Python Objects and Classes Lab

Estimated time needed: 10 minutes

Objective:

By the end of this reading, you should be able to:

1. Learn the fundamental concepts of Python objects and classes.
2. Understand the Structure of Clases and object code
3. Understand the concept with real-world example

Introduction to Classes and object

Python is an object-oriented programming (OOP) language, which means it uses a paradigm centered around objects and classes. Here's an explanation of these fundamental concepts:

Classes:

A class is a blueprint or template for creating objects. It defines the structure and behavior that its objects will have.

Think of a class as a cookie cutter, and objects as the cookies cut from that template.

In Python, classes are created using the `class` keyword.

Creating Classes:

When you create a class, you specify the `attributes`(data) and `methods` (functions) that objects of that class will have.
`Attributes` are defined as variables within the class, and `methods` are defined as functions.

For example,you can design a "Car" class with attributes such as "color" and "speed," along with methods like "accelerate."

Objects:

An *object* is a fundamental unit in Python that represents a real-world entity or concept.
Objects can be tangible (like a car) or abstract (like a student's grade).

Every object has two main characteristics:

State:

The *attributes or data* that describe the object. For our "Car" object, this might include attributes like "color", "speed", and "fuel level".

Behavior:

The *actions or methods* that the object can perform. In Python, methods are functions that belong to objects and can change the object's state or perform specific operations.

Instantiating Objects:

- Once you've defined a class, you can create individual objects (instances) based on that class.
- Each object is independent and has its own set of attributes and methods.
- To create an object, you use the class name followed by parentheses, so: "my_car = Car()"

Interacting with Objects:

You interact with objects by calling their methods or accessing their attributes using dot notation.

For example, if you have a Car object named **my_car**, you can set its color with **my_car.color = "blue"** and accelerate it with **my_car.accelerate()** if there's an accelerate method defined in the class.

Structure of classes and object code

> Please don't directly copy and use this code as it's meant as a template for explanation and isn't tailored for specific results.

Class Declaration (class ClassName):

- The class keyword is used to declare a class in Python.
- ClassName is the name of the class, typically following CamelCase naming conventions.

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class ClassName:
```

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Class Attributes (class_attribute = value):

- Class attributes are variables that are shared among all instances (objects) of the class.
- They are defined within the class but outside of any methods.

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```
class ClassName:
    # Class attributes (shared by all instances)
    class_attribute = value
```

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Constructor Method (def init(self, attribute1, attribute2, …):):

- The `__init__` method is a special method known as the constructor.
- It initializes the **instance attributes** (also called instance variables) when an object is created.
- The `self` parameter is the first parameter of the constructor, referring to the instance being created.
- **attribute1**, **attribute2**, and so on are parameters passed to the constructor when creating an object.
- Inside the constructor, `self.attribute1`, `self.attribute2`, and so on are used to assign values to instance attributes.

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```

```
class ClassName:
    # Class attributes (shared by all instances)
```

```
    class_attribute = value

    # Constructor method (initialize instance attributes)
    def __init__(self, attribute1, attribute2, ...):
        pass
        # ...
```

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Instance Attributes (self.attribute1 = attribute1):

- Instance attributes are variables that store data specific to each instance of the class.
- They are initialized within the **init** method using the self keyword followed by the attribute name.
- These attributes hold unique data for each object created from the class.

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```

```
class ClassName:
    # Class attributes (shared by all instances)
    class_attribute = value

    # Constructor method (initialize instance attributes)
    def __init__(self, attribute1, attribute2, ...):
        self.attribute1 = attribute1
        self.attribute2 = attribute2
        # ...
```

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Instance Methods (def method1(self, parameter1, parameter2, …):):

- Instance methods are functions defined within the class.
- They operate on the instance's data (instance attributes) and can perform actions specific to instances.
- The **self** parameter is required in instance methods, allowing them to access instance attributes and call other methods within the class.

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```

```
class ClassName:
    # Class attributes (shared by all instances)
    class_attribute = value

    # Constructor method (initialize instance attributes)
    def __init__(self, attribute1, attribute2, ...):
        self.attribute1 = attribute1
        self.attribute2 = attribute2
        # ...

    # Instance methods (functions)
    def method1(self, parameter1, parameter2, ...):
        # Method logic
        pass

```

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Using same steps you can define multiple instance methods.

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```

```
1.  class ClassName:
2.      # Class attributes (shared by all instances)
3.      class_attribute = value
4.
5.      # Constructor method (initialize instance attributes)
6.      def __init__(self, attribute1, attribute2, ...):
7.          self.attribute1 = attribute1
8.          self.attribute2 = attribute2
9.          # ...
10.
11.     # Instance methods (functions)
12.     def method1(self, parameter1, parameter2, ...):
13.         # Method logic
14.         pass
15.
16.     def method2(self, parameter1, parameter2, ...):
17.         # Method logic
18.         pass
```

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Note:- Now, we have successfully created a dummy class.

Creating Objects (Instances):

- To create objects (instances) of the class, you call the class like a function and provide arguments required by the constructor.
- Each object is a distinct instance of the class, with its own set of instance attributes and the ability to call methods defined in the class.

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```

```
1. # Create objects (instances) of the class
2. object1 = ClassName(arg1, arg2, ...)
3. object2 = ClassName(arg1, arg2, ...)
```

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Calling methods on objects:

- In this section we will call methods on objects, specifically `object1` and `object2`.
- The methods **method1** and **method2** are defined in the ClassName **class**, and you're calling them on **object1** and **object2** respectively.
- You pass values **param1_value** and **param2_value** as arguments to these methods. These arguments are used within the method's logic.

Method 1: Using dot notation:

- This is the most straightforward way to call an object's method. In this we use the dot notation **(object.method())** to directly invoke the method on the object.
- For example, `result1 = object1.method1(param1_value, param2_value, ...)` calls method1 on object1.

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# Calling methods on objects
# Method 1: Using dot notation
result1 = object1.method1(param1_value, param2_value, ...)
result2 = object2.method2(param1_value, param2_value, ...)
```

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Method 2: Assigning object methods to variables:

- Here's an alternative way to call an object's method by assigning the method reference to a variable.
- `method_reference = object1.method1` assigns the method **method1** of **object1** to the variable **method_reference**.
- Later, we call the method using the variable like this: **result3 = method_reference(param1_value, param2_value, …)**.

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```
# Method 2: Assigning object methods to variables
method_reference = object1.method1  # Assign the method to a variable
result3 = method_reference(param1_value, param2_value, ...)
```

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Accessing object attributes:

- Here, we are accessing an object's attribute using dot notation.
- `attribute_value = object1.attribute1` retrieves the value of the attribute **attribute1** from **object1** and assigns it to the variable **attribute_value**.

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```
# Accessing object attributes
attribute_value = object1.attribute1  # Access the attribute using dot notation
```

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Modifying object attributes:

- We are modifying an object's attribute using dot notation.
- `object1.attribute2 = new_value` sets the attribute **attribute2** of **object1** to the new value **new_value**.

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```
# Modifying object attributes
object1.attribute2 = new_value  # Change the value of an attribute using dot notation
```

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Accessing class attributes (shared by all instances):

- Finally,we access a class attribute, which is shared by all instances of the class.
- `class_attr_value = ClassName.class_attribute` accesses the class attribute `class_attribute` from the ClassName `class` and assigns its value to the variable
  `class_attr_value`.

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```
# Accessing class attributes (shared by all instances)
class_attr_value = ClassName.class_attribute
```

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Real-world example

Let's write a python program that simulates a simple car class, allowing you to create car instances, accelerate them, and display their current speeds.

1. Let's start by defining a Car class that includes the following attributes and methods:

- Class attribute `max_speed`, which is set to **120 km/h**.
- Constructor method `__init__` that takes parameters for the **car's make, model, color, and an optional speed (defaulting to 0)**. This method initializes instance attributes for make, model, color, and speed.
- Method `accelerate(self, acceleration)` that allows the car to accelerate. If the acceleration does not exceed the `max_speed`, update the **car's speed** attribute. Otherwise, set the speed to the **max_speed**.
- Method `get_speed(self)` that returns the current speed of the car.

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```
class Car:
    # Class attribute (shared by all instances)
    max_speed = 120  # Maximum speed in km/h

    # Constructor method (initialize instance attributes)
    def __init__(self, make, model, color, speed=0):
        self.make = make
        self.model = model
        self.color = color
        self.speed = speed  # Initial speed is set to 0

    # Method for accelerating the car
```

```
    def accelerate(self, acceleration):
        if self.speed + acceleration <= Car.max_speed:
            self.speed += acceleration
        else:
            self.speed = Car.max_speed

    # Method to get the current speed of the car
    def get_speed(self):
        return self.speed
```

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2. Now, we will instantiate two objects of the Car class, each with the following characteristics:

- car1: **Make = "Toyota", Model = "Camry", Color = "Blue"**
- car2: **Make = "Honda", Model = "Civic", Color = "Red"**

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```
# Create objects (instances) of the Car class
car1 = Car("Toyota", "Camry", "Blue")
car2 = Car("Honda", "Civic", "Red")
```

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3. Using the `accelerate` method, we will increase the speed of car1 by 30 km/h and car2 by 20 km/h.

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# Accelerate the cars
car1.accelerate(30)
car2.accelerate(20)
```

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4. Lastly, we will display the current speed of each car by utilizing the `get_speed method.

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2. 2
3. 3
4. 4

1.
2. # Print the current speeds of the cars
3. print(f"{car1.make} {car1.model} is currently at {car1.get_speed()} km/h.")
4. print(f"{car2.make} {car2.model} is currently at {car2.get_speed()} km/h.")
```

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Next Steps

In conclusion, this reading provides a fundamental understanding of objects and classes in Python, essential concepts in object-oriented programming. Classes serve as blueprints for creating objects, encapsulating both data attributes and methods. Objects represent real-world entities and possess their own unique state and behavior. The structured code example presented in the reading outlines the key elements of a class, including class attributes, the constructor method for initializing instance attributes, and instance methods for defining object-specific functionality.

You can apply the concepts of objects and classes in the upcoming laboratory session to gain hands-on experience.

Author

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Changelog

Date	Version	Changed by	Change Description
2023-09-05	1.0	Akansha Yadav	Created reading