Welcome to the CoGrammar Modules

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

- We would love your **feedback** on lectures: **Feedback on Lectures**

Safeguarding & Welfare

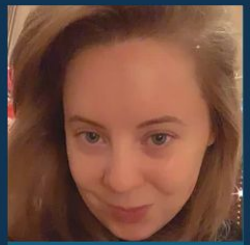
We are committed to all our students and staff feeling safe and happy; we want to make sure there is always someone you can turn to if you are worried about anything.

If you are feeling upset or unsafe, are worried about a friend, student or family member, or you feel like something isn't right, speak to our safeguarding team:

Ian Wyles
Designated Safeguarding Lead

Simone Botes

Rafiq Manan



Charlotte Witcher

Nurhaan Snyman

Ronald Munodawafa

Tevin Pitts

Scan to report a safeguarding concern

or email the Designated Safeguarding Lead:
Ian Wyles
safeguarding@hyperiondev.com

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Skills Bootcamp Progression Overview

To be eligible for a certificate of completion, students must fulfil three specific criteria. These criteria ensure a high standard of achievement and alignment with the requirements for the successful completion of a Skills Bootcamp.

✅ Criterion 1 - Meeting Initial Requirements

Criterion 1 involves specific achievements within the first two weeks of the program. To meet this criterion, students need to:

- Attend a minimum of 7-8 hours per week of guided learning (lectures, workshops, or mentor calls) within the initial two-week period, for a total minimum of 15 guided learning hours (GLH), by no later than 15 September 2024.
- Successfully complete the Initial Assessment by the end of the first 14 days, by no later than 15 September 2024.

Skills Bootcamp Progression Overview

✅ Criterion 2 - Demonstrating Mid-Course Progress

Criterion 2 involves demonstrating meaningful progress through the successful completion of tasks within the first half of the bootcamp.
To meet this criterion, students should:

- Complete 42 guided learning hours and the first half of the assigned tasks by the end of week 7, no later than 20 October 2024.

Skills Bootcamp Progression Overview

✅ Criterion 3 - Demonstrating Post-Course Progress

Criterion 3 involves showcasing students' progress after completing the course.
To meet this criterion, students should:

- Complete all mandatory tasks before the bootcamp's end date. This includes any necessary resubmissions, no later than 22 December 2024.
- Achieve at least 84 guided learning hours by the end of the bootcamp, 22 December 2024.

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Department for Education
CoGrammar
Modules

Learning Objectives

- Define the purpose and importance of Python **modules, requirements files and virtual environments**.
- Differentiate between **scripts, modules, packages, and libraries** in Python
- Import and use modules from the **Python Standard Library**
- Create **custom** Python **modules and import and use them into scripts**
- Apply object-oriented principles to modularisation by defining **classes, functions and other variables within modules**
- Get with **Python code style guidelines (PEP 8)**, type hinting **(PEP 484)**, and linting tools

Poll

Do you have Python installed and working well? Can you hello_world.py

- Yes
- No

animal.py

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

    def get_name(self):
        return self.name

    def get_age(self):
        return self.age

    def sleep(self):
        return f"{self.name} sleeps"

    def make_sound(self):
        pass

    def __str__(self):
        return f"Animal: {self.name}"
```

cat.py

```python
from animal import Animal

class Cat(Animal):
    def __init__(self, name, age):
        super(Cat, self).__init__(name, age)

    def make_sound(self):
        print("meow")

    # def sleep(self):
    #     print("cat sleeps")
```

dog.py

```python
from animal import Animal
from cat import Cat

class Dog(Animal):
    def __init__(self, name, age):
        super(Dog, self).__init__(name, age)
        self.cat_instance = Cat("", 0)

    def make_sound(self):
        print("wooo")

    def sleep(self):
        return self.cat_instance.sleep()
```

Poll

From the picture, why is this a bad design?

- The code demonstrates high coupling between classes due to interdependencies that may require changes in one class to be reflected in others.
- The code exhibits low coupling as each class is designed to be independent, minimising dependencies between them.
- The code shows moderate coupling because it relies on inheritance, which establishes a relationship between classes.
- The code doesn't display any significant coupling issues as it follows standard object-oriented principles.

Poll

How would you assess the level of cohesion in the provided object-oriented code?

- The code demonstrates high cohesion as each class encapsulates related functionality within itself.
- The code exhibits low cohesion because it contains unrelated methods within the same class.
- The code shows moderate cohesion due to its reliance on inheritance, which can lead to scattering of related functionality across multiple classes.
- The code doesn't display any significant cohesion issues as it adheres to standard object-oriented design principles.

Introduction

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Analogy

Just as a toolbox organizes various tools into separate compartments, modules in programming organize related **functions**, **classes**, and **variables** into **separate "compartments"** or **"drawers".** Each module serves a specific purpose, like a drawer containing tools for a particular task.

Just as you wouldn't mix your screwdrivers with your hammers, modules keep related elements separate and organised. When you need a specific function or variable, you can "open the drawer" (import the module) and access the tools (functions and variables) inside.

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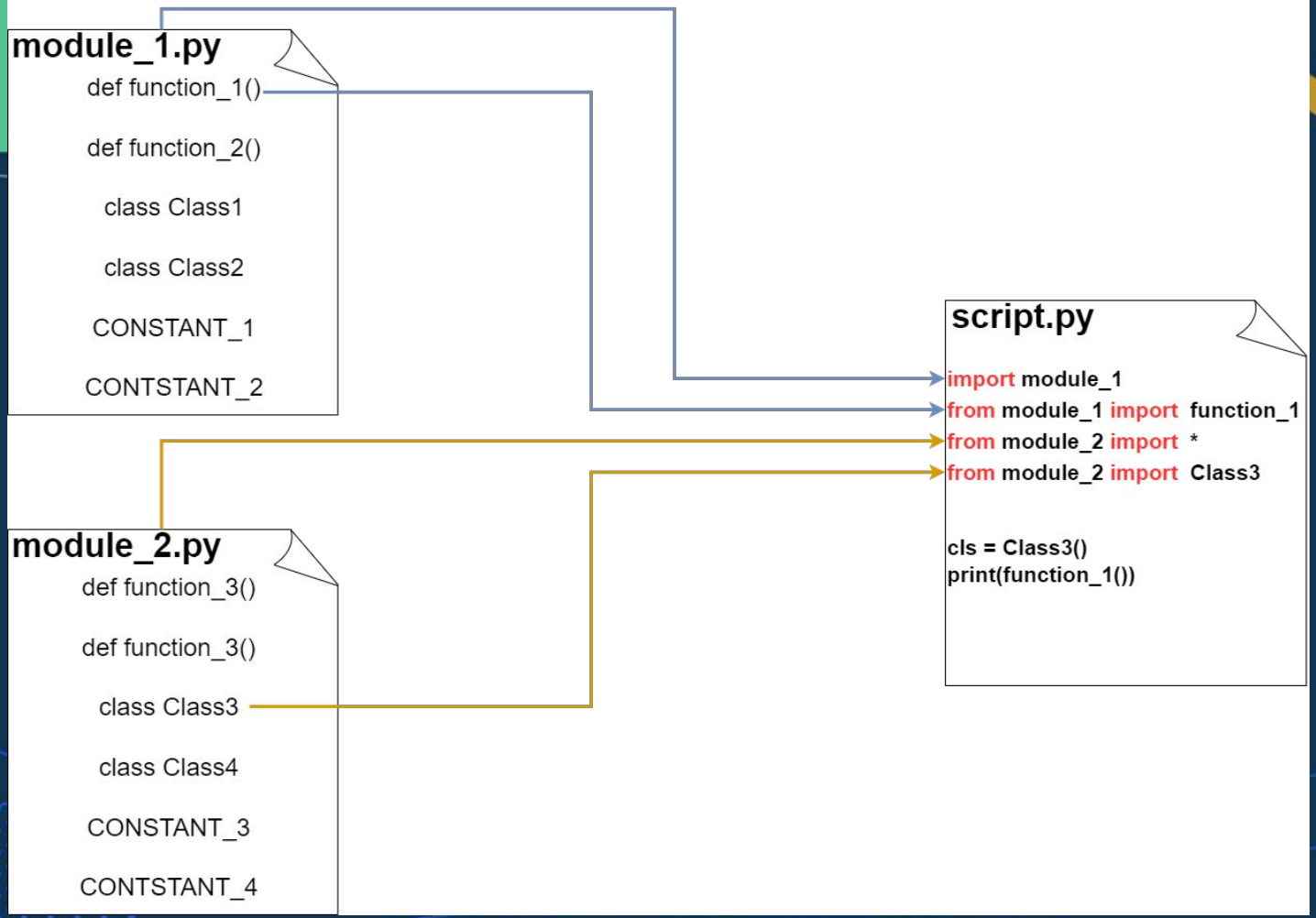
module_1.py
def function_1()
def function_2()
class Class1
class Class2
CONSTANT_1
CONTSTANT_2
module_2.py
def function_3()
def function_3()
class Class3
class Class4
CONSTANT_3
CONTSTANT_4
script.py
import module_1
from module_1 import function_1
from module_2 import *
from module_2 import Class3
cls = Class3()
print(function_1())

Differentiating Scripts, Modules, Packages, and Libraries

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Scripts

- A script is a standalone file containing executable Python code. It typically encapsulates a sequence of instructions to perform a specific task or set of tasks. It has the extension .py
- A Jupyter notebook is an interactive document that combines code, text, and visualisations in a browser-based environment, featuring cells for separate code execution and documentation, making automation challenging due to its interactive nature. It has the extension .ipynb

Scripts

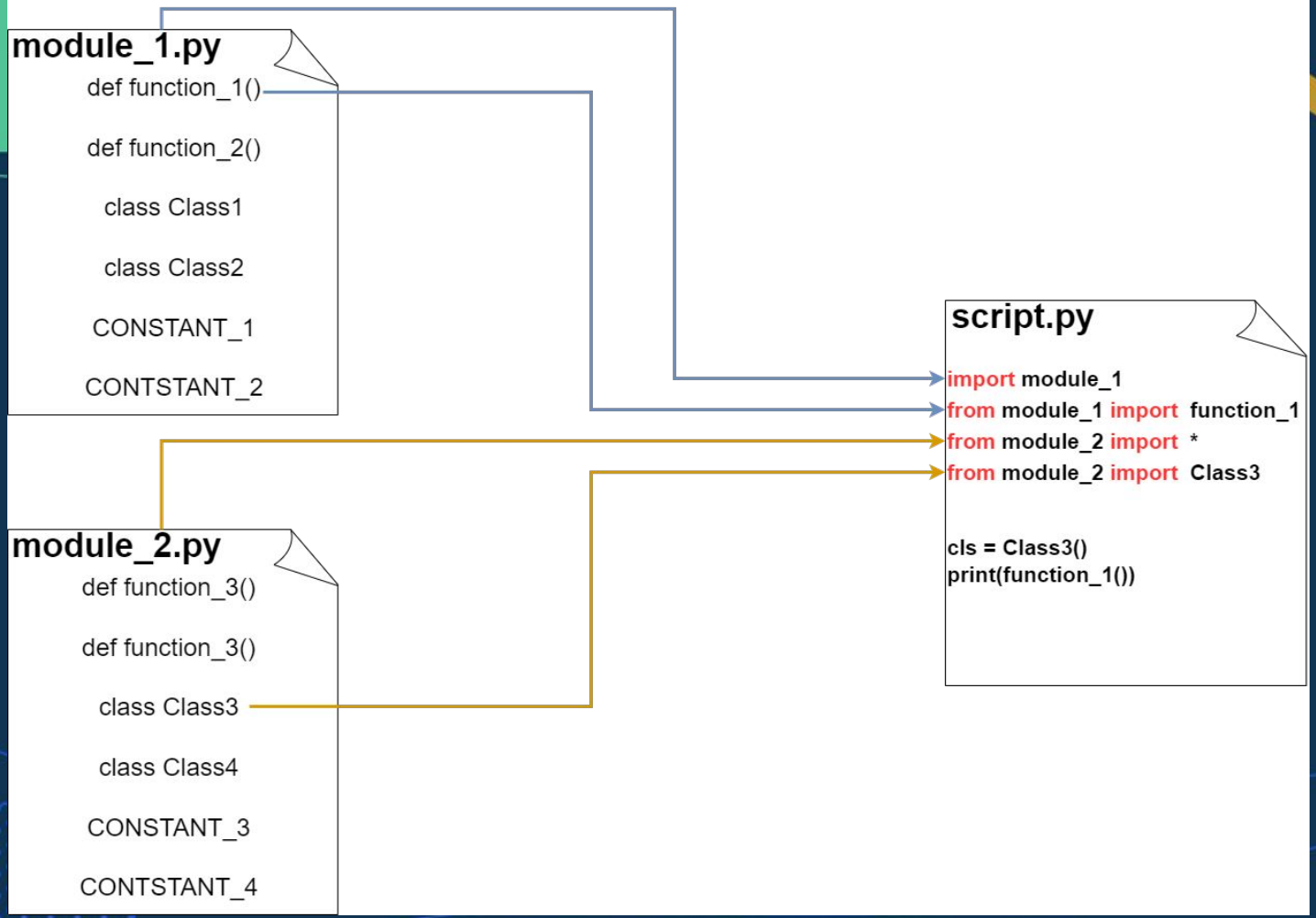
- Scripts are designed to accomplish a particular goal or solve a specific problem
- They often automate repetitive tasks, process data
- Scripts can be standalone programs or part of a larger software system, focusing on a specific functionality or aspect of the application
- Shouldn't be used to implement new classes or functions. Those are for modules.

Scripts

- "__name__" variable in Python:
  - Special variable managed by Python
  - Automatically set:
    - To "__main__" when script is run directly.
    - To module's name (filename) when executed as part of an import statement.

Scripts

```
from cat import Cat
from dog import Dog

dog_1 = Dog("Rocky", 5)
cat_1 = Cat("Charlie", 3)

if __name__ == "__main__":
    print(f"Dog 1: {dog_1}")
    print(f"Cat 1: {cat_1}")

    dog_1.get_name()
    cat_1.get_name()

    print(dog_1.sleep())
    print(cat_1.sleep())

    print(dog_1.make_sound())
    print(cat_1.make_sound())
```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CONTSTANT_2
module_2.py
def function_3()
def function_3()
class Class3
class Class4
CONSTANT_3
CONTSTANT_4
script.py
import module_1
from module_1 import function_1
from module_2 import *
from module_2 import Class3
cls = Class3()
print(function_1())

Module

- A module is a Python file (.py) that encapsulates reusable code elements such as functions, classes, and variables.
- They can be accessed by import-ing the module into other Python files (modules or scripts), enabling code reuse, maintenance and organization
- Once imported, the functionalities defined in the module can be accessed and utilised in any script that imports it.

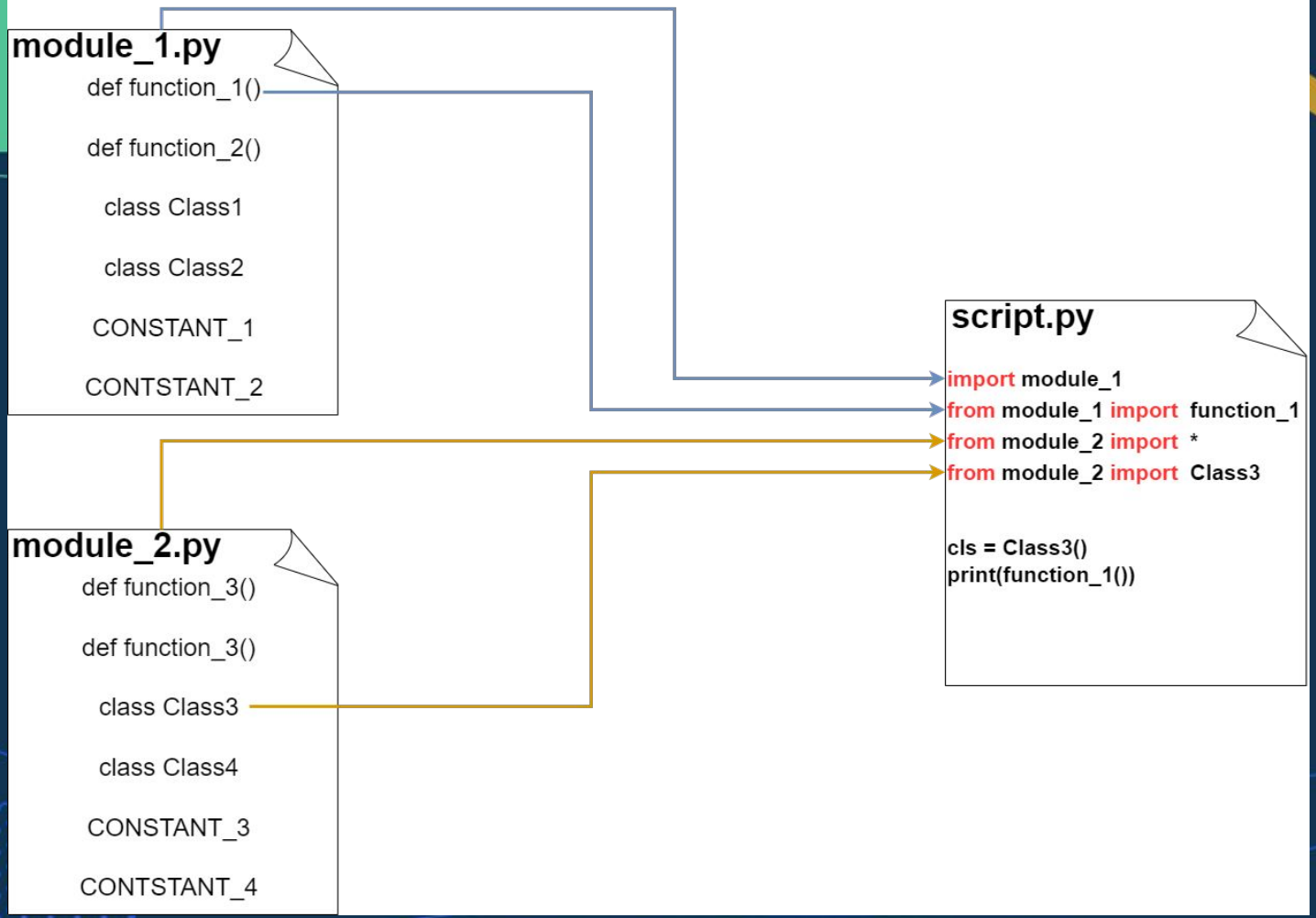
Module

Module-level names are global within the module, but they are not visible outside the module unless explicitly exported:

- Names defined at the module level, such as functions and variables, are accessible globally within the module
- However, these names are not visible to other scripts unless explicitly exported using techniques like the __all__ list or using the from module import * syntax
- This encapsulation ensures that module internals remain private unless explicitly exposed, promoting encapsulation and preventing namespace pollution.

```python
__all__ = ["addition", "subtraction", "division", "multiplication"]

def addition(x, y):
    return _addition(x, y)

def subtraction(x, y):
    return _subtraction(x, y)

def division(x, y):
    return _division(x, y)

def multiplication(x, y):
    return _multiplication(x, y)


def _addition(x, y):
    return x + y

def _subtraction(x, y):
    return x - y

def _division(x, y):
    return x / y

def _multiplication(x, y):
    return x * y
```

```python
from module_ops import *

x = 10
y = 20


if __name__ == "__main__":

    print(addition(x, y))
    print(subtraction(x, y))
    print(division(x, y))
    print(multiplication(x, y))
```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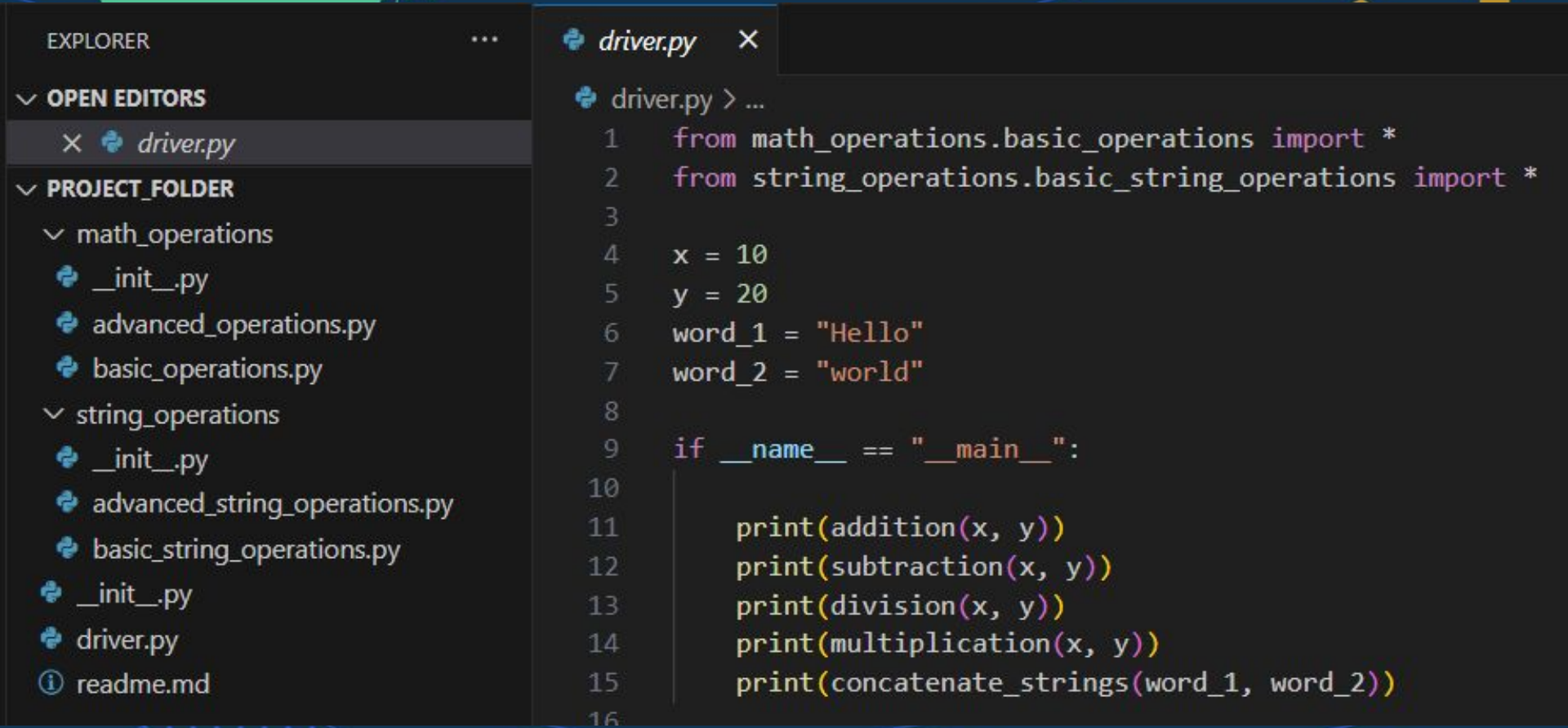
class Class4
CONSTANT_3
CONTSTANT_4
script.py
import module_1
from module_1 import function_1
from module_2 import *
from module_2 import Class3
cls = Class3()
print(function_1())

Package

- A package is a directory that contains Python modules, along with a special __init__.py file that signifies it as a Python package
- Packages are a way of structuring Python's module namespace by using "dotted module names". For example, the module name A.B designates a submodule named B in a package named A.
- The __init__.py file can be empty or contain initialisation code for the package
- This hierarchical structure aids in managing and navigating larger projects by grouping modules into logical units.


EXPLORER
OPEN EDITORS
driver.py
PROJECT_FOLDER
math_operations
__init__.py
advanced_operations.py
basic_operations.py
string_operations
__init__.py
advanced_string_operations.py
basic_string_operations.py
__init__.py
driver.py
readme.md
driver.py
driver.py > ...
1 from math_operations.basic_operations import *
2 from string_operations.basic_string_operations import *
3
4 x = 10
5 y = 20
6 word_1 = "Hello"
7 word_2 = "world"
8
9 if __name__ == "__main__":
10
11 print(addition(x, y))
12 print(subtraction(x, y))
13 print(division(x, y))
14 print(multiplication(x, y))
15 print(concatenate_strings(word_1, word_2))

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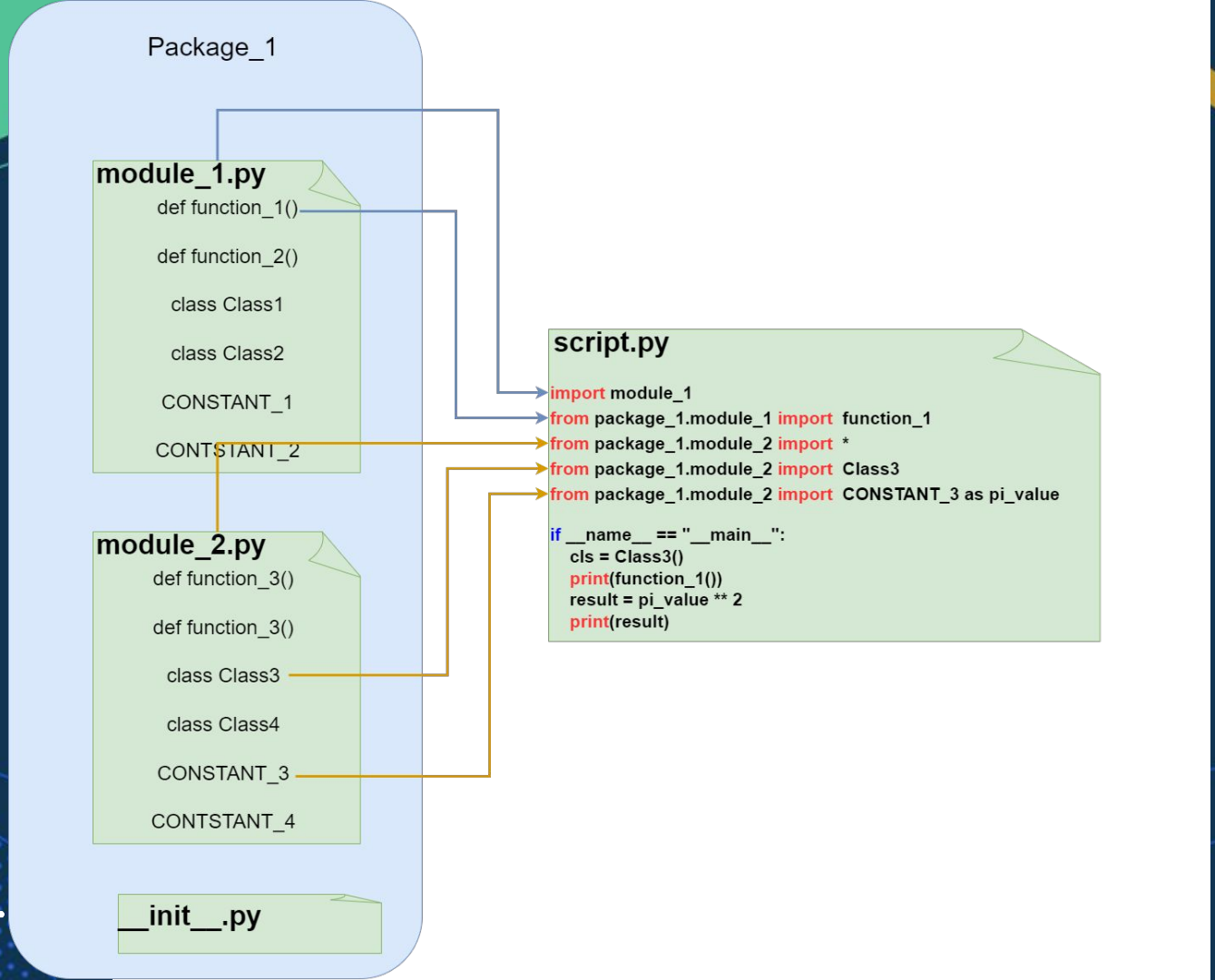
Package_1
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class Class2
CONSTANT_1
CONTSTANT_2
module_2.py
def function_3()
def function_3()
class Class3
class Class4
CONSTANT_3
CONTSTANT_4
__init__.py
script.py
import module_1
from package_1.module_1 import function_1
from package_1.module_2 import *
from package_1.module_2 import Class3
from package_1.module_2 import CONSTANT_3 as pi_value
if __name__ == "__main__":
cls = Class3()
print(function_1())
result = pi_value ** 2
print(result)

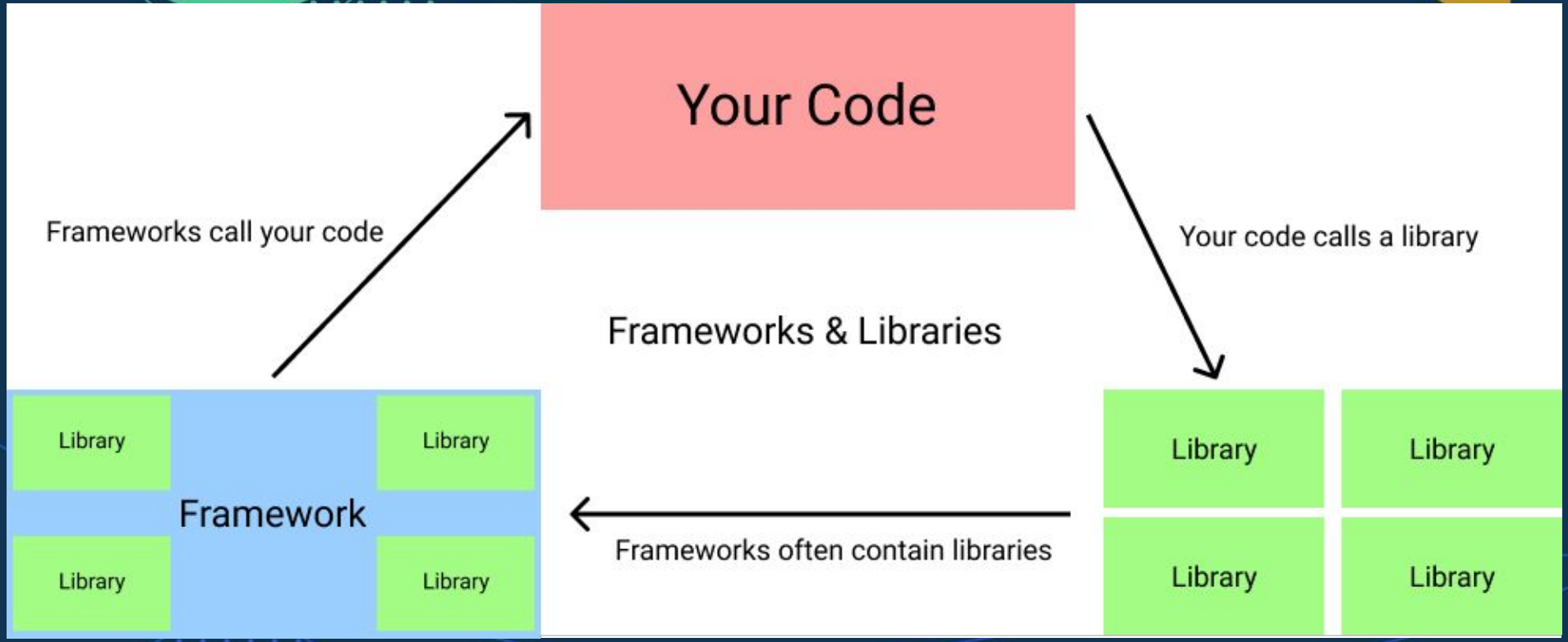
Library

- A library is fundamentally a collection of packages. Its objective is to offer a collection of ready-to-use features so that users won't need to be concerned about additional packages.

Framework

- Frameworks are pre-written code libraries that provide a structure and set of tools to simplify the development of web applications, APIs, and more.
- They offer a foundation for building applications by providing common functionalities and design patterns.

Framework


Your Code
Frameworks call your code
Your code calls a library
Frameworks & Libraries
Library
Library
Framework
Library
Library
Frameworks often contain libraries
Library
Library
Library
Library

Framework

django

Why all that?

1. **Code Organization**: Modules help organise code into logical units, making it easier to navigate and manage as your project grows.
2. **Reusability**: By encapsulating code into modules, you can reuse functions, classes, and variables across different parts of your program or in other projects, saving time and effort
3. **Maintainability**: Modular code is easier to maintain and update. Changes or fixes can be made to specific modules without affecting other parts of the codebase, leading to better organisation and collaboration among developers.

BREAK!

Python Standard Library Modules, pip and PyPi

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Python Standard Library

- The **Python Standard Library (PSL)** is a collection of modules and packages that come pre-installed with Python.
- The PSL contains all the built-in functions commonly used like: **min, max, float, int, eval, print** ← Those do not even need to be imported
- It is considered to be the set of pillars building up the Python language
- The **Python Standard Library** is comprehensive, providing developers with tools to accomplish common tasks without having to install additional third-party packages.

Python Standard Library: Common Modules

Although, many python keywords do not need to be imported, some need the **import** keyword to be used. Those are built-in modules:

- **print:** Allowing you to perform mathematical operations
- **random:** generating random numbers
- **datetime:** Enables manipulation of dates and times
- **os:** Allows you to interact with the operating system
- **math:** Allowing you to perform mathematical operations

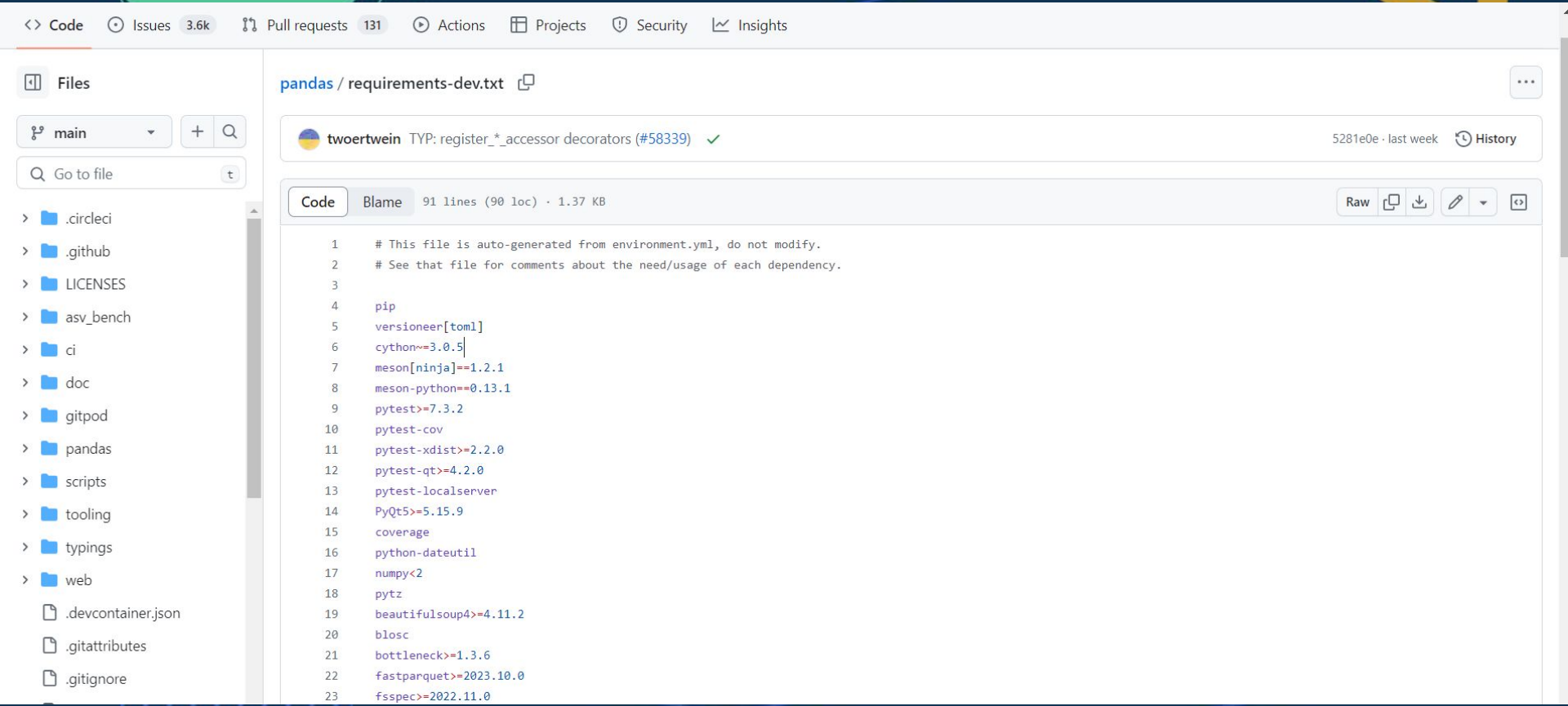
pip, PyPi

- **pip**: **Preferred Installer Program** is the package installer for Python. It allows you to install, upgrade, and manage Python packages from the Python Package Index (PyPi) or other sources. You can use pip to install third-party packages that are not included in the Python Standard Library.
- To install a new package: pip install new_package
- **PyPi:** PyPi is the official Python Package Index, a repository of software packages for Python. It hosts thousands of third-party packages that can be installed using pip.

Requirements File, and Virtual Environment

- **Requirements File**
  - Text file listing required Python packages and versions
  - Usually call **requirements.txt**
  - Ensures **exact dependencies** are installed for your project
  - **Facilitates replicating your environment for others**
- **Virtual Environment:**
  - Self-contained directory with Python interpreter and libraries
  - Isolates project dependencies
  - Prevents conflicts between projects or system-wide installations

Requirements File



Python Code Style and Type Hinting

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```
# Examine this code and decide whether it is correct or not. Why?

def AreaOfCircle(radius):
    area = 3.14159 * radius**2
    return area

def Print_Area(radius):
    print("The Area of the Circle with Radius", radius, "is", AreaOfCircle(radius))

def get_radius():
    radius = float(input("Enter the Radius of the Circle:"))
    return radius

def main():
     Radius=get_radius()
Print_Area(Radius)

if __name__=="__main__":
    main()
```

PEP 8 - Python Style Guide

- PEP 8 is the official style guide for Python code, providing guidelines on formatting, naming, and organising Python code.
- It aims to promote consistency and readability in Python code across projects and developers.
- It provides guidelines and best practices on how to write Python code

PEP 8 - Python Style Guide

Key Recommendations from PEP 8 (some)

- **Indentation**: Use 4 spaces (not tabs) per indentation level.
- **Maximum Line Length**: Limit all lines to a maximum of 79 characters.
- **Comments:** Comments that contradict the code are worse than no comments. Always make a priority of keeping the comments up-to-date when the code changes!
- **Class Names:** Class names should normally use the CapWords convention.
- **Method Names and Instance Variables:** Use the function naming rules: lowercase with words separated by underscores as necessary to improve readability.

PEP 8 Law Enforcement: Linting

- **Linting (Lint)** is the automated checking of your source code for programmatic and stylistic errors.
- Flags unused constructs such as variables and unreachable code
- Helps standardize code by replacing tabs with spaces or the other way around so that the codebase is written consistently.
- Makes it easier to review code because it ensures the reviewer that certain standards are already met.

Linting: Common Tools

flake8

Type Hinting (PEP 484)

- It is the practice of adding annotations to Python code to indicate the expected types of function parameters, return values, and variables.
- Introduced in PEP 484, type hinting helps improve code clarity and enables static analysis tools to catch type-related errors.
- Improves code clarity by documenting expected types.
- Enables static analysis tools to perform type checking, catching errors early.
- Facilitates code maintenance by making code easier to understand and modify.

Type Hinting (PEP 484)

Type hints can be added using annotations for function parameters, return values, and variable declarations.

Example:

```
from typing import Tuple

class Person:
    pass

def add(x: int, y: int) -> int:
    list_value: list[int] = [1, 2, 3, 4, 5]
    person: dict[str, str] = {"name": "Alice", "age":
"30"}
    learner: Person = Person("Alice", 30)
    Coordinates = Tuple[int, int]
    return 9
```

Practical Exercise: Building a GUI Python Calculator

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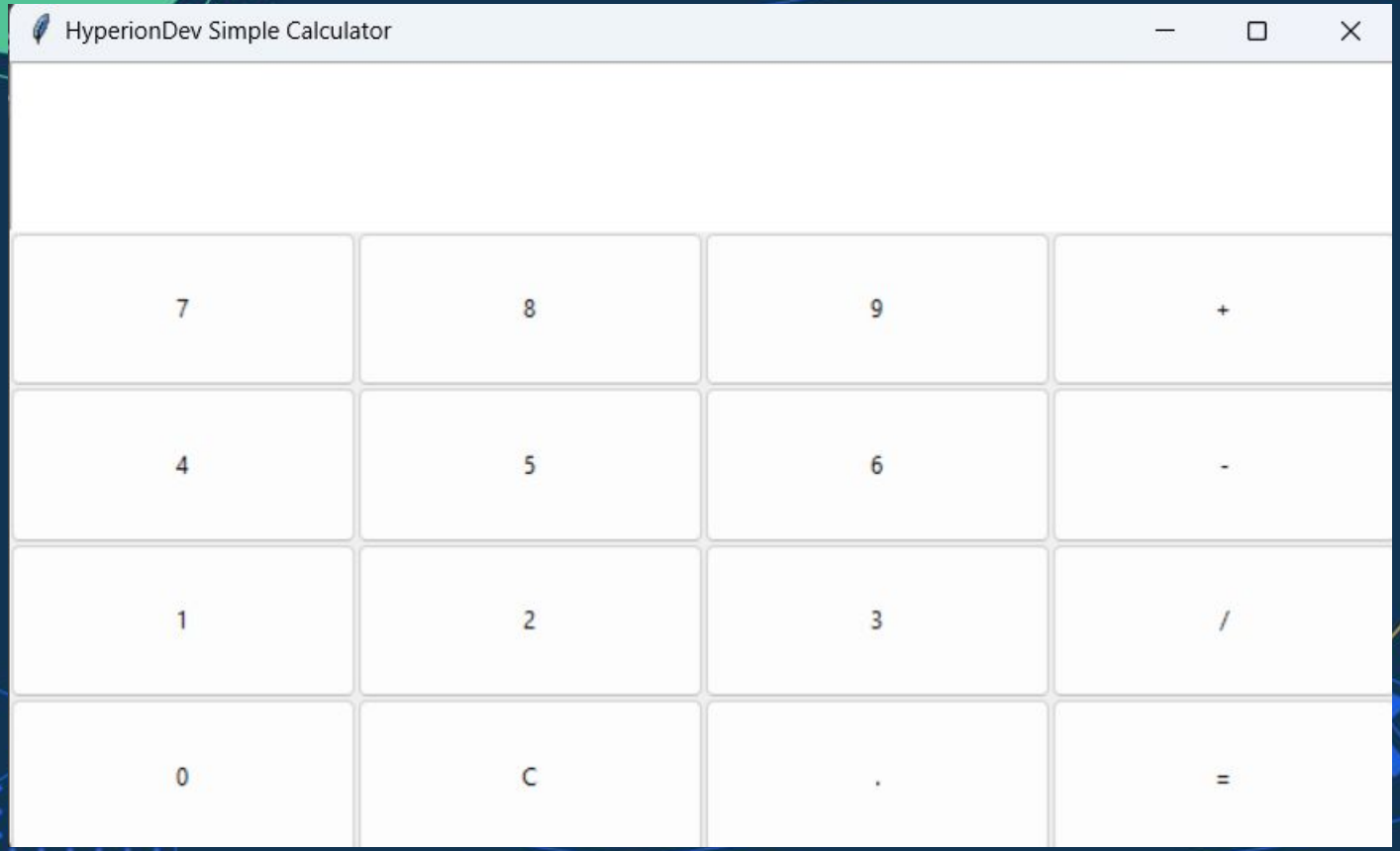

Objectives

I. **Design the Calculator GUI:**
   a. Design the layout of the calculator interface using tkinter, including buttons for digits, arithmetic operations, and clear/reset functionality.
   b. Organise GUI elements using layout managers (grid, pack, or place) and consider using frames for better organisation.

II. **Implement the Calculator Logic:**
   a. Create a Calculator class to encapsulate the logic and functionality of the calculator.
   b. Define methods within the Calculator class to perform arithmetic operations (addition, subtraction, multiplication, division) and handle user input.

Objectives

III. Modularization and Inheritance

a. Organise the code into separate modules for better maintainability and code organisation.

b. Create a module for the calculator GUI layout and functionality, and another module for the calculator logic

c. Utilise inheritance to extend functionality, if applicable (e.g., creating specialised calculator classes)

IV. Testing and Debugging:

a. Test the calculator's arithmetic operations

b. Debug any errors or issues encountered during testing, ensuring the calculator functions as expected

c. Use print statements or logging to debug and trace the flow of execution if necessary.

Final Assessment - Poll

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Poll

1 - Which of the following accurately describes the purpose of Python modules?

A. To organise code into reusable units and promote maintainability.

B. To execute specific tasks within a Python script

C. To provide graphical user interfaces (GUIs) for Python applications.

D. To manage dependencies between Python packages

Poll

2 - Given a Python script named main.py and a module named my_module.py in the same directory, what is the proper way to import the my_module module within main.py?

A. import my_module
B. from my_module import *
C. import my_module.py
D. import .my_module

Poll

3 - Given a Python module named my_module.py containing a function named my_function, how would you import and use this function within another Python script?

A. import my_module.my_function

B. from my_module import my_function

C. import my_function from my_module

D. from my_function import my_module

Lesson Conclusion and Recap

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Summary

- **Understanding Modules**
  - Modules are used in Python to organise code into reusable units, enhancing maintainability and readability.
- **Exploring Standard Library Modules**
  - Python's Standard Library offers a wide range of modules for common tasks, such as math calculations, file manipulation, and datetime operations.
- **Differentiating Components**
  - Scripts, modules, packages, and libraries serve distinct purposes in Python, with modules acting as reusable units of code.

Summary

- **Creating Custom Modules**
  - Create own modules by encapsulating related code in separate `.py` files, promoting code organisation and reusability.
- **Importing Modules**
  - Modules are imported into Python scripts using the `import` statement, providing access to their contents.
- **Understanding Object-Oriented Principles**
    i. Object-oriented programming principles like encapsulation and inheritance can be applied to modularisation, allowing for the creation of versatile and extensible modules.

Homework/ Follow-up Activities

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Homework/ Follow-up Activities

Use the code from the practical and add a factorial operation such that 5! = 120.

1. Add the factorial (!) button at the position of your choice
2. Add the factorial functionality
3. Make sure that the result comes out on the screen
4. Have a test case for it
5. Do not break the rest of the code

Questions and Answers

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References

- https://docs.python.org/3/library/index.html
- https://docs.python.org/3/library/functions.html
- https://www.toppr.com/guides/python-guide/references/methods-and-functions/python-standard-library-reference/
- https://peps.python.org/pep-0001/#what-is-a-pep
- https://peps.python.org/pep-0008/
- https://designenterprisestudio.com/2022/05/26/libraries-frameworks/

Thank you for attending

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