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Unit-05

Object Oriented Programming with python

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Outline

- ✔ Object Oriented Approach
- ✔ Custom Classes: Attributes and Methods
- ✔ Inheritance,
- ✔ Polymorphism
- ✔ Abstract class
- ✔ Abstract method

Introduction

- The main concept of OOPs is to bind the data and the functions that work on that together as a single unit so that no other part of the code can access this data.
- Main Components of OOPs
  - Class
  - Objects
  - Polymorphism
  - Encapsulation
  - Inheritance

Overview of OOP Terminology

- Class
- Class variable
- Data member
- Function overloading
- Instance variable
- Inheritance
- Instance
- Instantiation
- Method
- Object

Class

- A class is a user defined blueprint or prototype from which objects are created.
- It represents the set of properties and methods that are common to all objects of one type.
- Defines new datatype (primitive ones are not enough). For Example : **Car**
- A class is a template for an object .

```
class Car{



        .....
}
```

syntax

```
class className:
    # Statement-1
    .
    .
    .
    # Statement-N
```

Class

Properties (Describe)
Company
Model
Color
Mfg. Year
Price
Fuel Type
Mileage
Gear Type
Power Steering
Anti-Lock braking system

Methods (Functions)
Start
Drive
Park
On_break
On_lock
On_turn

Objects

- It is a basic unit of Object Oriented Programming and represents the real life entities.
- An object is an **instance** of a **class**.
- An object has a **state** and **behavior**.
- The **state** of an object is stored in **fields** (variables), while **methods** (functions) display the object's **behavior**.

Honda City

Hyundai i20

Sumo Grand

syntax

```
objectName =  ClassName()
```

Mercedes E class

Swift Dzire

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The self

- Class methods must have an extra first parameter in the method definition. We do not give a value for this parameter when we call the method, Python provides it
- If we have a method that takes no arguments, then we still have to have one argument.
- When we call a method of this object as myobject.method(arg1, arg2), this is automatically converted by Python into MyClass.method(myobject, arg1, arg2) – this is all the special self is about.

Example.py

```
1  class Demo:
2      # Method of Class Demo
3      def printMyName(self,name):
4          print('My name is =',name)
5
6
7  object1 = Demo() # Object created
8  object1.printMyName("DIET") # Method Called
```

OUTPUT

```
My name is = DIET
```

The __init__ method

- The __init__ method is similar to constructors in C++ and Java.
- It called when object of class created.
- Used for initialization of object data members.

Example.py

```
1  class Demo:
2      #class Attributes
3      Name = ""
4
5      #Constructor Method
6      def __init__(self,n):
7          self.Name = n
8
9      # Method of Class Demo
10     def printMyName(self):
11         print('My name is =',self.Name)
12
13
14 object1 = Demo("DIET") # Object created
15 object1.printMyName() # Method Called
```

OUTPUT

```
My name is = DIET
```

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Example

Example.py

```
1  # Write a Program to create Circle class and
2  define findarea method to calculate are of
3  circle.
4  class Circle:
5      def __init__(self,r):
6          self.r = r
7
8      def findarea(self):
9          return 3.14 * self.r * self.r
10
11 r = int(input("Enter radius="))
12 c = Circle(r)
13 area = c.findarea()
14 print("Area = ",area)
```

OUTPUT

```
Enter radius=1
Area =  3.14
```

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Built-in class attributes

- Python class also contains some built-in class attributes which provide information about the class.

attributes	Description
__dict__	It provides the dictionary containing the information about the class namespace.
__doc__	It contains a string which has the class documentation
__name__	It is used to access the class name.
__module__	It is used to access the module in which, this class is defined.

Example

Example.py

```
1  class Student:
2      '''Student Class'''
3      def __init__(self,rno,sname):
4          self.rollno = rno
5          self.studentName = sname
6
7      def display(self):
8          print(self.rollno,self.studentName)
9
10 object = Student(23,"ABC")
11 print(object.__doc__)
12 print(object.__dict__)
13 print(object.__module__)
```

OUTPUT

```
Student Class
{'rollno': 23, 'studentName': 'ABC'}
__main__
```

Class Attributes vs Instance Attributes

Class Attributes	Instance Attributes
Class attributes are the variables defined directly in the class that are shared by all objects of the class.	**Instance attributes** are attributes or properties attached to an instance of a class. Instance attributes are defined in the constructor.
Shared across all objects.	Specific to object.
Accessed using class name as well as using object with dot notation, e.g. **classname.class_attribute or object.class_attribute**	Accessed using object dot notation e.g. **object.instance_attribute**
Changing value by using **classname.class_attribute = value** will be reflected to all the objects.	Changing value of **instance attribute will not be reflected to other** objects.

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Class Attributes vs Instance Attributes

Example.py

```
1  class Counter:
2      #Class Attribute
3      count = 0
4      def __init__(self):
5          Counter.count = Counter.count + 1
6
7  s1 = Counter() # Object 1 created
8  s2 = Counter() # Object 2 created
9
10 print(s1.count) # Counter Value
11 print(s2.count) # Counter Value
12 print(Counter.count) # Counter value
13
14 Counter.count = 100 # Updating Class Attribute
15
16 print(s1.count)
17 print(s2.count)
```

OUTPUT

```
2
2
2
100
100
```

Public, Private and Protected

- Python uses '_' symbol to determine the access control for a specific data member or a member function of a class.
- **Public Access :**
  - The members of a class that are declared public are easily accessible from any part of the program. All data members and member functions of a class are public by default.
- **Protected Access Modifier:**
  - The members of a class that are declared protected are only accessible to a class derived from it.
  - Data members of a class are declared protected by adding a **single underscore '_' symbol** before the data member name.
- **Private Access Modifier:**
  - The members of a class that are declared private are accessible within the class only.
  - We can declared private by adding a **double underscore '__' symbol** before before the data member name.

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Class Attributes vs Instance Attributes

Example.py

```
1  class Date:
2      def __init__(self,d,m,y):
3          self.__d = d # Private
4          self.__m = m # Private
5          self.__y = y # Private
6
7      #Private Method
8      def __displaydate(self):
9          print("{}-{}-{}".format(self.__d,self.__m,self.__y))
10
11     # Public Method
12     def display(self):
13         self.__displaydate()
14
15 y1 = Date(10,10,2022)
16 y1.display()
17
18 y1.__displaydate() #errorobject has no attribute
19 y1.__m # error object has no attribute
```

OUTPUT

```
10-10-2022
```

Types of Methods

- We can classify the methods in the following 3 types:

Instance methods

- Instance methods are bound to instances and hence called as: instancename.method().
- The purpose of instance methods is to set or get details about instances (objects), and that is why they're known as instance methods.
- They have one default parameter- self, which points to an instance of the class.
- Although you don't have to pass that every time. You can change the name of this parameter but it is better to stick to the convention i.e self.
- In order to call an instance method, you've to create an object/instance of the class. With the help of this object, you can access any method of the class.

Class methods

- These methods act on class level.
- Class methods are the methods which act on the class variables.
- These methods are written using @classmethod decorator above them.

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Types of Methods

- **Class methods:**
  - By default, the first parameter for class methods is “cls” which refers to the class itself.
  - Without creating an instance of the class, you can call the class method with – Class_name.Method_name().
- **Static methods:**
  - Static methods cannot access the class data.
  - They are self-sufficient and can work on their own.
  - they cannot get or set the instance state or class state.
  - In order to define a static method, we can use the @staticmethod decorator
  - we do not need to pass any special or default parameters.
  - we can call them using object/instance of the class or class name.

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Types of Methods

Example.py

```
1  class Student:
2      firstname = ""
3
4      #Instance Methods
5      def method1(self,lname):
6          self.lastname = lname
7
8      @classmethod
9      def classMethod(cls,fname):
10         cls.firstname = fname
11
12     @staticmethod
13     def staticMethod(fname):
14         print(fname)
15
16     #Instance Methods
17     def printData(self):
18         print(self.firstname,self.lastname)
```

Example.py

```
19 s1 = Student()
20 s1.method1("ABC")
21 Student.classMethod("XYZ")
22 Student.staticMethod("Z")
23 s1.printData()
```

OUTPUT

```
Z
XYZ ABC
```

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Passing Object as function Arguments

Example.py

```
1  class Time:
2          #Constructor
3          def __init__(self,h,m):
4                  self.h = h
5                  self.m = m
6
7          #add Two Time Objects
8          def addTime(self,t1,t2):
9                  self.h = t1.h + t2.h
10                 self.m = t1.m + t2.m
11
12         # Display Time
13         def displayTime(self):
14                 print(self.h,self.m)
15
16 t1 = Time(4,4)
17 t2 = Time(3,2)
18 t3 = Time(0,0)
```

Example.py

```
19 t3.addTime(t1,t2)
20 t1.displayTime()
21 t2.displayTime()
22 t3.displayTime()
```

OUTPUT

```
4 4
3 2
7 6
```

Inheritance in Python

- Inheritance is the capability of one class to derive or inherit the properties from another class.
- Advantages:
  - It represents real-world relationships.
  - It provides **reusability** of a code. We don't have to write the same code again and again. Also, it allows us to add more features to a class without modifying it.
  - It is transitive in nature.
- Parent class is the class being inherited from, also called base class.
- Child class is the class that inherits from another class, also called derived class.
- Inheritance in Java can be best understood in terms of **Parent** and **Child** relationship, also known as **Super class**(Parent) and **Sub class**(Child).
- Inheritance defines **IS-A** relationship between a **Super class** and its **Sub class**.

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Syntax

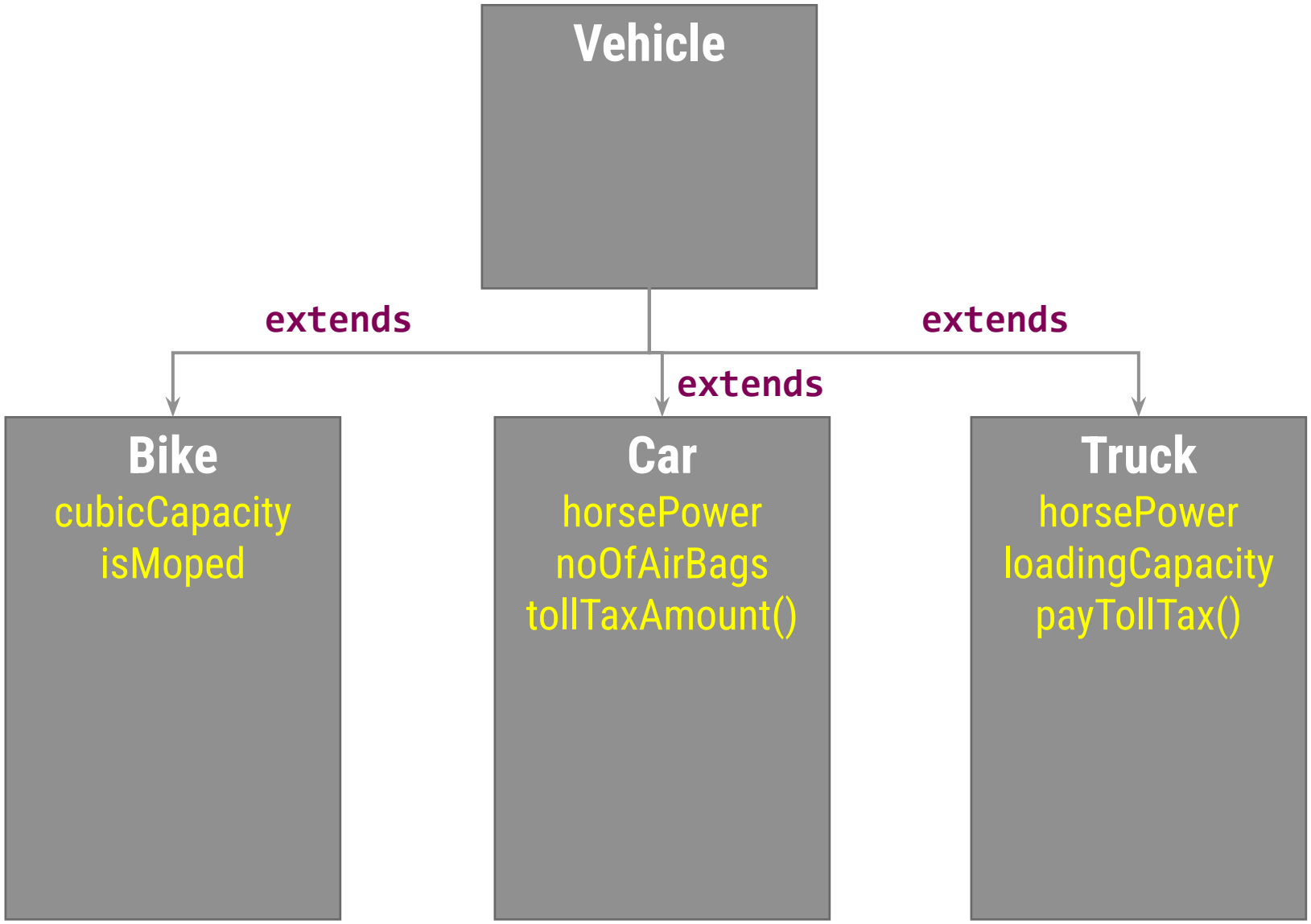
Syntax :

```
class A {

    // code

}

class B extends A{

    // code

}
```

syntax

```
class A:
    -
    -
class B(A):
    -
    -
```

Example


Vehicle
extends
extends
extends
Bike
cubicCapacity
isMoped
Car
horsePower
noOfAirBags
tollTaxAmount()
Truck
horsePower
loadingCapacity
payTollTax()

Example

Example.py

```
1  class Parent():
2      def first(self):
3          print('Parent Class’)
4
5  class Child(Parent):
6      def second(self):
7          print('Child Class’)
8
9  ob = Child()
10 ob.first()
11 ob.second()
```

OUTPUT

```
Parent Class
Child Class
```

Example.py

```
1  class Person:
2      def __init__(Self,fName,lName):
3          Self.firstName = fName
4          Self.lastName = lName
5
6      def displayPerson(self):
7          print(self.firstName,self.lastName)
8
9  class Student(Person):
10     def __init__(Self, fName, lName,gYear):
11         Self.graduateYear = gYear
12     Person.__init__(Self,fName, lName)
13
14     def displayStudent(self):
15         print(self.firstName,self.lastName,self.graduateYear)
16
17 ob = Student("jayesh","Vagadiya","2015")
18 ob.displayStudent()
```

OUTPUT

```
jayesh Vagadiya 2015
```

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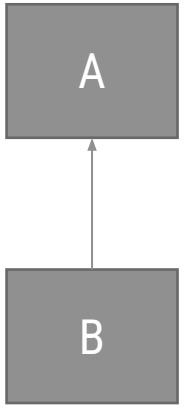
Inheritance Types

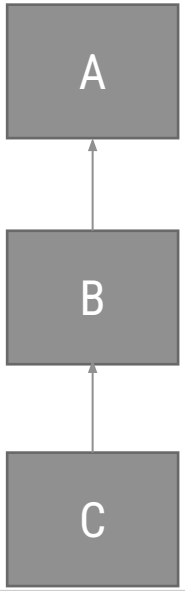
- Single:
  - When a child class inherits only a single parent class.



syntax

```
class ParentClass:
    -
    -
class ChildClass(ParentClass):
    -
    -
```

- Multilevel:
  - When a child class becomes a parent class for another child class.

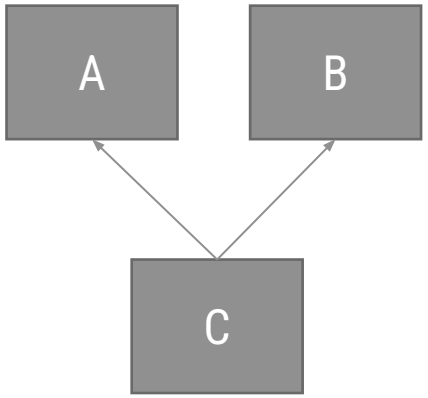


syntax

```
class ParentClass:
    -
    -
class Child1(ParentClass):
    -
    -
class Child2(Child1):
    -
    -
```

Inheritance Types (cont.)

- Multiple:
  - When a child class inherits from more than one parent class.

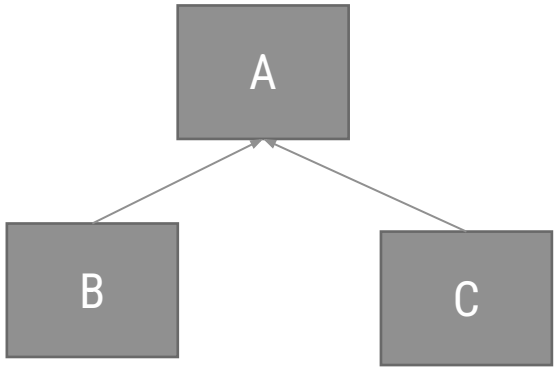


syntax

```
class ParentClass1:
    -
    -
class ParentClass2:
    -
    -

class ChildClass(ParentClass1,
ParentClass2):
    -
    -
```

- Hierarchical :
  - When a more then one chid is derived from parent class.

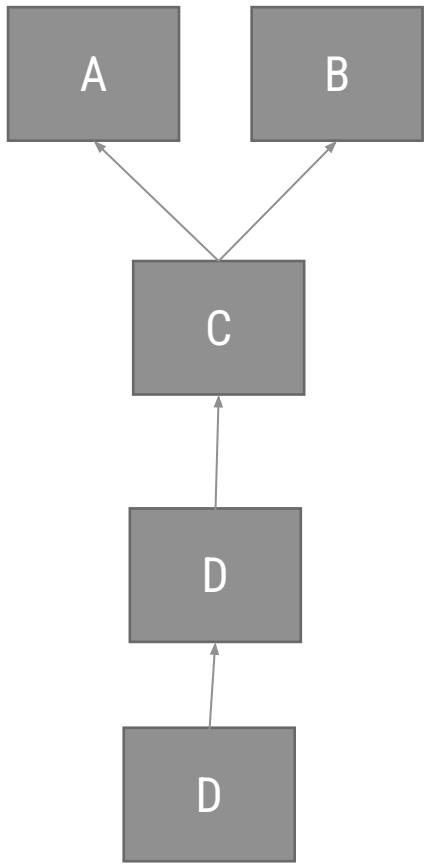


syntax

```
class ParentClass:
    -
    -
class Child1(ParentClass):
    -
    -
class Child2(ParentClass):
    -
    -
```

Inheritance Types (cont.)

- Hybrid:
  - This form combines more than one form of inheritance. Basically, it is a blend of more than one type of inheritance.



syntax

```
class ParentClass1:
    -
    -
class ParentClass2:
    -
    -

class ChildClass1(ParentClass1,
ParentClass2):
    -
    -
class ChildClass2(ChildClass1):
    -
    -
class ChildClass3(ChildClass2):
    -
    -
```

Examples

Single.py

```
1  class A:
2      def diplayA(self):
3          print("Class A")
4
5  class B(A):
6      def diplayB(self):
7          print("Class B")
8
9  object = B()
10 object.diplayA()
11 object.diplayB()
```

OUTPUT

```
Class A
Class B
```

Multi.py

```
1  class A:
2      def diplayA(self):
3          print("Class A")
4
5  class B(A):
6      def diplayB(self):
7          print("Class B")
8
9  class C(B):
10     def diplayC(self):
11         print("Class C")
12
13 object = C()
14 object.diplayA()
15 object.diplayB()
16 object.diplayC()
```

OUTPUT

```
Class A
Class B
Class C
```

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Examples

Multiple.py

```
1  class A:
2      def diplayA(self):
3          print("Class A")
4
5  class B:
6      def diplayB(self):
7          print("Class B")
8
9  class C(A,B):
10     def diplayC(self):
11         print("Class C")
12
13 object = C()
14 object.diplayA()
15 object.diplayB()
16 object.diplayC()
```

OUTPUT

```
Class A
Class B
Class C
```

Hierarchical.py

```
1  class A:
2      def diplayA(self):
3          print("Class A")
4
5  class B(A):
6      def diplayB(self):
7          print("Class B")
8
9  class C(A):
10     def diplayC(self):
11         print("Class C")
12
13 object1 = B()
14 object2 = C()
15 object1.diplayA()
16 object1.diplayB()
17 object2.diplayA()
18 object2.diplayC()
```

OUTPUT

```
Class A
Class B
Class A
Class C
```

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Polymorphism

- If one task is performed in different ways, it is known as polymorphism.
- OOP concept lets programmers use the same word to mean different things in different contexts.
- Polymorphism is taken from the Greek words Poly (many) and morphism (forms).

Example1.py

```
1  num1 = 3
2  num2 = 4
3  print(num1+num2)
4
5  str1 = "Python "
6  str2 = "Programming"
7  print(str1+str2)
```

Example2.py

```
1  print(len("DIET"))
2  print(len([1,2,3,4,5,6]))
3  print(len((1,2,3,4,5,6,7,)))
```

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Method Overloading

- The problem with method overloading in Python is that we may overload the methods but can only use the latest defined method.

Example1.py

```
1  def display():
2   print("Hello")
3
4  def display(name):
5   print(name)
6
7  #display() Error Message
8  display("Name")
```

- In the above code, we have defined two display method, but we can only use the second display method, as python does not support method overloading.

Method Overloading

- To overcome the above problem, we can use different ways to achieve the method overloading.
- We need to write the method's logic so that different code executes inside the function depending on the parameter passes.

Example1.py

```
1  class Shape:
2      # function with two default parameters
3      def area(self, a, b=0):
4          if b > 0:
5              print('Area of Rectangle is:', a * b)
6          else:
7              print('Area of Square is:', a ** 2)
8
9  square = Shape()
10 square.area(5)
11 square.area(1,2)
```

OUTPUT

```
Area of Square is: 25
Area of Rectangle is: 2
```

Polymorphism with Function and Objects

- We can create polymorphism with a function that can take any object as a parameter and execute its method without checking its class type.
- Using this, we can call object actions using the same function instead of repeating method calls.

Example1.py

```
1  class Honda:
2      def fuel_type(self):
3          print("Petrol")
4
5      def max_speed(self):
6          print("Max speed 180")
7
8  class Skoda:
9      def fuel_type(self):
10         print("Diesel")
11
12     def max_speed(self):
13         print("Max speed is 220")
```

Example1.py

```
14 # normal function
15 def car_details(obj):
16         obj.fuel_type()
17         obj.max_speed()
18
19 honda = Honda()
20 skoda = Skoda()
21 car_details(honda)
22 car_details(skoda)
```

OUTPUT

```
Petrol
Max speed 180
Diesel
Max speed is 220
```

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Method Overriding

- Method overriding allows a subclass or child class to provide a specific implementation of a method that is already provided by one of its super-classes or parent classes.
- When a method in a subclass has the same name, same parameters or signature and same return type(or sub-type) as a method in its super-class, then the method in the subclass is said to override the method in the super-class.
- If an object of a parent class is used to invoke the method, then the version in the parent class will be executed.
- if an object of the subclass is used to invoke the method, then the version in the child class will be executed.

Example

Example1.py

```
1  class A:
2      def display(self):
3          print("Inside class A")
4
5  class B(A):
6    # Method override by Sublcass
7      def display(self):
8          print("Inside class B")
9
10
11 object1 = B()
12 object1.display()
```

OUTPUT

```
Inside class B
```

Example1.py

```
1  class A:
2      def display(self):
3          print("Inside class A")
4
5  class B(A):
6      # Method override by Sublcass
7      def display(self):
8          print("Inside class B")
9
10
11 object1 = A()
12 object1.display()
13 object2 = B()
14 object2.display()
```

OUTPUT

```
Inside class A
Inside class B
```

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Calling the Parent's method

- Parent class methods can also be called within the overridden methods. This can generally be achieved by two ways.
- **Using Classname**
  - Parent's class methods can be called by using the Parent classname.method inside the overridden method.

Example1.py

```
1  class A:
2      def display(self):
3          print("Inside class A")
4
5  class B(A):
6      # Method override by Sublcass
7      def display(self):
8          #Calling Super Class Method
9          A.display(self)
10         print("Inside class B")
11
12 object1 = B()
13 object1.display()
```

OUTPUT

```
Inside class A
Inside class B
```

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Calling the Parent's method

Using Super()

- Python super() function provides us the facility to refer to the parent class explicitly. It is basically useful where we have to call superclass functions.

Example1.py

```
1  class A:
2      def display(self):
3          print("Inside class A")
4
5  class B(A):
6      # Method override by Sublcass
7      def display(self):
8          #Calling Super Class Method
9          super().display()
10         print("Inside class B")
11
12
13 object1 = B()
14 object1.display()
```

OUTPUT

```
Inside class A
Inside class B
```

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Abstract class

- python supports all the features of object-oriented programming including abstraction and abstract classes.
- We cannot create an abstract class in Python directly. However, Python does provide a module that allows us to define abstract classes.
- The module we can use to create an abstract class in Python is abc(abstract base class) module.
- Abstract methods force the child classes to give the implementation of these methods in them and thus help us achieve abstraction as each subclass can give its own implementation.
- A class containing one or more than one abstract method is called an abstract class.

Syntax

```
from abc import ABC
class <Abstract_Class_Name>(ABC):
        # body of the class
```

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Abstract class

- we cannot create an instance or object of an abstract class in Python.
- abstract classes are used to create a blueprint of our classes as they don't contain the method implementation.
- This is a very useful capability, especially in situations where child classes should provide their own separate implementation.

Abstract Method

- To define an abstract method we use the @abstractmethod decorator of the abc module.
- It tells Python that the declared method is abstract and should be overridden in the child classes.
- We just need to put this decorator over any function we want to make abstract, and the abc module takes care of the rest.

Syntax

```
from abc import ABC, abstractmethod
class <Abstract_Class_Name>(ABC):
        @abstractmethod
        def <abstract_method_name>(self,other_parameters):
                pass
```

Example.py

```
from abc import ABC, abstractmethod
class Demo(ABC):
        @abstractmethod
        def printName(self):
                pass
```

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Example

Example1.py

```
1  from abc import ABC,abstractmethod
2
3  class Shape(ABC):
4          @abstractmethod
5          def drawShape(self):
6                  pass
7
8  class Circle(Shape):
9          def drawShape(self):
10                 print("Drawing a Circle")
11
12 a = Circle()
13 a.drawShape()
14 B = Shape()
```

OUTPUT

```
Drawing a Circle

TypeError: Can't instantiate abstract class Shape with abstract
method drawShape
```