Object Oriented Programming (OPP):

1- Encapsulation.

2- Polymorphism.

3- Abstraction.

4- Inheritance.

Primitive Data Types: saves single simple Value, like Byte int float Boolean Char

Primitive data types were not a problem for simple programs but when the programs started to get complex, we had to make grouping for variables together, example: we want to programming a chess game, the chess pieces (as king, Queen, Bishop, knight, rook, pawn) need many variables like position, color(white or black), Boolean(1:dead, 0 live).., in array we can save more variables but with the same type, we need a new thing that can save more variable types structure can save more variable type but we have with structure the problem that we cant define function inside the structure (we need in our chess game functions like move() that allow us to move inside the checkerboard→ so we need objects

An object is an instance of a class and the class is a template for the object.

Class is bishop(with color-var, position-var, color-var, and move()-function) but in class we don't add values because class is general for all bishops but we can define the move()-function because all bishops have the same movement. The object of the class bishop had a new name like b_1→

b_1=new bishop(3, "white", false);

1- Encapsulation (Black Box):

We have to handle classes with fun functions like (Setter & Getter) so Encapsulation means we cant handle Objects variable without these Setter and Getter functions because if we handle objects without Setters we can man mistakes like move bishop like a rook. And with Setter we can make other functions with out command example if we move bishop to other place where there is another bishop we can make the other bishop automatically dead.

So the concept of encapsulation: The access to Object should be just with Setters and Getters so we cannot allow the impossible movement.

2-Abstraction: show just important details. If many people work on project we can with abstraction divide the project. That I know what make this class without to know how. I need to know if I have Check Mate or not with function check_mate() but how this function works is not important.

The idea of Libraries is abstraction

The methode like chek_mate() called Interface.

3- Inheritance (parent & child):

Example: Student-Calss and Teacher-Class have similar properties(name, address), and differences (with student (degree) with teacher (salary) so we make Parent class Person-Class with Attributes(name and address) and two Child-Classes (student(with degree and inheritance of person-class) and teacher (with salary and inheritance of person-class).

4-Polymorphism (poly: has many and morphism: forms):

Animal-class with methode makeSound() and Dog-class with the same methode() and cat-class with the same methode makeSound() and with cat and dog I should make overwriting of makeSound() with the suitable Sound.

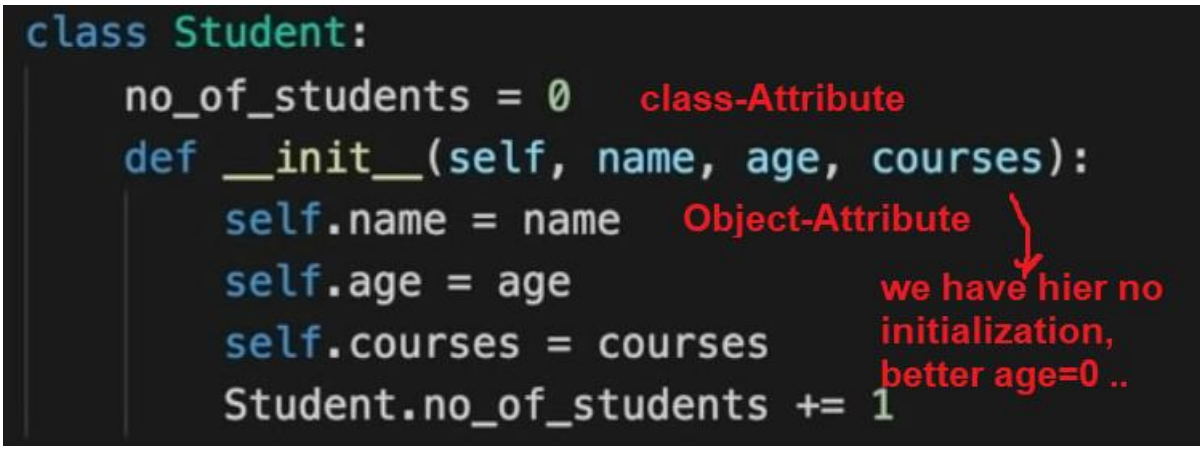
Method: is function inside a class

Practice:

Instance=Object (instance of a class = object of a class)

Attributes are properties of class (with student attributes are name age number …)

Class-attribute Vs. Object-Attribute:



In instance-method (objects-method) we always need the self-parameter.

In class-method we always need the cls-parameter.

-very helpful method: with f “”

```
def describe(self):
    print(f"my name is {self.name} and my age is {self.age}")
```

or with .format()

```
def describe(self):
    print("my name is {} and my age is {}".format(self.name,self.age))
```

we should access attributes with setter() but how can we forbid the command student_1.name=..

→ we make the attributes private with the command in __init__ : self.__name=..

Wenn we now make student_1.name=”x” then we create an new attribute for the object student_1 but our attribute name can not be accessed now→ name ≠ __name

→→ This is the encapsulation concept (no direct access).

Class-Method Vs. Instance-Method:

```
from datetime import date
class Student:
    def __init__(self,name,age):
        self.name = name
        self.age = age

    def desc(self): # Instance-/Object-Method
        print("my name is {} and my age is {}".format(self.name,self.age))

    @classmethod    # Class-Method
    def initfrombirthyear(cls,name,birthYear):
        return cls(name,date.today().year - birthYear)

student_1=Student("Mohammad",29)
student_2=Student.initfrombirthyear("Ahmad",1991)
student_1.desc()
student_2.desc()
```

Output:

```
my name is Mohammad and my age is 29
my name is Ahmad and my age is 31
```

Other Example:

```
class Pizza:
    def __init__(self, ingredients):
        self.ingredients=ingredients

    @classmethod
    def veg(cls):
        return cls(["mushrooms", "olives","onions"])

    @classmethod
    def margherita(cls):
        return cls(["mozarella", "suade"])

pizza_1=Pizza(["tomatos","olives"])
pizza_2=Pizza.veg()
pizza_3=Pizza.margherita()
print(pizza_1.ingredients)
print(pizza_2.ingredients)
print(pizza_3.ingredients)
```

Outout:

```
['tomatos', 'olives']
['mushrooms', 'olives', 'onions']
['mozarella', 'suade']
```

Other way to write this program with handle the standard function __str__

```
class Pizza:
    def __init__(self, ingredients):
        self.ingredients=ingredients

    @classmethod
    def veg(cls):
        return cls(["mushrooms", "olives","onions"])

    @classmethod
    def margherita(cls):
        return cls(["mozarella", "suade"])

pizza_1=Pizza(["tomatos","olives"])
pizza_2=Pizza.veg()
pizza_3=Pizza.margherita()

print(pizza_1,pizza_2,pizza_3)
```

Output:

```
<__main__.Pizza object at 0x000001EF448EDF10>
<__main__.Pizza object at 0x000001EF448EDD90>
<__main__.Pizza object at 0x000001EF448EDD30>
```

The output is the standard __str__ so we need to edit this standard function:

```
def __str__(self):
    return f"Pizza ingredients are {self.ingredients}.\n"
```

this full program looks like this:

```
class Pizza:
    def __init__(self, ingredients):
        self.ingredients=ingredients

    @classmethod
    def veg(cls):
        return cls(["mushrooms", "olives","onions"])

    @classmethod
    def margherita(cls):
        return cls(["mozarella", "suade"])

    def __str__(self):
        return f"Pizza ingredients are {self.ingredients}.\n"

pizza_1=Pizza(["tomatos","olives"])
pizza_2=Pizza.veg()
pizza_3=Pizza.margherita()

print(pizza_1,pizza_2,pizza_3)
```

The Output:

```
Pizza ingredients are ['tomatos', 'olives'].
 Pizza ingredients are ['mushrooms', 'olives', 'onions'].
 Pizza ingredients are ['mozarella', 'suade'].
```

The @classmethod above called decorator.

Know static method with the decorator @staticmethod +dunder functions + Abstraction → https://www.youtube.com/watch?v=A9kSngn7254&t=7215s

---

Functions with two underscores called dunder-functions like __init__ and the are standard but we can overwrite them and to show them we write dir() and in the brackets the name of the Class

→ print(dir (Class-Name)) ;

ASoleman