OOP

OOP in Python

Everything is an object.

- The int object 10 is instantiated.
- The variable i is referencing the object.

```python
i = 10 # Python
```

__init__ as a Constructor

- Python does not have a constructor; instead, it has **init**(self).

```
class ...:
  def __init__(self):
    self.speed = 0
    self.altitude = 0
    self.rollAngle = 0
    self.pitchAngle = 0
    self.yawAngle = 0
```

- We can use parameters and default values.

```python
# when no argument is given,
# default values are assigned
def __init__(self, speed = 0,
             altitude = 0,
             rollAngle = 0):
  self.speed = speed
  self.altitude = altitude
  self.rollAngle = rollAngle
```

Instantiation

- No `new` needed; everything in Python is an object.
- Objects are created, and references point to them.

```
# Airplane.__init__(self) is invoked.
a = Airplane()
```

Overriding Python class methods

- Python’s print shows an object’s reference by default.
- Override `__str__` to print a custom string instead.

```python
a = Airplane(speed = 100)
 # <__main__.Airplane object at 0x106f13220>
print(a)

class Airplane(object):
  ...
  def __str__(self):
    return f"Speed: {self.speed} ..."

b = Airplane(speed = 100)
print(a) # Speed: 100 ...
```

Overriding __eq__

- When we override the __eq__() method, we can change how the `==` operator works.

```python
a = Airplane(speed = 100)
b = Airplane(speed = 100)
# False, as they are different object
print(a == b)
```

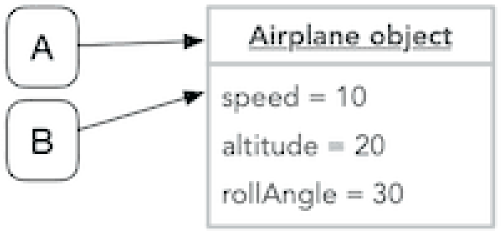
```python
class Airplane(object):
 ...
 def __eq__(self, other):
  return self.speed == other.speed

a = Airplane(speed = 100)
b = Airplane(speed = 100)

# True because the speeds are the same
print(a == b)
```

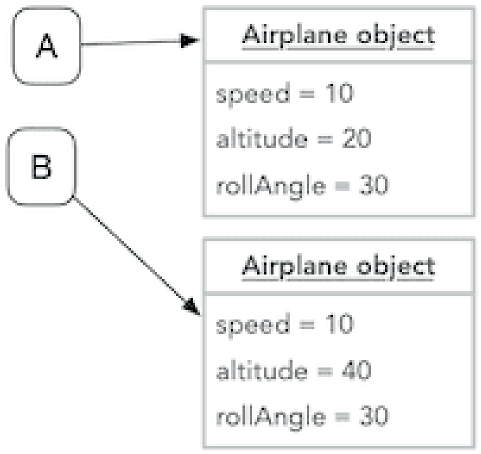
Shallow and Deep Copy

- In OOP, the = (assignment) operator copies the reference.



```python
a = Airplane(speed = 100)
b = a
print(a == b) # True as same reference
b.speed = 500
print(a.speed) # 500
```

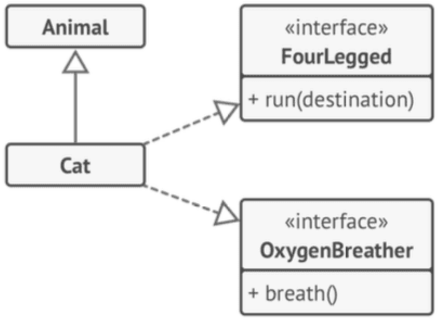
- To make a new object, we should use the copy.deepcopy() function.

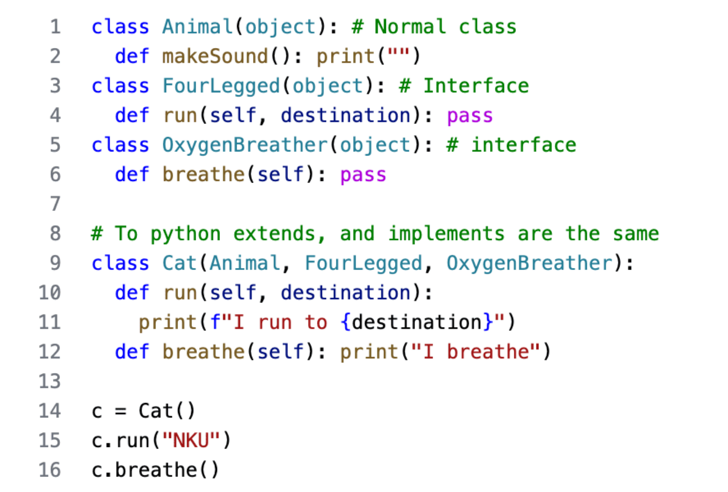


```python
from copy import deepcopy
...
a = Airplane(speed = 100)
b = deepcopy(Airplane(speed = 100))
print(a == b) # False
b.speed = 500
print(a.speed) # 100
```

Python and Interface

- Python does not have an interface, but we can mimic an interface with an empty method.





```python
class Animal(object): # Normal class
  def makeSound(): print("")
class FourLegged(object): # Interface
  def run(self, destination): pass
class OxygenBreather(object): # interface
  def breathe(self): pass

# To python extends, and implements are the same
class Cat(Animal, FourLegged, OxygenBreather):
  def run(self, destination):
    print(f"I run to {destination}")
  def breathe(self): print("I breathe")

c = Cat()
c.run("NKU")
c.breathe()
```

Python Duck Typing

- Duck typing means Python cares about an object's behavior, not its type.
- If an object has the required methods/attributes, it can be used regardless of its class.
- "If it walks like a duck and quacks like a duck, it’s a duck."

- Both have the `__len__` method, so the `len` function invokes the method without knowing anything about the object.

```python
# len is used for both data structures.
a = []; len(a) # a.__len__()
b = (); len(b) # b.__len__()
```

- We have the Duck and Tiger class that has the quack() method.
- The method is invoked in the same way.

```
class Duck(): def quack(self): print("Quack")
class Tiger(): def quack(self): print("Wow")
def quack_checker(q): q.quack()

quack_checker(Duck())
quack_checker(Tiger())
```

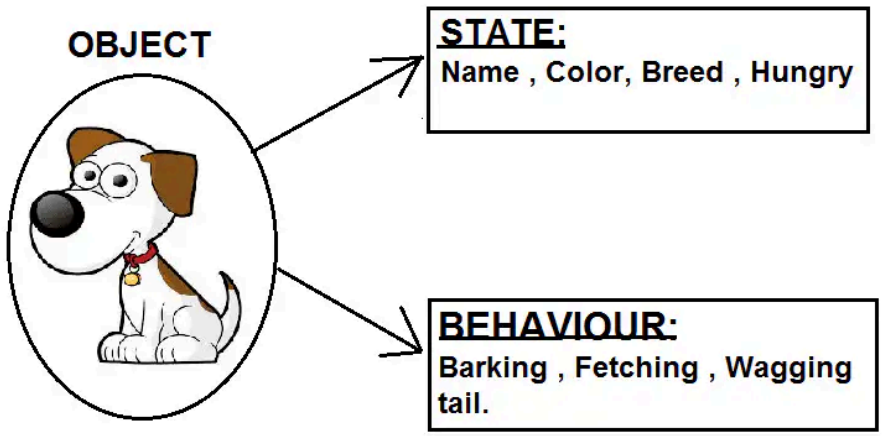
Python: Modeling with OOP

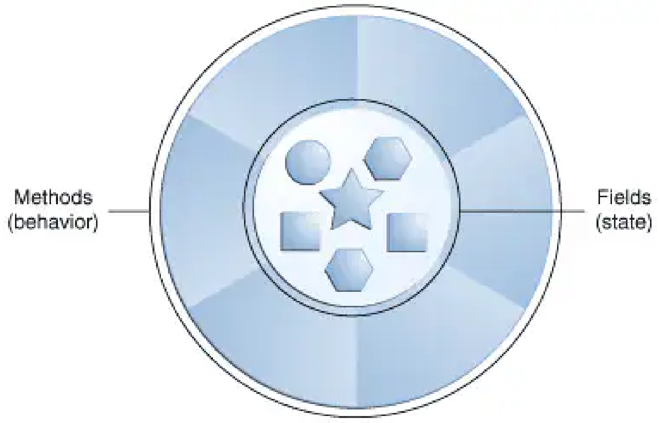
Python is an OOP language that can model the world effectively.

- Abstraction
- Polymorphism
- Interface
- Encapsulation

Abstraction

- Software modeling represents the real world.
- This is called abstraction.
- Abstraction captures an object's states (nouns) and behaviors (verbs).

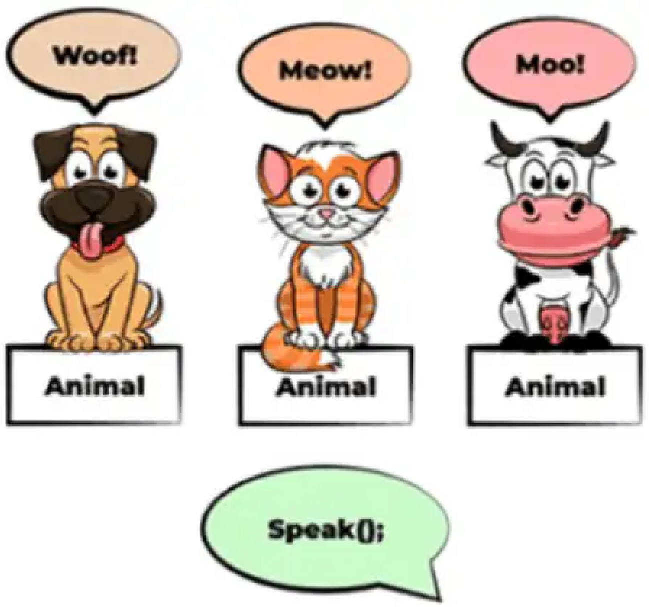

OBJECT
STATE:
Name , Color, Breed , Hungry
BEHAVIOUR:
Barking , Fetching , Wagging tail.



- A Dog object has states and behaviors.
- The states/behaviors are called states/methods.

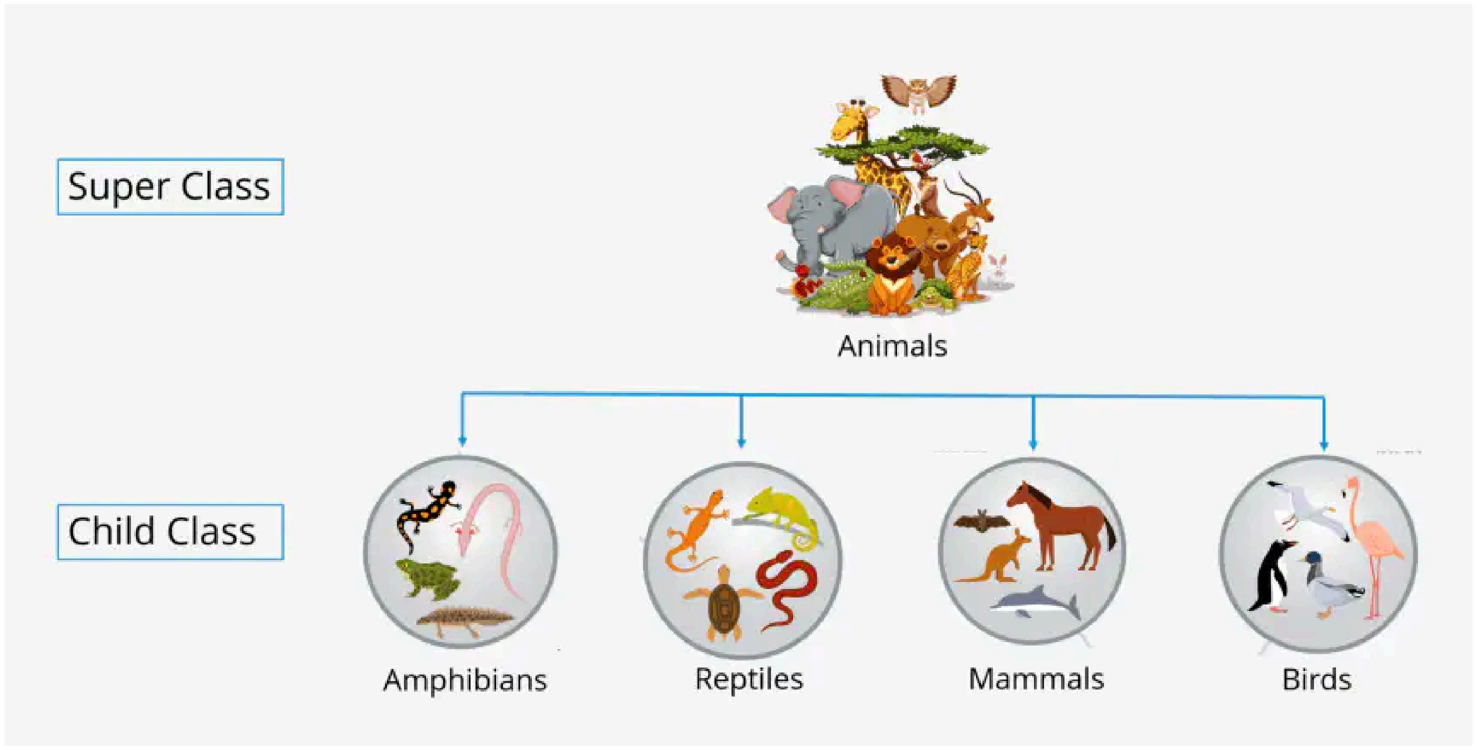
Polymorphism

- One message, different actions – this is polymorphism.



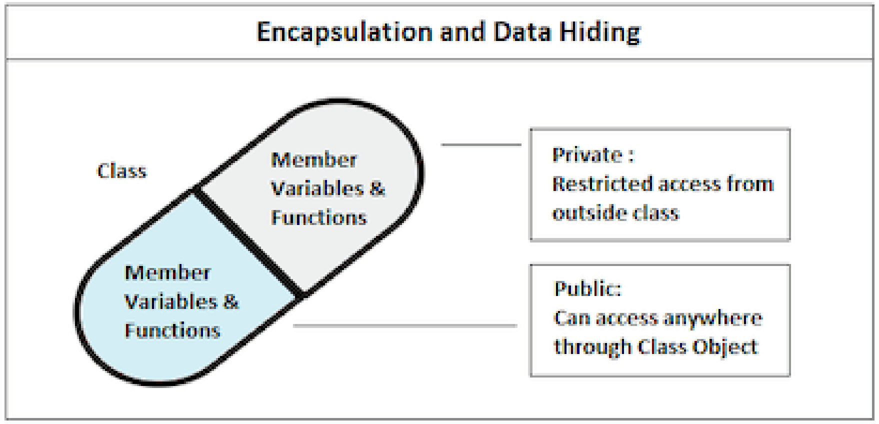
Inheritance

- We can model the real world with hierarchical general and specific concepts.
- This is called inheritance: superclasses are general, subclasses are specific, and creating one is called subclassing.


Super Class
Animals
Child Class
Amphibians
Reptiles
Mammals
Birds

Encapsulation

- In OOP, encapsulation means keeping fields (state) private and using public methods to access them.


Encapsulation and Data Hiding
Class
Member Variables & Functions
Member Variables & Functions
Private : Restricted access from outside class
Public: Can access anywhere through Class Object