

# CoPL

# OBJECT ORIENTED PROGRAMMING

## CRASHCOURSE

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# INHERITANCE

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  - ▶ **Duplicate code**
- What is the best way to model this?



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- We have now modeled a person with our *Person* class
- What if we want to model a student?
- A student is also a person!
  - ▶ **Duplicate code**
- What is the best way to model this?
  - ▶ using **Inheritance!**

So, what is inheritance?

# INHERITANCE

Lets look at the definition in the context of biology

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## Inheritance (Biology)

Inheritance is the way that genetic information is passed from a parent to a child. Members of the same biological family tend to have similar characteristics

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## Inheritance (OOP)

Inheritance is the concept in which a class can *inherit* **data attributes** and **methods** from another class. Here, the class that inherits, is called the **derived class**. The class that the derived class inherits from, is called the **base class**.

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## Alternative terminology

Inheriting is sometimes called **deriving**. So you can also say, the derived class **derives** data attributes and methods from it's base class.

# INHERITANCE

In the case of our example:

## Inheritance (OOP)

Inheritance is the concept in which a class (**Student**) can *inherit* data attributes (**first\_name, last\_name, age**) and methods (**speak()**) from another class (**Person**). The class that the derived class inherits from, is called the **base class**.

## Alternative terminology

Inheriting is sometimes called **deriving**. So you can also say, the derived class **derives** data attributes and methods from its base class.

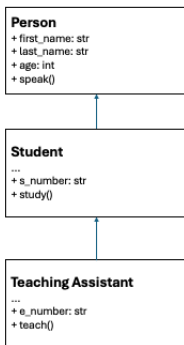


# WHAT CAN WE DO WITH INHERITANCE?

- Create a **hierarchy** of classes (i.e. a class hierarchy :D) which describes their relationship (e.g. a Student is a Person, but not the other way around)
- Avoid writing duplicate code!
- **Encapsulation** (more on that later)

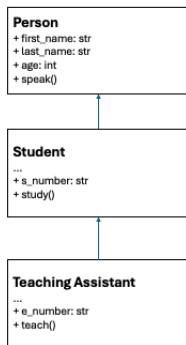
Let's look at the class hierarchy of our example!

# HIERARCHIES



**Figure:** our hierarchy

# HIERARCHIES



**Figure:** our hierarchy

**Note:** Inheriting classes (Student) can also be inherited from (TeachingAssistant)!

Surprise quiz (no grade)

# INHERITANCE QUIZ

What is the *base class* of *Student*?

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■ **Answer:** Person

# INHERITANCE QUIZ

What is the *base class* of *Student*?

■ **Answer:** Person

Which class is *Student* a *derived class* of?



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What is a *derived class* of *Student*?

# INHERITANCE QUIZ

What is the *base class* of *Student*?

■ **Answer:** Person

Which class is *Student* a *derived class* of?

■ **Answer:** Person

What is a *derived class* of *Student*?

■ **Answer:** TeachingAssistant

# INHERITANCE QUIZ

What is the *base class* of *Student*?

■ **Answer:** Person

Which class is *Student* a *derived class* of?

■ **Answer:** Person

What is a *derived class* of *Student*?

■ **Answer:** TeachingAssistant

Which data attributes does *TeachingAssistant* inherit?

# INHERITANCE QUIZ

What is the *base class* of *Student*?

- **Answer:** Person

Which class is *Student* a *derived class* of?

- **Answer:** Person

What is a *derived class* of *Student*?

- **Answer:** TeachingAssistant

Which data attributes does *TeachingAssistant* inherit?

- **Answer:** first\_name, last\_name, age, and s\_number

# INHERITANCE QUIZ

What is the *base class* of *Student*?

- **Answer:** Person

Which class is *Student* a *derived class* of?

- **Answer:** Person

What is a *derived class* of *Student*?

- **Answer:** TeachingAssistant

Which data attributes does *TeachingAssistant* inherit?

- **Answer:** first\_name, last\_name, age, and s\_number

Which class is *TeachingAssistant* a *derived class* of?

# INHERITANCE QUIZ

What is the *base class* of *Student*?

- **Answer:** Person

Which class is *Student* a *derived class* of?

- **Answer:** Person

What is a *derived class* of *Student*?

- **Answer:** TeachingAssistant

Which data attributes does *TeachingAssistant* inherit?

- **Answer:** first\_name, last\_name, age, and s\_number

Which class is *TeachingAssistant* a *derived class* of?

- **Answer:** Person and Student (sorry, it's both)

How do we implement this in Python?



## REMEMBER OUR BEAUTIFUL CLASS

```
class Person():
```

```
    # The constructor
```

```
    def __init__(self, first_name, last_name, age):  
        self.first_name = first_name # Attribute  
        self.last_name = last_name # Attribute  
        self.age = age # Attribute
```

```
    # Method
```

```
    def speak(self):  
        print(f"Hey, my name is {self.first_name}")
```

## LET'S DERIVE FROM IT

```
class Student(Person):
```

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```
class Student(Person):
```

```
    # The constructor
```

```
    def __init__(self, first_name, last_name, age, s_number):
```

```
        # Calling the constructor of base class
```

```
        super().__init__(first_name, last_name, age)
```

```
        self.s_number = s_number
```

```
    # Method
```

```
    def study(self):
```

```
        print(f"Student {self.s_number} is studying!")
```

# THE SUPER() FUNCTION

## super()

The **super()** function refers to the base class of the class. We can use it to access/call methods of the base class.

If we call a method on the super() function, it is just like we would call it on **self**, but than as if it were an object of the base class!



## LETS TEST IT

```
student = Student("Daan", "Wichmann", "secret", "secret")
```

## LETS TEST IT

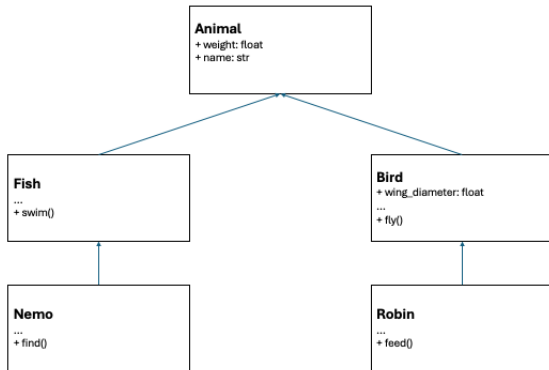
```
student = Student("Daan", "Wichmann", "secret", "secret")
student.speak()
>>> Hey, my name is Daan
```

## LETS TEST IT

```
student = Student("Daan", "Wichmann", "secret", "secret")
student.speak()
>>> Hey, my name is Daan
student.study()
>>> Student secret is studying!
```



# HIERARCHIES - ANOTHER EXAMPLE



**Figure:** Another example

# METHOD OVERRIDING

- What if we want Student's *speak()* to do something different from Person's *speak()*?
- We can **override** the method! (**Method overriding**)

## OUR BEAUTIFUL CLASS AGAIN

```
class Person():
```

```
    # The constructor
```

```
    def __init__(self, first_name, last_name, age):  
        self.first_name = first_name # Attribute  
        self.last_name = last_name # Attribute  
        self.age = age # Attribute
```

```
    # Method
```

```
    def speak(self):  
        print(f"Hey, my name is {self.first_name}")
```

# AND ITS SUBCLASS

```
class Student(Person):  
  
    # The constructor  
    def __init__(self, first_name, last_name, age, s_number):  
  
        # Calling the constructor of base class  
        super().__init__(first_name, last_name, age)  
        self.s_number = s_number  
  
    # Method  
    def study(self):  
        print(f"Student {self.s_number} is studying!")
```



```
student = Student("Daan", "Wichmann", "secret", "secret")
```

```
student = Student("Daan", "Wichmann", "secret", "secret")  
student.speak()  
>>> Hey, my name is Daan
```



- We want student to also mention their s-number when speaking!
- **Lets override speak()**

# OVERRIDING...

```
class Student(Person):
```

```
    # The constructor
```

```
    def __init__(self, first_name, last_name, age,  
        ↪ s_number):
```

```
        # Calling the constructor of base class
```

```
        super().__init__(first_name, last_name, age)  
        self.s_number = s_number
```

```
    # Method
```

```
    def study(self):  
        print(f"Student {self.s_number} is studying!")
```

```
    def speak(self):  
        print(f"Hey, my name is {self.first_name} and my  
        ↪ s-number is {self.s_number}")
```

## AND NOW

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```
student = Student("Daan", "Wichmann", "secret", "secret")
```

## AND NOW

```
student = Student("Daan", "Wichmann", "secret", "secret")  
student.speak()  
>>> Hey, my name is Daan and my s-number is secret
```

# **OPERATOR OVERLOADING**

## Operator overloading

Operator overloading refers to a single operator's capacity to perform several operations based on the class (type) of operands

Now in human terms:



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- Operators like addition (+), equals (==), and greater than (>) can perform certain actions based on their type/class.

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- Operators like addition (+), equals (==), and greater than (>) can perform certain actions based on their type/class.
- Other operator are:
  - ▶ +, -, /, //, %, ==, in, >, <, >=, <=, !=, and more!

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- Addition:
  - ▶  $5 + 3 = 8$  (int)
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- Greater than:
  - ▶  $5 > 3 = \text{True}$  (bool)



- Let's look at some examples
- Addition:
  - ▶  $5 + 3 = 8$  (int)
  - ▶ `"Cogn" + "AC" = "CognAC"` (str)
- Greater than:
  - ▶  $5 > 3 = \text{True}$  (bool)
  - ▶ `Person(...) > Person(...)` = ???

- We can define how these operators should behave in our classes!

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- We use so called double underscore methods (dunder methods, you may forget that name).

- Consider two objects of our person class: person1 and person2.

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- We want `person1 > person2 = True`, iff person1 is older than person2.

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- We want `person1 > person2 = True`, iff person1 is older than person2.
- Let's **overload** the *greater than* operator in our class Person.

# LET'S OVERLOAD

```
class Person():  
    ...
```

# LET'S OVERLOAD

```
class Person():  
    ...  
    def __gt__(self, other): # Note the parameters
```



# LET'S OVERLOAD

```
class Person():  
    ...  
    def __gt__(self, other): # Note the parameters  
        return self.age > other.age
```

# TESTING NEVER ENDS

Let's test again

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```
person1 = Person("Daan", "Wichmann", 19)
person2 = Person("Damai", "Jiwordo", 18)
```

# TESTING NEVER ENDS

Let's test again

```
person1 = Person("Daan", "Wichmann", 19)
person2 = Person("Damai", "Jiwooro", 18)
print(person1 > person2)  # What will this return?
```

Let's test again

```
person1 = Person("Daan", "Wichmann", 19)
person2 = Person("Damai", "Jiwooro", 18)
print(person1 > person2)  # What will this return?
>>> True
```

## WHY IS 'OVERLOADING'

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- We are not overriding operators, because they should still behave the same for integers, strings, etc.
- We are 'loading' the operator with functionality for more classes, i.e. **overloading operators**.



Part 2 of 3 done! Break?