Introduction to Python

Session 02

Introduction to Object Oriented Programming (OOP)

Encapsulation
Inheritance

Encapsulation in OOP

Encapsulation:

A method for **restricting access** to object's components (variables or methods).

- Used to hide the values or state of a structure data object inside a class.

- Protects object integrity by controlling how data is accessed and modified

- **Private:** Accessible only within the **class** itself
- **Protected**: Accessible within the **class** and its **subclasses**
- **Public:** Accessible from **anywhere** in the code

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Encapsulation in OOP

Encapsulation:

In Python, everything is public !!!

But the is a naming convention, not enforced restrictions to indicate it:

- **Private:** `__member_name`

  Name mangling: Makes it harder to accidentally access from outside the class. Automatically renamed to `_ClassName__member_name`

- **Protected**: `_member_name`.

- **Public:** By default, all is public.

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Encapsulation in OOP

Encapsulation examples:

- **Public:** By default, everything is is public.

```
class Cup:

    def __init__(self):
        self.content = None

    def fill(self, beverage):
        self.content = beverage

    def get_beverage(self):
        return self.content
```

Public attribute

Public method

Public method

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Encapsulation in OOP

Encapsulation examples:

- **Public:** By default, everything is is public.

```
>>> cup_instance = Cup()

>>> cup_instance.fill("Coffee")

>>> print(cup_instance.get_beverage())
Coffee

>>> print(cup_instance.content)
Coffee
```

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Encapsulation in OOP

Encapsulation examples:

- **Private:** Nobody should be a able to access it from outside the class.

```
class Cup:

    def __init__(self):
        self.__content = None

    def fill(self, beverage):
        self.__content = beverage

    def get_beverage(self):
        return self.__content
```

Private attribute

Public method

Public method

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Encapsulation in OOP

Encapsulation examples:

- **Private: __**

```
>>> cup_instance = Cup()

>>> cup_instance.fill("Coffee")

>>> print(cup_instance.__content)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
AttributeError: Cup instance has no attribute '__content'

>>> print(cup_instance.get_beverage())
Coffee
```

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Object Oriented Programming

Class: Defines the structure: attributes and methods

Student
Name
Surname
Identification Number
Birth date

Instances: Specific realization of any class. Objects that exist in a given program execution

Name: Antonio
Surname: Gómez
Identification Number: 1234
Birth date: 1/1/1990

Name: Alba
Surname: González
Identification Number: 3456
Birth date: 1/1/1992

Name: Agapito
Surname: Garcia
Identification Number: 2827
Birth date: 21/10/1992

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Class attributes

Attributes (data): Variables that define the state of a class instance.

- Defined inside the constructor method `__init __`
- `self.`

Class attributes: Variables that define “class-level” **constants**.

- Same variable **shared** by all instances.
- Defined after the class statement outside the constructor `__init__`
- Defined without `self.`
- Accessed both inside the instance using `self.` and as a property of the class.

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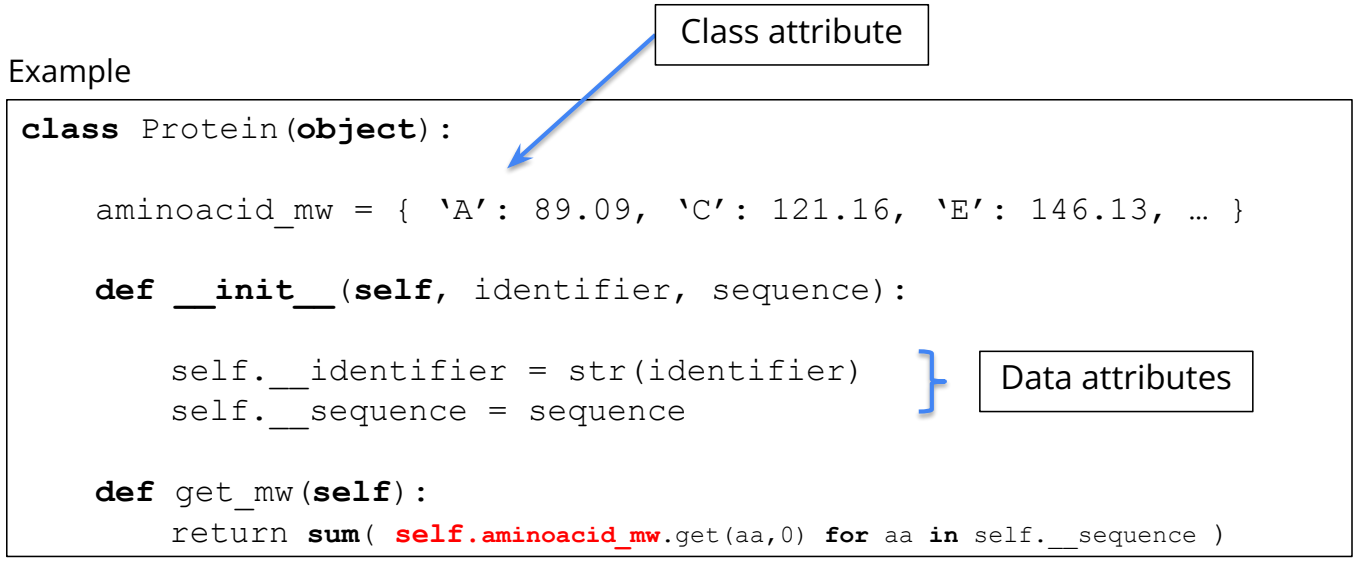
Class attributes

Example



- **Reading**: All instances can access the same class attribute
- **Modifying** via the **class**: Changes are visible to all instances
- **Modifying** via an **instance**: Creates a new instance attribute that shadows the class attribute (only for that instance) When **mutable** (list, dict, set), modifying the object itself (not reassigning) affects all instances:

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Class attributes


```
>>> p1 = Protein(1, "AC")
>>> p2 = Protein(2, "AE")

>>> p1.aminoacid_mw
{'A': 89.09, 'C': 121.16, 'E': 146.13}

>>> Protein.aminoacid_mw
{'A': 89.09, 'C': 121.16, 'E': 146.13}

>>> p1.get_mw()
210.25

>>> p2.get_mw()
235.22

>>> Protein.aminoacid_mw["A"] = 145.23
>>> p2.get_mw()
291.36
```

Call to the constructor

Accessed as an instance property

Accessed as a class property

Shared property between all instances.

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Inheritance

Student	Teacher
+name: String +surname: String +identification_number: Integer +birth_date: Date +subjects: List of subjects +passed_subjects: List	+name: String +surname: String +identification_number: Integer +birth_date: Date +salary: Float +subjects: List
+set_name(String): void +get_name(): String +set_id(Integer): void +get_id(): integer	+set_name(String): void +get_name(): String +set_id(Integer): void +get_id(): integer

Inheritance

Student
+**name**: String +**surname**: String +**identification_number:** Integer +**birth_date**: Date +**subjects**: List of subjects +**passed_subjects**: List
+set_name(String): void +get_name(): String +set_id(Integer): void +get_id(): integer

Teacher
+**name**: String +**surname**: String +**identification_number**: Integer +**birth_date**: Date +**salary**: Float +**subjects**: List
+set_name(String): void +get_name(): String +set_id(Integer): void +get_id(): integer

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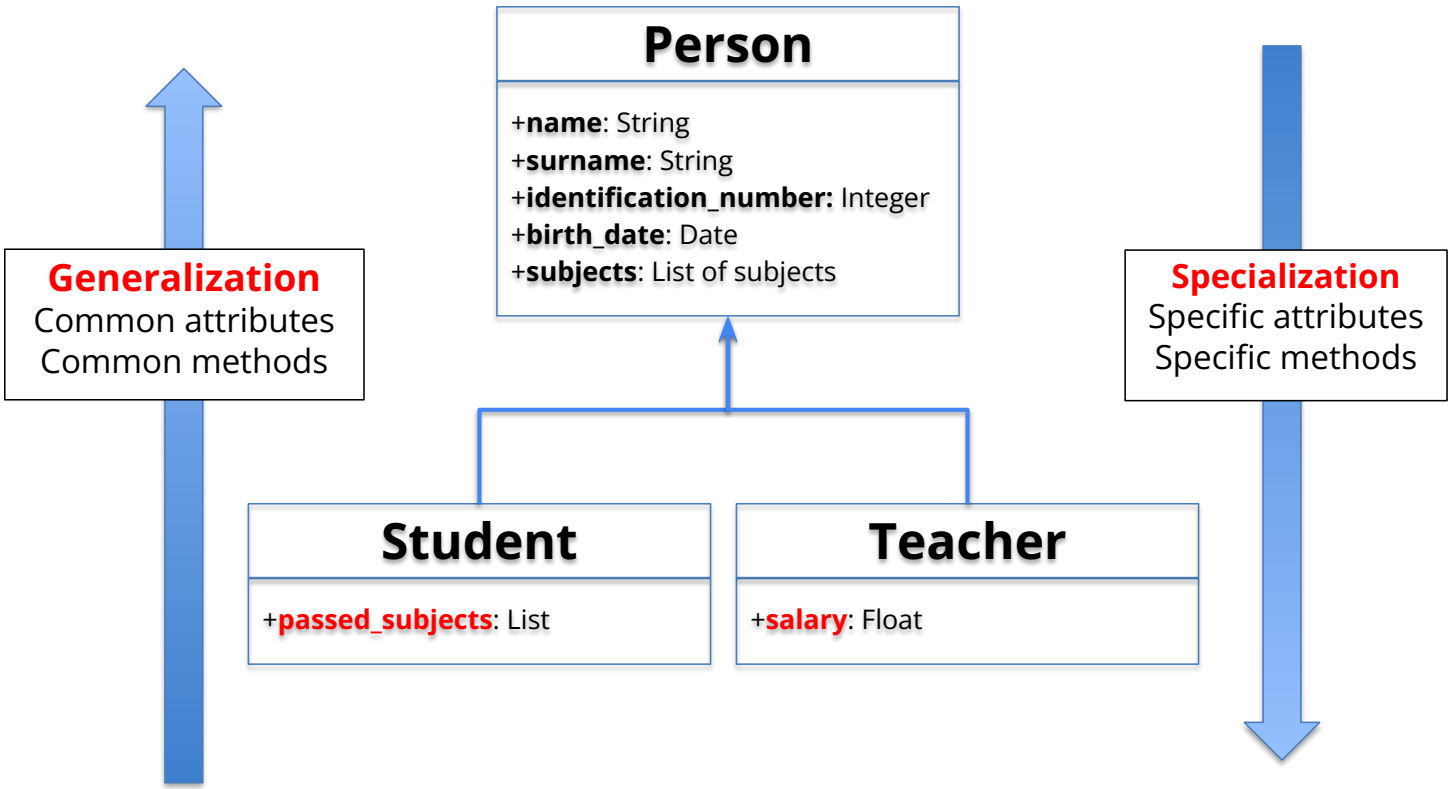
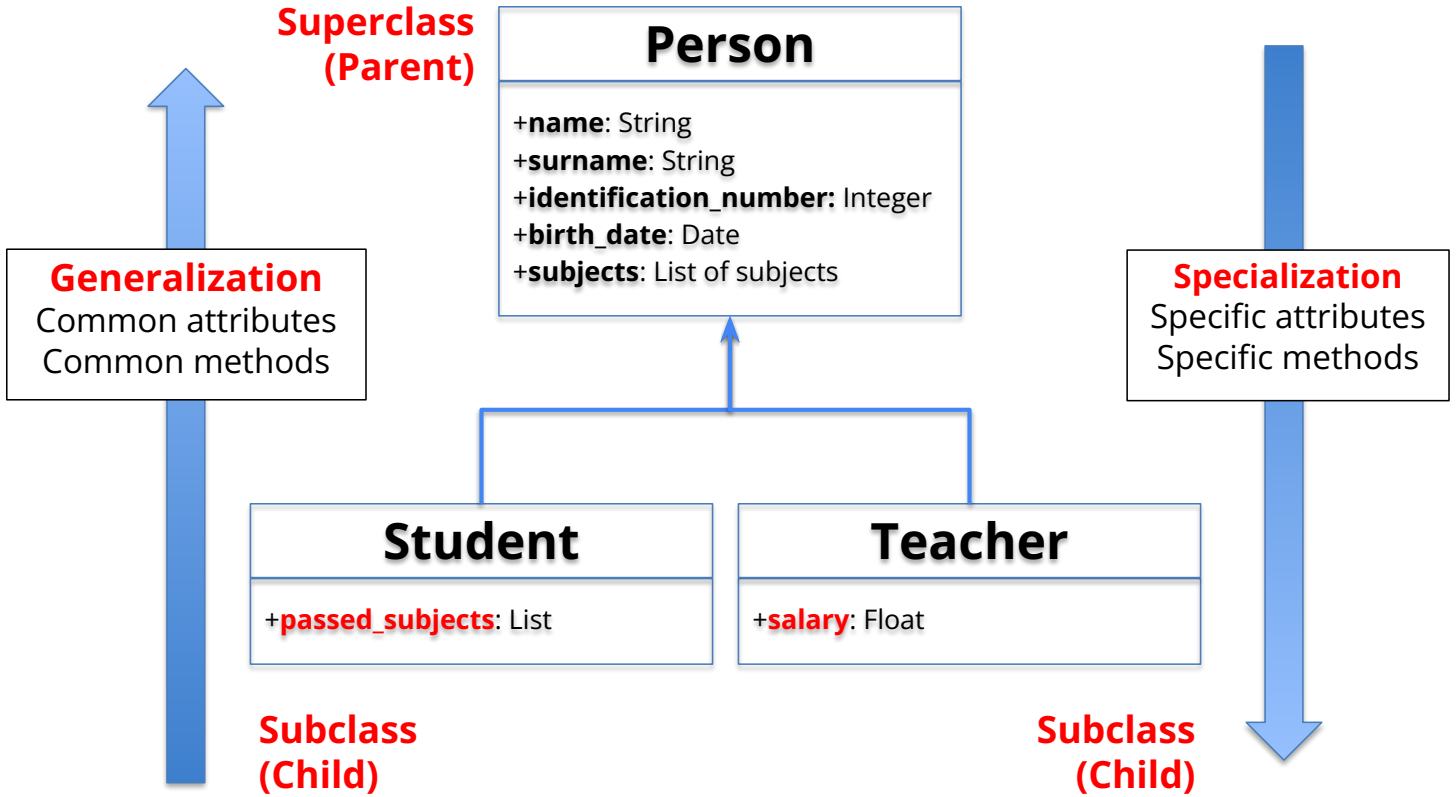
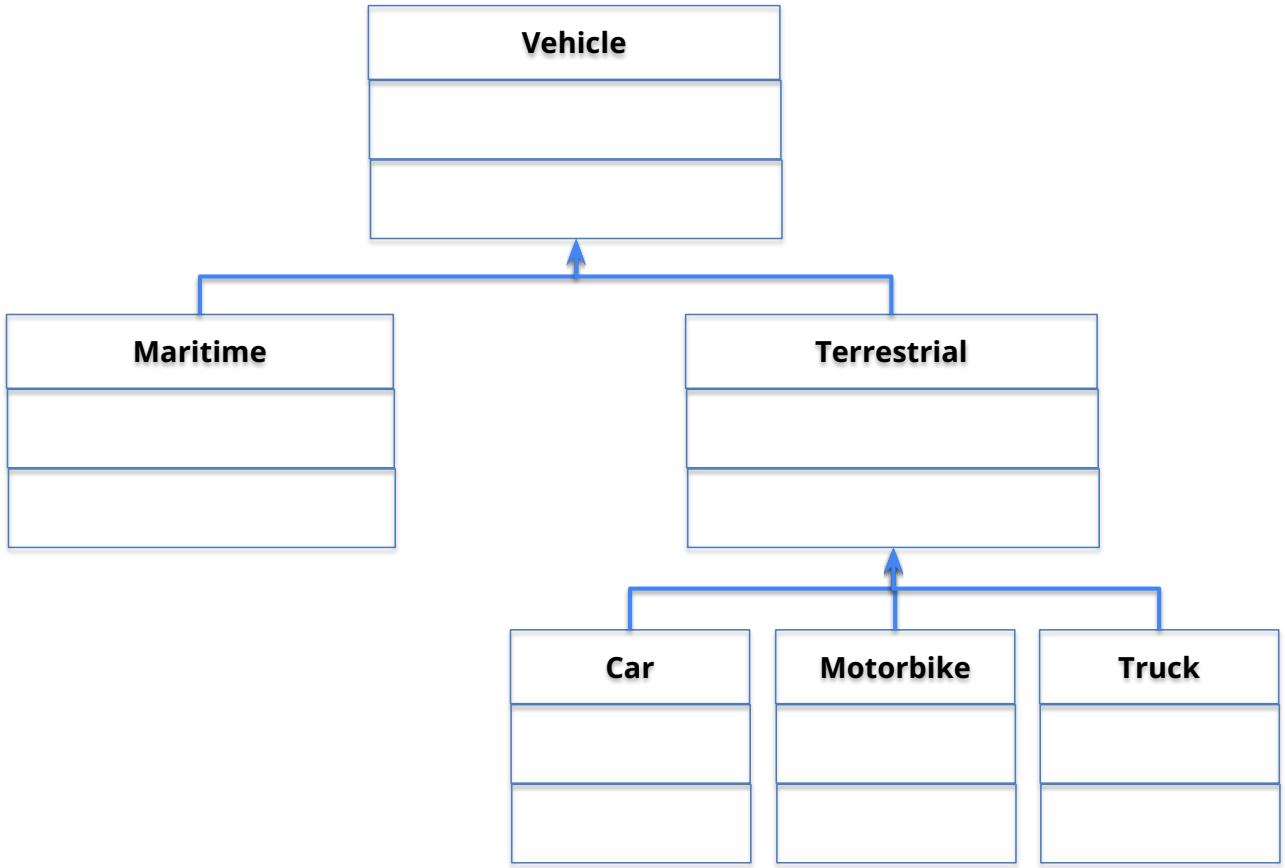
Inheritance



Inheritance



Inheritance



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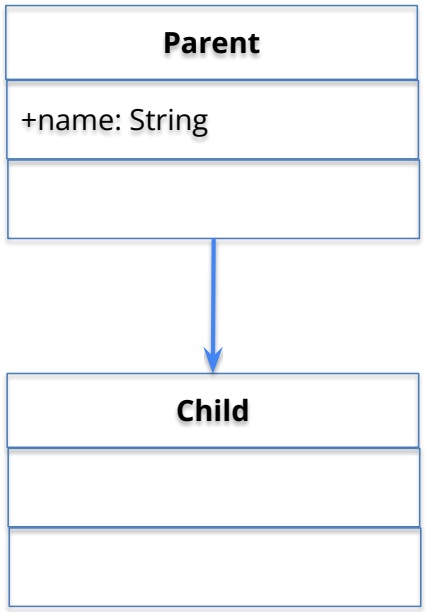
Implementing Inheritance




```
class Parent():

    def __init__(self, name):
        self.name = name

class Child(Parent):
    pass
```

Superclass

Create an instance of class Parent:

```
parent_instance = Parent("ABC")
```

Create an instance of class Child:

```
child_instance = Child("TTT")
```

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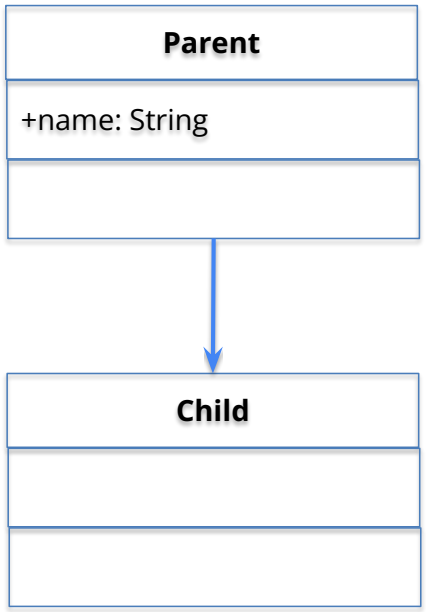
Implementing Inheritance

Childs inherit ALL attributes and methods from its superclass !!




```
class Parent():

    def __init__(self, name):
        self.name = name

class Child(Parent):
    pass
```

Superclass

Create an instance of class Parent:

```
parent_instance = Parent("ABC")
```

Create an instance of class Child:

```
child_instance = Child("TTT")
```

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Implementing Inheritance

In this example, the Child class **inherits** the method print_name from its superclass

```
class Parent():

    def __init__(self, name):
        self.name = name

    def print_name(self):
        print("I am the parent and my name is %s" %self.name)

class Child(Parent):
    pass
```

```
>>> parent_instance = Parent("ABC")
>>> parent_instance.print_name()
I am the parent and my name is ABC

>>> child_instance = Child("TTT")
>>> child_instance.print_name()
I am the parent and my name is TTT
```

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Overriding methods and attributes

In this example, the Child class **overrides** the method print_name

```
class Parent():

    def __init__(self, name):
        self.name = name

    def print_name(self):
        print("I am the parent and my name is %s" %self.name)

class Child(Parent):

    def print_name(self):
        print("I am the child and my name is %s" %self.name)
```

```
>>> parent_instance = Parent("ABC")
>>> parent_instance.print_name()
I am the parent and my name is ABC

>>> child_instance = Child("TTT")
>>> child_instance.print_name()
I am the child and my name is TTT
```

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Overriding methods and attributes

Overriding: Re-implementing a method for a Child class:

- You want the Child to behave differently.
- Replace a functionality
- Add new functionality to an existing method.

Overriding the constructor method:

```
class Parent():

    def __init__(self, name):
        self.name = name


class Child(Parent):

    def __init__(self, name, age):

        self.age = age
        super().__init__(name)
```

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Overriding methods and attributes

Overriding: Re-implementing a method for a Child class:

- You want the Child to behave differently.
- Replace a functionality
- Add new functionality to an existing method.

Overriding the constructor method:

```
class Parent(object):

    def __init__(self, name):
        self.name = name

class Child(Parent):

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

Initializer of the superclass

Arguments for the initializer

Returns the parent class

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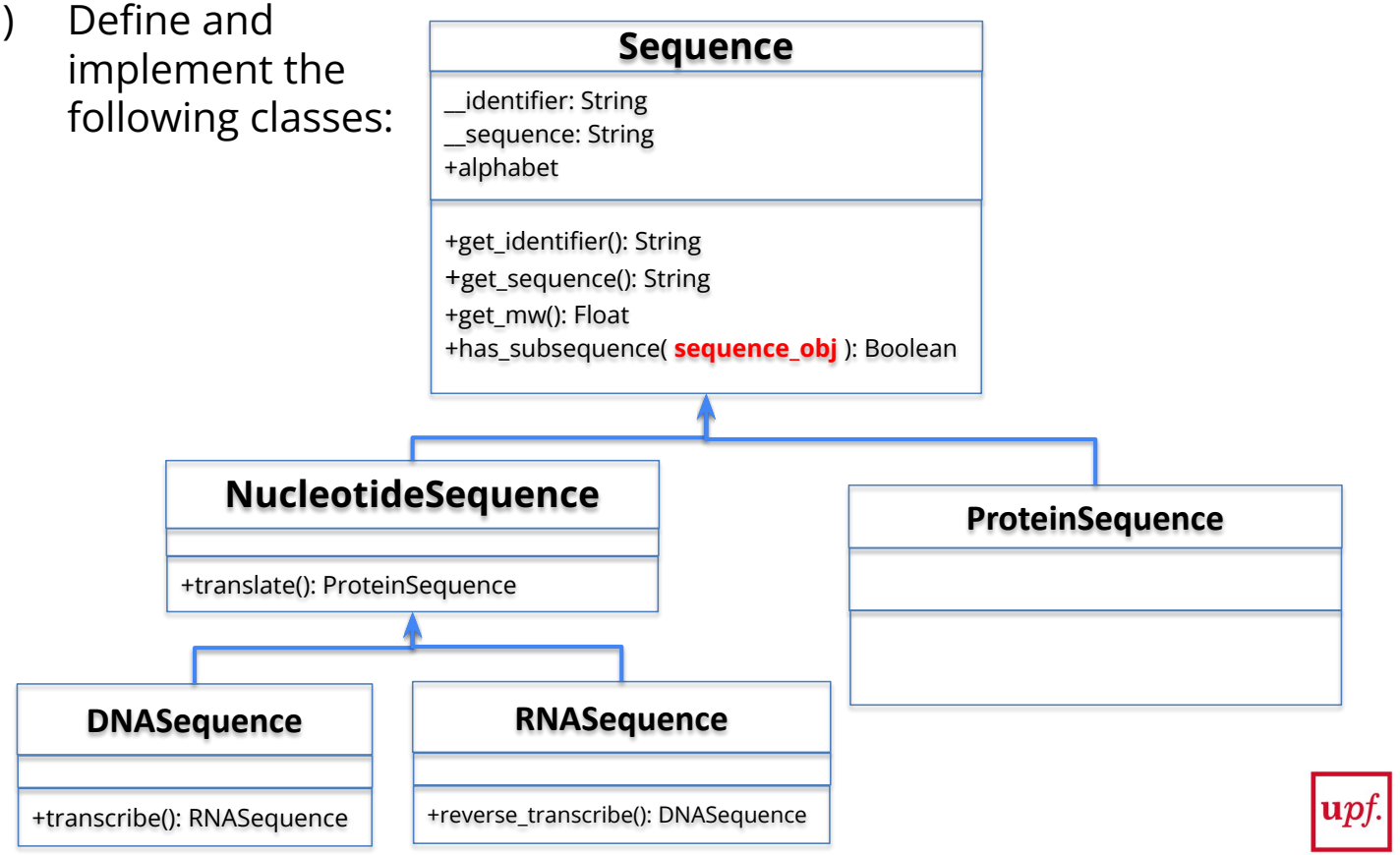
Exercises. Session 08

Create a python script called **NIE_exercise_block2_part2.py** with:

1) Define and implement the following classes:



Exercises. Session 08

Specifications:

1. **`alphabet`** must be a **class attribute** that specifies the possible alphabet of the sequence.

2. Only ProteinSequence, DNASequence and RNASequence are instantiated.

3. When creating a new Sequence instance (ProteinSequence, DNASequence or RNASequence), it must check that the sequence is correct by checking in the alphabet. If not, **raise an exception** with the following statement, where *X* is the incorrect letter: **`raise ValueError("Impossible to create instance: X not possible")`**

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Exercises. Session 08

Specifications:

4. You can find required data in a file called: `Sequence_dictionaries.py`

5. No need to take into account alternate ORF for traduction.

6. Biological accuracy will not penalize if reasonable.