Python Notes
PGDCA
Unit – II
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Python OOPs Concepts

Like other general purpose languages, python is also an object-oriented language since its beginning. Python is an object-oriented programming language. It allows us to develop applications using an Object Oriented approach. In Python, we can easily create and use classes and objects.
Major principles of object-oriented programming system are given below.

- Object
- Class
- Method
- Inheritance
- Polymorphism
- Data Abstraction
- Encapsulation

Object

The object is an entity that has state and behavior. It may be any real-world object like the mouse, keyboard, chair, table, pen, etc.
Everything in Python is an object, and almost everything has attributes and methods. All functions have a built-in attribute __doc__, which returns the doc string defined in the function source code.

Class

The class can be defined as a collection of objects. It is a logical entity that has some specific attributes and methods. For example: if you have an employee class then it should contain an attribute and method, i.e. an email id, name, age, salary, etc.

Syntax

```
class ClassName:
        <statement-1>
        .
        .
        <statement-N>
```

Method

The method is a function that is associated with an object. In Python, a method is not unique to class instances. Any object type can have methods.

Inheritance

Inheritance is the most important aspect of object-oriented programming which simulates the real world concept of inheritance. It specifies that the child object acquires all the properties and behaviors of the parent object.
By using inheritance, we can create a class which uses all the properties and behavior of another class. The new class is known as a derived class or child class, and the one whose properties are acquired is known as a base class or parent class.
It provides re-usability of the code.

Polymorphism

Polymorphism contains two words "poly" and "morphs". Poly means many and Morphs means form, shape. By polymorphism, we understand that one task can be performed in different ways. For example You have a class animal, and all animals speak. But they speak differently. Here, the "speak" behavior is polymorphic in the sense and depends on the animal. So, the abstract "animal" concept does not actually "speak", but specific animals (like dogs and cats) have a concrete implementation of the action "speak".

Encapsulation

Encapsulation is also an important aspect of object-oriented programming. It is used to restrict access to methods and variables. In encapsulation, code and data are wrapped together within a single unit from being modified by accident.

Data Abstraction

Data abstraction and encapsulation both are often used as synonyms. Both are nearly synonym because data abstraction is achieved through encapsulation.
Abstraction is used to hide internal details and show only functionalities. Abstracting something means to give names to things so that the name captures the core of what a function or a whole program does.

Object-oriented vs Procedure-oriented Programming languages

Index	Object-oriented Programming	Procedural Programming
1.	Object-oriented programming is the problem-solving approach and used where computation is done by using objects.	Procedural programming uses a list of instructions to do computation step by step.
2.	It makes the development and maintenance easier.	In procedural programming, It is not easy to maintain the codes when the project becomes lengthy.
3.	It simulates the real world entity. So real-world problems can be easily solved through oops.	It doesn't simulate the real world. It works on step by step instructions

		divided into small parts called functions.
4.	It provides data hiding. So it is more secure than procedural languages. You cannot access private data from anywhere.	Procedural language doesn't provide any proper way for data binding, so it is less secure.
5.	Example of object-oriented programming languages is C++, Java, .Net, Python, C#, etc.	Example of procedural languages are: C, Fortran, Pascal, VB etc.

Python Class and Objects

As we have already discussed, a class is a virtual entity and can be seen as a blueprint of an object. The class came into existence when it instantiated. Let's understand it by an example.
Suppose a class is a prototype of a building. A building contains all the details about the floor, doors, windows, etc. we can make as many buildings as we want, based on these details. Hence, the building can be seen as a class, and we can create as many objects of this class.
On the other hand, the object is the instance of a class. The process of creating an object can be called as instantiation.
In this section of the tutorial, we will discuss creating classes and objects in python. We will also talk about how an attribute is accessed by using the class object.

Creating classes in python

In python, a class can be created by using the keyword class followed by the class name. The syntax to create a class is given below.

Syntax

```
class ClassName:
    #statement_suite
```

In python, we must notice that each class is associated with a documentation string which can be accessed by using **<class-name>.__doc__**. A class contains a statement suite including fields, constructor, function, etc. definition.
Consider the following example to create a class Employee which contains two fields as Employee id, and name.
The class also contains a function display() which is used to display the information of the Employee.

Example

```
class Employee:
    id = 10;
    name = "ayush"
    def display (self):
        print(self.id,self.name)
```

Here, the self is used as a reference variable which refers to the current class object. It is always the first argument in the function definition. However, using self is optional in the function call.

Creating an instance of the class

A class needs to be instantiated if we want to use the class attributes in another class or method. A class can be instantiated by calling the class using the class name.
The syntax to create the instance of the class is given below.

```
<object-name> = <class-name>(<arguments>)
```

The following example creates the instance of the class Employee defined in the above example.

Example

```
class Employee:
    id = 10;
    name = "John"
    def display (self):
        print("ID: %d \nName: %s"%(self.id,self.name))
emp = Employee()
emp.display()
```

Output:

```
ID: 10
Name: ayush
```

Python Constructor

A constructor is a special type of method (function) which is used to initialize the instance members of the class.
Constructors can be of two types.

1. Parameterized Constructor
2. Non-parameterized Constructor

Constructor definition is executed when we create the object of this class. Constructors also verify that there are enough resources for the object to perform any start-up task.

Creating the constructor in python

In python, the method **__init__** simulates the constructor of the class. This method is called when the class is instantiated. We can pass any number of arguments at the time of creating the class object, depending upon **__init__** definition. It is mostly used to initialize the class attributes. Every class must have a constructor, even if it simply relies on the default constructor.
Consider the following example to initialize the Employee class attributes.

Example

```
class Employee:
    def __init__(self,name,id):
        self.id = id;
        self.name = name;
    def display (self):
        print("ID: %d \nName: %s"%(self.id,self.name))
emp1 = Employee("John",101)
emp2 = Employee("David",102)

#accessing display() method to print employee 1 information

emp1.display();

#accessing display() method to print employee 2 information
emp2.display();
```

Output:

```
ID: 101
Name: John
ID: 102
Name: David
```

Example: Counting the number of objects of a class

```
class Student:
    count = 0
    def __init__(self):
        Student.count = Student.count + 1
s1=Student()
s2=Student()
s3=Student()
print("The number of students:",Student.count)
```

Output:

```
The number of students: 3
```

Python Non-Parameterized Constructor Example

```
class Student:
    # Constructor - non parameterized
    def __init__(self):
        print("This is non parametrized constructor")
    def show(self,name):
        print("Hello",name)
student = Student()
student.show("John")
```

Output:

```
This is non parametrized constructor
Hello John
```

Python Parameterized Constructor Example

```python
class Student:
    # Constructor - parameterized
    def __init__(self, name):
        print("This is parametrized constructor")
        self.name = name
    def show(self):
        print("Hello",self.name)
student = Student("John")
student.show()
```

Output:

```
This is parametrized constructor
Hello John
```

Python In-built class functions

The in-built functions defined in the class are described in the following table.

SN	Function	Description
1	getattr(obj,name,default)	It is used to access the attribute of the object.
2	setattr(obj, name,value)	It is used to set a particular value to the specific attribute of an object.
3	delattr(obj, name)	It is used to delete a specific attribute.
4	hasattr(obj, name)	It returns true if the object contains some specific attribute.

Example

```python
class Student:
    def __init__(self,name,id,age):
        self.name = name;
        self.id = id;
        self.age = age

#creates the object of the class Student
s = Student("John",101,22)

```

```python
#prints the attribute name of the object s
print(getattr(s,'name'))

# reset the value of attribute age to 23
setattr(s,"age",23)

# prints the modified value of age
print(getattr(s,'age'))

# prints true if the student contains the attribute with name id

print(hasattr(s,'id'))
# deletes the attribute age
delattr(s,'age')

# this will give an error since the attribute age has been deleted
print(s.age)
```

Output:

```
John
23
True
AttributeError: 'Student' object has no attribute 'age'
```

Built-in class attributes

Along with the other attributes, a python class also contains some built-in class attributes which provide information about the class.

The built-in class attributes are given in the below table.

SN	Attribute	Description
1	__dict__	It provides the dictionary containing the information about the class namespace.
2	__doc__	It contains a string which has the class documentation
3	__name__	It is used to access the class name.
4	__module__	It is used to access the module in which, this class is defined.
5	__bases__	It contains a tuple including all base classes.

Example

```python
class Student:
    def __init__(self,name,id,age):
        self.name = name;
        self.id = id;
        self.age = age
    def display_details(self):
        print("Name:%s, ID:%d, age:%d"%(self.name,self.id))
s = Student("John",101,22)
print(s.__doc__)
print(s.__dict__)
print(s.__module__)
```

Output:

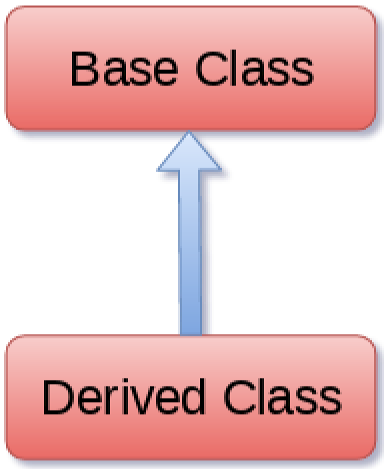
```
None
{'name': 'John', 'id': 101, 'age': 22}
__main__
```

Python Inheritance

Inheritance is an important aspect of the object-oriented paradigm. Inheritance provides code reusability to the program because we can use an existing class to create a new class instead of creating it from scratch.

In inheritance, the child class acquires the properties and can access all the data members and functions defined in the parent class. A child class can also provide its specific implementation to the functions of the parent class. In this section of the tutorial, we will discuss inheritance in detail.

In python, a derived class can inherit base class by just mentioning the base in the bracket after the derived class name. Consider the following syntax to inherit a base class into the derived class.



Syntax

```
class derived-class(base class):
    <class-suite>
```

A class can inherit multiple classes by mentioning all of them inside the bracket. Consider the following syntax.

Syntax

```
class derive-class(<base class 1>, <base class 2>, ..... <base class n>):
    <class - suite>
```

Example 1

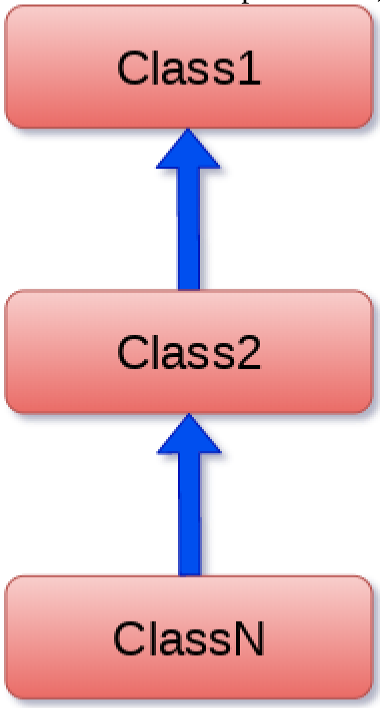
```
class Animal:
    def speak(self):
        print("Animal Speaking")
#child class Dog inherits the base class Animal
class Dog(Animal):
    def bark(self):
        print("dog barking")
d = Dog()
d.bark()
d.speak()
```

Output:

```
dog barking
Animal Speaking
```

Python Multi-Level inheritance

Multi-Level inheritance is possible in python like other object-oriented languages. Multi-level inheritance is archived when a derived class inherits another derived class. There is no limit on the number of levels up to which, the multi-level inheritance is archived in python.



The syntax of multi-level inheritance is given below.

Syntax

```
class class1:
    <class-suite>
```

```
class class2(class1):
    <class suite>
class class3(class2):
    <class suite>
.
.
```

Example

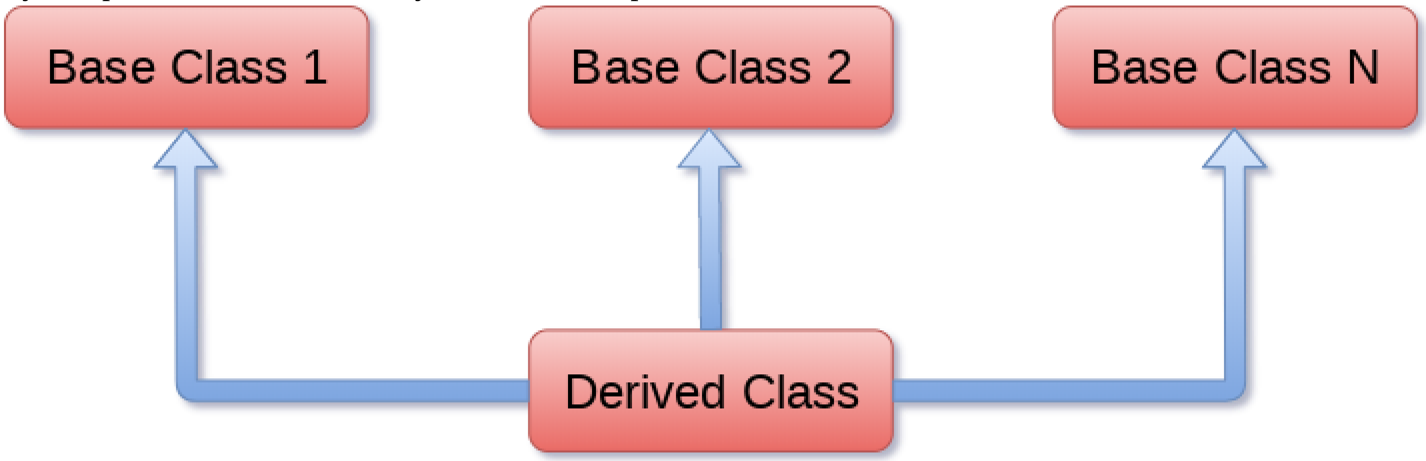
```
class Animal:
    def speak(self):
        print("Animal Speaking")
#The child class Dog inherits the base class Animal
class Dog(Animal):
    def bark(self):
        print("dog barking")
#The child class Dogchild inherits another child class Dog
class DogChild(Dog):
    def eat(self):
        print("Eating bread...")
d = DogChild()
d.bark()
d.speak()
d.eat()
```

Output:

```
dog barking
Animal Speaking
Eating bread...
```

Python Multiple inheritance

Python provides us the flexibility to inherit multiple base classes in the child class.



The syntax to perform multiple inheritance is given below.

Syntax

```
class Base1:
    <class-suite>

class Base2:
    <class-suite>
.
.
.
class BaseN:
    <class-suite>

class Derived(Base1, Base2, ...... BaseN):
    <class-suite>
```

Example

```
class Calculation1:
    def Summation(self,a,b):
        return a+b;
class Calculation2:
    def Multiplication(self,a,b):
        return a*b;
class Derived(Calculation1,Calculation2):
    def Divide(self,a,b):
        return a/b;
d = Derived()
print(d.Summation(10,20))
print(d.Multiplication(10,20))
print(d.Divide(10,20))
```

Output:

```
30
200
0.5
```

The issubclass(sub,sup) method

The issubclass(sub, sup) method is used to check the relationships between the specified classes. It returns true if the first class is the subclass of the second class, and false otherwise.

Consider the following example.

Example

```
class Calculation1:
    def Summation(self,a,b):
        return a+b;
class Calculation2:
```

```python
    def Multiplication(self,a,b):
        return a*b;
class Derived(Calculation1,Calculation2):
    def Divide(self,a,b):
        return a/b;
d = Derived()
print(issubclass(Derived,Calculation2))
print(issubclass(Calculation1,Calculation2))
```

Output:

```
True
False
```

The isinstance (obj, class) method

The isinstance() method is used to check the relationship between the objects and classes. It returns true if the first parameter, i.e., obj is the instance of the second parameter, i.e., class.
Consider the following example.

Example

```python
class Calculation1:
    def Summation(self,a,b):
        return a+b;
class Calculation2:
    def Multiplication(self,a,b):
        return a*b;
class Derived(Calculation1,Calculation2):
    def Divide(self,a,b):
        return a/b;
d = Derived()
print(isinstance(d,Derived))
```

Output:

```
True
```

Method Overriding

We can provide some specific implementation of the parent class method in our child class. When the parent class method is defined in the child class with some specific implementation, then the concept is called method overriding. We may need to perform method overriding in the scenario where the different definition of a parent class method is needed in the child class.
Consider the following example to perform method overriding in python.

Example

```python
class Animal:
    def speak(self):
        print("speaking")
class Dog(Animal):
    def speak(self):
        print("Barking")
d = Dog()
d.speak()
```

Output:

```
Barking
```

Real Life Example of method overriding

```
class Bank:
    def getroi(self):
        return 10;
class SBI(Bank):
    def getroi(self):
        return 7;

class ICICI(Bank):
    def getroi(self):
        return 8;
b1 = Bank()
b2 = SBI()
b3 = ICICI()
print("Bank Rate of interest:",b1.getroi());
print("SBI Rate of interest:",b2.getroi());
print("ICICI Rate of interest:",b3.getroi());
```

Output:

```
Bank Rate of interest: 10
SBI Rate of interest: 7
ICICI Rate of interest: 8
```

Data abstraction in python

Abstraction is an important aspect of object-oriented programming. In python, we can also perform data hiding by adding the double underscore (___) as a prefix to the attribute which is to be hidden. After this, the attribute will not be visible outside of the class through the object.

Consider the following example.

Example

```
class Employee:
    __count = 0;
    def __init__(self):
        Employee.__count = Employee.__count+1
    def display(self):
        print("The number of employees",Employee.__count)
emp = Employee()
emp2 = Employee()
```

```
try:
   print(emp.__count)
finally:
   emp.display()
```

Output:

```
The number of employees 2
AttributeError: 'Employee' object has no attribute '__count'
```

Environment Setup

To build the real world applications, connecting with the databases is the necessity for the programming languages. However, python allows us to connect our application to the databases like MySQL, SQLite, MongoDB, and many others.

In this section of the tutorial, we will discuss Python - MySQL connectivity, and we will perform the database operations in python. We will also cover the Python connectivity with the databases like MongoDB and SQLite later in this tutorial.

Install mysql.connector

To connect the python application with the MySQL database, we must import the mysql.connector module in the program.

The mysql.connector is not a built-in module that comes with the python installation. We need to install it to get it working.

Execute the following command to install it using pip installer.

```
>  python -m pip install mysql-connector
```

Or follow the following steps.

1. Click the link: https://files.pythonhosted.org/packages/8f/6d/fb8ebcbbaee68b172ce3dfd08c7b8660d09f91d8d5411298bcacbd309f96/mysql-connector-python-8.0.13.tar.gz to download the source code.

2. Extract the archived file.

3. Open the terminal (CMD for windows) and change the present working directory to the source code directory.

```
$  cd mysql-connector-python-8.0.13/
```

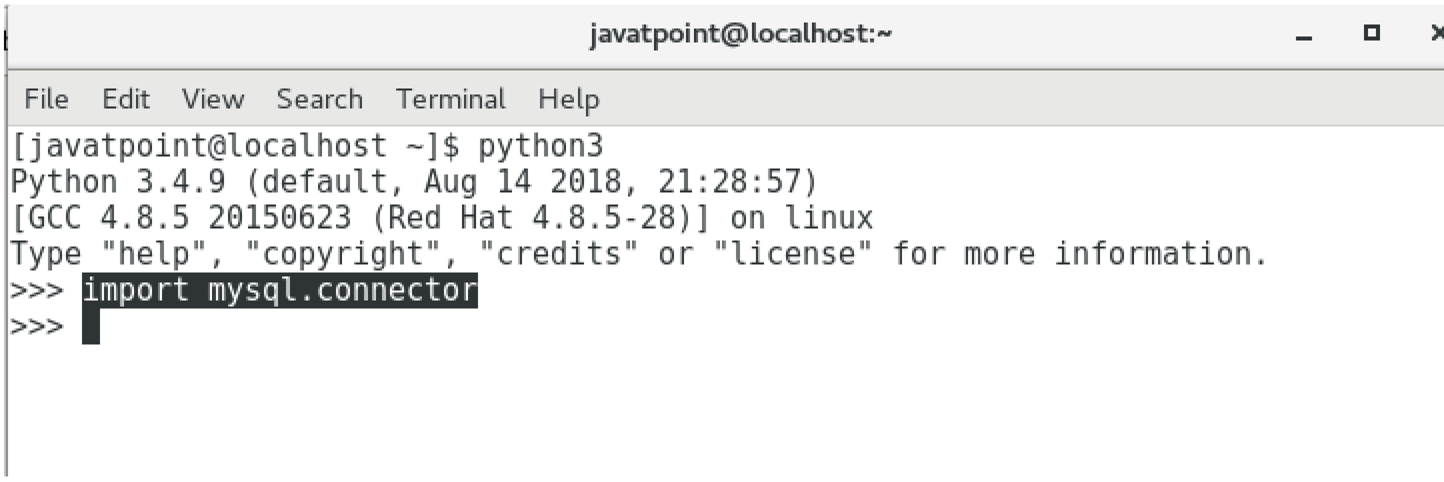
4. Run the file named setup.py with python (python3 in case you have also installed python 2) with the parameter build.

```
$ python setup.py build
```

5. Run the following command to install the mysql-connector.

```
$ python setup.py install
```

This will take a bit of time to install mysql-connector for python. We can verify the installation once the process gets over by importing mysql-connector on the python shell.



```
[javatpoint@localhost ~]$ python3
Python 3.4.9 (default, Aug 14 2018, 21:28:57)
[GCC 4.8.5 20150623 (Red Hat 4.8.5-28)] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> import mysql.connector
>>> 
```

Hence, we have successfully installed mysql-connector for python on our system.