Welcome to this CoGrammar session:

Inheritance

The session will start shortly...

Questions? Drop them in the chat.
We'll have dedicated moderators
answering questions.

Software Engineering Session Housekeeping

- The use of disrespectful language is prohibited in the questions, this is a supportive, learning environment for all - please engage accordingly. **(Fundamental British Values: Mutual Respect and Tolerance)**
- No question is daft or silly - **ask them!**
- There are **Q&A sessions** midway and at the end of the session, should you wish to ask any follow-up questions. Moderators are going to be answering questions as the session progresses as well.
- If you have any questions outside of this lecture, or that are not answered during this lecture, please do submit these for upcoming Academic Sessions. You can submit these questions here: **Questions**

Software Engineering Session Housekeeping cont.

- For all **non-academic questions**, please submit a query: **www.hyperiondev.com/support**
- Report a **safeguarding** incident: **www.hyperiondev.com/safeguardreporting**
- We would love your **feedback** on lectures: **Feedback on Lectures**

Skills Bootcamp
8-Week Progression Overview

Fulfil 4 Criteria to Graduation

✅ Criterion 1: Initial Requirements

- ***Timeframe:*** First 2 Weeks
- ***Guided Learning Hours (GLH):*** Minimum of 15 hours
- ***Task Completion:*** First four tasks

Due Date: 24 March 2024

✅ Criterion 2: Mid-Course Progress

- ***Guided Learning Hours (GLH):*** **60**
- ***Task Completion:*** 13 tasks

Due Date: 28 April 2024

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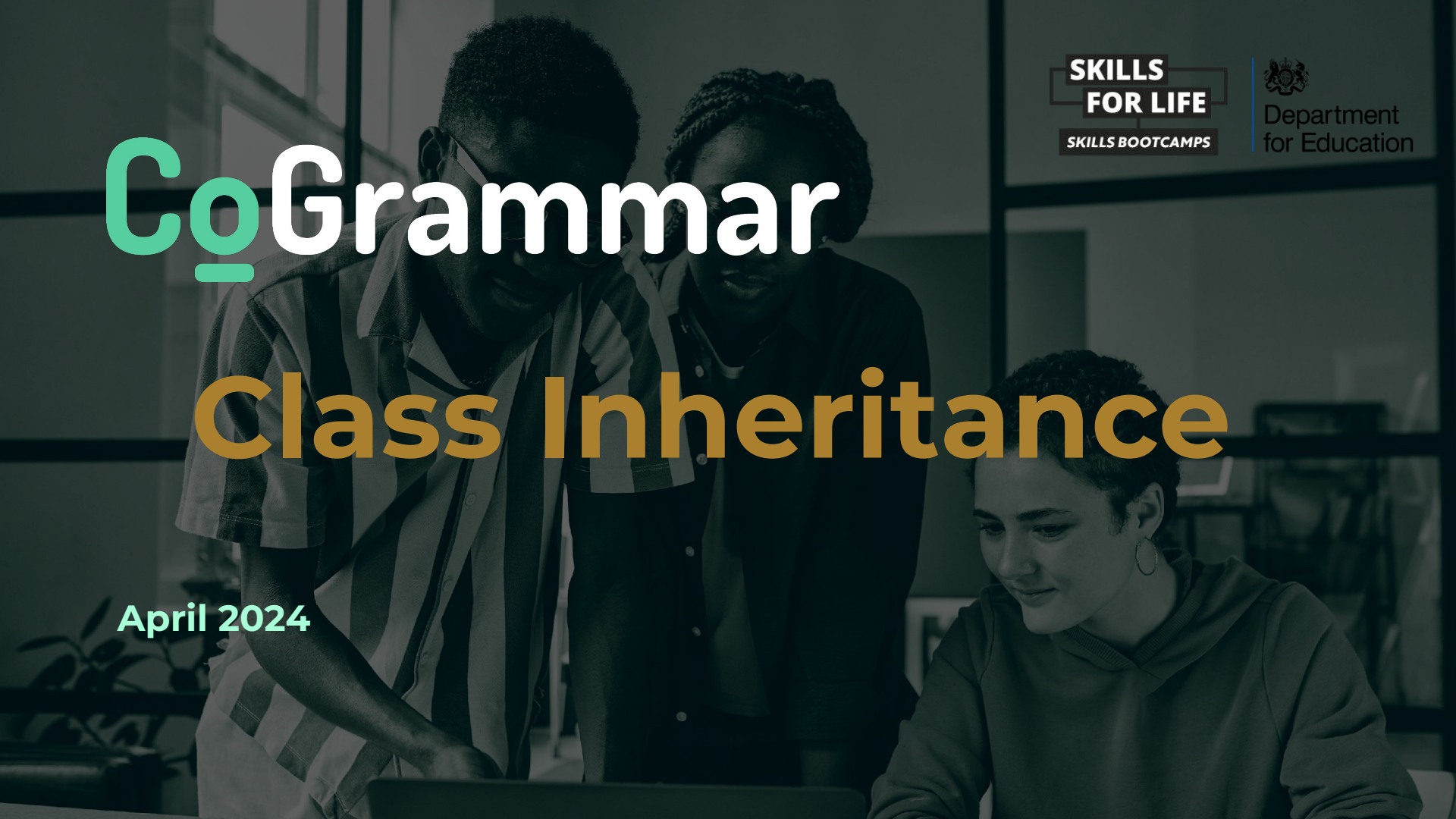

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Class Inheritance

April 2024

Learning Objectives

- Define inheritance and its role in object-oriented programming.
- Implement and utilise the principles of inheritance within your own projects.
- Use special methods in your classes to harness the full power of object-oriented programming in Python.
- Describe and utilise polymorphism with the use of method overriding and duck typing.

Inheritance

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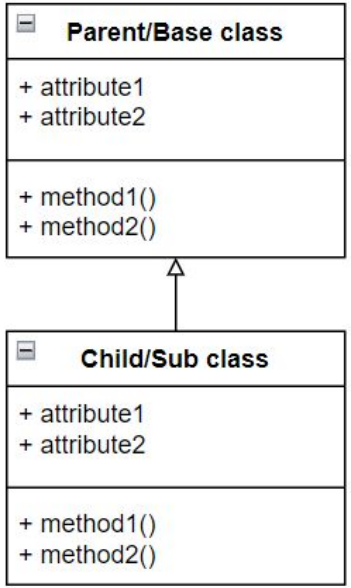
What is Inheritance?

- Sometimes we require a class with the same attributes and properties as another class but we want to extend some of the behaviour or add more attributes.
- Using inheritance we can create a new class with all the properties and attributes of a base class instead of having to redefine them.

What is Inheritance?



Inheritance

- Parent/Base class
  - The parent or base class contains all the attributes and properties we want to inherit.
- Child/Subclass
  - The sub class will inherit all of its attributes and properties from the parent class.

Inheritance

- Here we have an example of having a child class inherit from a parent class

```python
# Base/Parent class
class Animal:
    def __init__(self, sound: str) -> None:
        self.sound = sound

    def make_sound(self) -> str:
        return f"The {type(self).__name__} goes {self.sound}"
```



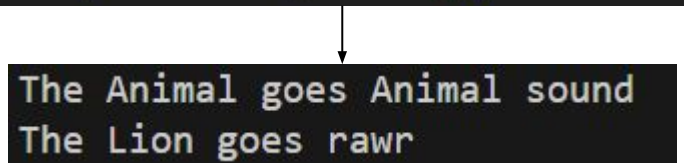
```python
# Sub/Child class
class Lion(Animal):
    pass
```

Inheritance

- Let's create one of each object and see how they behave.

```
animal = Animal("Animal sound")
lion = Lion("rawr")

print(animal.make_sound())
print(lion.make_sound())
```



```
The Animal goes Animal sound
The Lion goes rawr
```

Method Overriding

- We can override methods in our subclass to either extend or change the behaviour of a method.
- To apply method overriding you simply need to define a method with the same name as the method you would like to override.
- To extend functionality of a method instead of completely overriding we can use the super() function.

Method Overriding

- Let's override the make_sound() method.

```
# Sub/Child class
class Lion(Animal):
    pass
```

```
# Sub/Child class
class Lion(Animal):

    def make_sound(self) -> str:
        return f"The fierce lion let's out a big {self.sound}!!!!!!"
```

Method Overriding

- This will now be the new behaviour of the make_sound() method in the Lion class.

```
lion = Lion("rawr")
print(lion.make_sound())
```

Super()

- The super() function allows us to access the attributes and properties of our Parent/Base class.
- Using super() followed by a dot “.” we can call to the methods that reside inside our base class.
- When extending functionality of a method we would first want to call the base class method and then add the extended behaviour.

Methods overriding and Super()

- The method you will override the most will be __init__()
- When adding more instance attributes to the subclass we have to call to the base class __init__() to avoid having to redeclare all our base class attributes.
- We can use super().__init__() to call the constructor of the base class and set the values if the inherited attributes.

Methods overriding and Super()

Here we call __init__() from the Person class to set the values for the attributes “name” and “age”.

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

class Student(Person):
    def __init__(self, name, age):
        super().__init__(name, age)
        self.grades = []
```

Methods overriding and Super()

```
class BaseClass:
    # Base class definition
    def print_name(self):
        print(self.name)

class SubClass(BaseClass):
    # Subclass definition
    def print_name(self):
        print("Code before base method call.")
        super().print_name()
        print("Code after base method call.")
```

Multiple Inheritance

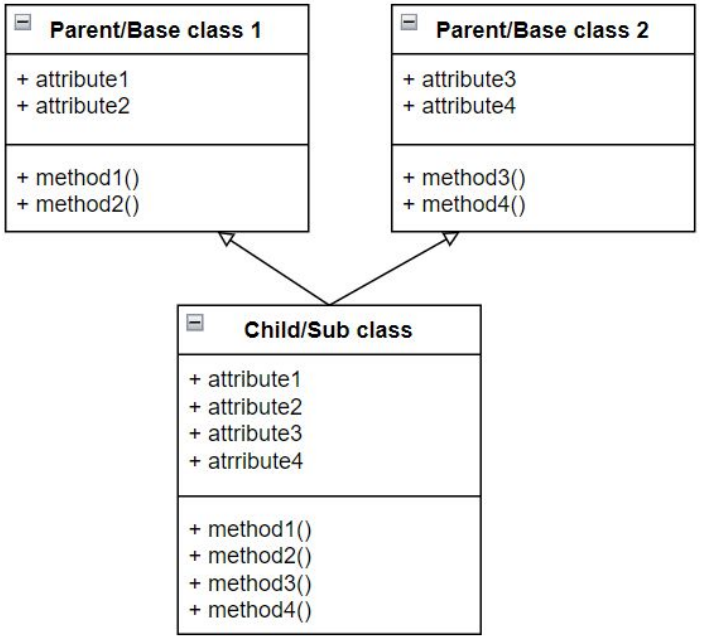
- Python allows multiple inheritance as well.
- This means we can have a subclass that inherits attributes and properties from more than one base class.

```
class BaseClass:
    # Base class definition
    pass

class BaseClassA:
    # Base class definition
    pass

class SubClass(BaseClass, BaseClassA):
    # Subclass definition
    pass
```

Multiple Inheritance



isinstance() and issubclass()

- We can determine if an object is an instance of a particular class using isinstance()
  - E.g. isinstance(object, ClassType)
- We can determine if a class is a subclass of another using issubclass()
  - E.g. issubclass(SubClass, BaseClass)

isinstance()

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

person = Person("Peter", "Parker")
print(isinstance(person, Person)) # True
```

issubclass()

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

class Student(Person):
    def __init__(self, name, age):
        super().__init__(name, age)
        self.grades = []

print(issubclass(Student, Person)) # True
```

Special Methods

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__init__()

- The first special method you have seen and used is __init__().
- We use this method to initialize our instance variables and run any setup code when an object is being created.
- The method is automatically called when using the class constructor and the arguments for the method are the values given in the class constructor.

__init__()

```
class Student:

    def __init__(self, fullname, student_number):
        self.fullname = fullname
        self.student_number = student_number

new_student = Student("John McClane", "DH736648")
```

Objects As Strings

- You have probably noticed when using print() that some objects are represented differently than others.
- Some dictionaries and list have {} and [] in the representation and when we print an object we get a memory address <__main__.Person object at 0x000001EBCA11E650>
- We can set the string representations for our objects to whatever we like using either __repr__() or __str__()

__repr__()

- This method returns a string for an official representation of the object.
- __repr__() is usually used to build a representation that can assist developers when working with the class.
- The representation will contain extra information about the object that the user would not necessarily see.

__repr__()

```python
class Student:

    def __init__(self, fullname, student_number):
        self.fullname = fullname
        self.student_number = student_number

    def __repr__(self):
        return f"Student({self.fullname}, {self.student_number})"

new_student = Student("Percy Jackson", "PJ323423")
```

__str__()

- This method return a representation for your object when the str() function is called.
- When your object is used in the print function it will automatically try to cast your object to a string and will then receive the representation returned by __str__()
- This is usually a representation that users will see.

__str__()

```python
class Student:

    def __init__(self, fullname, student_number):
        self.fullname = fullname
        self.student_number = student_number

    def __str__(self):
        return f"Fullname:\t{self.fullname}\nStudent Num:\t{self.student_number}\n"

new_student = Student("Percy Jackson", "PJ323423")
print(new_student)
```

Special Methods And Math

- Special methods also allow us to set the behaviour for mathematical operations such as +, -, *, /, **
- Using these methods we can determine how the operators will be applied to our objects.
- E.g. When trying to add two of your objects, x and y, together python will try to invoke the __add__() special method that sits inside your object x. The code inside __add__() will then determine how your objects will be added together and returned.
- x + y -> x.__add__(y)

Special Methods And Math

```python
class MyNumber:

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

    def __add__(self, other):
        return MyNumber(self.value + other.value)

num1 = MyNumber(10)
num2 = MyNumber(5)
num3 = num1 + num2
print(num3.value) # Output: 15
```

Special Methods And Math

- Some mathematical special operators that are available are:
  - Add -> __add__(self, other)
  - Subtract -> __sub__(self, other)
  - Multiply -> __mul__(self, other)
  - Divide -> __truediv__(self, other)
  - Power -> __pow__(self, other)

Container-Like Objects

- Using special methods we can also incorporate behaviour that we see in container-like objects such as iterating, indexing, adding and removing items, and getting the length.
- E.g. When we try to get an item from a list the special method __getitem__(self,key) is called. We can then override the behaviour of the method to return the item we desire.
- Object[y] -> Object.__getitem__(y)

Container-Like Objects

```python
class ContactList:

    def __init__(self):
        self.contact_list = []

    def add_contact(self, contact):
        self.contact_list.append(contact)

    def __getitem__(self, key):
        return self.contact_list[key]


contact_list = ContactList()
contact_list.add_contact("Test Contact")
print(contact_list[0]) # Output: Test Contact
```

Container-Like Objects

- Some special methods to add for container-like objects are:
  - Length -> __len__(self)
  - Get Item -> __getitem__(self, key)
  - Set Item -> __setitem__(self, key, item)
  - Contains -> __contains__(self, item)
  - Iterator -> __iter__(self)
  - Next -> __next__(self)

Comparators

- The last special methods we will look at are comparators.
- We will use these methods to set the behaviour when we try to compare our objects to determine which one is smaller or larger or are they equal.
- E.g. When trying to see if object x is greater than object y. The method x__gt__(y) will be called to determine the result. We can then set the behaviour of __gt__() inside our class.
- x > y -> x.__gt__(y)

Comparators

```python
class Student:

    def __init__(self, fullname, student_number, average):
        self.fullname = fullname
        self.student_number = student_number
        self.average = average

    def __gt__(self, other):
        return self.average > other.average

student1 = Student("Peter Parker", "PP734624", 88)
student2 = Student("Tony Stark", "TS23425", 85)
print(student1 > student2) # Output: True
```

Polymorphism

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Method Overriding

- When extending or changing behaviour of a parent class is best to make sure we do it in a polymorphic way. Here we changed the behaviour of the make_sound method in the Lion class but we can still use it in our animal_make_sound() function.

```python
class Animal:

    def __init__(self) -> None:
        self.sound = ""

    def make_sound(self):
        return f"The animal goes {self.sound}"
```

```python
class Lion(Animal):

    def __init__(self) -> None:
        super().__init__("Rawr")

    def make_sound(self):
        return f"The lion goes {self.sound}"
```

```python
def animal_make_sound(animal):
    print(animal.make_sound())
```

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Duck Typing

- Duck typing is where the type or class of an object is less important than the methods or properties it possesses.
- The term "duck typing" comes from the saying, "If it looks like a duck, swims like a duck, and quacks like a duck, then it probably is a duck.“

```python
class Dog:
    def speak(self):
        return "Woof!"

# Function that expects an object with a speak method
def make_sound(animal):
    return animal.speak()

# Using duck typing
dog = Dog()

print(make_sound(dog))  # Outputs: Woof!
```

Questions and Answers

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Let’s take a short break

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Summary

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Questions and Answers

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Summary

1. Inheritance
   - ➢ Allows us to reuse code and reduce redundancy by inheriting attributes and properties from a parent.
2. Special Methods
   - ➢ Also called dunder or magic methods are used to implement special behaviours into our classes to allow them to interact with built in python methods.
3. Polymorphism
   - ➢ An idea where we care about the behaviours of an object rather than the pacific type of the object.

Thank you for attending

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