10.1_OOP(3)

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1 Introduction to Python for Open Source Geocomputation

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Content:

- Class: parent and child classes
- Inheritance
- Review of OOP

2 Overview of Class

```
class Point:
    def __init__(self, x=3, y=4):
        self.x = x
        self.y = y

    def translate(self, dx, dy):
        '''
        Translate the point dx units to the right and dy units up
        '''
        self.x = self.x + dx
        self.y = self.y + dy

    def distance(self):
        return (self.x**2 + self.y**2)**0.5
    def __str__(self):
        return "<"+str(self.x)+","+str(self.y)+">"

    def __add__(self, other):
        return Point(self.x+other.x, self.y+other.y)

p1 = Point(1,2)
p2 = Point()
p1.translate(1,2)
distance_p2 = p2.distance()
print(p1)
p3 = p1 + p2
print(p3)
```

Class activity: discuss with your group members about the python program above for 5 minutes. * What does the program do? * What are the main compoents? * What are the attributes? * What are the methods? * What are the outputs?

[1]:
```
class Point:
    def __init__(self, x=3, y=4):
        self.x = x
        self.y = y

    def translate(self, dx, dy):
        '''
        Translate the point dx units to the right and dy units up
        '''
        self.x = self.x + dx
        self.y = self.y + dy

    def distance(self):
        return (self.x**2 + self.y**2)**0.5

    def __str__(self):
        return "<"+str(self.x)+","+str(self.y)+">"

    def __add__(self, other):
        return Point(self.x+other.x, self.y+other.y)

p1 = Point(1,2)
p2 = Point()
p1.translate(1,2)
distance_p2 = p2.distance()
print(distance_p2)
print(p1)
p3 = p1 + p2
print(p3)
```

```
5.0
<2,4>
<5,8>
```

[2]:

```python
print(p1)
```

```
<2,4>
```

[3]:

```python
vary = p1.translate(1,2)
```

[4]:

```python
print(p1)
```

```
<3,6>
```

2.1 Class and Inheritance in OOP

- Inheritance: How attributes and methods of a **parent class** are passed down to **offspring classes**
- Derivation: The creation of subclasses, which are new classes which retain the data and functionality of the existing class, but permit additional modificatin and customization
- Hierarchy: Multiple generations of derivation.

2.2 Hierarchies

- parent class (superclass)
- child class (subclass)
  - inherits all attributes and methods of parent class
  - add more info (attributes)
  - add more behavior (methods)
  - override behavior

2.2.1 Inheritance: parent class

```python
class Animal:
    def __init__(self, age):
        self.age = age
        self.name = None
    def __str__(self):
        return "animal:" + str(self.name)+":"+str(self.age)
```

- defining a class `Animal`
- two attributes: `age`, `name`
  - The `None` keyword is used to define a null value, or no value at all. `None` is not the same as 0, False, or an empty string. `None` is a data type of its own (NoneType) and only `None` can be None.
- customize `print()` function with the definition of `__str__`

[5]:

```python
class Animal:
    def __init__(self, age):
        self.age = age
        self.name = None
    def __str__(self):
        return "animal:" + str(self.name)+":"+str(self.age)
```

[6]:
```
a1 = Animal(2)
```

[7]:
```
print(a1)
```

```
animal:None:2
```

2.2.2 Inheritance: subclass `Cat`

```
class Cat(Animal):
    def speak(self):
        print("meow")
    def __str__(self):
        return "cat:" + str(self.name)+":"+str(self.age)
```

- defining a class `Cat` which inherits everything from the parent class `Animal`
- `__init__` is not missing, uses the `Animal` version
  - two attributes: `age`, `name`
- add new functionality with `speak()`
- override `__str__` to customize `print()` function to better work with `Cat`

[8]:
```
class Cat(Animal):
    def speak(self):
        print("meow")
    def __str__(self):
        return "cat:" + str(self.name)+":"+str(self.age)
```

[9]:
```
help(Cat)
```

```
Help on class Cat in module __main__:

class Cat(Animal)
 |  Cat(age)
 |
 |  Method resolution order:
 |      Cat
 |      Animal
 |      builtins.object
 |
 |  Methods defined here:
 |
 |  __str__(self)
 |      Return str(self).
 |
 |  speak(self)
 |
 |  ----------------------------------------------------------------------
 |  Methods inherited from Animal:
 |
 |  __init__(self, age)
 |      Initialize self.  See help(type(self)) for accurate signature.
 |
 |  ----------------------------------------------------------------------
 |  Data descriptors inherited from Animal:
 |
 |  __dict__
 |      dictionary for instance variables (if defined)
 |
 |  __weakref__
 |      list of weak references to the object (if defined)
```

[10]:
```
c1 = Cat(1.5)
```

[11]:
```
print(c1)
```

```
cat:None:1.5
```

[12]:
```
c1.speak()
```

```
meow
```

[13]:
```
a1.speak()
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[13], line 1
----> 1 a1.speak()

AttributeError: 'Animal' object has no attribute 'speak'
```

2.2.3 Which method to use?

- subclasses can have methods with same name as their superclass
- for an instance of a class, look for a method name in **current** class definition
  - if not found, look for method name up the hierarchy (in parent, then grandparent, and so on)
  - use first method up the hierarchy that you found with that method name

2.2.4 Inheritance: subclass `Person`

```
class Person(Animal):
    def __init__(self, name, age, friends):
        Animal.__init__(self, age)
        self.name = name
        self.friends = friends

    def speak(self):
        print("Hello!")
    def __str__(self):
        return "person:" + str(self.name)+":"+str(self.age)
```

- defining a class `Person` which inherits everything from the parent class `Animal`
- `__init__` is overridden
  - three attributes
  - call `Animal`'s `__init__` method
- add new functionality with `speak()`
- override `__str__` to customize `print()` function to better work with `Person`

[14]:
```
class Person(Animal):
    def __init__(self, name, age, friends):
        Animal.__init__(self, age)
        self.name = name
        self.friends = friends

    def speak(self):
        print("Hello!")
    def __str__(self):
        return "person:" + str(self.name)+":"+str(self.age)+ ":"+str(self.
 ↪friends)
```

[15]:
```
p1 = Person("Peter",23, ["Hanna", "Wendy"] )
```

[16]:
```
print(p1)
```

```
person:Peter:23:['Hanna', 'Wendy']
```

[17]:
```
p1.speak()
```

```
Hello!
```

Exercise:

```
class Person(Animal):
    def __init__(self, name, age, friends):
        Animal.__init__(self, age)
        self.name = name
        self.friends = friends
    def speak(self):
        print("Hello!")
    def __str__(self):
        return "person:" + str(self.name)+":"+str(self.age)+ ":"+str(self.friends)
```

Define class Student which is a subclass of Person above. * Add another attribute major and instantiate its value in __init__. * Override speak method by printing out I have homework * Override print function so that it will print student instead of person

Raise your hand when you are done

[18]:
```
class Student(Person):
    def __init__(self, name, age, friends, major_student):
        Person.__init__(self, name, age, friends)
        self.major = major_student
    def speak(self):
        print("I have homework")
    def talk(self):
        self.speak()
    def __str__(self):
        return "student:" + str(self.name)+":"+str(self.age)+ ":"+str(self.
 ↪friends) +":" + str(self.major)
```

[19]:
```
s1 = Student("Jane", 19, ["Hanna", "Wendy"], "Geography")
```

[20]:
```
s1.speak()
```

```
I have homework
```

[21]:
```
s1.talk()
```

```
I have homework
```

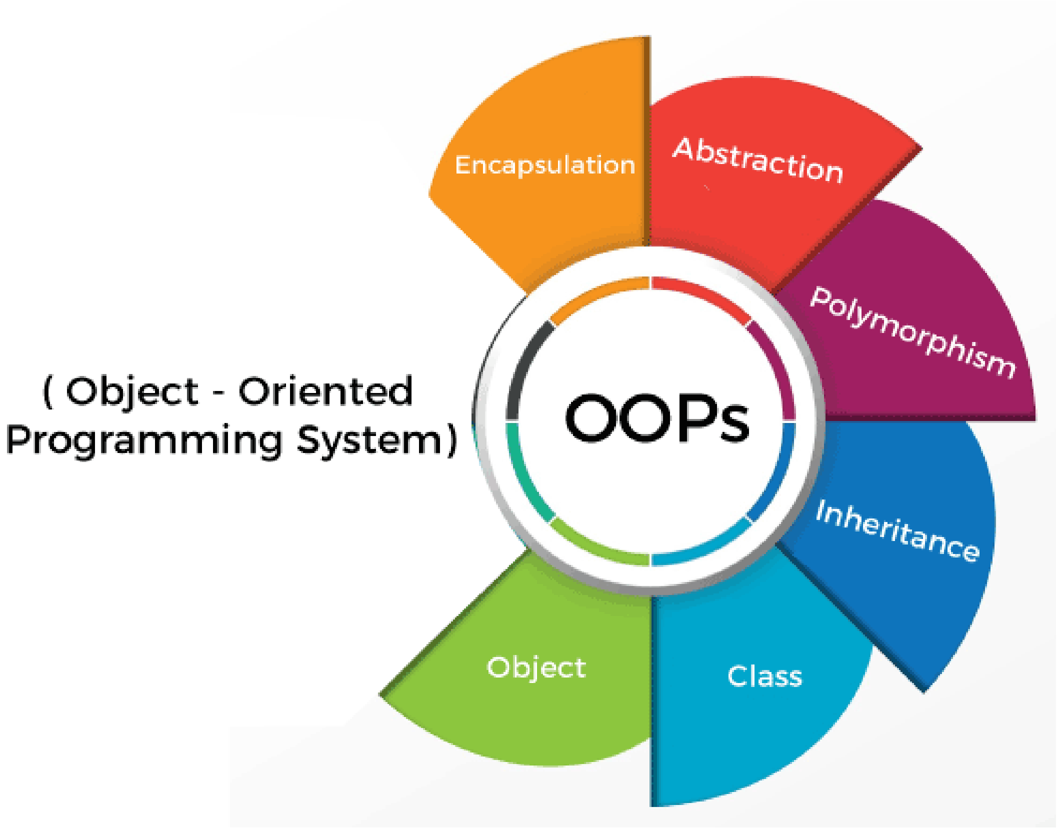
[22]:
```
print(s1)
```

```
student:Jane:19:['Hanna', 'Wendy']:Geography
```

2.3 OOP

- create your own collections of data
- organize information
- division of work
- access information in a consistent manner
- add layers of complexity
- like functions, classes are a mechanism for decomposition and abstraction in programming

2.3.1 Characteristics of OOP


Encapsulation
Abstraction
Polymorphism
(Object - Oriented Programming System)
OOPs
Inheritance
Object
Class