LISBON
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Object Oriented Programming

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Traditional Perspective

- The traditional perspective in software development had adopted is algorithm perspective.
- In this view, the main software building block are procedures or functions

Object oriented Approach

The main structural components of all systems are:

- Objects
- Class Objects

Main Concepts

- Classes,
- Objects, and
- Instances

Object

- Objects represent an entity and the basic building block.
- Object is something that takes up space in the real or conceptual world with which sombody may do things (Booch et al . 1999)
- The objects have :
  - Name (or ID)
  - state
  - Operations (or behavior)

Object

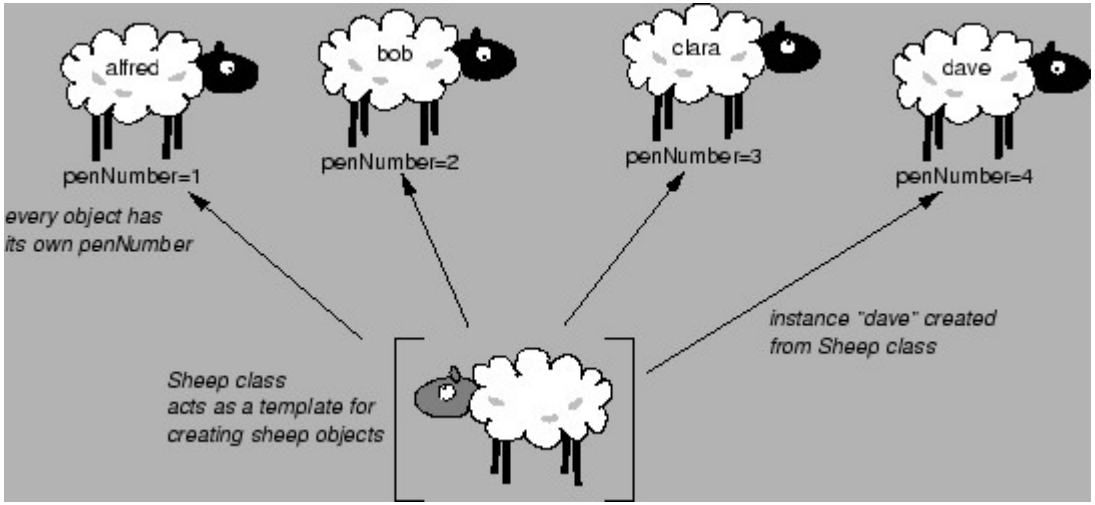
- Name (ID) - The entire object must have a name that will differentiate from other objects in a context (eg my calculator)
- State - An object has state, which involves the object's properties together with the values of these properties (eg connected calculator)
- Operations (behavior) - can do something with the object or the object can do something with another object (eg calculator does sums)

Class

- A class is the description of a set of objects that share the same attributes, operations, relationships and semantics. (Eg calculators).
- Class is the blue print of an object.

Instance

- An object is an instance of a class.
- It is a concrete manifestation of an abstraction . (Eg " my calculator" is an instance of the class "calculating machines ") .

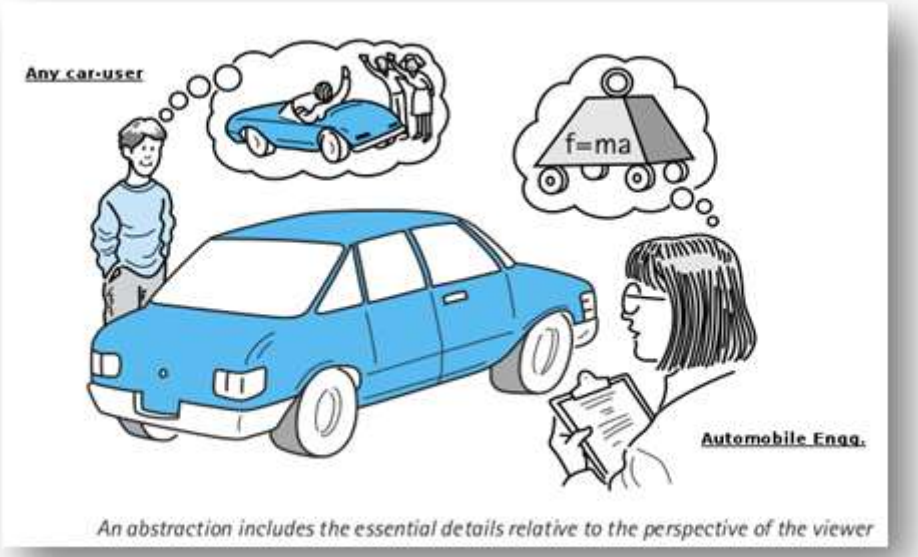


Main caracteristics of the approach

- The object oriented approach has as main characteristics:
  - encapsulation
  - abstraction
  - inheritance
  - polymorphism

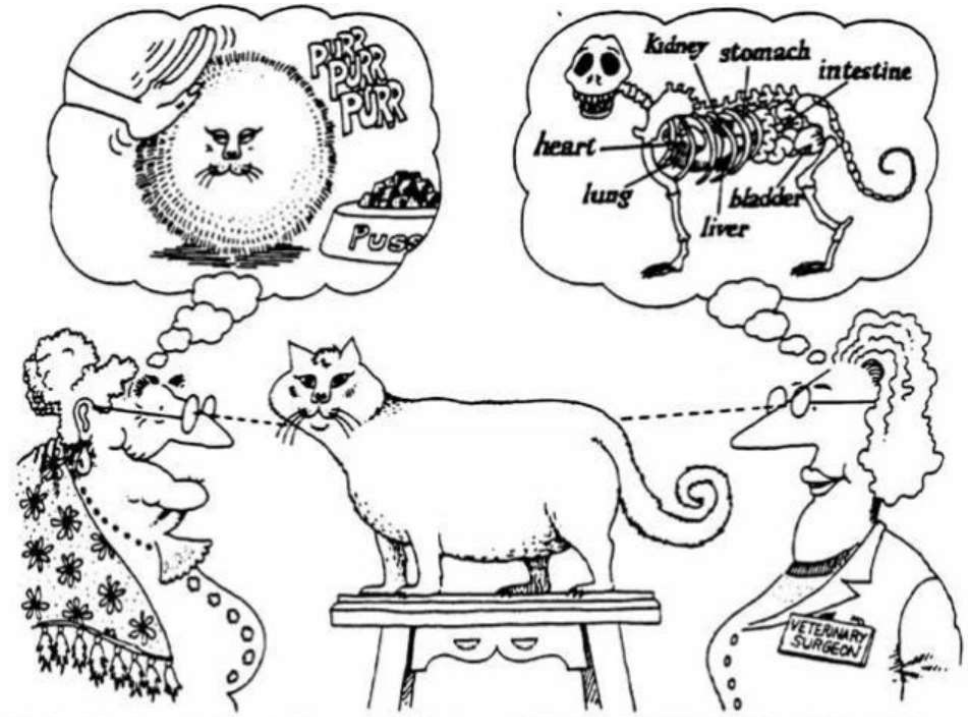
Abstraction

- Abstraction is a principle which consists of ignoring the aspects of a subject that is not relevant for the present purpose, in order to concentrate on in those aspects that are really relevant .



Abstraction

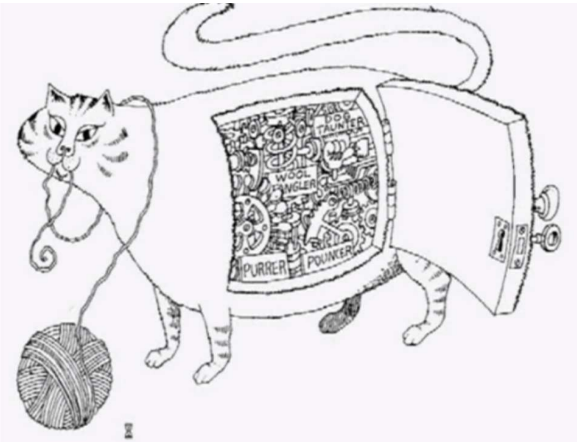
- Abstraction is the concise representation of a more complex object, focusing on the essential characteristics of the object .
- Good abstraction:
  - Appropriate (If there is a real need can be satisfied)
  - appropriate level



Abstraction focuses upon the essential characteristics of some object, relative to the perspective of the viewer.

Encapsulation

- Encapsulation is the mechanism of hiding the implementation of the object, so that other system components do not have access to what is happening inside the object.



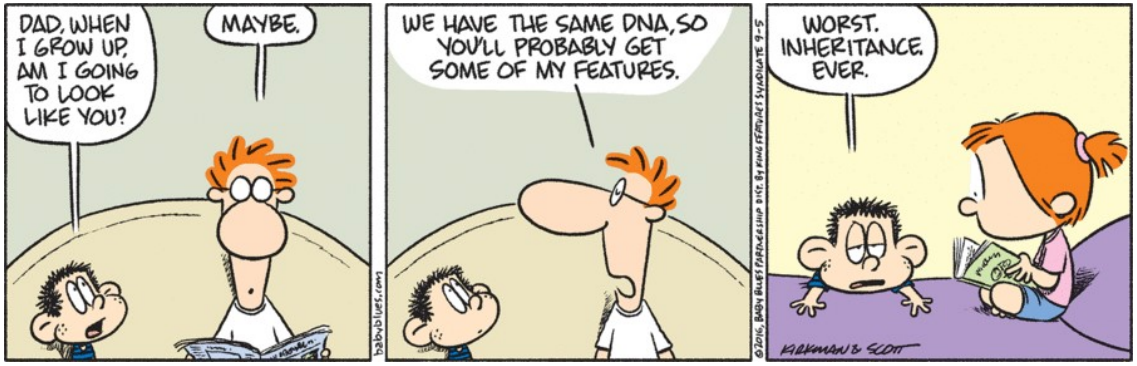
Encapsulation hides the details of the implementation of an object.

Encapsulation

- This concept is associated with modularity , consisting in decomposing a system in a cohesive set of connected modules.
- Encapsulation is the mechanism of binding the data together and hiding them from outside world.
- Objects interact by message.

Inheritance

- Inheritance is a mechanism that allows an object to incorporate all or part of the definitions of another object as part of itself (eg " doctor " and " optometrist ").
- Inheritance is the mechanism of making new classes from existing one.



Polymorphism

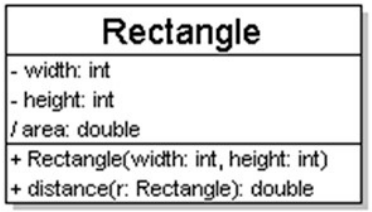
- The word polymorphism means having many forms. In programming, polymorphism means same function name (but different signatures) being uses for different types.

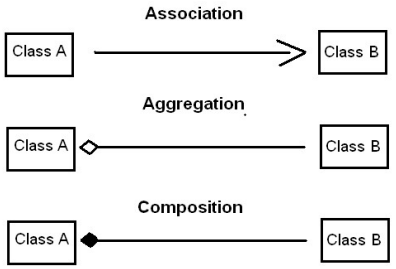
Class Diagrams

- Diagrams that allow analysist
  - to specify the static structure of a system
  - according to the object-oriented approach .
- Used to describe the class model

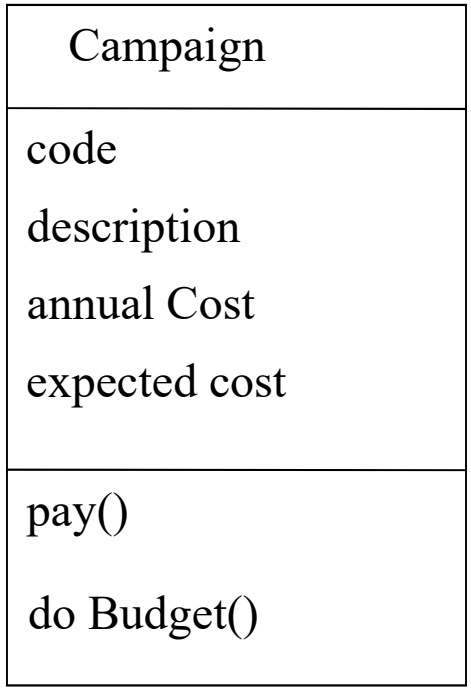
Class Diagrams

- Elements of a class diagram :
  - Classes
  - Relations between classes
    - Associations
    - Compositions
    - Aggregations
    - Generalizations





Classe



ID Class (Class Name)

- Refers to specific objects, but the must abstract
- Nouns associated with the textual description of a problem
- Choose carefully the names
- using singular

Attributes

- Values that characterize the objects of a class
- Types : Real, Integer , Text, Boolean , Enumerated , ...

Operations

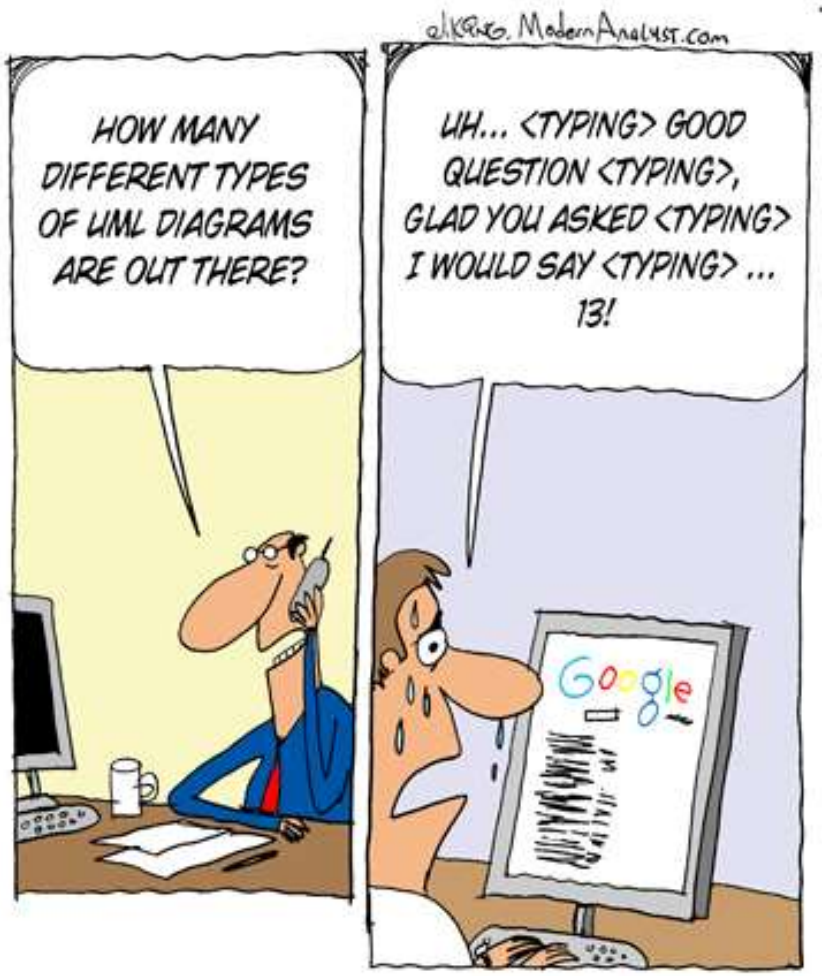
- Behaviors of the class (service, method)

Relationship

- A relationship UML establishes the connection between elements
- A relationship is graphically represented by a given type of line.
- In object-oriented modeling the three most important types of relationships are:
  - Associations
  - Generalizations
  - Dependencies

Dependency

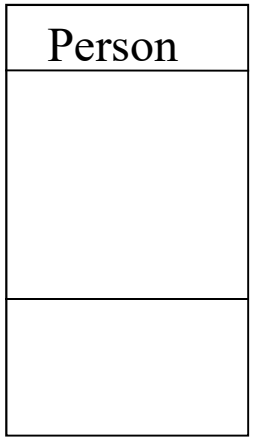
- A relationship of dependence, or simply dependence indicates that the change in the specification of an element can affect another element that uses it , but not necessarily the opposite.


HOW MANY DIFFERENT TYPES OF UML DIAGRAMS ARE OUT THERE?
UH... <TYPING> GOOD QUESTION <TYPING>, GLAD YOU ASKED <TYPING> I WOULD SAY <TYPING> ... 13!
Google

Now let’s go to Python…

Class

```
class Person:
    pass  # An empty block

p = Person()
print(p)
```



Result:

```
<__main__.Person object at 0x0000021D9EED60F0>
```

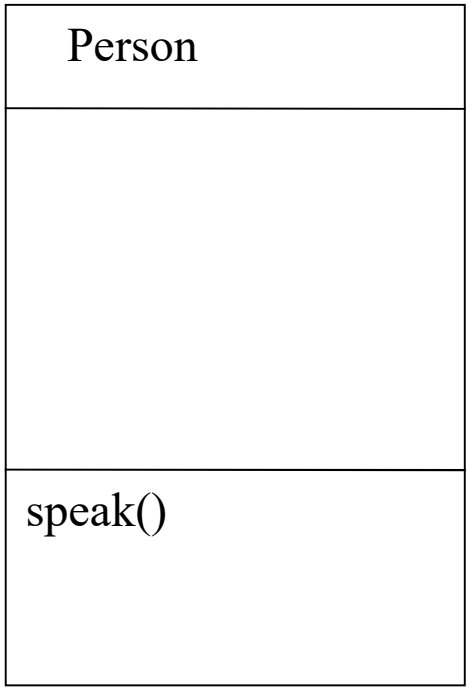
Method

- define class with method

```
# class Person:
    def speak(self):
        print('Hello, how are you?')
```

- create object and call method

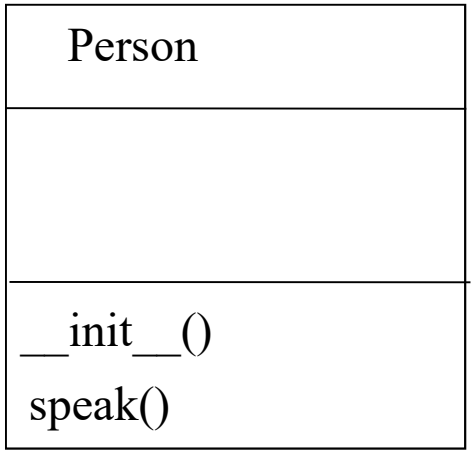
```
p = Person()
p.speak()
```



init method

- The first method **init**() is a special method,
- It is called class constructor or initialization
- Is a method that Python calls when you create a new instance of this class.

init method




```
class Person:
    def __init__(self, name):
        self.name = name
    def speak(self):
        print('Hello, my name is', self.name)
p = Person('Carlos')
p.speak()
```

self

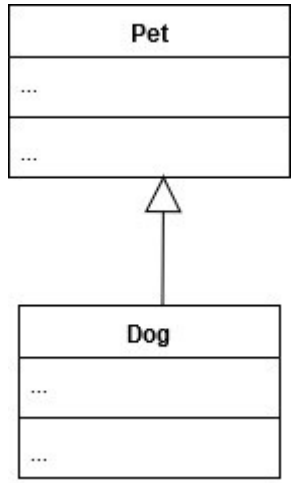
- The first argument of every class method, including init, is always a reference to the current instance of the class.
- By convention, this argument is always named self.
- In the init method, self refers to the newly created object;
- in other class methods, it refers to the instance whose method was called.

Class Pet

```
class Pet(object):
    def __init__(self, name, species):
        self.name = name
        self.species = species
    def getName(self):
        return self.name
    def getSpecies(self):
        return self.species
    def __str__(self):
        return "%s is a %s" % (self.name, self.species)
```

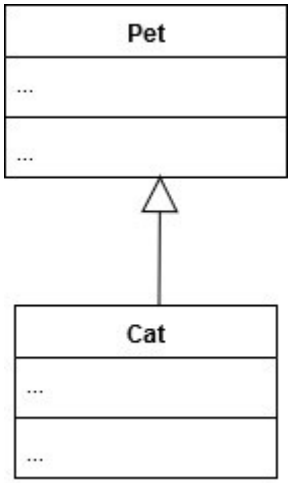
Inheritance

```
class Dog(Pet):

    def __init__(self, name, chases_cats):
        Pet.__init__(self, name, "Dog")
        self.chases_cats = chases_cats

    def chasesCats(self):
        return self.chases_cats
```



Inheritance

```
class Cat(Pet):
    def __init__(self, name, hates_dogs):
        Pet.__init__(self, name, "Cat")
        self.hates_dogs = hates_dogs

    def hatesDogs(self):
        return self.hates_dogs
```



```
myPet = Pet("Boby", "Dog")
myDog = Dog("Boby", True)
isinstance(myDog, Pet)
isinstance(myDog, Dog)
isinstance(myPet, Pet)
isinstance(myPet, Dog)
```

Access Modifiers

- Classical object-oriented languages, such as C++ and Java, control the access to class resources by public, private and protected keywords
- The access modifiers in Python are used to modify the default scope of variables.
- There are three types of access modifiers in Python: public, private, and protected.

Private

- Private members of a class are denied access from the environment outside the class.
- They can be handled only from within the class.

```
class Person:
    def __init__(self, name, age):
        self.__name=name
        self.__age=age


p=Person(“David",23)
p.__name
```

Public

- Public members (e.g. methods declared in a class) are accessible from outside the class.
- The object of the same class is required to invoke a public method.
- This arrangement of private instance variables and public methods ensures the principle of data encapsulation.

Public

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

p=Person(“David",23)
p.name
```

Protected

- Protected members of a class are accessible from within the class and are also available to its sub-classes.
- No other environment is permitted access to it.
- This enables specific resources of the parent class to be inherited by the child class.

Protected

```
class Person:
    def __init__(self, name, age):
        self._name=name
        self._age=age

p=Person(“David",23)
p.name
```

Bibliography

- **Bennet, S. McRobb, S & Farmer, R., *Object Oriented Systems Analysis and Design using UML,* MacGarw-Hill, 1999.**
- **Booch, G., Rumbaugh, J. & Jacobson, I, *The Unified Modeling Language User Guide*. Addison Wesley, 1999 (tradução portuguesa brasileira _____; *UML Guia do Usuário*; Campus, 2000).**
- **Costa, C. *Desenvolvimento para Web*, ITML Press, 2007**
- **Nunes, M & O´Neill, H. *Fundamental de UML*, FCA, 2001**
- **Silva, A & Videira, C., *UML, Metodologias e Ferramentas CASE*, Edições Centro Atlântico, 2001**
- **Terry, Q. *Visual Modeling With Rational Rose 2000 and UML*, Addison-Wesley. 2000.**
- ***Oxford Dictionary of Computing*, Oxford University Press.**