the method add_radius(5):',RedCircle.radius)
```

Radius of object: 1

Radius of object of after applying the method add_radius(2): 3

Radius of object of after applying the method add_radius(5): 8

Let's create a blue circle. As the default colour is blue, all we have to do is specify what the radius is:

In [11]:

```
# Create a blue circle with a given radius

BlueCircle = Circle(radius=100)
```

As before we can access the attributes of the instance of the class by using the dot notation:

In [12]:

```
# Print the object attribute radius

BlueCircle.radius
```

Out[12]:

100

In []:

```
# Print the object attribute color

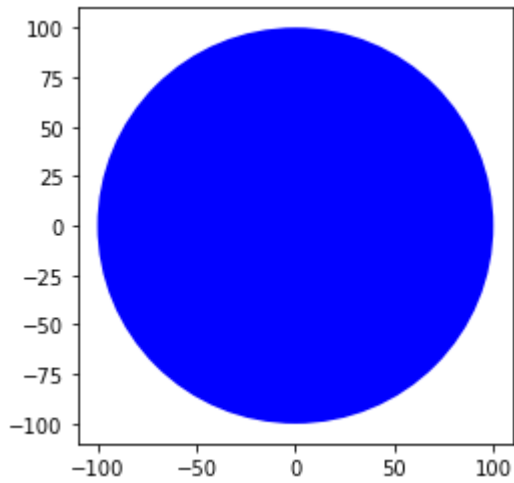
BlueCircle.color
```

We can draw the object by using the method `drawCircle()` :

In [13]:

```
# Call the method drawCircle
```

```
BlueCircle.drawCircle()
```



Compare the x and y axis of the figure to the figure for RedCircle ; they are different.

The Rectangle Class

Let's create a class rectangle with the attributes of height, width and color. We will only add the method to draw the rectangle object:

In [14]:

```
# Create a new Rectangle class for creating a rectangle object

class Rectangle(object):

    # Constructor
    def __init__(self, width=2, height=3, color='r'):
        self.height = height
        self.width = width
        self.color = color

    # Method
    def drawRectangle(self):
        plt.gca().add_patch(plt.Rectangle((0, 0), self.width, self.height ,fc=self.color))
        plt.axis('scaled')
        plt.show()
```

Let's create the object `SkinnyBlueRectangle` of type `Rectangle`. Its width will be 2 and height will be 3, and the color will be blue:

In [15]:

```
# Create a new object rectangle

SkinnyBlueRectangle = Rectangle(2, 10, 'blue')
```

As before we can access the attributes of the instance of the class by using the dot notation:

In [16]:

```
# Print the object attribute height

SkinnyBlueRectangle.height
```

Out[16]:

10

In [17]:

```
# Print the object attribute width

SkinnyBlueRectangle.width
```

Out[17]:

2

In [18]:

```
# Print the object attribute color
```

```
SkinnyBlueRectangle.color
```

Out[18]:

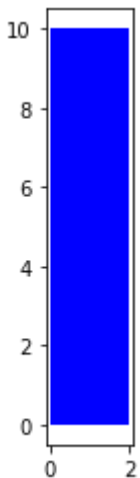
'blue'

We can draw the object:

In [19]:

```
# Use the drawRectangle method to draw the shape
```

```
SkinnyBlueRectangle.drawRectangle()
```



Let's create the object `FatYellowRectangle` of type `Rectangle` :

In [20]:

```
# Create a new object rectangle
```

```
FatYellowRectangle = Rectangle(20, 5, 'yellow')
```

We can access the attributes of the instance of the class by using the dot notation:

In [21]:

```
# Print the object attribute height
```

```
FatYellowRectangle.height
```

Out[21]:

5

In [22]:

```
# Print the object attribute width
```

```
FatYellowRectangle.width
```

Out[22]:

20

In [23]:

```
# Print the object attribute color
```

```
FatYellowRectangle.color
```

Out[23]:

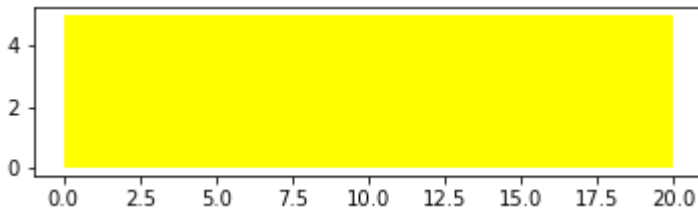
'yellow'

We can draw the object:

In [24]:

```
# Use the drawRectangle method to draw the shape
```

```
FatYellowRectangle.drawRectangle()
```



The last exercise!

Congratulations, you have completed your first lesson and hands-on lab in Python. However, there is one more thing you need to do. The Data Science community encourages sharing work. The best way to share and showcase your work is to share it on GitHub. By sharing your notebook on GitHub you are not only building your reputation with fellow data scientists, but you can also show it off when applying for a job. Even though this was your first piece of work, it is never too early to start building good habits. So, please read and follow [this article \(https://cognitiveclass.ai/blog/data-scientists-stand-out-by-sharing-your-notebooks/\)](https://cognitiveclass.ai/blog/data-scientists-stand-out-by-sharing-your-notebooks/) to learn how to share your work.

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