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Object Oriented Programming

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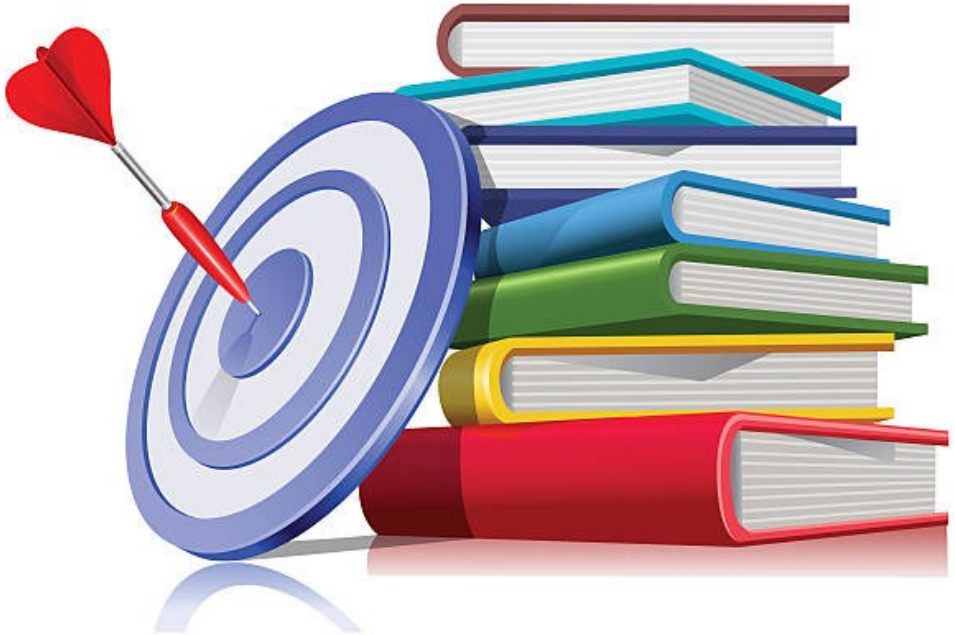
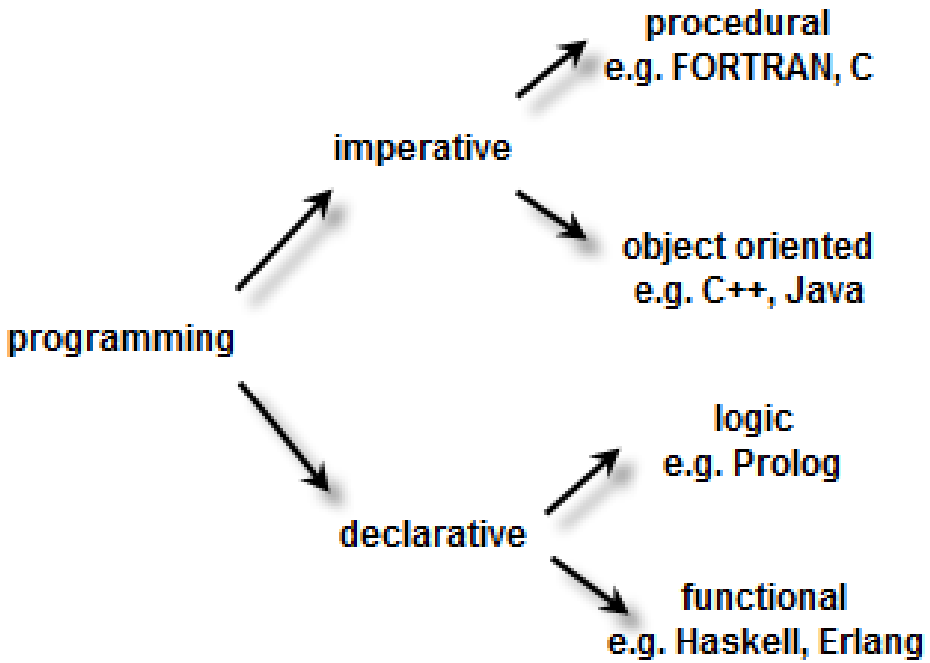
Learning Objectives

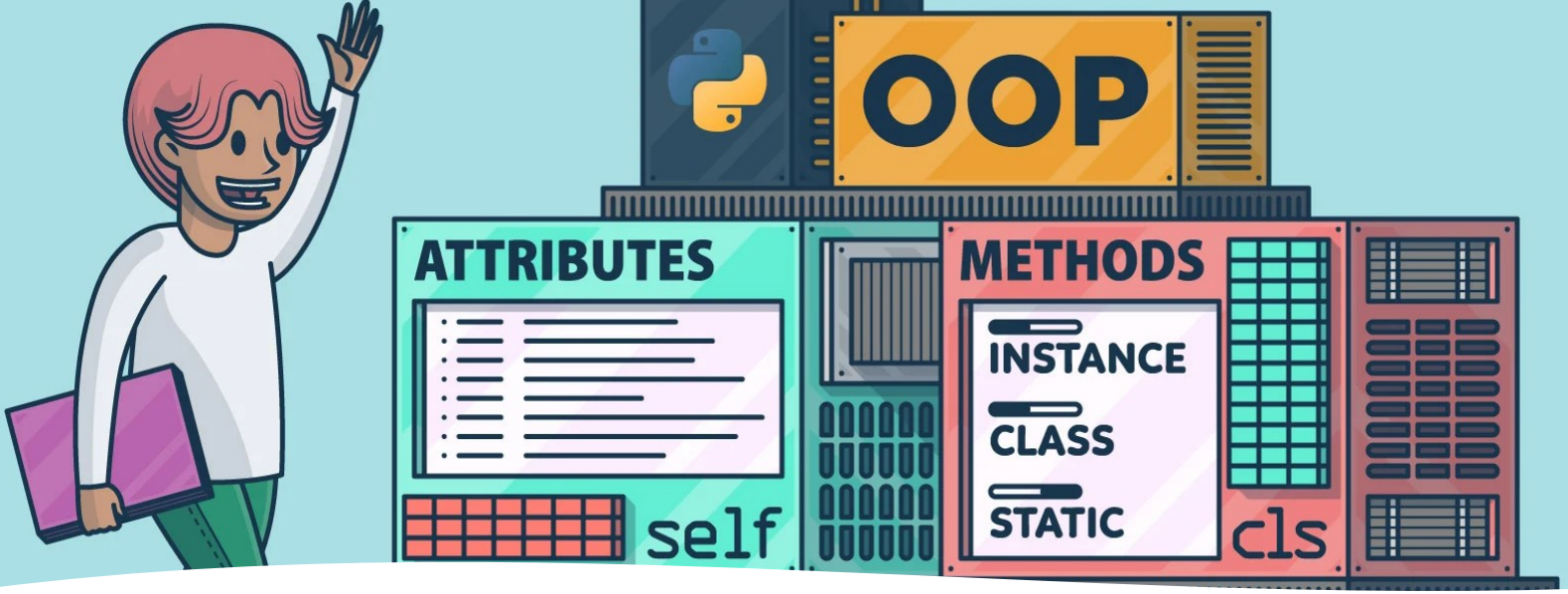
- Understand the main concepts related to the object-oriented approach
- Understand how object-oriented programming is implemented in Python
- Create a small application with object-oriented programming



Imperative Programming

- Procedural - instructions grouped into procedures
- Object-Oriented - instructions grouped together with the part of the state they operate on.

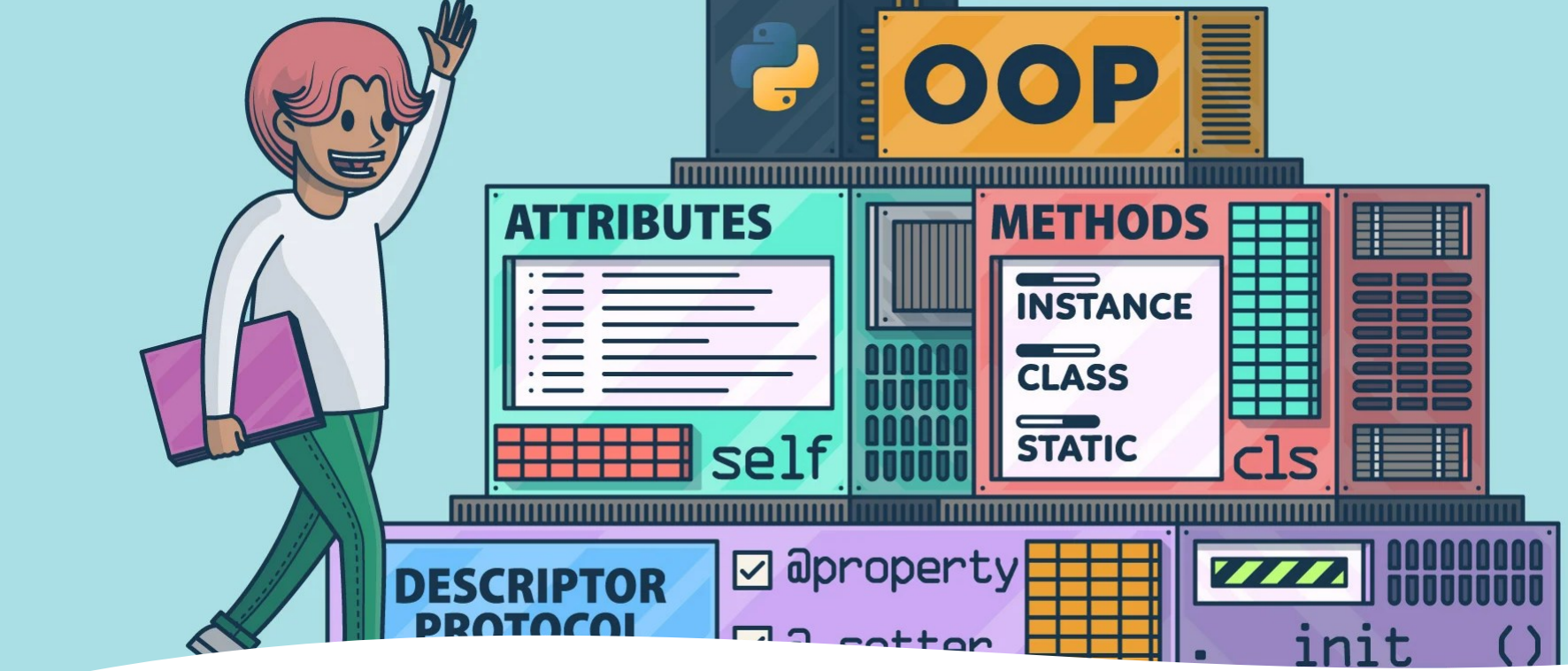




Object oriented Approach

The main structural components of all systems are:

- Objects
- Class Objects



Object

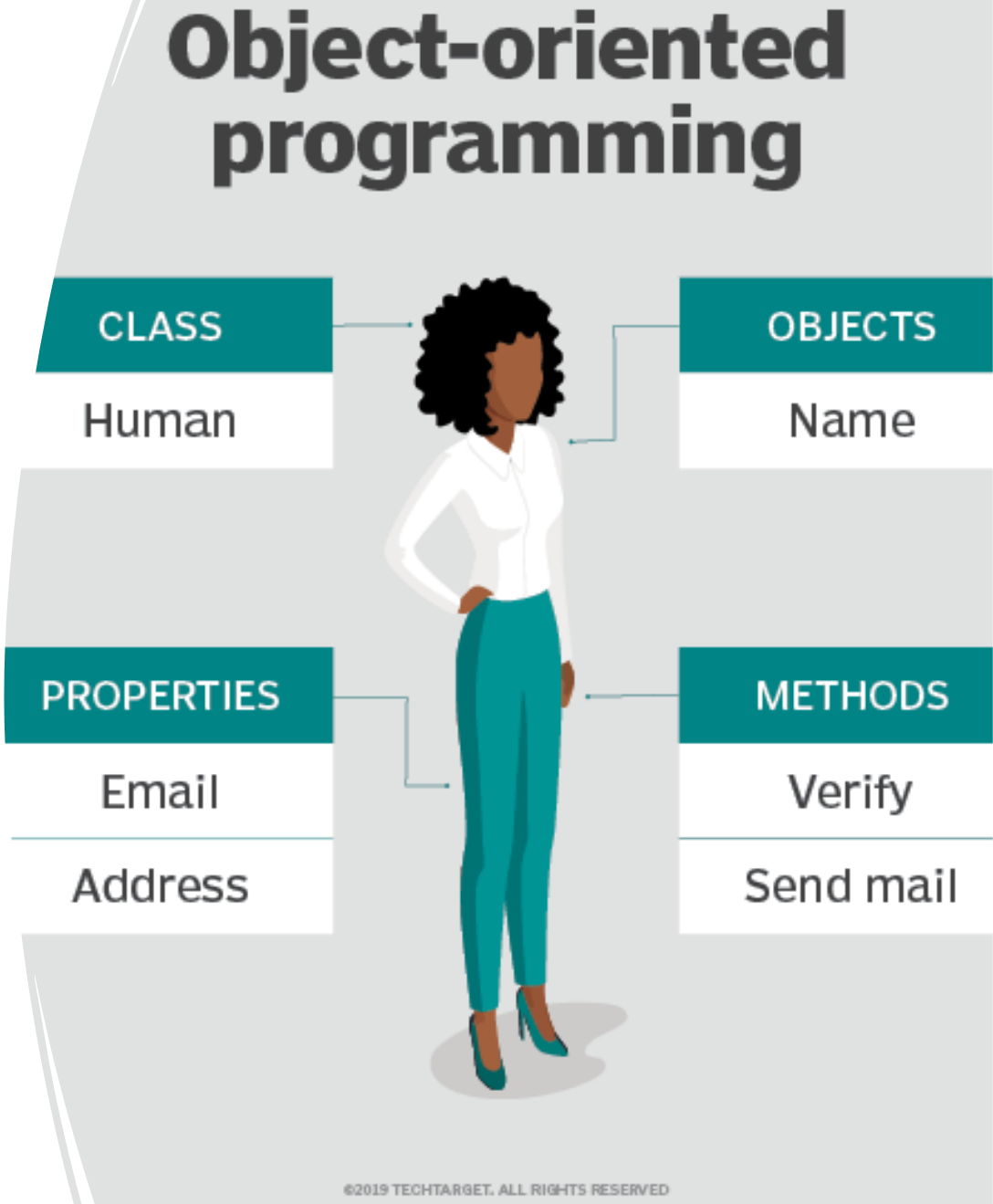
Object is something that takes up space in the real or conceptual world with which somebody may do things

(Booch et al . 1999)

Object

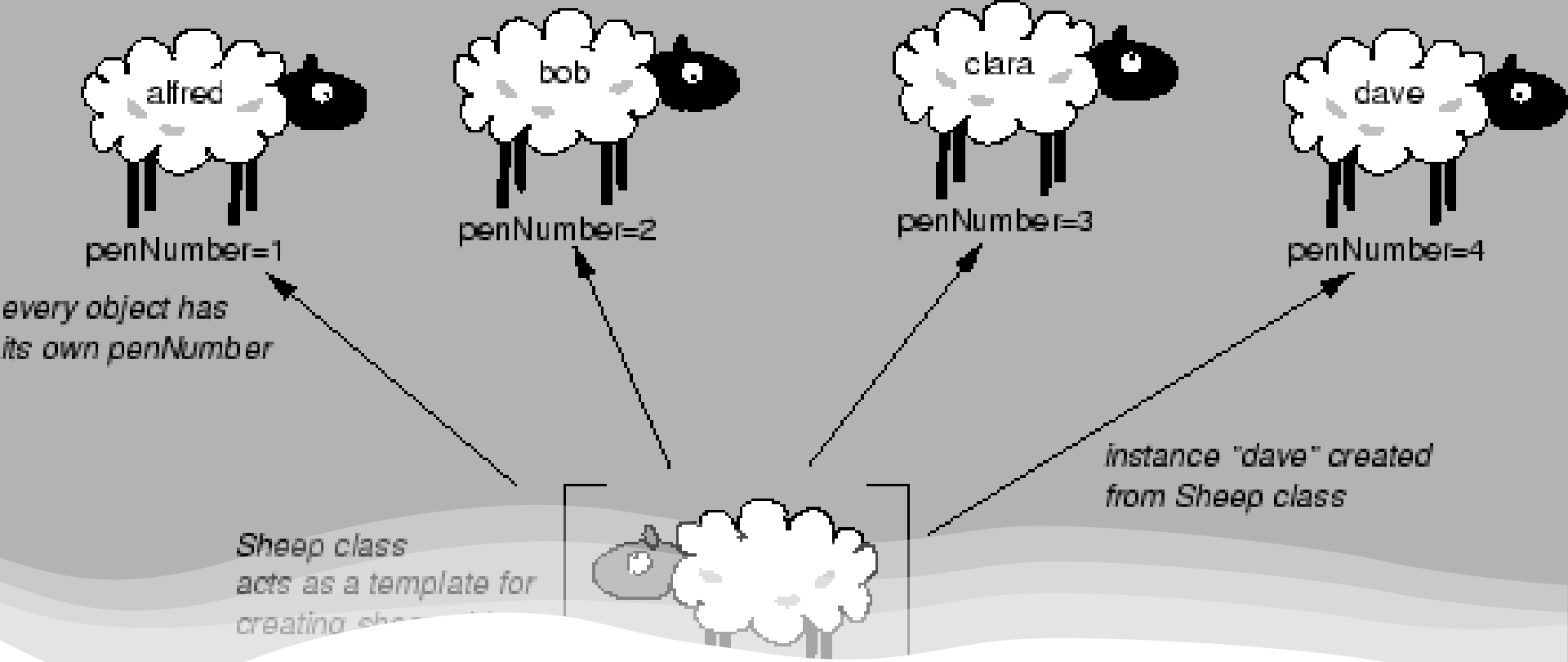
The objects have :

- Name (or ID)
- State
- Operations (or behavior)



Class

Class is the blueprint of an object.

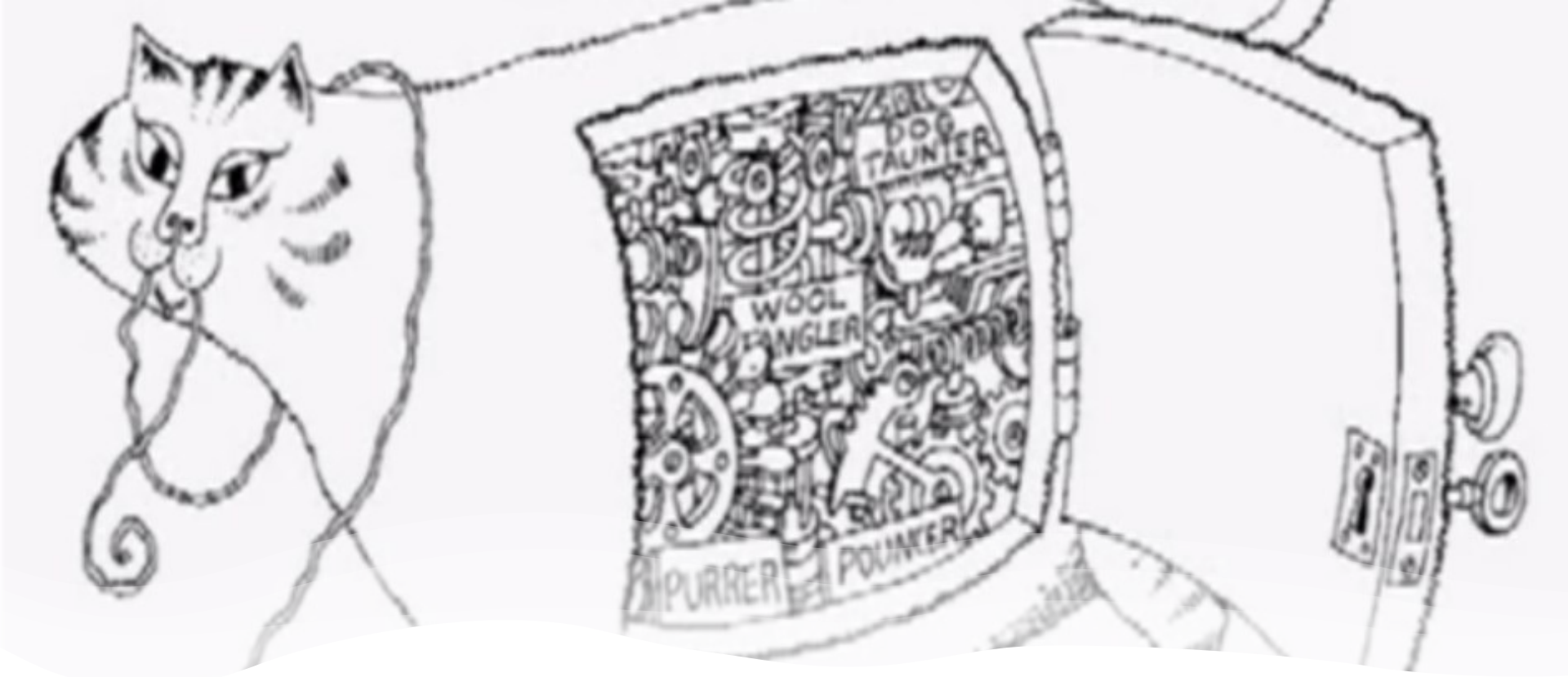


An object is an instance of a class.

Instance

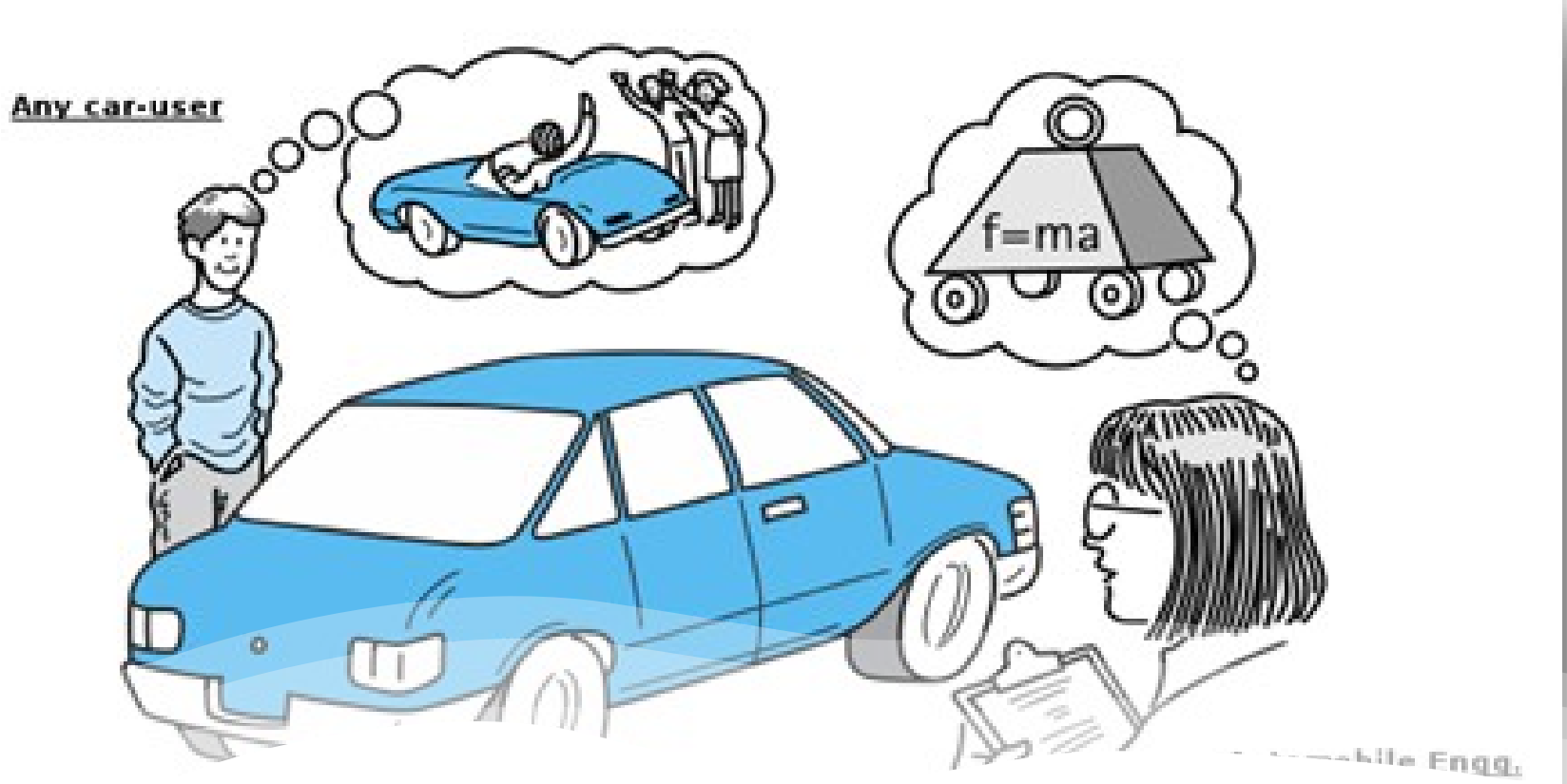
Main caracteristics of the approach

- encapsulation
- abstraction
- inheritance
- polymorphism



Encapsulation

- is the mechanism of hiding the implementation of the object

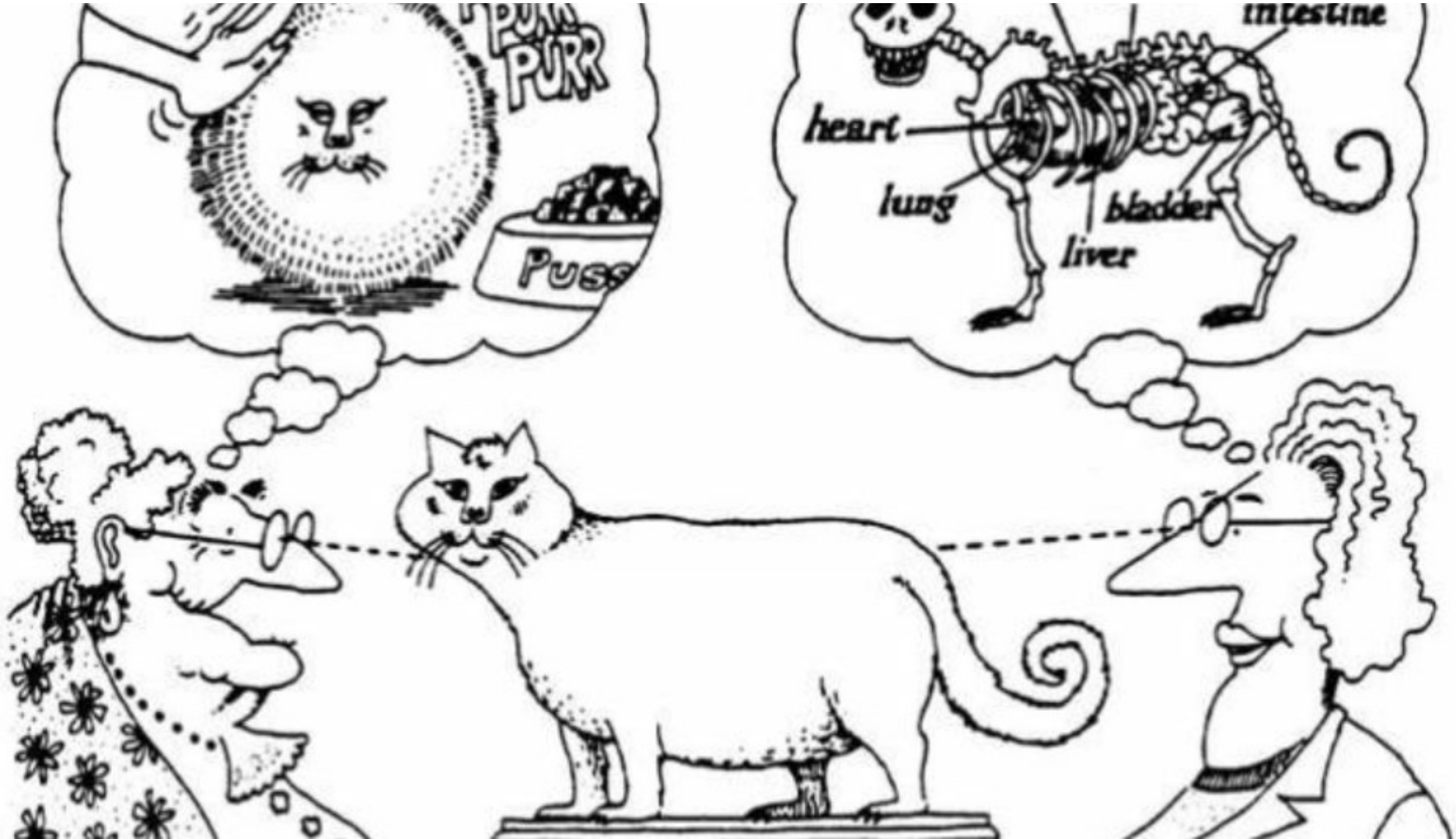


Abstraction

- is a principle which consists of ignoring the aspects of a subject that is not relevant for the present purpose

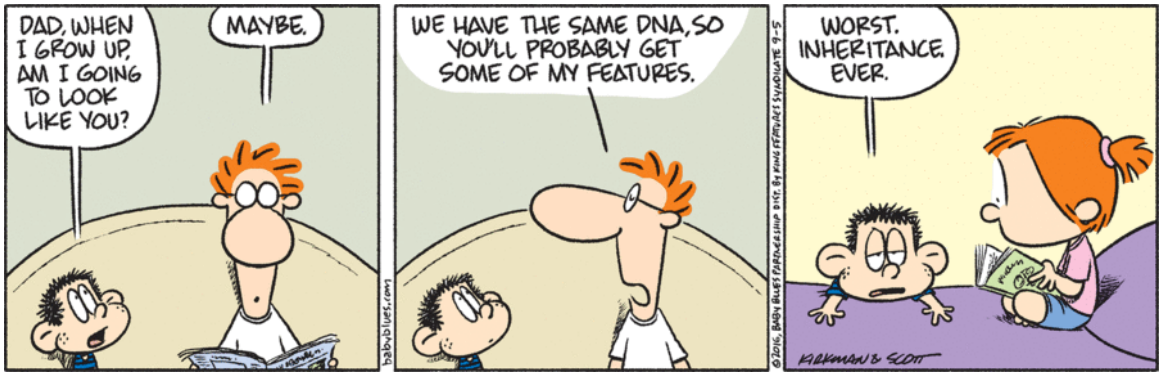
Abstraction

Abstraction is the concise representation of a more complex object



Inheritance

- Inheritance is the mechanism of making new classes from existing one.

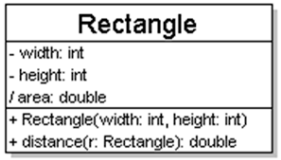


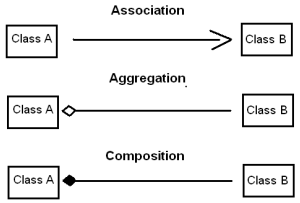
Polymorphism

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

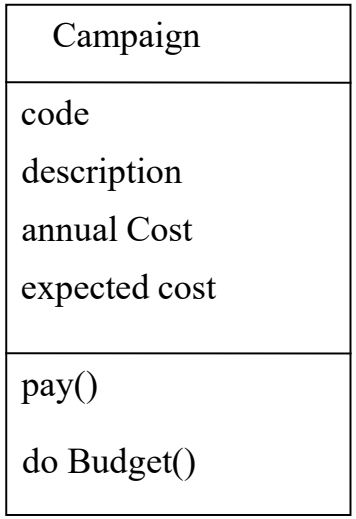
Class Diagrams

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





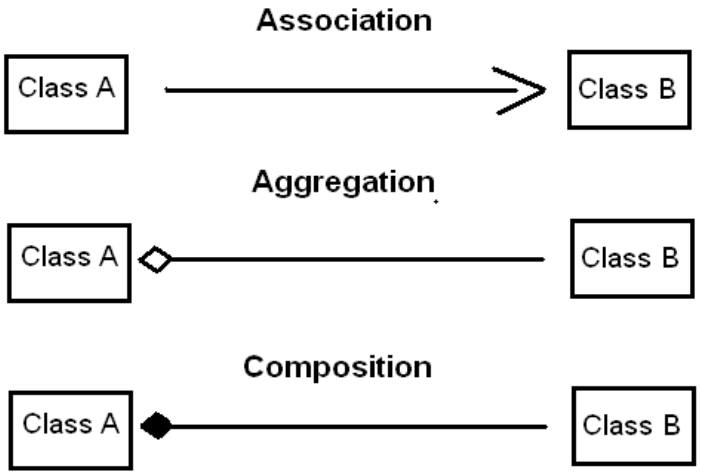
Classe



- ID Class (Class Name)
  - Refers to specific objects, but the must abstract
  - Nouns associated with the textual description of a problema
  - 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

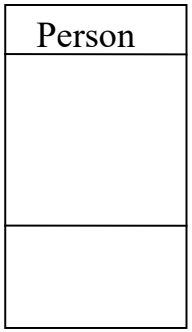
- A relationship UML establishes the connection between elements



- Now let’s go to

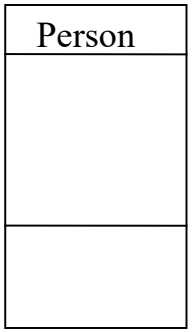
Class

```
class Person:
    pass  # An empty block
```



Class

```
class Person:
    pass  # An empty block

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



- Result:

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

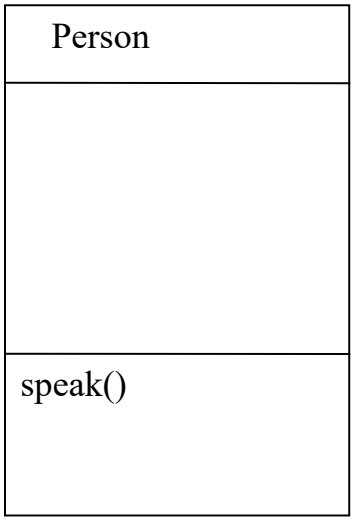
Method

- Define class with method

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

- Create object and call method

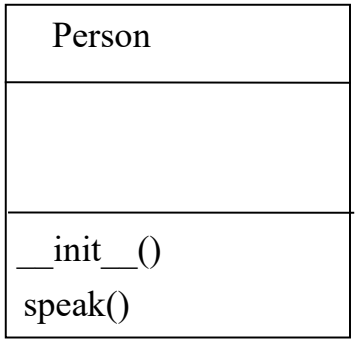
```
p = Person()
p.speak()
```



init method

- The method **init**() is a special method,
- 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

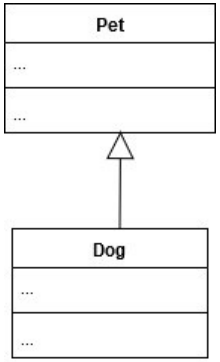
- The first argument of every class method, including init, is always a reference to the current instance of the class.
- By convention, this argument is always named self.

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)
```

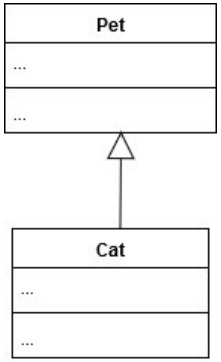
Inheritance

```
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

- Public,
- Private
- Protected

Private

- 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

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

p=Person(“David",23)
p.name
```

Protected

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

p=Person(“David",23)
p.name
```

Class Person

```
class Person:
    def __init__(self, money=0, energy=100):
        self.money = money
        self.energy = energy

    def work(self, hours):
        if self.energy >= hours * 10:
            self.money += hours * 10  # Assume earning $10 per hour of work
            self.energy -= hours * 10
            print(f"Worked for {hours} hours. Money increased to ${self.money}. Energy
decreased to {self.energy}.")
        else:
            print("Not enough energy to work.")

# Example usage:
```

Adding Comments to Class

```
class Person:
    """
    Represents a person with attributes like money and energy.
     Attributes:
        money (int): The person's current amount of money.
        energy (int): The person's current energy level.
     Methods:
        __init__(self, money=0, energy=100):
            Initializes a new Person object with default values.
         work(self, hours):
            Simulates the person working for a certain number of hours,
            earning money but losing energy.
     """
```

Adding comments to init method

```
class Person:
    def __init__(self, money=0, energy=100):
        """
        Initializes a new Person object.
        Args:
            money (int, optional): The person's starting amount of money.
             Defaults to 0.
            energy (int, optional): The person's starting energy level.
             Defaults to 100.
        """

        self.money = money
        self.energy = energy
```

Adding comments to methods

```
class Person:
        ….
    def work(self, hours):
            """
            Simulates the person working for a certain number of hours.
             Args:
                hours (int): The number of hours the person will work.

            Raises:
                ValueError: If the provided hours are negative.
            """
            if hours < 0:
                raise ValueError("Hours cannot be negative.")

            if self.energy >= hours * 10:
                self.money += hours * 10
                self.energy -= hours * 10
                print(f"Worked for {hours} hours. Money increased to
${self.money}. Energy decreased to {self.energy}.")
            else:
                print("Not enough energy to work.")
```

Conclusions

- Object Oriented Approach
- Concept of Class, Object, Methods, Variables
- Inheritance and Modifiers access

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.**