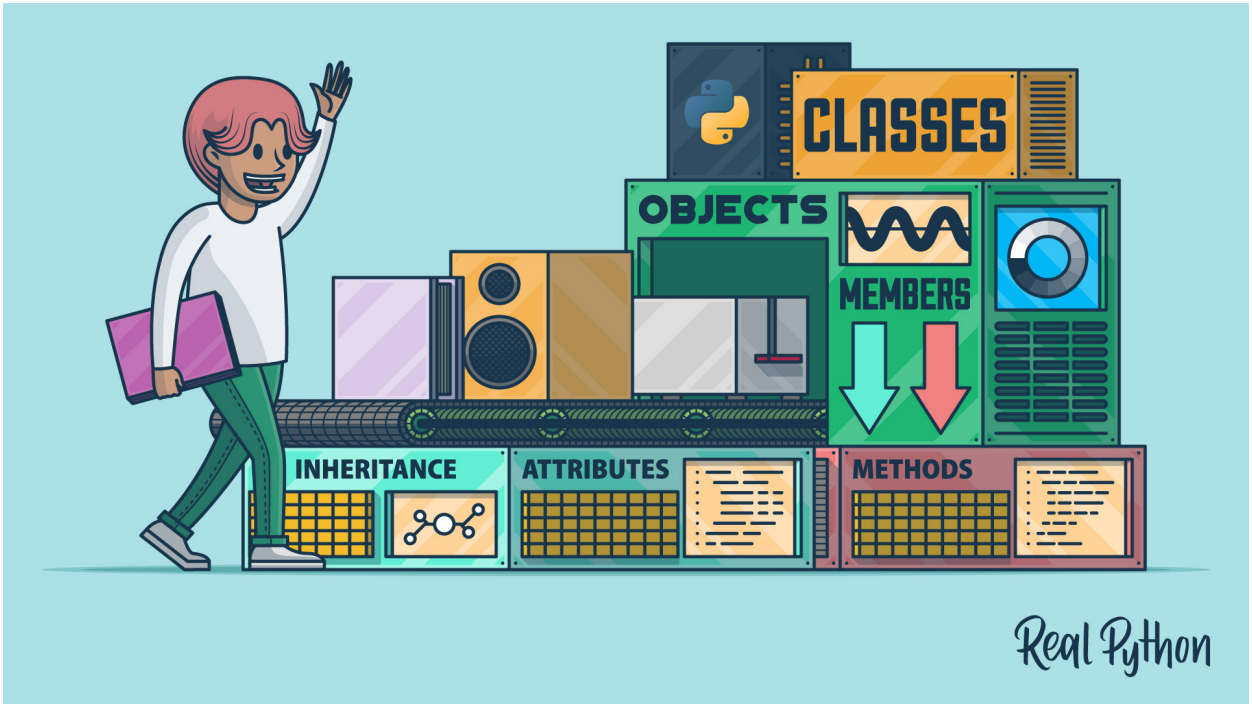
CLASS CONCEPTS : OBJECT-ORIENTED CODING IN PYTHON



MULTI-PART COURSE

- Course parts:
  - **A: Class Concepts**
  - B: Inheritance and Internals
  - C: Design and Guidance

IN THIS COURSE, YOU WILL LEARN ABOUT:

1. Why write object-oriented code
2. How to write classes
3. What attributes and methods are
4. How to use the descriptor protocol

VERSIONS

Note:

- Code samples were tested using:
  - Python 3.11.4

OVERVIEW

- Python is a mixed language, supporting:
  - Procedural coding
  - Functional coding
  - Object-oriented coding
- Object-oriented coding is the process of grouping data and the operations on that data together, structurally
- The `class` keyword allows you to define structures containing **attributes** and **methods**
- There are different several variations on attributes and methods that give you the power of abstracting your code

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Why you use an object oriented approach?

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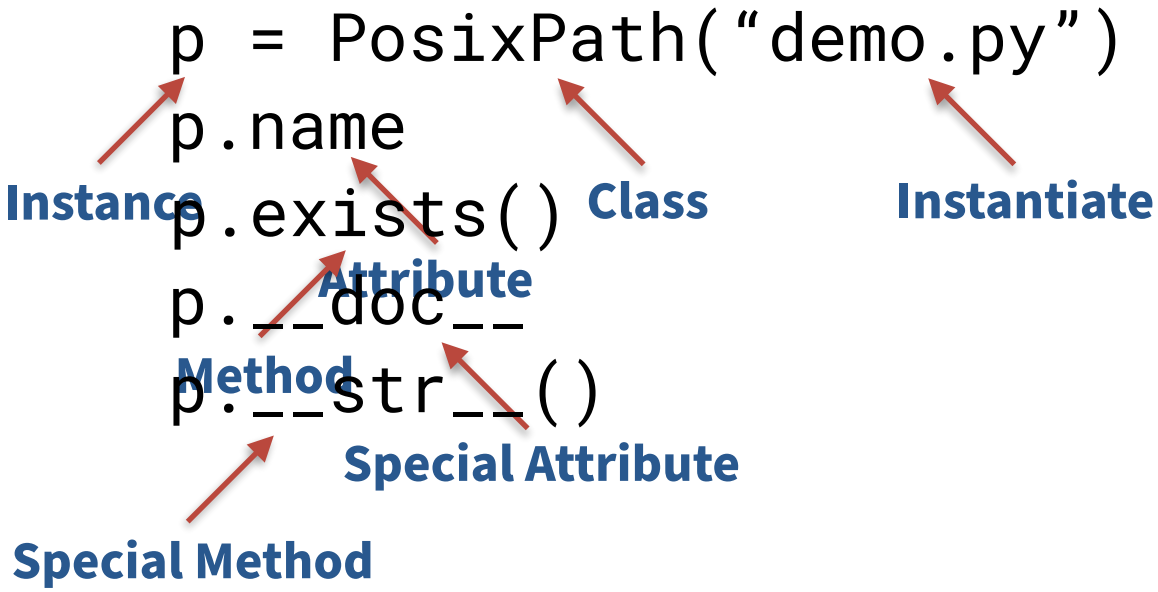
THE CASE FOR OBJECT-ORIENTED CODING

- Logical to associate data and operations on that data together
- Can be done by file grouping
  - Better if the compiler helps to enforce rules

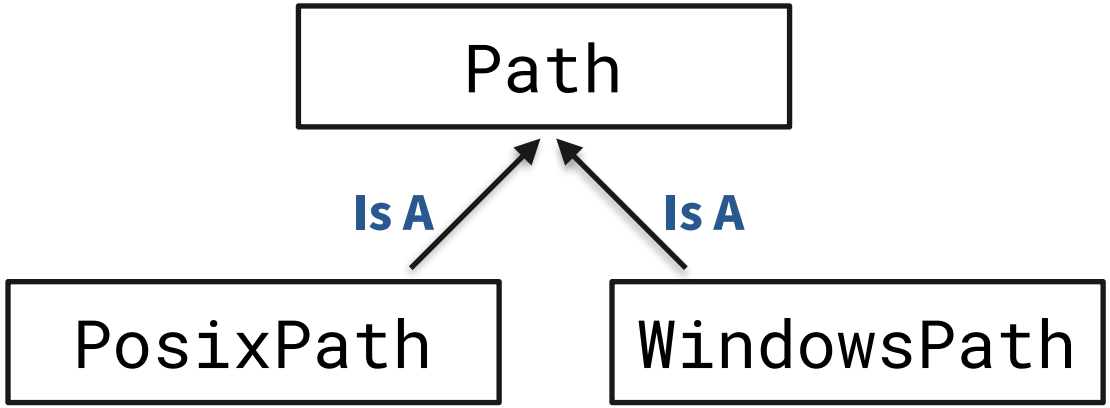
THE CASE FOR OBJECT-ORIENTED CODING

- Structure data for re-use
- “is a” relationships
- Inheritance
- Changes to “person” should effect “employee”

OBJECTS AND CLASSES



OBJECTS AND CLASSES



WHY USE CLASSES

- Code often relates to real-world things (people, places, machines, ...)
  - Modelling data actions together
- Code reuse
  - Inheritance structures help your code be DRY
- Code abstraction
  - Objects provide an interface (API) that can abstract away details
- Flexibility
  - Interfaces can be built for general use (duck-typing, polymorphism)
  - Example: file-like behavior

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Your first class

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DUNDER INIT

- To instantiate a class you call it with parenthesis
- Arguments to the class constructor are usually stored as attributes
- You write a special `.__init__()` method that gets called when a class is instantiated
- All methods on an object require at least one argument
  - A reference to the object
  - Known as `self`

NAMING CONVENTIONS AND STYLE

- Python variables and attributes use `snake_case`
- Python class names use `PascalCase`
- Python has no concept of private, protected, or public
  - Uses convention instead
- Non-Public members of a class use an underscore prefix
  - A warning to other developers that they shouldn't rely on that member existing
  - Developer style varies on when to use non-public members

NAME MANGLING

- Dunder or special methods have leading double-underscores
- Python uses these for built-in parts of a class
- You can write your own
- Any member with two leading underscores gets renamed
  - “Hides” the member
  - Doesn’t make it un-callable, just not obvious
- `.__member` becomes `._ClassName__member`
- Works for both attributes and methods

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Attributes

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CLASS vs INSTANCE ATTRIBUTES

- Classes support two kinds of attributes:
  - Instance attributes are on the object instance
  - Class attributes are on the class and shared across instances
- Instance attributes are on `self`
- Class attributes are directly on the class

CLASS vs INSTANCE ATTRIBUTES

- Class attributes can be accessed through an object instance
- Class attributes can only be modified through the Class reference
- Objects can have attributes assigned dynamically
  - Not just in the `.__init__()` or other class code
  - Attempting to assign a Class attribute through the object results in the creation of an instance attribute

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Properties and descriptor-based attributes

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PROPERTIES

- The `@property` decorator allows you to create a method that is accessed like an attribute
- This means you can do calculation to return a value

DESCRIPTORS

- The `@property` decorator is for accessing a value
- You can also set a value by defining a companion method
- Decorate the method using the property name and `@.setter`
- Allows you to perform side-effects when a value is set
  - Perform calculations
  - Caching
  - Error checks

DESCRIPTORS AND PRIVATE ATTRIBUTES

- A common pattern you'll find in code:
  - Argument to `.__init__()` passes in initial value
  - Value is assigned to private attribute
  - `@property` method with the same name uses the private attribute
  - `@.setter` method with the same name sets the private attribute with error checking
- Some programmers are very strict about this and have no public attributes, only getter/setter methods

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More on methods

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MULTIPLE TYPES OF METHODS

- There are three types of methods in Python:
  - Instance methods
  - Class methods
  - Static methods

INSTANCE METHODS

- The methods you've used so far are instance methods
- Require an instantiated object
- Typically used to perform operations on associated data
- First argument is always an instance of the object
    - By convention named `self`

CLASS METHODS

- Methods that operate on the class itself
- Created using the `@classmethod` decorator
- First argument is always a reference to the class
  - By convention named `cls`
- Used for:
  - Manipulating data common across all instances
  - Factories

STATIC METHODS

- Static methods require neither a class nor instance
- Created using the `@staticmethod` decorator
- No required arguments
- Typically used for:
  - Grouping data-less functions together (although this can be done equally well with a module)
    - Example: `Converter.km_to_miles(distance)`, `Converter.litres_to_gallons(amount)`
- Very seldom needed in Python and can always be achieved with a classmethod

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Putting it all together

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PUTTING IT ALL TOGETHER

- So far you've learned about:
  - Declaring classes
  - Attributes
  - Instances
  - Instance, class, and static methods
  - Properties and descriptors

QUICK TANGENT

- A few quick things to know about the coming code:
  - When using a classmethod, the `cls` reference is a class
    - You can instantiate an object by calling it with parenthesis
  - You can use the `**kwargs` mechanism to instantiate a class
    - Key/value pairs in the dictionary become the arguments to the constructor
  - The `.__str__()` method gets called when you convert an object to a string
  - The `.__repr__()` method gets called when you "view" an object in the REPL
    - By convention this should output a string version of the code needed to instantiate the object

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Summary

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A: Class Concepts

SUMMARY

- The `class` keyword allows you to declare the structure of set of attributes and methods that are used together
- You create an object by instantiating a class
- Each object gets its own data but can use the methods from the class
- The `.__init__()` method is called when a class has been initialized
  - The first argument is `self`, a reference to constructed object
  - You can assign arguments passed in from the constructor onto the object using dot-notation on `self`

SUMMARY

- Instances of an object have their own copy of attributes
  - Accessible using dot notation on the object
  - Or on `self` inside the object's methods
- Class attributes are stored on the class instead of the object
  - Shared across all object instances of that class
- Methods are like functions associated with a class
- Instance methods require at least one argument: `self`
- Class methods operate on the class rather than an instance
  - Require at least one argument: `cls`
- Static methods require neither a class nor an object

SUMMARY

- The descriptor protocol is a pattern you can use to change how attributes are accessed on an object
- The `@property` decorator allows you to have a method accessed like an attribute
- The `@.setter` decorator allows you to define a method called when an attribute's value is set

B: INHERITANCE AND INTERNALS

- A class definition can be based on another class by inheriting its properties
- You can have multiple levels of inheritance
- A class can inherit from multiple classes
- Inheritance is a way of re-using code and making data structures hierarchical

Thanks!

Dankie ju faleminderit faleminderit شكرا Grazias Շնորհակալություն Sağ ol eskerrik asko Дзякуй তোমাকে ধন্যবাদ hvala trugéré

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