UNIT-9

Python OOPs Concepts

Python is an object-oriented language since its beginning. 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.

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

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>
```

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.

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 the re-usability of the code.

Polymorphism

Polymorphism contains two words "poly" and "morphs". Poly means many, and morph means shape. By polymorphism, we understand that one task can be performed in different ways.

Encapsulation

Encapsulation is also an essential 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 synonyms 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.

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.

CLASS:➔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, rooms, 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 instantiation.

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
```

The class also contains a function **display()**, which is used to display the information of the **Employee.**

Example

```
class Employee:
    id = 10
    name = "Devansh"
```

```
4.      def display (self):
5.          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.

The self-parameter

The self-parameter refers to the current instance of the class and accesses the class variables. We can use anything instead of self, but it must be the first parameter of any function which belongs to the class.

Self is always pointing to Current Object.

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.

1. <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))
# Creating a emp instance of Employee class
emp = Employee()
emp.display()
```

Output:

```
ID: 10
Name: John
```

Delete the Object

We can delete the properties of the object or object itself by using the del keyword. Consider the following example.

Example

```
class Employee:
    id = 10
    name = "John"

    def display(self):
        print("ID: %d \nName: %s" % (self.id, self.name))
    # Creating a emp instance of Employee class

emp = Employee()

# Deleting the property of object
del emp.id
# Deleting the object itself
del emp
emp.display()
```

Python Constructor

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

In C++ or Java, the constructor has the same name as its class, but it treats constructor differently in Python.

Constructors are generally used for instantiating an object. The task of constructors is to initialize(assign values) to the data members of the class when an object of the class is created. In Python the __init__() method is called the constructor and is always called when an object is created.

Syntax of constructor declaration :

```
def __init__(self):
    # body of the constructor
```

Constructors can be of two types.

- **default constructor:** The default constructor is a simple constructor which doesn't accept any arguments. Its definition has only one argument which is a reference to the instance being constructed.
- **parameterized constructor:** constructor with parameters is known as parameterized constructor. The parameterized constructor takes its first argument as a reference to the instance being constructed known as self and the rest of the arguments are provided by the programmer.

Counting the number of objects of a class

The constructor is called automatically when we create the object of the class. Consider the following example.

Example

```
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

The non-parameterized constructor uses when we do not want to manipulate the value or the constructor that has only self as an argument. Consider the following example.

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")
```

Python Parameterized Constructor

The parameterized constructor has multiple parameters along with the **self**. Consider the following example.

Example

```
1. class Student:
2.     # Constructor - parameterized
3.     def __init__(self, name):
4.         print("This is parametrized constructor")
5.         self.name = name
6.     def show(self):
7.         print("Hello",self.name)
8. student = Student("John")
9. student.show()
```

Output:

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

Python Default Constructor

When we do not include the constructor in the class or forget to declare it, then that becomes the default constructor. It does not perform any task but initializes the objects. Consider the following example.

Example

```
1. class Student:
2.     roll_num = 101
3.     name = "Joseph"
4.
5.     def display(self):
6.         print(self.roll_num,self.name)
7.
8. st = Student()
```

9. st.display()

Output:

```
101 Joseph
```

More than One Constructor in Single class

Let's have a look at another scenario, what happen if we declare the two same constructors in the class.

Example

```
1. class Student:
2.     def __init__(self):
3.         print("The First Constructor")
4.     def __init__(self):
5.         print("The second contructor")
6.
7. st = Student()
```

Output:

```
The Second Constructor
```

In the above code, the object **st** called the second constructor whereas both have the same configuration. The first method is not accessible by the **st** object. Internally, the object of the class will always call the last constructor if the class has multiple constructors.

> *Note: The constructor overloading is not allowed in Python.*

Python built-in class functions

The built-in 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

```
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)

# 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

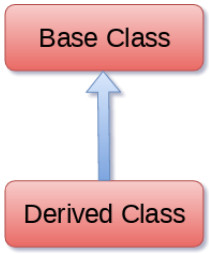
```
class Student:
    def __init__(self,name,id,age):
        self.name = name;
        self.id = id;
        self.age = age
    def display_details(self):
        print("Name:%s, ID:%d, age:%d"%(self.name,self.id))
s = Student("John",101,22)
print(s.__doc__)
print(s.__dict__)
print(s.__module__)
```

Output:

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

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 .



Syntax

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

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

Syntax

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

Example 1

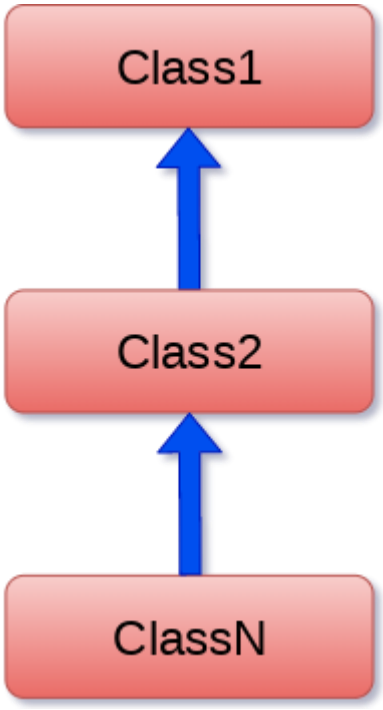
```
class Animal:
    def speak(self):
        print("Animal Speaking")
#child class Dog inherits the base class Animal
class Dog(Animal):
    def bark(self):
        print("dog barking")
d = Dog()
d.bark()
d.speak()
```

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):
```

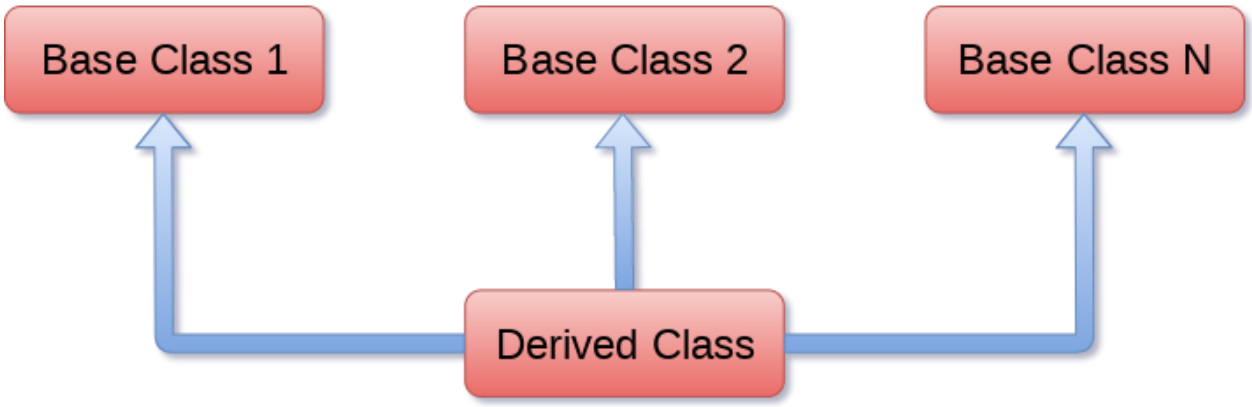
```
    def eat(self):
        print("Eating bread...")
d = DogChild()
d.bark()
d.speak()
d.eat()
```

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
```

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'
```

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.

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(issubclass(Derived,Calculation2))
print(issubclass(Calculation1,Calculation2))
```

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

```
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))
```

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.

```
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):
```

```
6.          return 7;
7.
8.   class ICICI(Bank):
9.       def getroi(self):
10.         return 8;
11. b1 = Bank()
12. b2 = SBI()
13. b3 = ICICI()
14. print("Bank Rate of interest:",b1.getroi());
15. print("SBI Rate of interest:",b2.getroi());
16. print("ICICI Rate of interest:",b3.getroi());
```

Output:

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