AI Assisted Coding Assignment-13.1

💡 **Task Description #1 (Refactoring – Removing Code Duplication)**

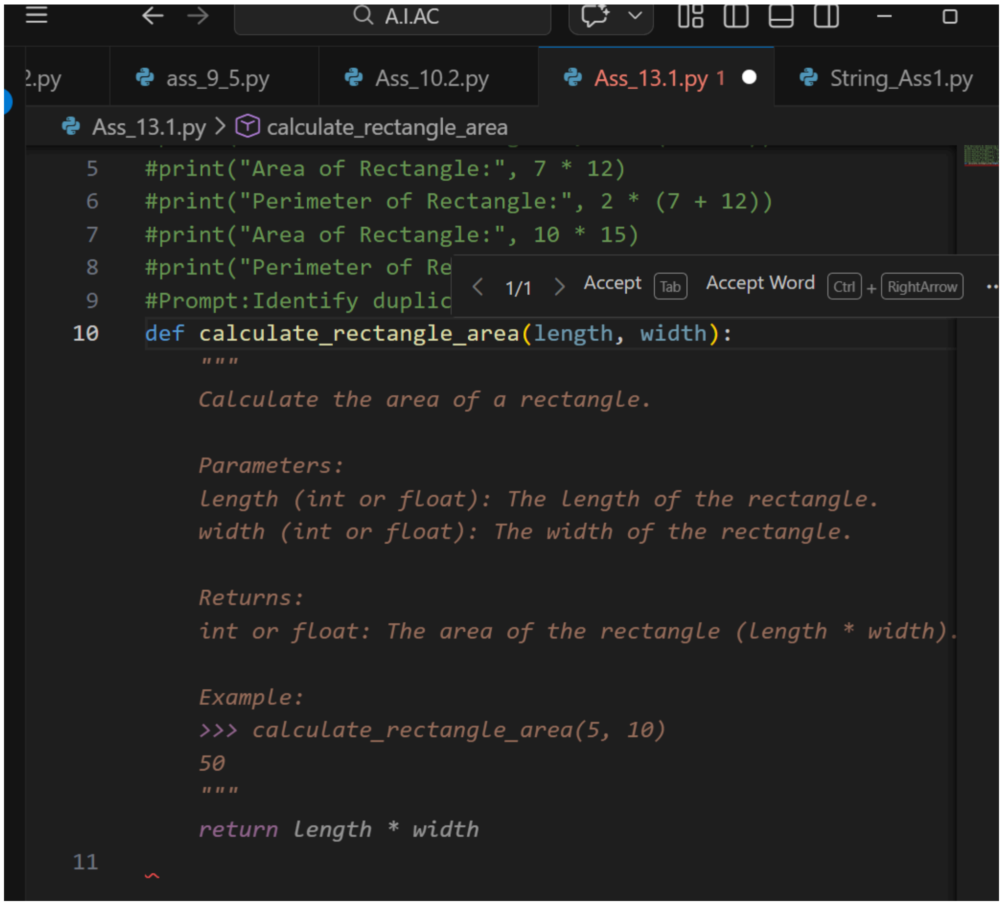
- Task: Use AI to refactor a given Python script that contains multiple repeated code blocks.
- Instructions:
    - Prompt AI to identify duplicate logic and replace it with functions or classes.
    - Ensure the refactored code maintains the same output.
    - Add docstrings to all functions.
- Sample Legacy Code:

```
# Legacy script with repeated logic
print("Area of Rectangle:", 5 * 10)
print("Perimeter of Rectangle:", 2 * (5 + 10))
print("Area of Rectangle:", 7 * 12)
print("Perimeter of Rectangle:", 2 * (7 + 12))
print("Area of Rectangle:", 10 * 15)
print("Perimeter of Rectangle:", 2 * (10 + 15))
```

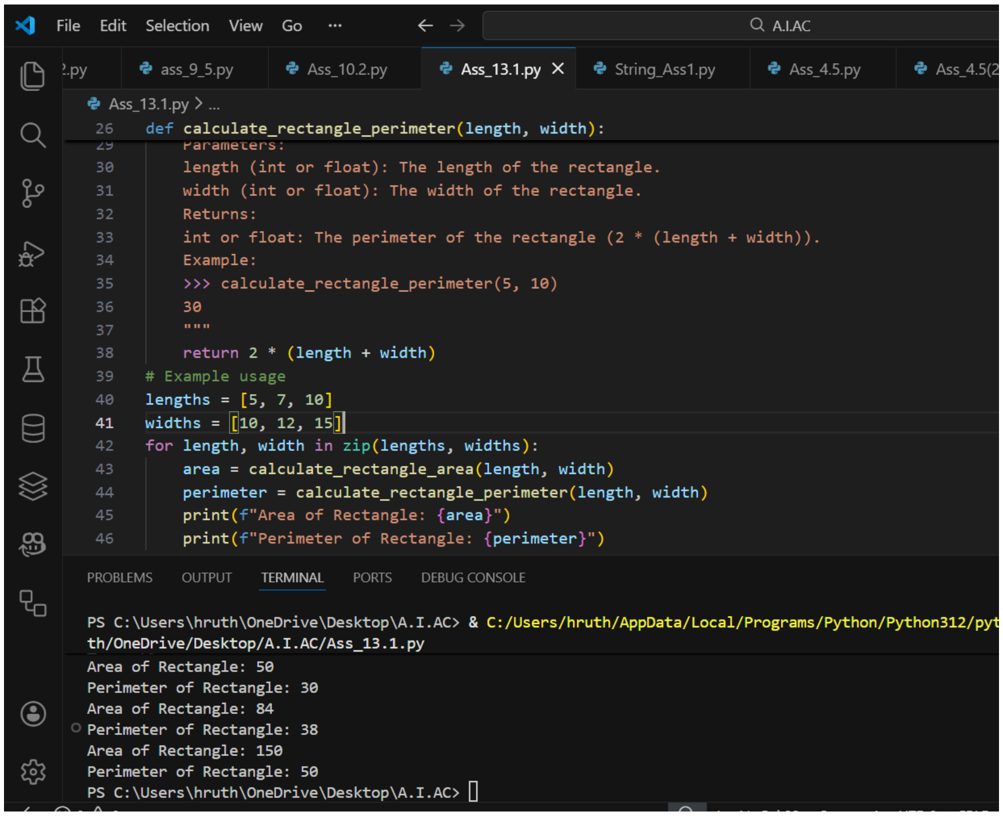
- Expected Output:
    - Refactored code with a reusable function and no duplication.

Well documented code

```
#2303A51543
#Task Description #1 (Refactoring – Removing Code Duplication)
# Legacy script with repeated logic
#print("Area of Rectangle:", 5 * 10)
#print("Perimeter of Rectangle:", 2 * (5 + 10))
#print("Area of Rectangle:", 7 * 12)
#print("Perimeter of Rectangle:", 2 * (7 + 12))
#print("Area of Rectangle:", 10 * 15)
#print("Perimeter of Rectangle:", 2 * (10 + 15))
#Prompt:Identify duplicate logic and replace it with functions or classes.o Add docstring
s to all functions.
def calculate_rectangle_area(length, width):
    """
    Calculate the area of a rectangle.

    Parameters:
    length (int or float): The length of the rectangle.
    width (int or float): The width of the rectangle.

    Returns:
    int or float: The area of the rectangle (length * width).

    Example:
    >>> calculate_rectangle_area(5, 10)
    50
    """
    return length * width
def calculate_rectangle_perimeter(length, width):
    """
    Calculate the perimeter of a rectangle.
    Parameters:
    length (int or float): The length of the rectangle.
    width (int or float): The width of the rectangle.
    Returns:
    int or float: The perimeter of the rectangle (2 * (length + width)).
    Example:
    >>> calculate_rectangle_perimeter(5, 10)
    30
    """
    return 2 * (length + width)
# Example usage
lengths = [5, 7, 10]
widths = [10, 12, 15]
for length, width in zip(lengths, widths):
    area = calculate_rectangle_area(length, width)
    perimeter = calculate_rectangle_perimeter(length, width)
    print(f"Area of Rectangle: {area}")
    print(f"Perimeter of Rectangle: {perimeter}")
```



```python
#print("Area of Rectangle:", 7 * 12)
#print("Perimeter of Rectangle:", 2 * (7 + 12))
#print("Area of Rectangle:", 10 * 15)
#print("Perimeter of Re
#Prompt:Identify duplic
def calculate_rectangle_area(length, width):
    """
    Calculate the area of a rectangle.

    Parameters:
    length (int or float): The length of the rectangle.
    width (int or float): The width of the rectangle.

    Returns:
    int or float: The area of the rectangle (length * width).

    Example:
    >>> calculate_rectangle_area(5, 10)
    50
    """
    return length * width
```



```
def calculate_rectangle_perimeter(length, width):
        Parameters:
        length (int or float): The length of the rectangle.
        width (int or float): The width of the rectangle.
        Returns:
        int or float: The perimeter of the rectangle (2 * (length + width)).
        Example:
        >>> calculate_rectangle_perimeter(5, 10)
        30
        """
        return 2 * (length + width)
# Example usage
lengths = [5, 7, 10]
widths = [10, 12, 15]
for length, width in zip(lengths, widths):
    area = calculate_rectangle_area(length, width)
    perimeter = calculate_rectangle_perimeter(length, width)
    print(f"Area of Rectangle: {area}")
    print(f"Perimeter of Rectangle: {perimeter}")
```

```
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC> & C:/Users/hruth/AppData/Local/Programs/Python/Python312/pyt
th/OneDrive/Desktop/A.I.AC/Ass_13.1.py
Area of Rectangle: 50
Perimeter of Rectangle: 30
Area of Rectangle: 84
Perimeter of Rectangle: 38
Area of Rectangle: 150
Perimeter of Rectangle: 50
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC> 
```

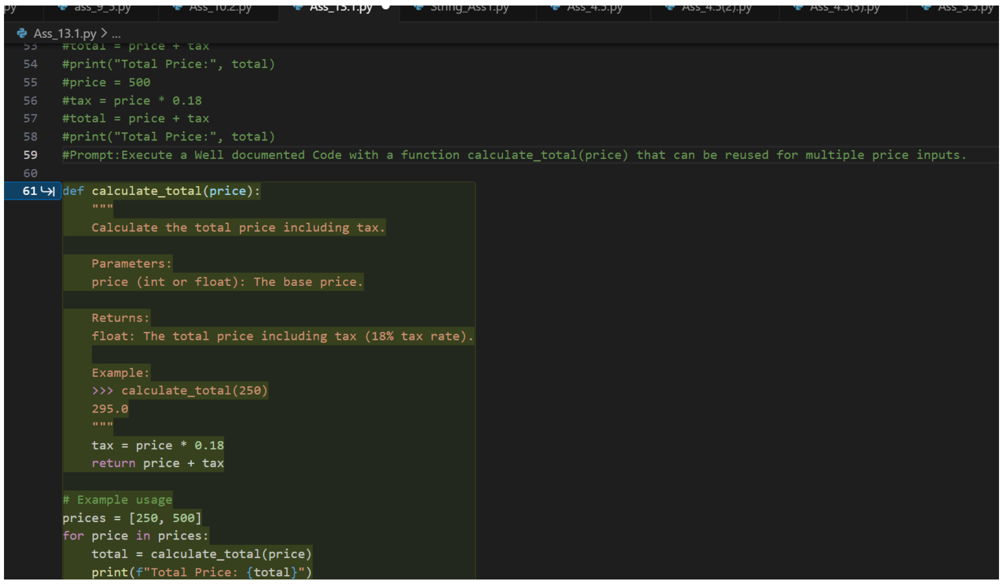
💡 **Task Description #2 (Refactoring – Extracting Reusable Functions)**

- Task: Use AI to refactor a legacy script where multiple calculations are embedded directly inside the main code block.
- Instructions:
  - Identify repeated or related logic and extract it into reusable functions.
  - Ensure the refactored code is modular, easy to read, and documented with docstrings.
- Sample Legacy Code:

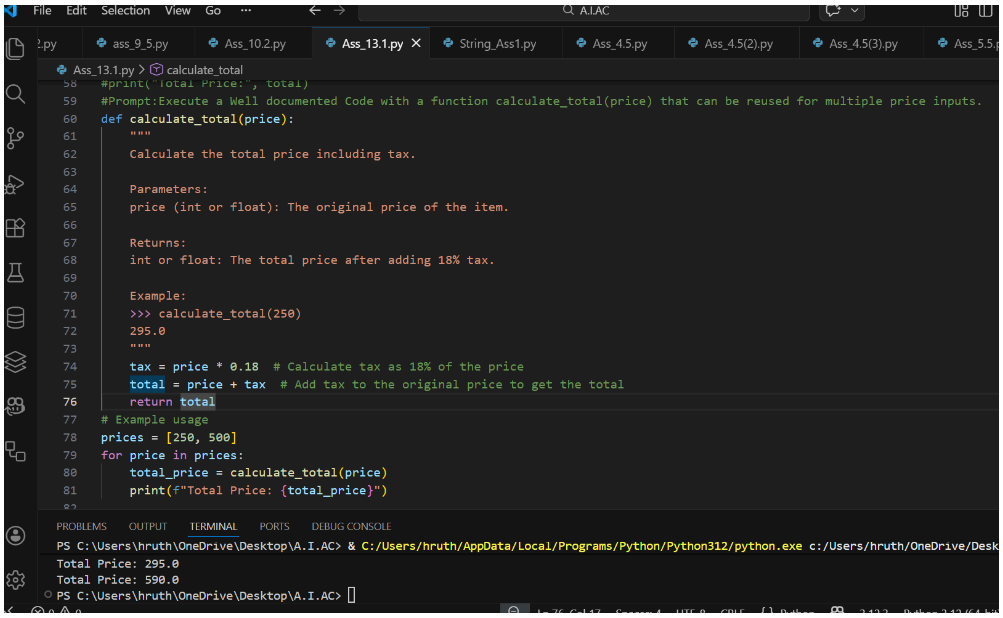
```
# Legacy script with inline repeated logic
price = 250
tax = price * 0.18
total = price + tax
print("Total Price:", total)
price = 500
tax = price * 0.18
total = price + tax
print("Total Price:", total)
```

- Expected Output:
  - Code with a function calculate_total(price) that can be reused for multiple price inputs.
  - Well documented code

```
#Task Description #2 (Refactoring – Extracting Reusable Functions)
# Legacy script with inline repeated logic
#price = 250
#tax = price * 0.18
#total = price + tax
#print("Total Price:", total)
#price = 500
#tax = price * 0.18
#total = price + tax
#print("Total Price:", total)
#Prompt:Execute a Well documented Code with a function calculate_total(price) that can be
reused for multiple price inputs.
def calculate_total(price):
    """
    Calculate the total price including tax.
    Parameters:
    price (int or float): The original price of the item.
    Returns:
    int or float: The total price after adding 18% tax.
    Example:
    >>> calculate_total(250)
    295.0
    """
    tax = price * 0.18  # Calculate tax as 18% of the price
    total = price + tax  # Add tax to the original price to get the total
    return total
# Example usage
prices = [250, 500]
for price in prices:
    total_price = calculate_total(price)
    print(f"Total Price: {total_price}")
```



```
#total = price + tax
#print("Total Price:", total)
#price = 500
#tax = price * 0.18
#total = price + tax
#print("Total Price:", total)
#Prompt:Execute a Well documented Code with a function calculate_total(price) that can be reused for multiple price inputs.

def calculate_total(price):
    """
    Calculate the total price including tax.

    Parameters:
    price (int or float): The base price.

    Returns:
    float: The total price including tax (18% tax rate).

    Example:
    >>> calculate_total(250)
    295.0
    """
    tax = price * 0.18
    return price + tax

# Example usage
prices = [250, 500]
for price in prices:
    total = calculate_total(price)
    print(f"Total Price: {total}")
```



```python
#print("Total Price:", total)
#Prompt:Execute a Well documented Code with a function calculate_total(price) that can be reused for multiple price inputs.
def calculate_total(price):
    """
    Calculate the total price including tax.

    Parameters:
    price (int or float): The original price of the item.

    Returns:
    int or float: The total price after adding 18% tax.

    Example:
    >>> calculate_total(250)
    295.0
    """
    tax = price * 0.18  # Calculate tax as 18% of the price
    total = price + tax  # Add tax to the original price to get the total
    return total
# Example usage
prices = [250, 500]
for price in prices:
    total_price = calculate_total(price)
    print(f"Total Price: {total_price}")
```

```
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC> & C:/Users/hruth/AppData/Local/Programs/Python/Python312/python.exe c:/Users/hruth/OneDrive/Desk
Total Price: 295.0
Total Price: 590.0
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC>
```

💡 **Task Description #3: Refactoring Using Classes and Methods (Eliminating Redundant Conditional Logic)**
Refactor a Python script that contains repeated if–elif–else grading logic by implementing a structured, object-oriented solution using a class and a method.
Problem Statement
The given script contains duplicated conditional statements used to assign grades based on student marks. This redundancy violates clean code principles and reduces maintainability.
You are required to refactor the script using a class-based design to improve modularity, reusability, and readability while preserving the original grading logic.
Mandatory Implementation Requirements

1. Class Name: GradeCalculator
2. Method Name: calculate_grade(self, marks)
3. The method must:
    - Accept marks as a parameter.
    - Return the corresponding grade as a string.
    - The grading logic must strictly follow the conditions below:

- Marks ≥ 90 and ≤ 100 → "Grade A"
- Marks ≥ 80 → "Grade B"
- Marks ≥ 70 → "Grade C"
- Marks ≥ 40 → "Grade D"
- Marks ≥ 0 → "Fail"

Note: Assume marks are within the valid range of 0 to 100.

1. Include proper docstrings for:
    - The class
    - The method (with parameter and return descriptions)
2. The method must be reusable and called multiple times without rewriting conditional logic.

- Given code:

```
marks = 85
if marks >= 90:
print("Grade A")
elif marks >= 75:
print("Grade B")
else:
print("Grade C")
marks = 72
if marks >= 90:
print("Grade A")
elif marks >= 75:
print("Grade B")
else:
print("Grade C")
```

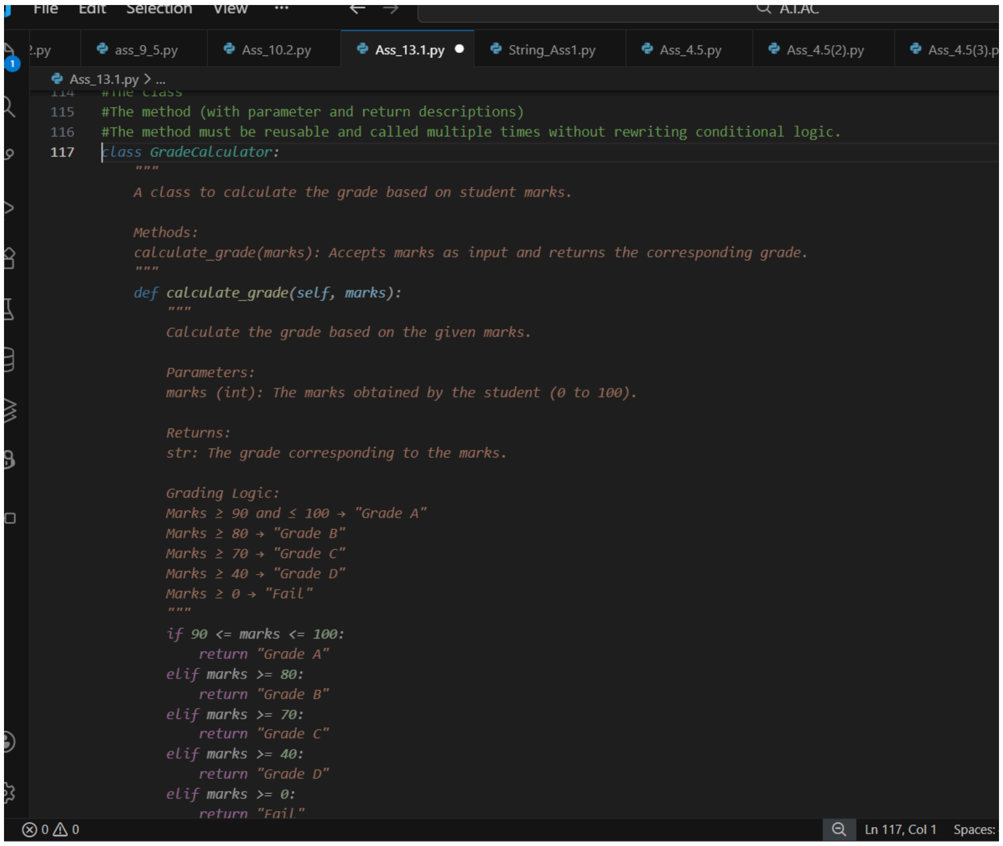
Expected Output:

- Define a class named GradeCalculator.

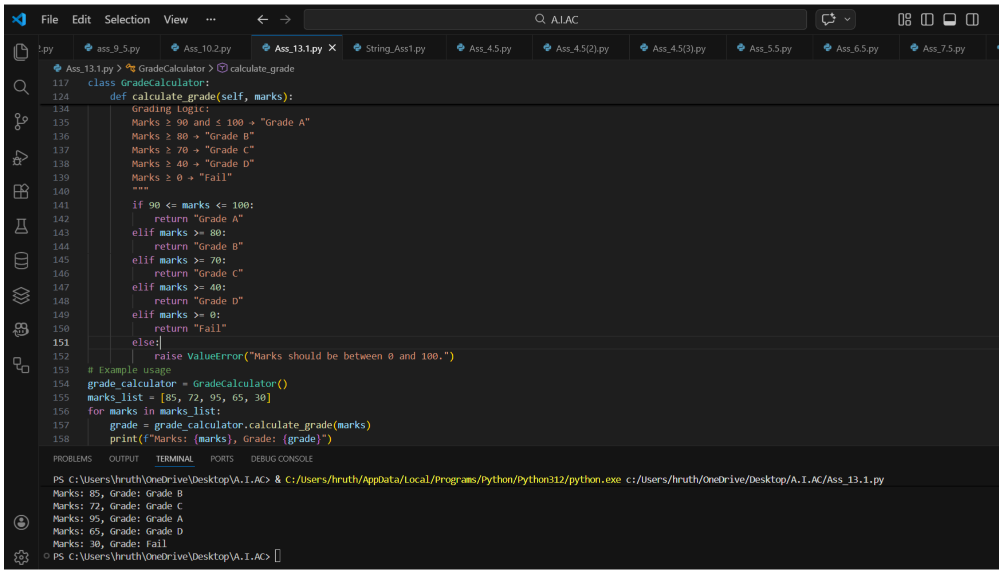
- Implement a method calculate_grade(self, marks) inside the class.
- Create an object of the class.
- Call the method for different student marks.
- Print the returned grade values.

```
#Task Description #3: Refactoring Using Classes and Methods (Eliminating Redundant Condit
ional Logic)
#Given code:
#marks = 85
#if marks >= 90:
#    print("Grade A")
#elif marks >= 75:
#    print("Grade B")
#else:
#    print("Grade C")
#marks = 72
#if marks >= 90:
#    print("Grade A")
#elif marks >= 75:
#    print("Grade B")
#else:
#    print("Grade C")
#Prompt:The given script contains duplicated conditional statements used to assign grades
based on student marks. This redundancy violates clean code principles and reduces mainta
inability.You are required to refactor the script using a class-based design to improve m
odularity, reusability, and readability while preserving the original grading logic.
#Mandatory Implementation Requirements
#1. Class Name: GradeCalculator
#2. Method Name: calculate_grade(self, marks)
#3. The method must:
#Accept marks as a parameter.
#Return the corresponding grade as a string.
#The grading logic must strictly follow the conditions below:
#Marks ≥ 90 and ≤ 100 → "Grade A"
#Marks ≥ 80 → "Grade B"
#Marks ≥ 70 → "Grade C"
#Marks ≥ 40 → "Grade D"
#Marks ≥ 0 → "Fail"
#Note: Assume marks are within the valid range of 0 to 100.
#Include proper docstrings for:
#The class
#The method (with parameter and return descriptions)
#The method must be reusable and called multiple times without rewriting conditional logi
c.
class GradeCalculator:
    """
    A class to calculate the grade based on student marks.
    Methods:
```

```
    calculate_grade(marks): Accepts marks as input and returns the corresponding grade.
    """
    def calculate_grade(self, marks):
        """
        Calculate the grade based on the given marks.
        Parameters:
        marks (int): The marks obtained by the student (0 to 100).
        Returns:
        str: The grade corresponding to the marks.
        Grading Logic:
        Marks ≥ 90 and ≤ 100 → "Grade A"
        Marks ≥ 80 → "Grade B"
        Marks ≥ 70 → "Grade C"
        Marks ≥ 40 → "Grade D"
        Marks ≥ 0 → "Fail"
        """
        if 90 <= marks <= 100:
            return "Grade A"
        elif marks >= 80:
            return "Grade B"
        elif marks >= 70:
            return "Grade C"
        elif marks >= 40:
            return "Grade D"
        elif marks >= 0:
            return "Fail"
        else:
            raise ValueError("Marks should be between 0 and 100.")
# Example usage
grade_calculator = GradeCalculator()
marks_list = [85, 72, 95, 65, 30]
for marks in marks_list:
    grade = grade_calculator.calculate_grade(marks)
    print(f"Marks: {marks}, Grade: {grade}")
```



```python
#The class
#The method (with parameter and return descriptions)
#The method must be reusable and called multiple times without rewriting conditional logic.
class GradeCalculator:
    """
    A class to calculate the grade based on student marks.

    Methods:
    calculate_grade(marks): Accepts marks as input and returns the corresponding grade.
    """
    def calculate_grade(self, marks):
        """
        Calculate the grade based on the given marks.

        Parameters:
        marks (int): The marks obtained by the student (0 to 100).

        Returns:
        str: The grade corresponding to the marks.

        Grading Logic:
        Marks ≥ 90 and ≤ 100 → "Grade A"
        Marks ≥ 80 → "Grade B"
        Marks ≥ 70 → "Grade C"
        Marks ≥ 40 → "Grade D"
        Marks ≥ 0 → "Fail"
        """
        if 90 <= marks <= 100:
            return "Grade A"
        elif marks >= 80:
            return "Grade B"
        elif marks >= 70:
            return "Grade C"
        elif marks >= 40:
            return "Grade D"
        elif marks >= 0:
            return "Fail"
```



```python
class GradeCalculator:
    def calculate_grade(self, marks):
        Grading Logic:
        Marks ≥ 90 and ≤ 100 → "Grade A"
        Marks ≥ 80 → "Grade B"
        Marks ≥ 70 → "Grade C"
        Marks ≥ 40 → "Grade D"
        Marks ≥ 0 → "Fail"
        """
        if 90 <= marks <= 100:
            return "Grade A"
        elif marks >= 80:
            return "Grade B"
        elif marks >= 70:
            return "Grade C"
        elif marks >= 40:
            return "Grade D"
        elif marks >= 0:
            return "Fail"
        else:
            raise ValueError("Marks should be between 0 and 100.")
# Example usage
grade_calculator = GradeCalculator()
marks_list = [85, 72, 95, 65, 30]
for marks in marks_list:
    grade = grade_calculator.calculate_grade(marks)
    print(f"Marks: {marks}, Grade: {grade}")
```

```
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC> & C:/Users/hruth/AppData/Local/Programs/Python/Python312/python.exe c:/Users/hruth/OneDrive/Desktop/A.I.AC/Ass_13.1.py
Marks: 85, Grade: Grade B
Marks: 72, Grade: Grade C
Marks: 95, Grade: Grade A
Marks: 65, Grade: Grade D
Marks: 30, Grade: Fail
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC>
```

💡 **Task Description #4 (Refactoring – Converting Procedural Code to Functions)**

- **Task: Use AI to refactor procedural input–processing logic into functions.**

Instructions:
o Identify input, processing, and output sections.
o Convert each into a separate function.
o Improve code readability without changing behavior.

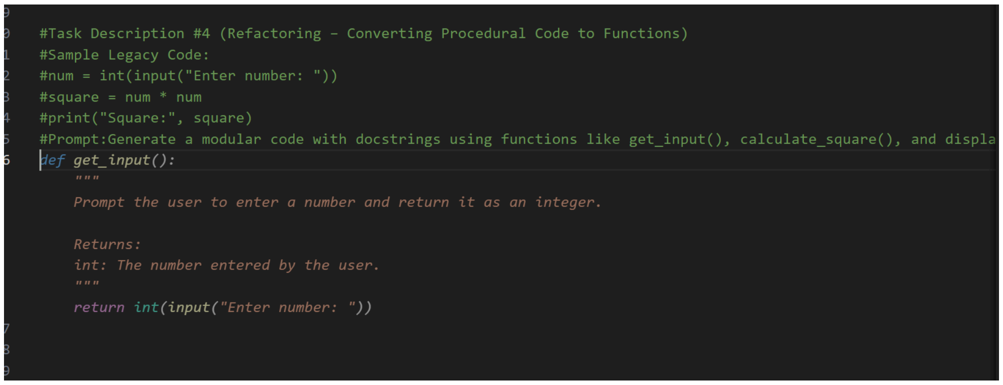
- Sample Legacy Code:

num = int(input("Enter number: "))
square = num * num
print("Square:", square)

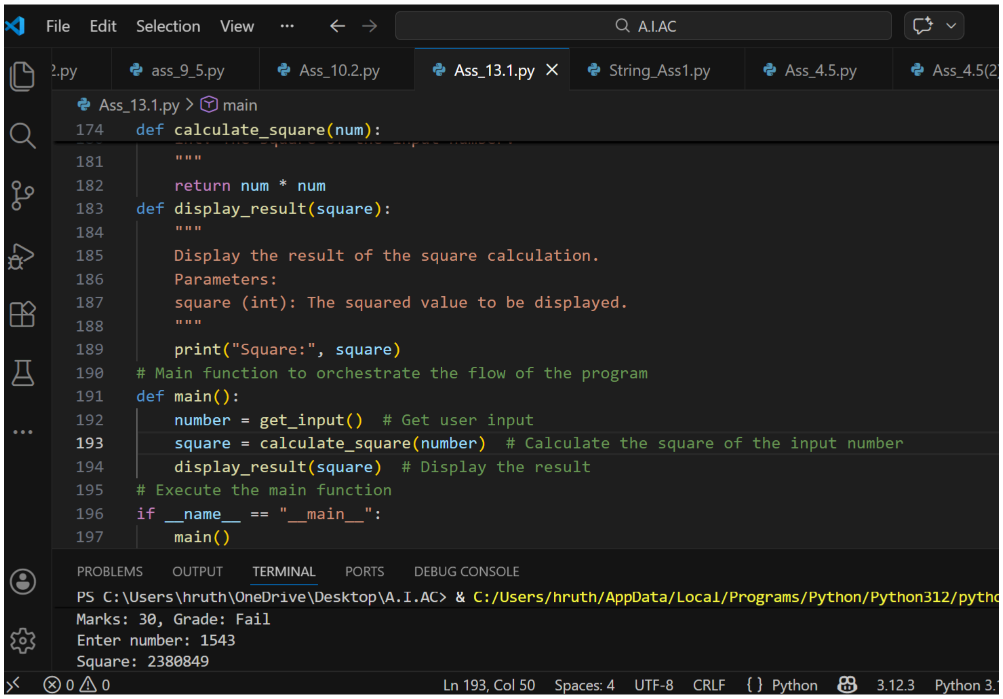
- Expected Output:

o Modular code using functions like get_input(), calculate_square(), and display_result().

```
#Task Description #4 (Refactoring – Converting Procedural Code to Functions)
#Sample Legacy Code:
#num = int(input("Enter number: "))
#square = num * num
#print("Square:", square)
#Prompt:Generate a modular code with docstrings using functions like get_input(), calcula
te_square(), and display_result().To refactor procedural input–processing logic into func
tions.
def get_input():
    """
    Prompt the user to enter a number and return it as an integer.
    Returns:
    int: The number entered by the user.
    """
    return int(input("Enter number: "))
def calculate_square(num):
    """
    Calculate the square of a given number.
    Parameters:
    num (int): The number to be squared.
    Returns:
    int: The square of the input number.
    """
    return num * num
def display_result(square):
    """
    Display the result of the square calculation.
    Parameters:
    square (int): The squared value to be displayed.
    """
    print("Square:", square)
# Main function to orchestrate the flow of the program
def main():
    number = get_input()  # Get user input
    square = calculate_square(number)  # Calculate the square of the input number
    display_result(square)  # Display the result
# Execute the main function
if __name__ == "__main__":
    main()
```



```
#Task Description #4 (Refactoring - Converting Procedural Code to Functions)
#Sample Legacy Code:
#num = int(input("Enter number: "))
#square = num * num
#print("Square:", square)
#Prompt:Generate a modular code with docstrings using functions like get_input(), calculate_square(), and displa
def get_input():
    """
    Prompt the user to enter a number and return it as an integer.

    Returns:
    int: The number entered by the user.
    """
    return int(input("Enter number: "))
```



```
def calculate_square(num):
    """
    return num * num
def display_result(square):
    """
    Display the result of the square calculation.
    Parameters:
    square (int): The squared value to be displayed.
    """
    print("Square:", square)
# Main function to orchestrate the flow of the program
def main():
    number = get_input()  # Get user input
    square = calculate_square(number)  # Calculate the square of the input number
    display_result(square)  # Display the result
# Execute the main function
if __name__ == "__main__":
    main()
```

```
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC> & C:/Users/hruth/AppData/Local/Programs/Python/Python312/pytho
Marks: 30, Grade: Fail
Enter number: 1543
Square: 2380849
```

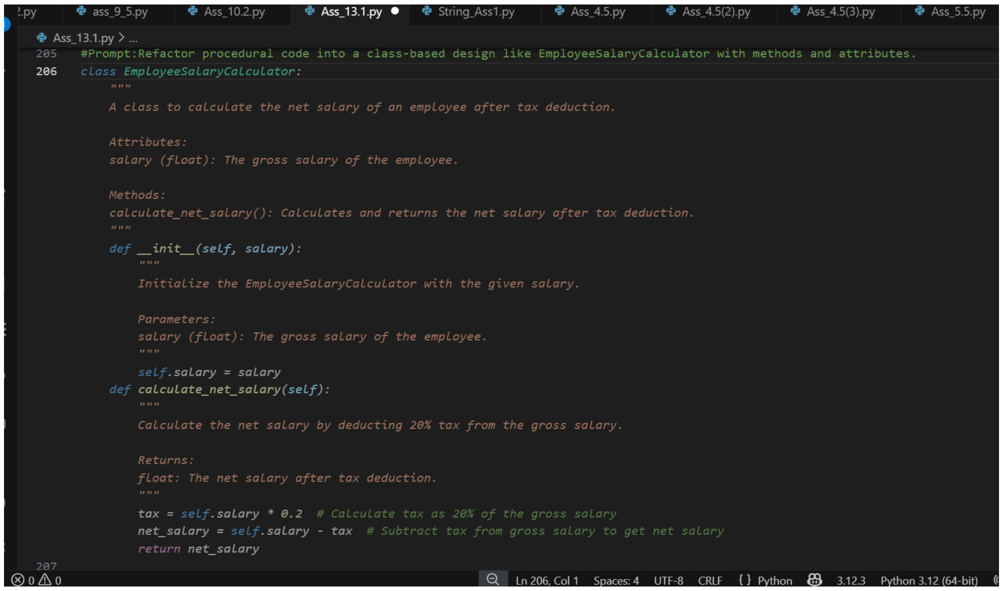
💡 **Task 5 (Refactoring Procedural Code into OOP Design)**

- **Task: Use AI to refactor procedural code into a class-based design.Focus Areas:**o Object-Oriented principleso Encapsulation

Legacy Code:
salary = 50000
tax = salary * 0.2
net = salary - tax
print(net)
Expected Outcome:
o A class like EmployeeSalaryCalculator with methods and attributes.

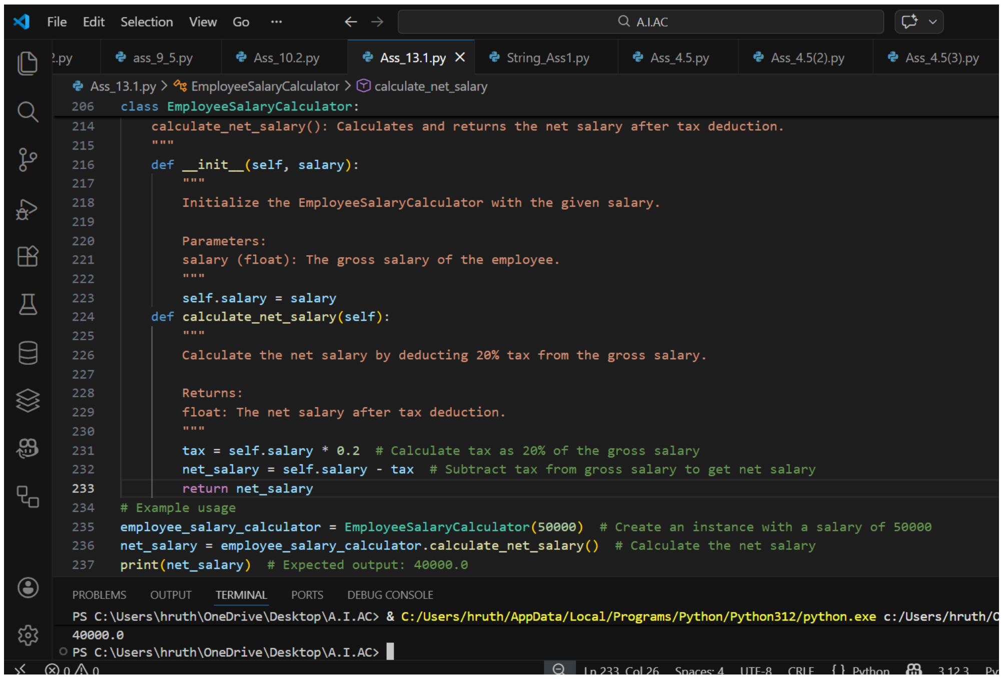
```
#Task 5 (Refactoring Procedural Code into OOP Design)
#Legacy Code:
#salary = 50000
#tax = salary * 0.2
#net = salary - tax
#print(net)
#Prompt:Refactor procedural code into a class-based design like EmployeeSalaryCalculator
with methods and attributes.
class EmployeeSalaryCalculator:
    """
    A class to calculate the net salary of an employee after tax deduction.
    Attributes:
    salary (float): The gross salary of the employee.
    Methods:
    calculate_net_salary(): Calculates and returns the net salary after tax deduction.
    """
    def __init__(self, salary):
        """
        Initialize the EmployeeSalaryCalculator with the given salary.
        Parameters:
        salary (float): The gross salary of the employee.
        """
        self.salary = salary
    def calculate_net_salary(self):
        """
        Calculate the net salary by deducting 20% tax from the gross salary.
        Returns:
        float: The net salary after tax deduction.
        """
        tax = self.salary * 0.2  # Calculate tax as 20% of the gross salary
        net_salary = self.salary - tax  # Subtract tax from gross salary to get net salar
y
        return net_salary
# Example usage
employee_salary_calculator = EmployeeSalaryCalculator(50000)  # Create an instance with a
salary of 50000
net_salary = employee_salary_calculator.calculate_net_salary()  # Calculate the net salar
```

```
y
print(net_salary)  # Expected output: 40000.0
```



```
#Prompt:Refactor procedural code into a class-based design like EmployeeSalaryCalculator with methods and attributes.
class EmployeeSalaryCalculator:
    """
    A class to calculate the net salary of an employee after tax deduction.

    Attributes:
    salary (float): The gross salary of the employee.

    Methods:
    calculate_net_salary(): Calculates and returns the net salary after tax deduction.
    """
    def __init__(self, salary):
        """
        Initialize the EmployeeSalaryCalculator with the given salary.

        Parameters:
        salary (float): The gross salary of the employee.
        """
        self.salary = salary
    def calculate_net_salary(self):
        """
        Calculate the net salary by deducting 20% tax from the gross salary.

        Returns:
        float: The net salary after tax deduction.
        """
        tax = self.salary * 0.2  # Calculate tax as 20% of the gross salary
        net_salary = self.salary - tax  # Subtract tax from gross salary to get net salary
        return net_salary
```

Ass_13.1.py
Ln 206, Col 1   Spaces: 4   UTF-8   CRLF   { } Python   3.12.3   Python 3.12 (64-bit)



```
class EmployeeSalaryCalculator:
    calculate_net_salary(): Calculates and returns the net salary after tax deduction.
    """
    def __init__(self, salary):
        """
        Initialize the EmployeeSalaryCalculator with the given salary.

        Parameters:
        salary (float): The gross salary of the employee.
        """
        self.salary = salary
    def calculate_net_salary(self):
        """
        Calculate the net salary by deducting 20% tax from the gross salary.

        Returns:
        float: The net salary after tax deduction.
        """
        tax = self.salary * 0.2  # Calculate tax as 20% of the gross salary
        net_salary = self.salary - tax  # Subtract tax from gross salary to get net salary
        return net_salary
# Example usage
employee_salary_calculator = EmployeeSalaryCalculator(50000)  # Create an instance with a salary of 50000
net_salary = employee_salary_calculator.calculate_net_salary()  # Calculate the net salary
print(net_salary)  # Expected output: 40000.0
```

```
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC> & C:/Users/hruth/AppData/Local/Programs/Python/Python312/python.exe c:/Users/hruth/
40000.0
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC>
```

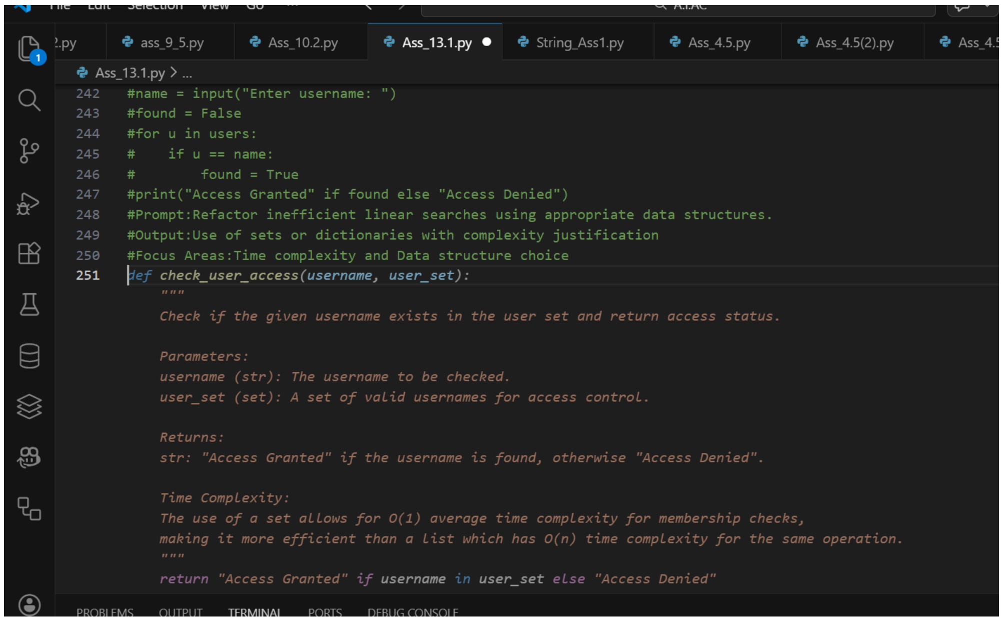
File Edit Selection View Go ...
A.I.AC
Ass_13.1.py > EmployeeSalaryCalculator > calculate_net_salary
PROBLEMS   OUTPUT   TERMINAL   PORTS   DEBUG CONSOLE

💡 **Task 6 (Optimizing Search Logic)**

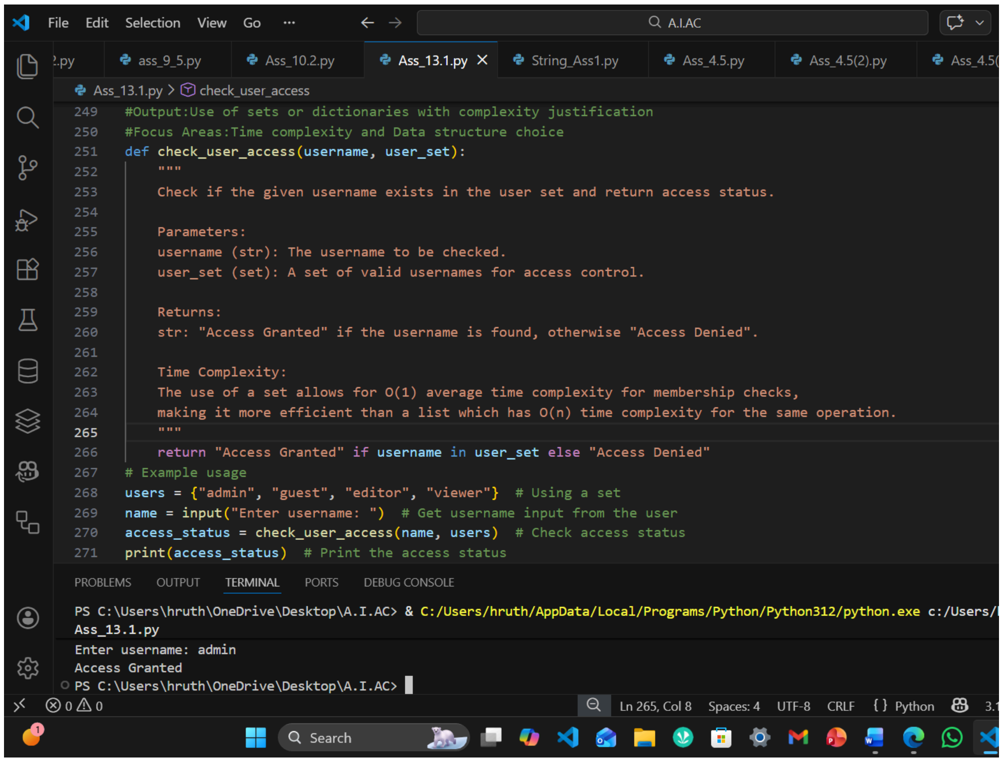
- **Task: Refactor inefficient linear searches using appropriate data structures.**Focus Areas:o Time complexityo Data structure choice

Legacy Code:
users = ["admin", "guest", "editor", "viewer"]
name = input("Enter username: ")
found = False
for u in users:
if u == name:
found = True
print("Access Granted" if found else "Access Denied")
Expected Outcome:
o Use of sets or dictionaries with complexity justification

```
#Task 6 (Optimizing Search Logic)
#Legacy Code:
#users = ["admin", "guest", "editor", "viewer"]
#name = input("Enter username: ")
#found = False
#for u in users:
#    if u == name:
#        found = True
#print("Access Granted" if found else "Access Denied")
#Prompt:Refactor inefficient linear searches using appropriate data structures.
#Output:Use of sets or dictionaries with complexity justification
#Focus Areas:Time complexity and Data structure choice
def check_user_access(username, user_set):
    """
    Check if the given username exists in the user set and return access status.
    Parameters:
    username (str): The username to be checked.
    user_set (set): A set of valid usernames for access control.
    Returns:
    str: "Access Granted" if the username is found, otherwise "Access Denied".
    Time Complexity:
    The use of a set allows for O(1) average time complexity for membership checks,
    making it more efficient than a list which has O(n) time complexity for the same oper
ation.
    """
    return "Access Granted" if username in user_set else "Access Denied"
# Example usage
users = {"admin", "guest", "editor", "viewer"}  # Using a set
name = input("Enter username: ")  # Get username input from the user
access_status = check_user_access(name, users)  # Check access status
print(access_status)  # Print the access status
```



```
#name = input("Enter username: ")
#found = False
#for u in users:
#    if u == name:
#        found = True
#print("Access Granted" if found else "Access Denied")
#Prompt:Refactor inefficient linear searches using appropriate data structures.
#Output:Use of sets or dictionaries with complexity justification
#Focus Areas:Time complexity and Data structure choice
def check_user_access(username, user_set):
    """
    Check if the given username exists in the user set and return access status.

    Parameters:
    username (str): The username to be checked.
    user_set (set): A set of valid usernames for access control.

    Returns:
    str: "Access Granted" if the username is found, otherwise "Access Denied".

    Time Complexity:
    The use of a set allows for O(1) average time complexity for membership checks,
    making it more efficient than a list which has O(n) time complexity for the same operation.
    """
    return "Access Granted" if username in user_set else "Access Denied"
```



```
#Output:Use of sets or dictionaries with complexity justification
#Focus Areas:Time complexity and Data structure choice
def check_user_access(username, user_set):
    """
    Check if the given username exists in the user set and return access status.

    Parameters:
    username (str): The username to be checked.
    user_set (set): A set of valid usernames for access control.

    Returns:
    str: "Access Granted" if the username is found, otherwise "Access Denied".

    Time Complexity:
    The use of a set allows for O(1) average time complexity for membership checks,
    making it more efficient than a list which has O(n) time complexity for the same operation.
    """
    return "Access Granted" if username in user_set else "Access Denied"
# Example usage
users = {"admin", "guest", "editor", "viewer"}  # Using a set
name = input("Enter username: ")  # Get username input from the user
access_status = check_user_access(name, users)  # Check access status
print(access_status)  # Print the access status
```

```
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC> & C:/Users/hruth/AppData/Local/Programs/Python/Python312/python.exe c:/Users/
Ass_13.1.py
Enter username: admin
Access Granted
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC>
```

Task 7 – Refactoring the Library Management System
Problem Statement
You are provided with a poorly structured Library Management script that:

- Contains repeated conditional logic
- Does not use reusable functions
- Lacks documentation
- Uses print-based procedural execution
- Does not follow modular programming principles

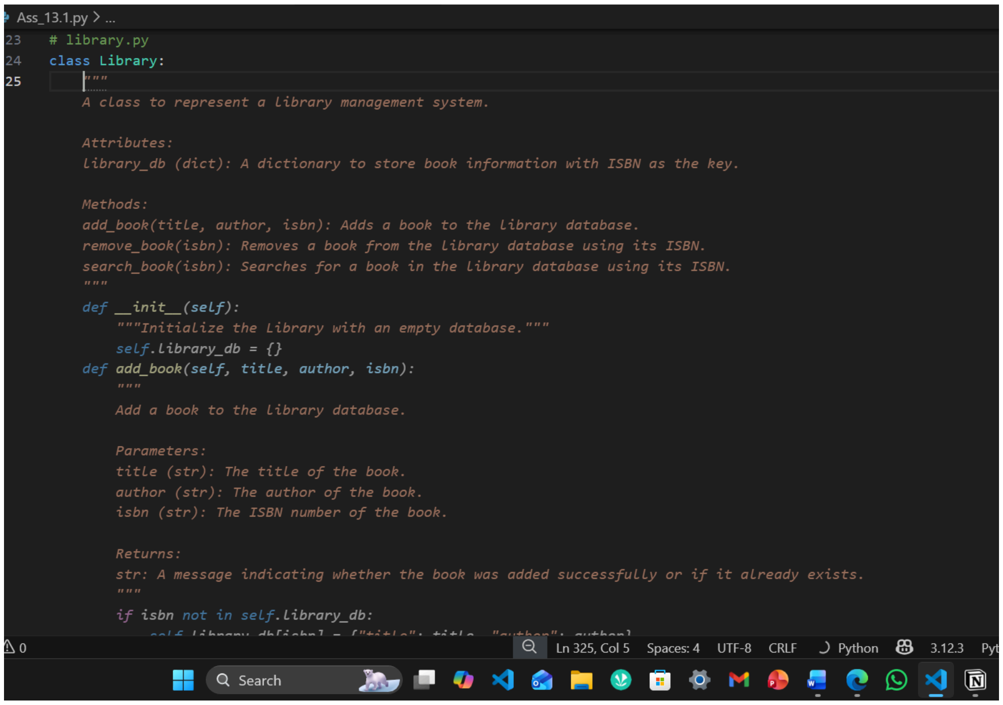
Your task is to refactor the code into a proper format

1. Create a module library.py with functions:
    - add_book(title, author, isbn)
    - remove_book(isbn)
    - search_book(isbn)
2. Insert triple quotes under each function and let Copilot complete the docstrings.
3. Generate documentation in the terminal.
4. Export the documentation in HTML format.
5. Open the file in a browser.

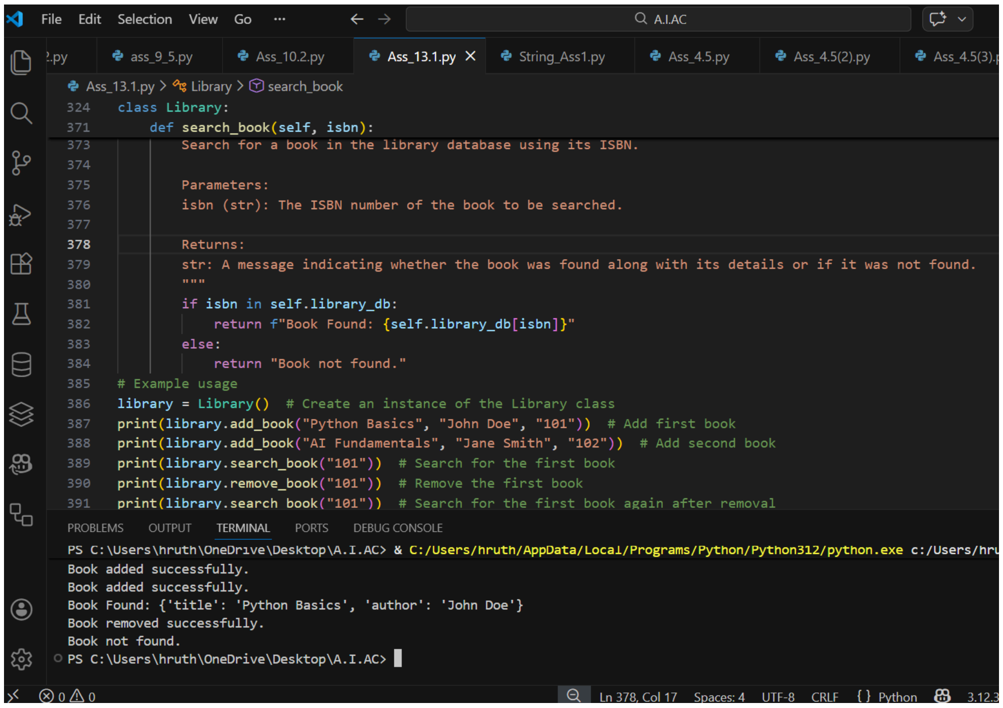
Given Code
```
# Library Management System (Unstructured Version)
# This code needs refactoring into a proper module with documentation.
library_db = {}
# Adding first book
title = "Python Basics"
author = "John Doe"
isbn = "101"
if isbn not in library_db:
library_db[isbn] = {"title": title, "author": author}
print("Book added successfully.")
else:
print("Book already exists.")
# Adding second book (duplicate logic)
title = "AI Fundamentals"
author = "Jane Smith"
isbn = "102"
if isbn not in library_db:
library_db[isbn] = {"title": title, "author": author}
print("Book added successfully.")
else:
print("Book already exists.")
# Searching book (repeated logic structure)
isbn = "101"
if isbn in library_db:
print("Book Found:", library_db[isbn])
else:
```

```
print("Book not found.")
# Removing book (again repeated pattern)
isbn = "101"
if isbn in library_db:
del library_db[isbn]
print("Book removed successfully.")
else:
print("Book not found.")
#Searching again
isbn = "101"
if isbn in library_db:
print("Book Found:", library_db[isbn])
else:
print("Book not found.")
```

```
#Task 7 – Refactoring the Library Management System
# Library Management System (Unstructured Version)
# This code needs refactoring into a proper module with documentation.
#library_db = {}
# Adding first book
#title = "Python Basics"
#author = "John Doe"
#isbn = "101"
#if isbn not in library_db:
#    library_db[isbn] = {"title": title, "author": author}
#    print("Book added successfully.")
#else:
#    print("Book already exists.")
# Adding second book (duplicate logic)
#title = "AI Fundamentals"
#author = "Jane Smith"
#isbn = "102"
#if isbn not in library_db:
#   library_db[isbn] = {"title": title, "author": author}
#    print("Book added successfully.")
#else:
#    print("Book already exists.")
# Searching book (repeated logic structure)
#isbn = "101"
#if isbn in library_db:
#    print("Book Found:", library_db[isbn])
#else:
#    print("Book not found.")
# Removing book (again repeated pattern)
#isbn = "101"
#if isbn in library_db:
#    del library_db[isbn]
#   print("Book removed successfully.")
#else:
#    print("Book not found.")
# Searching again
#isbn = "101"
#if isbn in library_db:
#    print("Book Found:", library_db[isbn])
#else:
#    print("Book not found.")
#Prompt:Refactor the code into a proper format
#1. Create a module library.py with functions:
#add_book(title, author, isbn)
#remove_book(isbn)
#search_book(isbn)
#2. Insert triple quotes under each function and let Copilot complete the docstrings.
#3. Generate documentation in the terminal.
#4. Export the documentation in HTML format.
#5. Open the file in a browser.
# library.py
class Library:
    """
    A class to represent a library management system.

    Attributes:
    library_db (dict): A dictionary to store book information with ISBN as the key.

    Methods:
    add_book(title, author, isbn): Adds a book to the library database.
    remove_book(isbn): Removes a book from the library database using its ISBN.
    search_book(isbn): Searches for a book in the library database using its ISBN.
    """
    def __init__(self):
        """Initialize the Library with an empty database."""
        self.library_db = {}
    def add_book(self, title, author, isbn):
        """
        Add a book to the library database.

        Parameters:
        title (str): The title of the book.
        author (str): The author of the book.
        isbn (str): The ISBN number of the book.

        Returns:
        str: A message indicating whether the book was added successfully or if it alread
y exists.
        """
        if isbn not in self.library_db:
            self.library_db[isbn] = {"title": title, "author": author}
            return "Book added successfully."
        else:
            return "Book already exists."
    def remove_book(self, isbn):
        """
        Remove a book from the library database using its ISBN.

        Parameters:
        isbn (str): The ISBN number of the book to be removed.

        Returns:
        str: A message indicating whether the book was removed successfully or if it was
not found.
        """
        if isbn in self.library_db:
            del self.library_db[isbn]
            return "Book removed successfully."
        else:
            return "Book not found."
    def search_book(self, isbn):
        """
        Search for a book in the library database using its ISBN.

        Parameters:
        isbn (str): The ISBN number of the book to be searched.

        Returns:
        str: A message indicating whether the book was found along with its details or if
it was not found.
        """
        if isbn in self.library_db:
            return f"Book Found: {self.library_db[isbn]}"
        else:
            return "Book not found."
# Example usage
library = Library()  # Create an instance of the Library class
print(library.add_book("Python Basics", "John Doe", "101"))  # Add first book
print(library.add_book("AI Fundamentals", "Jane Smith", "102"))  # Add second book
print(library.search_book("101"))  # Search for the first book
print(library.remove_book("101"))  # Remove the first book
print(library.search_book("101"))  # Search for the first book again after removal
```

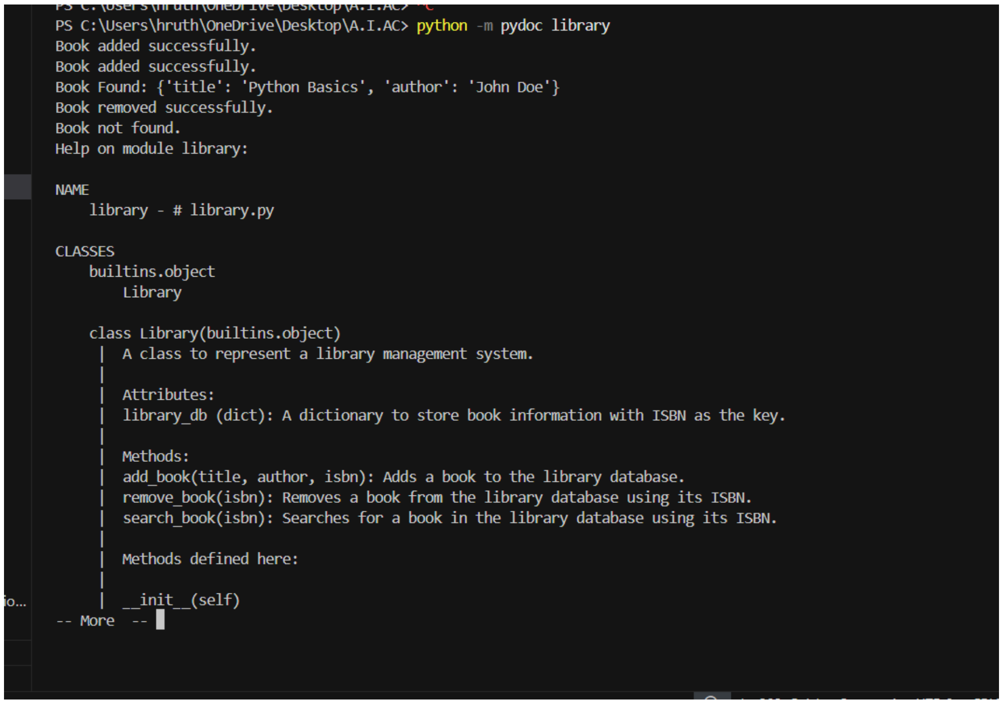


```
# library.py
class Library:
    """
    A class to represent a library management system.

    Attributes:
    library_db (dict): A dictionary to store book information with ISBN as the key.

    Methods:
    add_book(title, author, isbn): Adds a book to the library database.
    remove_book(isbn): Removes a book from the library database using its ISBN.
    search_book(isbn): Searches for a book in the library database using its ISBN.
    """
    def __init__(self):
        """Initialize the Library with an empty database."""
        self.library_db = {}
    def add_book(self, title, author, isbn):
        """
        Add a book to the library database.

        Parameters:
        title (str): The title of the book.
        author (str): The author of the book.
        isbn (str): The ISBN number of the book.

        Returns:
        str: A message indicating whether the book was added successfully or if it already exists.
        """
        if isbn not in self.library_db:
```

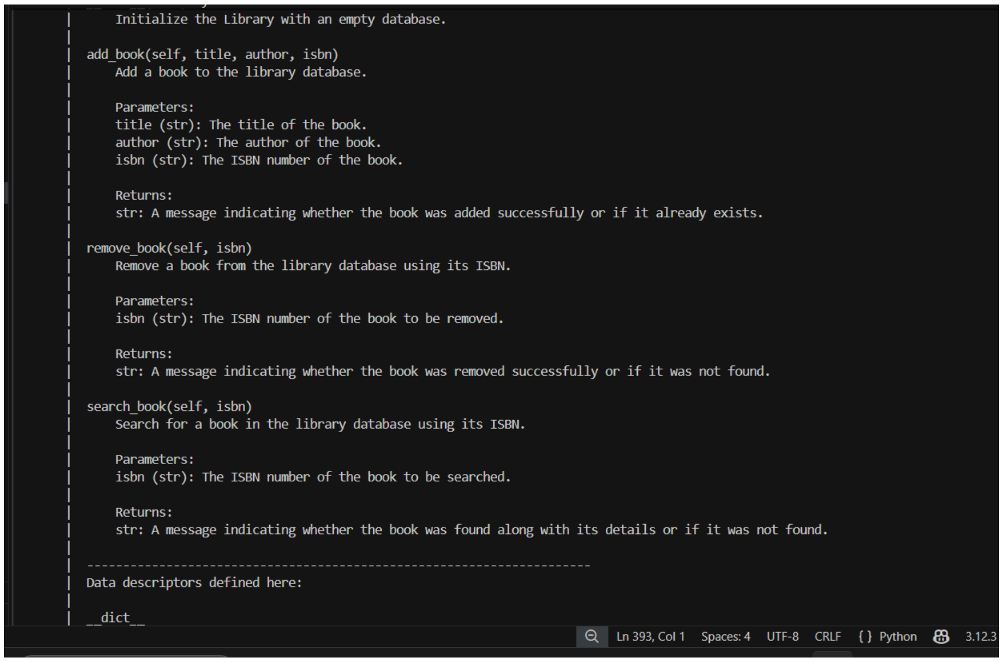


```
class Library:
    def search_book(self, isbn):
        Search for a book in the library database using its ISBN.

        Parameters:
        isbn (str): The ISBN number of the book to be searched.

        Returns:
        str: A message indicating whether the book was found along with its details or if it was not found.
        """
        if isbn in self.library_db:
            return f"Book Found: {self.library_db[isbn]}"
        else:
            return "Book not found."
# Example usage
library = Library()  # Create an instance of the Library class
print(library.add_book("Python Basics", "John Doe", "101"))  # Add first book
print(library.add_book("AI Fundamentals", "Jane Smith", "102"))  # Add second book
print(library.search_book("101"))  # Search for the first book
print(library.remove_book("101"))  # Remove the first book
print(library.search_book("101"))  # Search for the first book again after removal
```

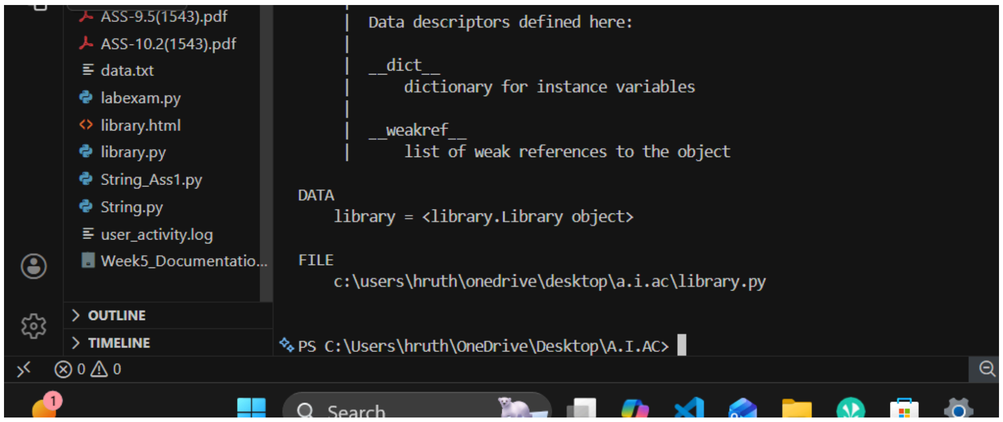
```
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC> & C:/Users/hruth/AppData/Local/Programs/Python/Python312/python.exe c:/Users/hru
Book added successfully.
Book added successfully.
Book Found: {'title': 'Python Basics', 'author': 'John Doe'}
Book removed successfully.
Book not found.
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC>
```



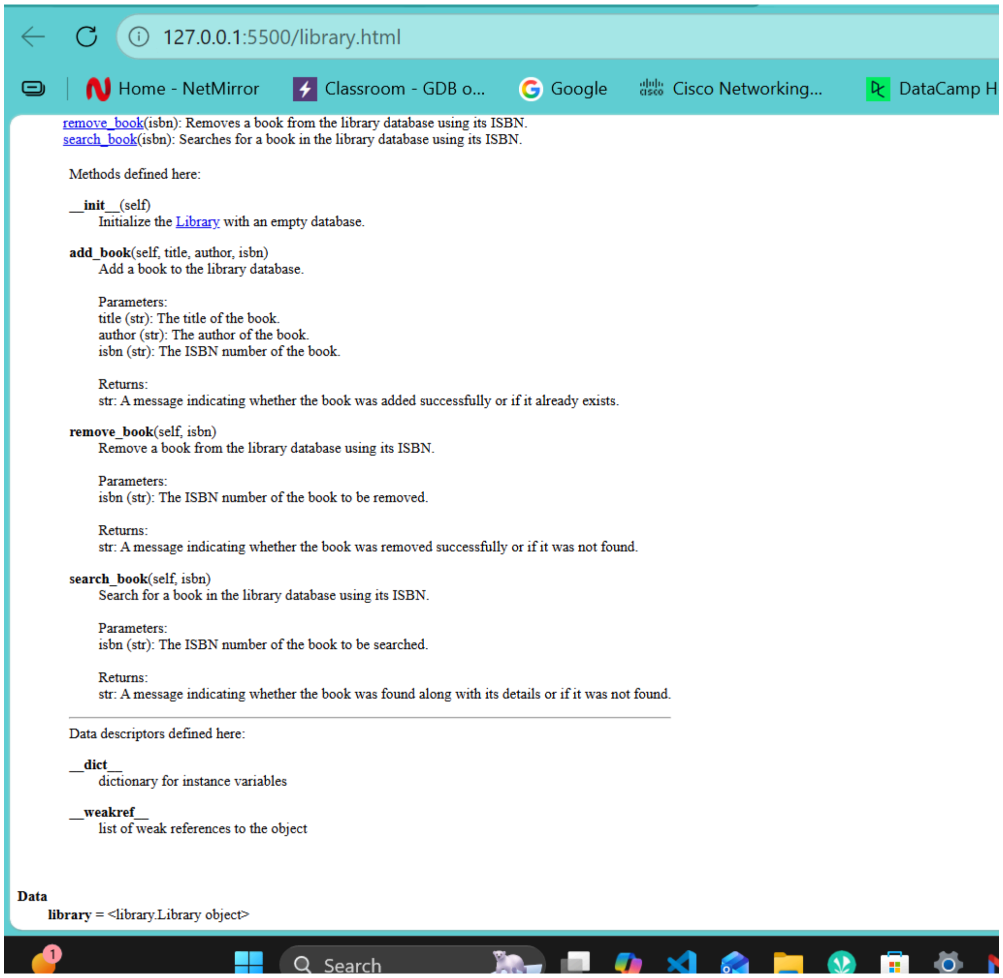
```
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC> python -m pydoc library
Book added successfully.
Book added successfully.
Book Found: {'title': 'Python Basics', 'author': 'John Doe'}
Book removed successfully.
Book not found.
Help on module library:

NAME
    library - # library.py

CLASSES
    builtins.object
        Library

    class Library(builtins.object)
     |  A class to represent a library management system.
     |
     |  Attributes:
     |  library_db (dict): A dictionary to store book information with ISBN as the key.
     |
     |  Methods:
     |  add_book(title, author, isbn): Adds a book to the library database.
     |  remove_book(isbn): Removes a book from the library database using its ISBN.
     |  search_book(isbn): Searches for a book in the library database using its ISBN.
     |
     |  Methods defined here:
     |
     |  __init__(self)
-- More  --
```



```
 |      Initialize the Library with an empty database.
 |
 |  add_book(self, title, author, isbn)
 |      Add a book to the library database.
 |
 |      Parameters:
 |      title (str): The title of the book.
 |      author (str): The author of the book.
 |      isbn (str): The ISBN number of the book.
 |
 |      Returns:
 |      str: A message indicating whether the book was added successfully or if it already exists.
 |
 |  remove_book(self, isbn)
 |      Remove a book from the library database using its ISBN.
 |
 |      Parameters:
 |      isbn (str): The ISBN number of the book to be removed.
 |
 |      Returns:
 |      str: A message indicating whether the book was removed successfully or if it was not found.
 |
 |  search_book(self, isbn)
 |      Search for a book in the library database using its ISBN.
 |
 |      Parameters:
 |      isbn (str): The ISBN number of the book to be searched.
 |
 |      Returns:
 |      str: A message indicating whether the book was found along with its details or if it was not found.
 |
 |  ----------------------------------------------------------------------
 |  Data descriptors defined here:
 |
 |  __dict__
```



```
 |  Data descriptors defined here:
 |
 |  __dict__
 |      dictionary for instance variables
 |
 |  __weakref__
 |      list of weak references to the object

DATA
    library = <library.Library object>

FILE
    c:\users\hruth\onedrive\desktop\a.i.ac\library.py

PS C:\Users\hruth\OneDrive\Desktop\A.I.AC>
```



```
remove_book(isbn): Removes a book from the library database using its ISBN.
search_book(isbn): Searches for a book in the library database using its ISBN.

 Methods defined here:

 __init__(self)
     Initialize the Library with an empty database.

 add_book(self, title, author, isbn)
     Add a book to the library database.

     Parameters:
     title (str): The title of the book.
     author (str): The author of the book.
     isbn (str): The ISBN number of the book.

     Returns:
     str: A message indicating whether the book was added successfully or if it already exists.

 remove_book(self, isbn)
     Remove a book from the library database using its ISBN.

     Parameters:
     isbn (str): The ISBN number of the book to be removed.

     Returns:
     str: A message indicating whether the book was removed successfully or if it was not found.

 search_book(self, isbn)
     Search for a book in the library database using its ISBN.

     Parameters:
     isbn (str): The ISBN number of the book to be searched.

     Returns:
     str: A message indicating whether the book was found along with its details or if it was not found.

 Data descriptors defined here:

 __dict__
     dictionary for instance variables

 __weakref__
     list of weak references to the object


Data
    library = <library.Library object>
```

💡 **Task 8– Fibonacci Generator.**
Write a program to generate Fibonacci series up to n.
The initial code has:

- Global variables.
- Inefficient loop.
- No functions or modularity.

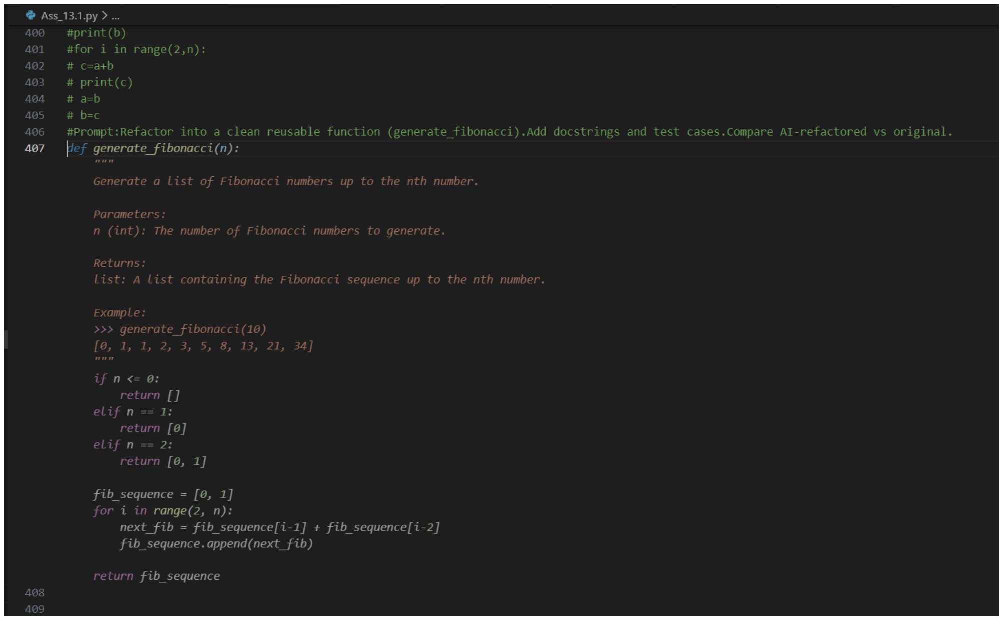
Task for Students:

- Refactor into a clean reusable function (generate_fibonacci).
- Add docstrings and test cases.
- Compare AI-refactored vs original.

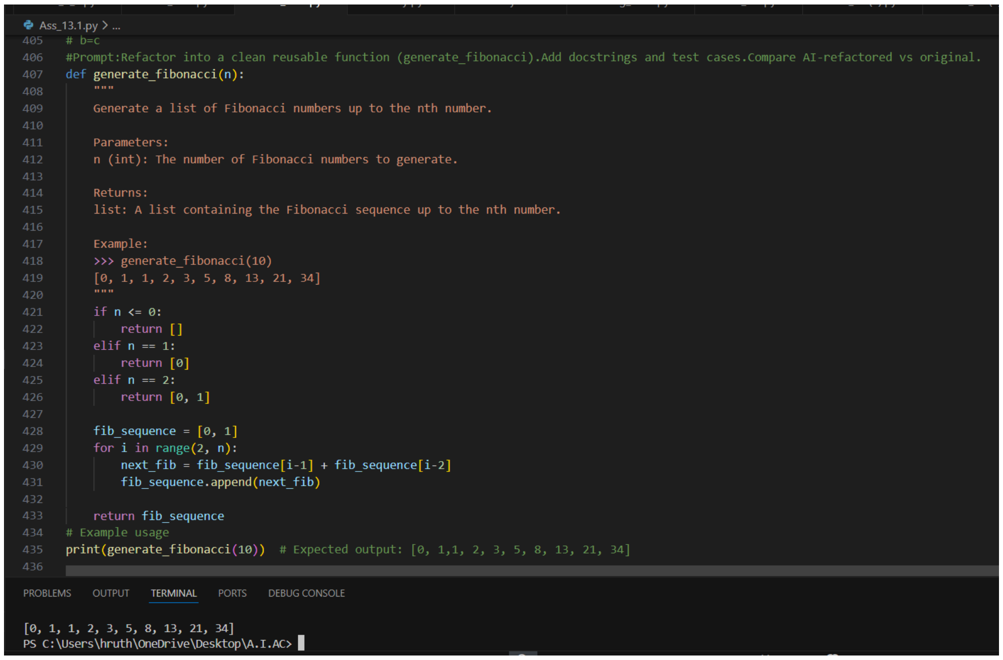
Bad Code Version:
# fibonacci bad version
n=int(input("Enter limit: "))
a=0
b=1
print(a)
print(b)
for i in range(2,n):
c=a+b
print(c)
a=b
b=c

```
#Task 8– Fibonacci Generator
#Bad Code Version:
# fibonacci bad version
#n=int(input("Enter limit: "))
#a=0
#b=1
#print(a)
#print(b)
#for i in range(2,n):
# c=a+b
# print(c)
# a=b
# b=c
#Prompt:Refactor into a clean reusable function (generate_fibonacci).Add docstrings and t
est cases.Compare AI-refactored vs original.
def generate_fibonacci(n):
    """
    Generate a list of Fibonacci numbers up to the nth number.
    Parameters:
    n (int): The number of Fibonacci numbers to generate.
    Returns:
    list: A list containing the Fibonacci sequence up to the nth number.
    Example:
```

```
    >>> generate_fibonacci(10)
    [0, 1, 1, 2, 3, 5, 8, 13, 21, 34]
    """
    if n <= 0:
        return []
    elif n == 1:
        return [0]
    elif n == 2:
        return [0, 1]
    fib_sequence = [0, 1]
    for i in range(2, n):
        next_fib = fib_sequence[i-1] + fib_sequence[i-2]
        fib_sequence.append(next_fib)
    return fib_sequence
# Example usage
print(generate_fibonacci(10))  # Expected output: [0, 1,1, 2, 3, 5, 8, 13, 21, 34]
```



```
#print(b)
#for i in range(2,n):
# c=a+b
# print(c)
# a=b
# b=c
#Prompt:Refactor into a clean reusable function (generate_fibonacci).Add docstrings and test cases.Compare AI-refactored vs original.
def generate_fibonacci(n):
    """
    Generate a list of Fibonacci numbers up to the nth number.

    Parameters:
    n (int): The number of Fibonacci numbers to generate.

    Returns:
    list: A list containing the Fibonacci sequence up to the nth number.

    Example:
    >>> generate_fibonacci(10)
    [0, 1, 1, 2, 3, 5, 8, 13, 21, 34]
    """
    if n <= 0:
        return []
    elif n == 1:
        return [0]
    elif n == 2:
        return [0, 1]

    fib_sequence = [0, 1]
    for i in range(2, n):
        next_fib = fib_sequence[i-1] + fib_sequence[i-2]
        fib_sequence.append(next_fib)

    return fib_sequence
```


Ass_13.1.py > ...

```python
# b=c
#Prompt:Refactor into a clean reusable function (generate_fibonacci).Add docstrings and test cases.Compare AI-refactored vs original.
def generate_fibonacci(n):
    """
    Generate a list of Fibonacci numbers up to the nth number.

    Parameters:
    n (int): The number of Fibonacci numbers to generate.

    Returns:
    list: A list containing the Fibonacci sequence up to the nth number.

    Example:
    >>> generate_fibonacci(10)
    [0, 1, 1, 2, 3, 5, 8, 13, 21, 34]
    """
    if n <= 0:
        return []
    elif n == 1:
        return [0]
    elif n == 2:
        return [0, 1]

    fib_sequence = [0, 1]
    for i in range(2, n):
        next_fib = fib_sequence[i-1] + fib_sequence[i-2]
        fib_sequence.append(next_fib)

    return fib_sequence
# Example usage
print(generate_fibonacci(10))  # Expected output: [0, 1,1, 2, 3, 5, 8, 13, 21, 34]
```

PROBLEMS OUTPUT TERMINAL PORTS DEBUG CONSOLE

```
[0, 1, 1, 2, 3, 5, 8, 13, 21, 34]
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC>
```

💡 **Task 9 – Twin Primes Checker**

Twin primes are pairs of primes that differ by 2 (e.g., 11 and 13, 17 and 19).
The initial code has:

- Inefficient prime checking.
- No functions.
- Hardcoded inputs.

Task for Students:

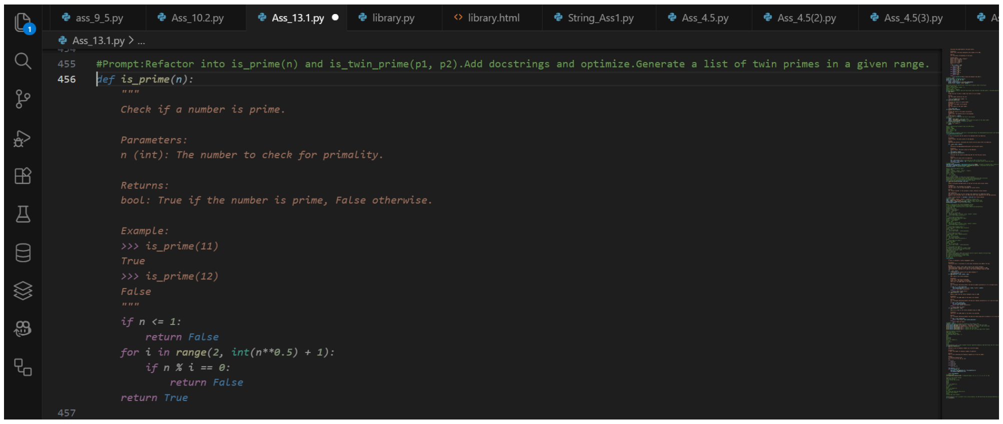
- Refactor into is_prime(n) and is_twin_prime(p1, p2).
- Add docstrings and optimize.
- Generate a list of twin primes in a given range using AI.

Bad Code Version:

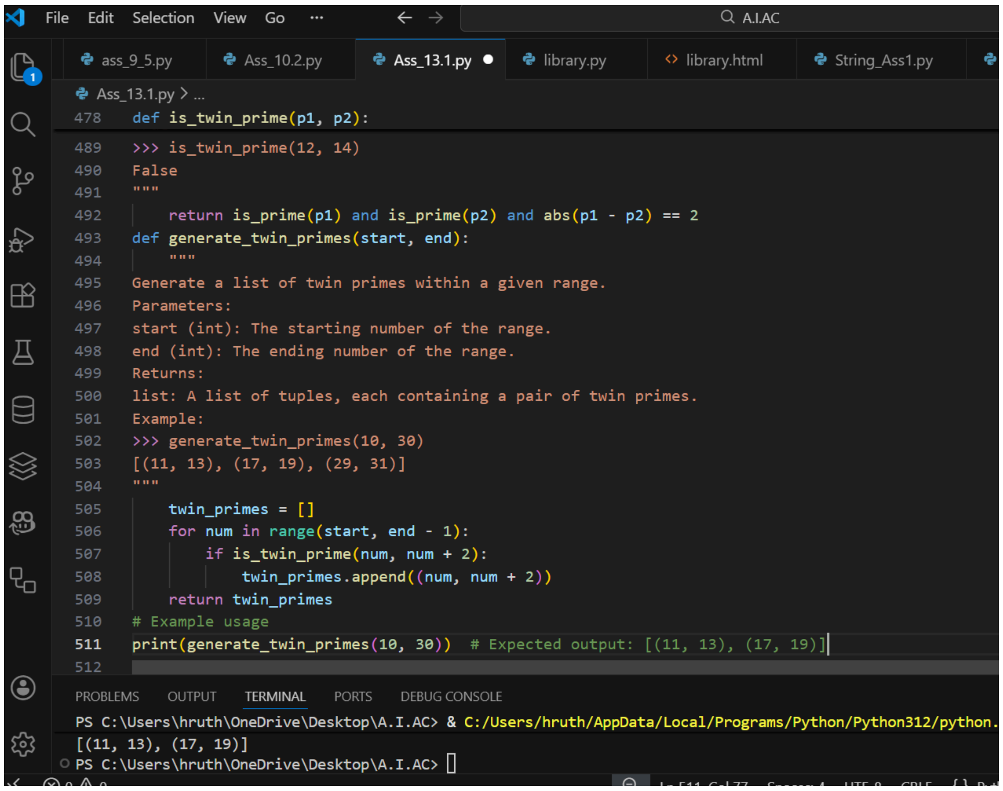
```
# twin primes bad version
a=11
b=13
fa=0
for i in range(2,a):
if a%i==0:
fa=1
fb=0
for i in range(2,b):
if b%i==0:
fb=1
if fa==0 and fb==0 and abs(a-b)==2:
print("Twin Primes")
else:
print("Not Twin Primes")
```

```
#Task 9 – Twin Primes Checker
#Bad Code Version:
# twin primes bad version
#a=11
#b=13
#fa=0
#for i in range(2,a):
# if a%i==0:
#  fa=1
#fb=0
#for i in range(2,b):
# if b%i==0:
#  fb=1
#if fa==0 and fb==0 and abs(a-b)==2:
# print("Twin Primes")
#else:
# print("Not Twin Primes")
#Prompt:Refactor into is_prime(n) and is_twin_prime(p1, p2).Add docstrings and optimize.G
enerate a list of twin primes in a given range.
def is_prime(n):
    """
    Check if a number is prime.
    Parameters:
    n (int): The number to check for primality
    Returns:
    bool: True if the number is prime, False otherwise.
    Example:
    >>> is_prime(11)
    True
    >>> is_prime(12)
    False
    """
    if n <= 1:
        return False
    for i in range(2, int(n**0.5) + 1):
        if n % i == 0:
            return False
    return True
def is_twin_prime(p1, p2):
    """
Check if two numbers are twin primes.
Parameters:
p1 (int): The first prime number.
p2 (int): The second prime number.
Returns:
bool: True if the numbers are twin primes, False otherwise.
Example:
>>> is_twin_prime(11, 13)
True
>>> is_twin_prime(12, 14)
```

```
False
"""
    return is_prime(p1) and is_prime(p2) and abs(p1 - p2) == 2
def generate_twin_primes(start, end):
    """
Generate a list of twin primes within a given range.
Parameters:
start (int): The starting number of the range.
end (int): The ending number of the range.
Returns:
list: A list of tuples, each containing a pair of twin primes.
Example:
>>> generate_twin_primes(10, 30)
[(11, 13), (17, 19), (29, 31)]
"""
    twin_primes = []
    for num in range(start, end - 1):
        if is_twin_prime(num, num + 2):
            twin_primes.append((num, num + 2))
    return twin_primes
# Example usage
print(generate_twin_primes(10, 30))  # Expected output: [(11, 13), (17, 19)]
```



```
#Prompt:Refactor into is_prime(n) and is_twin_prime(p1, p2).Add docstrings and optimize.Generate a list of twin primes in a given range.
def is_prime(n):
    """
    Check if a number is prime.

    Parameters:
    n (int): The number to check for primality.

    Returns:
    bool: True if the number is prime, False otherwise.

    Example:
    >>> is_prime(11)
    True
    >>> is_prime(12)
    False
    """
    if n <= 1:
        return False
    for i in range(2, int(n**0.5) + 1):
        if n % i == 0:
            return False
    return True
```



```
def is_twin_prime(p1, p2):
>>> is_twin_prime(12, 14)
False
"""
    return is_prime(p1) and is_prime(p2) and abs(p1 - p2) == 2
def generate_twin_primes(start, end):
    """
Generate a list of twin primes within a given range.
Parameters:
start (int): The starting number of the range.
end (int): The ending number of the range.
Returns:
list: A list of tuples, each containing a pair of twin primes.
Example:
>>> generate_twin_primes(10, 30)
[(11, 13), (17, 19), (29, 31)]
"""
    twin_primes = []
    for num in range(start, end - 1):
        if is_twin_prime(num, num + 2):
            twin_primes.append((num, num + 2))
    return twin_primes
# Example usage
print(generate_twin_primes(10, 30))  # Expected output: [(11, 13), (17, 19)]
```

```
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC> & C:/Users/hruth/AppData/Local/Programs/Python/Python312/python.
[(11, 13), (17, 19)]
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC> 
```

Task 10 – Refactoring the Chinese Zodiac Program

Objective

Refactor the given poorly structured Python script into a clean, modular, and reusable implementation.
The current program reads a year from the user and prints the corresponding Chinese Zodiac sign.
However, the implementation contains repetitive conditional logic, lacks modular design, and does not follow clean coding principles.
Your task is to refactor the code to improve readability, maintainability, and structure.

Chinese Zodiac Cycle (Repeats Every 12 Years)

1. Rat
2. Ox
3. Tiger
4. Rabbit
5. Dragon
6. Snake
7. Horse
8. Goat (Sheep)
9. Monkey
10. Rooster
11. Dog
12. Pig

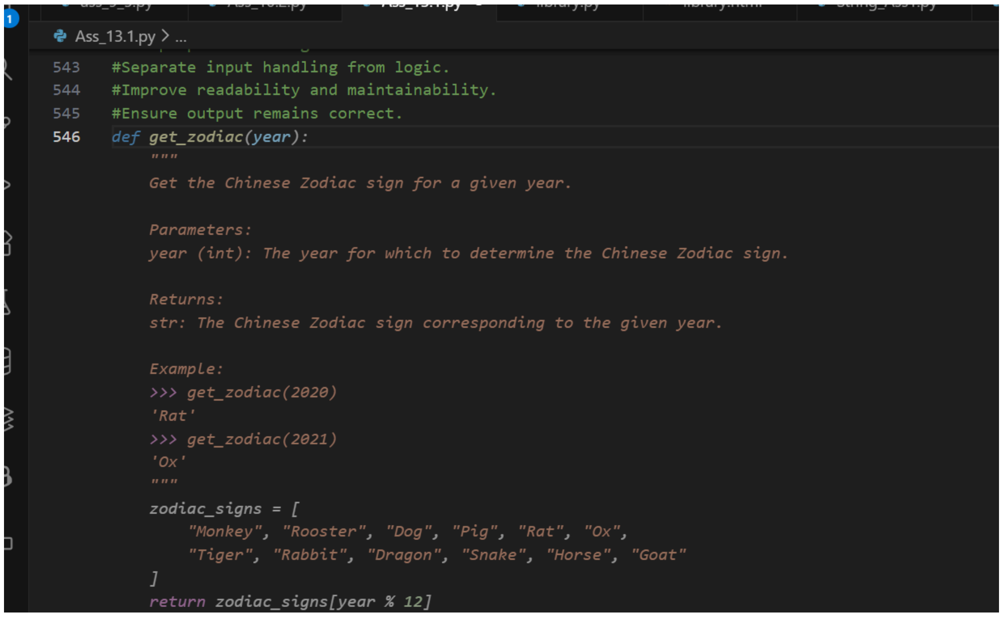
```
# Chinese Zodiac Program (Unstructured Version)
# This code needs refactoring.
year = int(input("Enter a year: "))
if year % 12 == 0:
print("Monkey")
elif year % 12 == 1:
print("Rooster")
elif year % 12 == 2:
print("Dog")
elif year % 12 == 3:
print("Pig")
elif year % 12 == 4:
print("Rat")
elif year % 12 == 5:
print("Ox")
elif year % 12 == 6:
print("Tiger")
elif year % 12 == 7:
print("Rabbit")
elif year % 12 == 8:
print("Dragon")
elif year % 12 == 9:
print("Snake")
elif year % 12 == 10:
print("Horse")
```

elif year % 12 == 11:
print("Goat")
You must:

1. Create a reusable function: get_zodiac(year)
2. Replace the if-elif chain with a cleaner structure (e.g., list or dictionary).
3. Add proper docstrings.
4. Separate input handling from logic.
5. Improve readability and maintainability.
6. Ensure output remains correct.

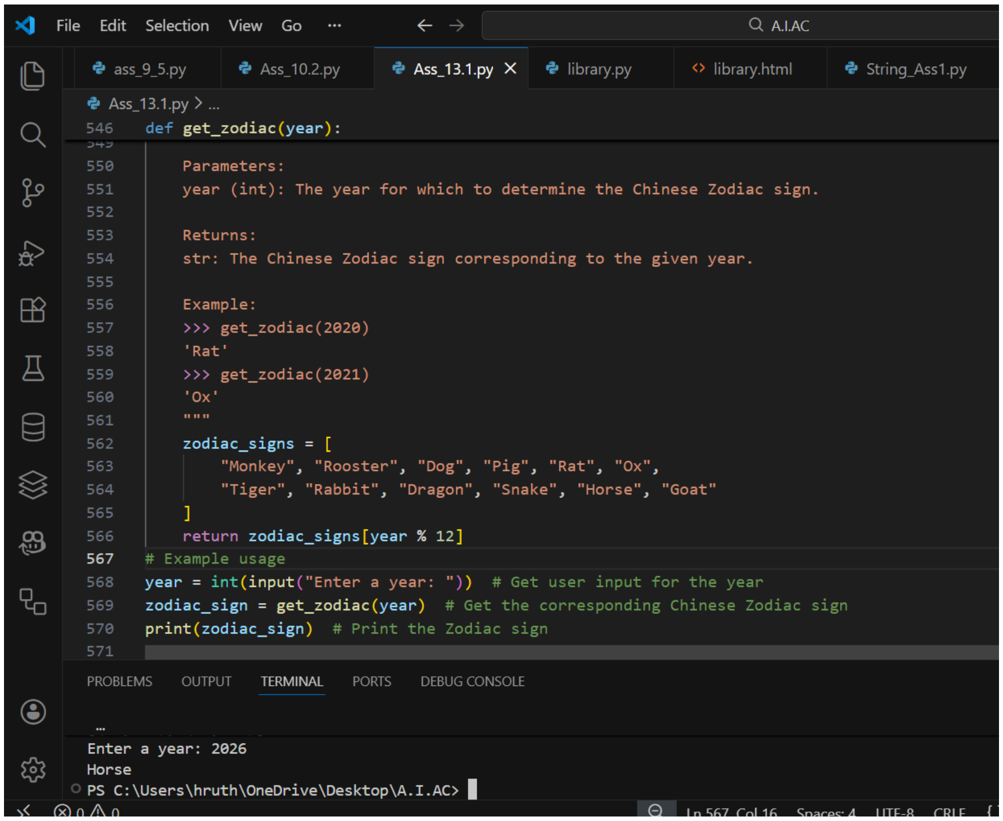
```
#Task 10 – Refactoring the Chinese Zodiac Program
# This code needs refactoring.
#year = int(input("Enter a year: "))
#if year % 12 == 0:
#    print("Monkey")
#elif year % 12 == 1:
#    print("Rooster")
#elif year % 12 == 2:
#    print("Dog")
#elif year % 12 == 3:
#    print("Pig")
#elif year % 12 == 4:
#    print("Rat")
#elif year % 12 == 5:
#    print("Ox")
#elif year % 12 == 6:
#    print("Tiger")
#elif year % 12 == 7:
#    print("Rabbit")
#elif year % 12 == 8:
#    print("Dragon")
#elif year % 12 == 9:
#    print("Snake")
#elif year % 12 == 10:
#    print("Horse")
#elif year % 12 == 11:
#    print("Goat")
#Prompt:Create a reusable function: get_zodiac(year)
#Replace the if-elif chain with a cleaner structure (e.g., list or dictionary).
#Add proper docstrings.
#Separate input handling from logic.
#Improve readability and maintainability.
#Ensure output remains correct.
def get_zodiac(year):
    """
    Get the Chinese Zodiac sign for a given year.
    Parameters:
```

```
    year (int): The year for which to determine the Chinese Zodiac sign.
    Returns:
    str: The Chinese Zodiac sign corresponding to the given year.
    Example:
    >>> get_zodiac(2020)
    'Rat'
    >>> get_zodiac(2021)
    'Ox'
    """
    zodiac_signs = [
        "Monkey", "Rooster", "Dog", "Pig", "Rat", "Ox",
        "Tiger", "Rabbit", "Dragon", "Snake", "Horse", "Goat"
    ]
    return zodiac_signs[year % 12]
# Example usage
year = int(input("Enter a year: "))  # Get user input for the year
zodiac_sign = get_zodiac(year)  # Get the corresponding Chinese Zodiac sign
print(zodiac_sign)  # Print the Zodiac sign
```



Ass_13.1.py > ...

```
#Separate input handling from logic.
#Improve readability and maintainability.
#Ensure output remains correct.
def get_zodiac(year):
    """
    Get the Chinese Zodiac sign for a given year.

    Parameters:
    year (int): The year for which to determine the Chinese Zodiac sign.

    Returns:
    str: The Chinese Zodiac sign corresponding to the given year.

    Example:
    >>> get_zodiac(2020)
    'Rat'
    >>> get_zodiac(2021)
    'Ox'
    """
    zodiac_signs = [
        "Monkey", "Rooster", "Dog", "Pig", "Rat", "Ox",
        "Tiger", "Rabbit", "Dragon", "Snake", "Horse", "Goat"
    ]
    return zodiac_signs[year % 12]
```



```python
def get_zodiac(year):

    Parameters:
    year (int): The year for which to determine the Chinese Zodiac sign.

    Returns:
    str: The Chinese Zodiac sign corresponding to the given year.

    Example:
    >>> get_zodiac(2020)
    'Rat'
    >>> get_zodiac(2021)
    'Ox'
    """
    zodiac_signs = [
        "Monkey", "Rooster", "Dog", "Pig", "Rat", "Ox",
        "Tiger", "Rabbit", "Dragon", "Snake", "Horse", "Goat"
    ]
    return zodiac_signs[year % 12]
# Example usage
year = int(input("Enter a year: "))  # Get user input for the year
zodiac_sign = get_zodiac(year)  # Get the corresponding Chinese Zodiac sign
print(zodiac_sign)  # Print the Zodiac sign
```

```
Enter a year: 2026
Horse
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC>
```

💡 **Task 11 – Refactoring the Harshad (Niven) Number Checker**
Refactor the given poorly structured Python script into a clean, modular, and reusable implementation.
A Harshad (Niven) number is a number that is divisible by the sum of its digits.**For example:**

- **18 → 1 + 8 = 9 → 18 ÷ 9 = 2 ✅ (Harshad Number)**
- **19 → 1 + 9 = 10 → 19 ÷ 10 ≠ integer ❌ (Not Harshad)**

Problem Statement
The current implementation:

- Mixes logic and input handling
- Uses redundant variables
- Does not use reusable functions properly
- Returns print statements instead of boolean values
- Lacks documentation

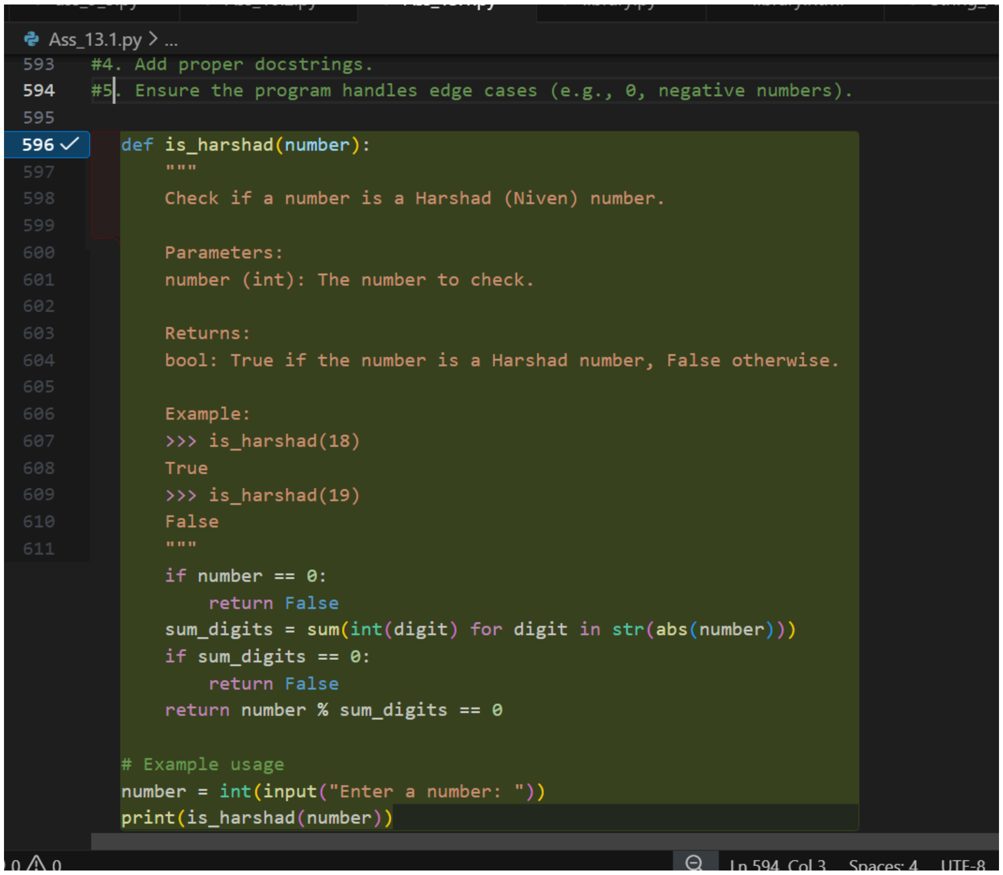
You must refactor the code to follow clean coding principles.
# Harshad Number Checker (Unstructured Version)
num = int(input("Enter a number: "))
temp = num
sum_digits = 0
while temp > 0:
digit = temp % 10
sum_digits = sum_digits + digit
temp = temp // 10
if sum_digits != 0:
if num % sum_digits == 0:
print("True")
else:
print("False")
else:
print("False")
You must:

1. Create a reusable function: is_harshad(number)
2. The function must:
    - Accept an integer parameter.
    - Return True if the number is divisible by the sum of its digits.
    - Return False otherwise.
3. Separate user input from core logic.
4. Add proper docstrings.
5. Improve readability and maintainability.
6. Ensure the program handles edge cases (e.g., 0, negative numbers).

```
#Task 11 – Refactoring the Harshad (Niven) Number Checker
#num = int(input("Enter a number: "))
#temp = num
```

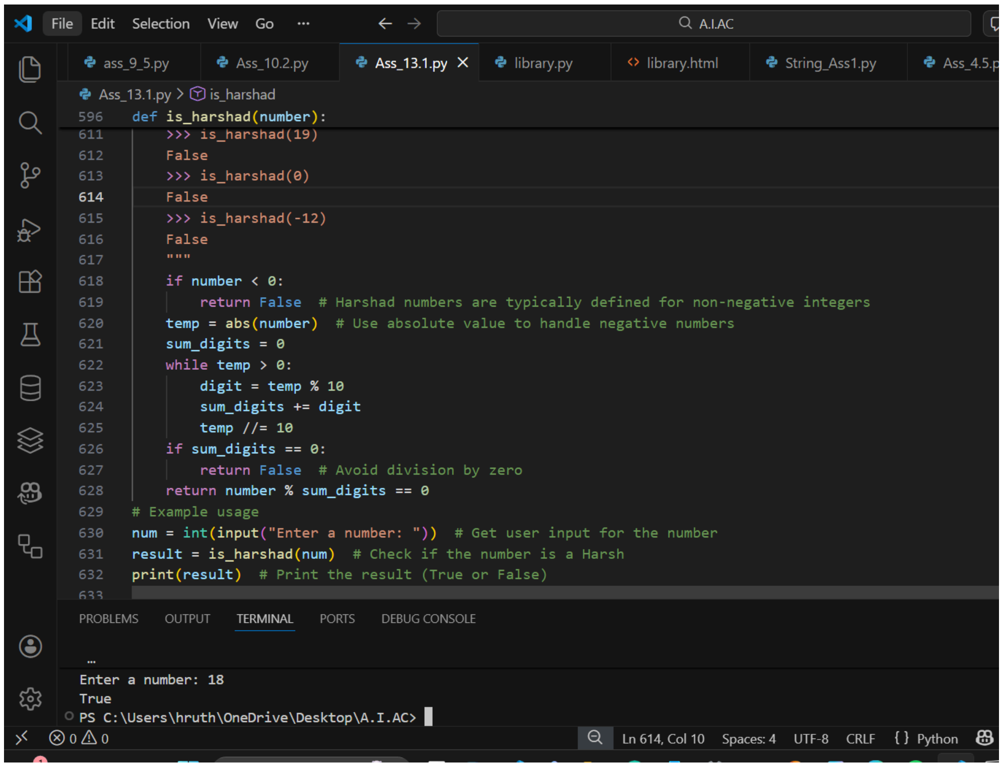
```
#sum_digits = 0
#while temp > 0:
#    digit = temp % 10
#    sum_digits = sum_digits + digit
#    temp = temp // 10
#if sum_digits != 0:
#    if num % sum_digits == 0:
#        print("True")
#    else:
#        print("False")
#else:
#    print("False")
#Prompt:1.Create a reusable function: is_harshad(number)
#2. The function must:
#Accept an integer parameter.
#Return True if the number is divisible by the sum of its digits.
#Return False otherwise.
#3. Separate user input from core logic.
#4. Add proper docstrings.
#5. Ensure the program handles edge cases (e.g., 0, negative numbers).
def is_harshad(number):
    """
    Check if a number is a Harshad (Niven) number.
    Parameters:
    number (int): The number to be checked.
    Returns:
    bool: True if the number is a Harshad number, False otherwise.
    A Harshad number is an integer that is divisible by the sum of its digits.
    Example:
    >>> is_harshad(18)
    True
    >>> is_harshad(19)
    False
    >>> is_harshad(0)
    False
    >>> is_harshad(-12)
    False
    """
    if number < 0:
        return False  # Harshad numbers are typically defined for non-negative integers
    temp = abs(number)  # Use absolute value to handle negative numbers
    sum_digits = 0
    while temp > 0:
        digit = temp % 10
        sum_digits += digit
        temp //= 10
    if sum_digits == 0:
        return False  # Avoid division by zero
    return number % sum_digits == 0
# Example usage
num = int(input("Enter a number: "))  # Get user input for the number
```

```
result = is_harshad(num)  # Check if the number is a Harsh
print(result)  # Print the result (True or False)
```



Ass_13.1.py > ...

```python
#4. Add proper docstrings.
#5. Ensure the program handles edge cases (e.g., 0, negative numbers).

def is_harshad(number):
    """
    Check if a number is a Harshad (Niven) number.

    Parameters:
    number (int): The number to check.

    Returns:
    bool: True if the number is a Harshad number, False otherwise.

    Example:
    >>> is_harshad(18)
    True
    >>> is_harshad(19)
    False
    """
    if number == 0:
        return False
    sum_digits = sum(int(digit) for digit in str(abs(number)))
    if sum_digits == 0:
        return False
    return number % sum_digits == 0

# Example usage
number = int(input("Enter a number: "))
print(is_harshad(number))
```



```python
def is_harshad(number):
    >>> is_harshad(19)
    False
    >>> is_harshad(0)
    False
    >>> is_harshad(-12)
    False
    """
    if number < 0:
        return False  # Harshad numbers are typically defined for non-negative integers
    temp = abs(number)  # Use absolute value to handle negative numbers
    sum_digits = 0
    while temp > 0:
        digit = temp % 10
        sum_digits += digit
        temp //= 10
    if sum_digits == 0:
        return False  # Avoid division by zero
    return number % sum_digits == 0
# Example usage
num = int(input("Enter a number: "))  # Get user input for the number
result = is_harshad(num)  # Check if the number is a Harsh
print(result)  # Print the result (True or False)
```

```
Enter a number: 18
True
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC>
```

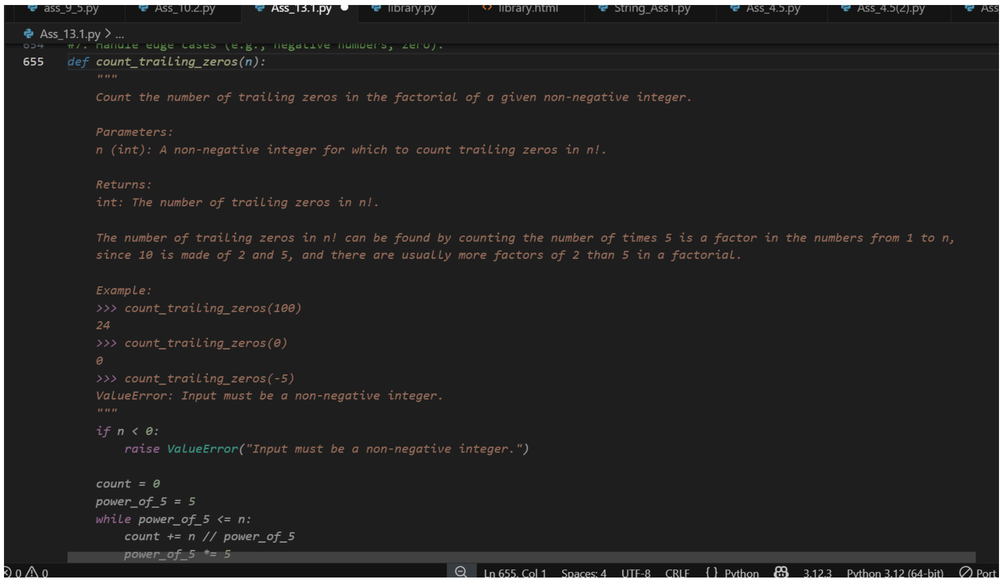
💡 **Task 12 – Refactoring the Factorial Trailing Zeros Program**
Refactor the given poorly structured Python script into a clean, modular, and efficient implementation.
The program calculates the number of trailing zeros in n! (factorial of n).
Problem Statement
The current implementation:

- Calculates the full factorial (inefficient for large n)
- Mixes input handling with business logic
- Uses print statements instead of return values
- Lacks modular structure and documentation

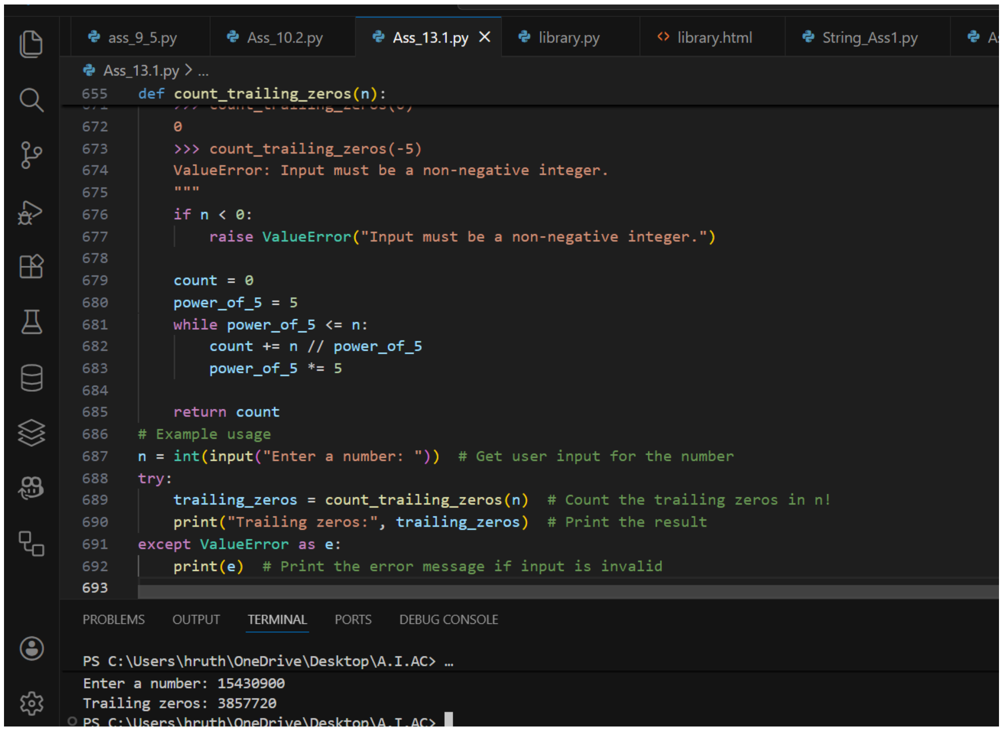
You must refactor the code to improve efficiency, readability, and maintainability.
# Factorial Trailing Zeros (Unstructured Version)
n = int(input("Enter a number: "))
fact = 1
i = 1
while i <= n:
fact = fact * i
i = i + 1
count = 0
while fact % 10 == 0:
count = count + 1
fact = fact // 10
print("Trailing zeros:", count)
You must:

1. Create a reusable function: count_trailing_zeros(n)
2. The function must:
   - Accept a non-negative integer n.
   - Return the number of trailing zeros in **n!**.
3. Do NOT compute the full factorial.
4. Use an optimized mathematical approach (count multiples of 5).
5. Add proper docstrings.
6. Separate user interaction from core logic.
7. Handle edge cases (e.g., negative numbers, zero).

```
#Task 12 – Refactoring the Factorial Trailing Zeros Program
#n = int(input("Enter a number: "))
#fact = 1
#i = 1
#while i <= n:
#    fact = fact * i
#    i = i + 1
#count = 0
#while fact % 10 == 0:
#    count = count + 1
#    fact = fact // 10
#print("Trailing zeros:", count)
#Prompt:1.  Create a reusable function: count_trailing_zeros(n)
#2. The function must:
#Accept a non-negative integer n.
#Return the number of trailing zeros in n!.
#3. Do NOT compute the full factorial.
#4. Use an optimized mathematical approach (count multiples of 5).
#5. Add proper docstrings.
#6. Separate user interaction from core logic.
#7. Handle edge cases (e.g., negative numbers, zero).
def count_trailing_zeros(n):
    """
    Count the number of trailing zeros in the factorial of a given non-negative integer.
    Parameters:
    n (int): A non-negative integer for which to count trailing zeros in n!.
    Returns:
    int: The number of trailing zeros in n!.
    The number of trailing zeros in n! can be found by counting the number of times 5 is
a factor in the numbers from 1 to n,
    since 10 is made of 2 and 5, and there are usually more factors of 2 than 5 in a fact
orial.
    Example:
    >>> count_trailing_zeros(100)
    24
    >>> count_trailing_zeros(0)
    0
    >>> count_trailing_zeros(-5)
    ValueError: Input must be a non-negative integer.
    """
    if n < 0:
        raise ValueError("Input must be a non-negative integer.")
    count = 0
    power_of_5 = 5
    while power_of_5 <= n:
        count += n // power_of_5
        power_of_5 *= 5
    return count
# Example usage
n = int(input("Enter a number: "))  # Get user input for the number
try:
    trailing_zeros = count_trailing_zeros(n)  # Count the trailing zeros in n!
    print("Trailing zeros:", trailing_zeros)  # Print the result
except ValueError as e:
    print(e)  # Print the error message if input is invalid
```



```python
    #7. Handle edge cases (e.g., negative numbers, zero).
def count_trailing_zeros(n):
    """
    Count the number of trailing zeros in the factorial of a given non-negative integer.

    Parameters:
    n (int): A non-negative integer for which to count trailing zeros in n!.

    Returns:
    int: The number of trailing zeros in n!.

    The number of trailing zeros in n! can be found by counting the number of times 5 is a factor in the numbers from 1 to n,
    since 10 is made of 2 and 5, and there are usually more factors of 2 than 5 in a factorial.

    Example:
    >>> count_trailing_zeros(100)
    24
    >>> count_trailing_zeros(0)
    0
    >>> count_trailing_zeros(-5)
    ValueError: Input must be a non-negative integer.
    """
    if n < 0:
        raise ValueError("Input must be a non-negative integer.")

    count = 0
    power_of_5 = 5
    while power_of_5 <= n:
        count += n // power_of_5
        power_of_5 *= 5
```



```python
def count_trailing_zeros(n):
    0
    >>> count_trailing_zeros(-5)
    ValueError: Input must be a non-negative integer.
    """
    if n < 0:
        raise ValueError("Input must be a non-negative integer.")

    count = 0
    power_of_5 = 5
    while power_of_5 <= n:
        count += n // power_of_5
        power_of_5 *= 5

    return count
# Example usage
n = int(input("Enter a number: "))  # Get user input for the number
try:
    trailing_zeros = count_trailing_zeros(n)  # Count the trailing zeros in n!
    print("Trailing zeros:", trailing_zeros)  # Print the result
except ValueError as e:
    print(e)  # Print the error message if input is invalid
```

```
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC> …
Enter a number: 15430900
Trailing zeros: 3857720
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC>
```

💡 **Test Cases Design**
Task 13 (Collatz Sequence Generator – Test Case Design)

- Function: Generate Collatz sequence until reaching 1.Test Cases to Design:
- Normal: 6 → [6,3,10,5,16,8,4,2,1]
- Edge: 1 → [1]
- Negative: -5
- Large: 27 (well-known long sequence) Requirement: Validate correctness with pytest.

Explanation:
We need to write a function that:

- Takes an integer n as input.
- Generates the Collatz sequence (also called the 3n+1 sequence).
- The rules are:
  - If n is even → next = n / 2.
  - If n is odd → next = 3n + 1.
- Repeat until we reach 1.
- Return the full sequence as a list.

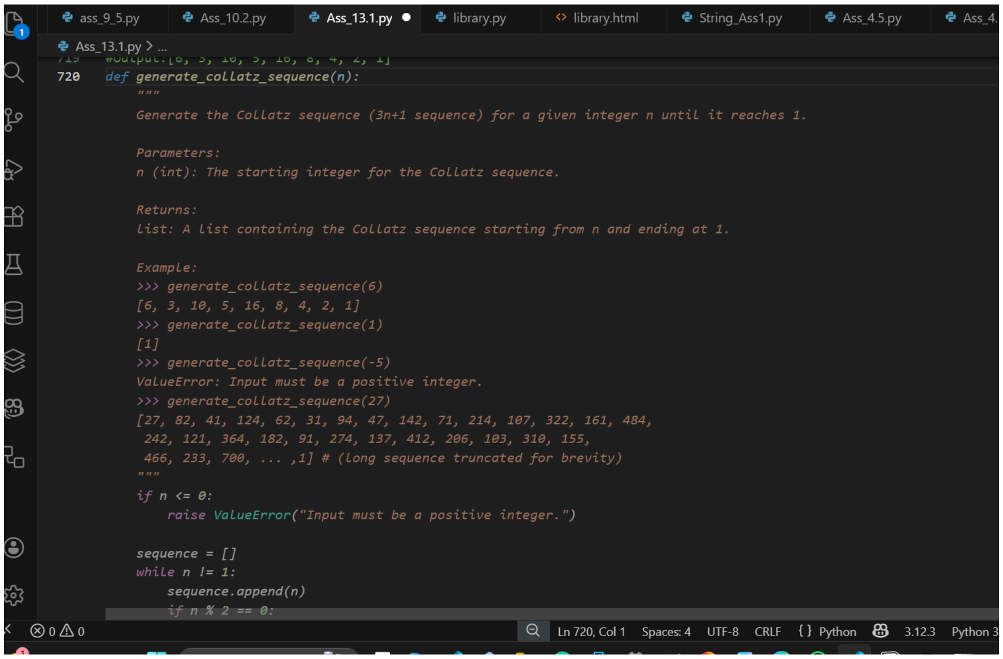
Example
Input: 6
Steps:

- 6 (even → 6/2 = 3)
- 3 (odd → 3*3+1 = 10)
- 10 (even → 10/2 = 5)
- 5 (odd → 3*5+1 = 16)
- 16 (even → 16/2 = 8)
- 8 (even → 8/2 = 4)
- 4 (even → 4/2 = 2)
- 2 (even → 2/2 = 1)

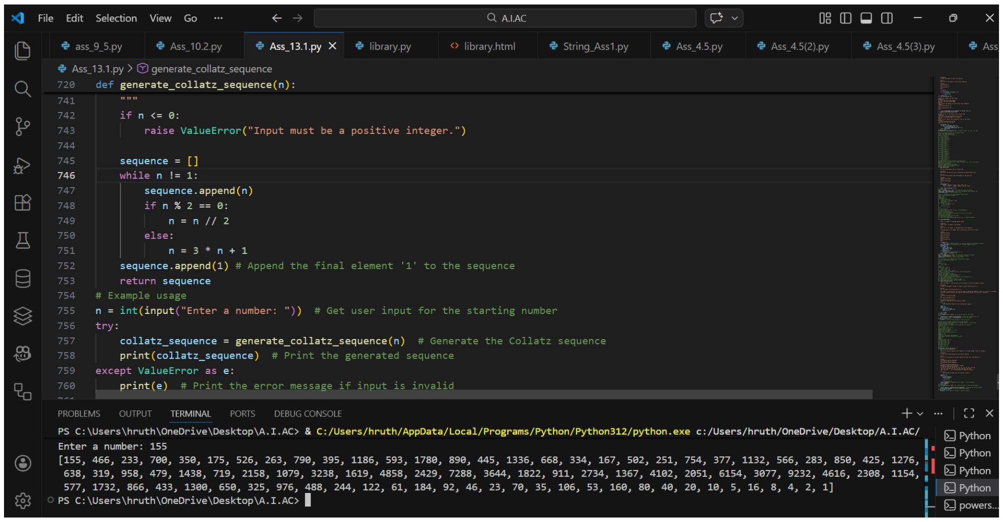
Output:
[6, 3, 10, 5, 16, 8, 4, 2, 1]

```
#Task 13 (Collatz Sequence Generator – Test Case Design)
#Prompt:Generate Collatz sequence until reaching 1.Write a function that:
#Takes an integer n as input.
#Generates the Collatz sequence (also called the 3n+1 sequence).
#The rules are:
#If n is even → next = n / 2.
#If n is odd → next = 3n + 1.
#Repeat until we reach 1.
#Return the full sequence as a list.
#Test Cases to Design:
```

```
#Normal: 6 → [6,3,10,5,16,8,4,2,1]
#Edge: 1 → [1]
#Negative: -5
#Large: 27 (well-known long sequence)
#Requirement: Validate correctness with pytest.
#Example
#Input: 6
#Steps:6 (even → 6/2 = 3)
#3 (odd → 3*3+1 = 10)
#10 (even → 10/2 = 5)
#5 (odd → 3*5+1 = 16)
#16 (even → 16/2 = 8)
#8 (even → 8/2 = 4)
#4 (even → 4/2 = 2)
#2 (even → 2/2 = 1)
#Output:[6, 3, 10, 5, 16, 8, 4, 2, 1]
def generate_collatz_sequence(n):
    """
    Generate the Collatz sequence (3n+1 sequence) for a given integer n until it reaches
1.
    Parameters:
    n (int): The starting integer for the Collatz sequence.
    Returns:
    list: A list containing the Collatz sequence starting from n and ending at 1.
    Example:
    >>> generate_collatz_sequence(6)
    [6, 3, 10, 5, 16, 8, 4, 2, 1]
    >>> generate_collatz_sequence(1)
    [1]
    >>> generate_collatz_sequence(-5)
    ValueError: Input must be a positive integer.
    >>> generate_collatz_sequence(27)
    [27, 82, 41, 124, 62, 31, 94, 47, 142, 71, 214, 107, 322, 161, 484,
     242, 121, 364, 182, 91, 274, 137, 412, 206, 103, 310, 155,
     466, 233, 700, ... ,1] # (long sequence truncated for brevity)
    """
    if n <= 0:
        raise ValueError("Input must be a positive integer.")
    sequence = []
    while n != 1:
        sequence.append(n)
        if n % 2 == 0:
            n = n // 2
        else:
            n = 3 * n + 1
    sequence.append(1) # Append the final element '1' to the sequence
    return sequence
# Example usage
n = int(input("Enter a number: "))  # Get user input for the starting number
try:
    collatz_sequence = generate_collatz_sequence(n)  # Generate the Collatz sequence
    print(collatz_sequence)  # Print the generated sequence
except ValueError as e:
    print(e)  # Print the error message if input is invalid
```



```
#Output:[6, 3, 10, 5, 16, 8, 4, 2, 1]
def generate_collatz_sequence(n):
    """
    Generate the Collatz sequence (3n+1 sequence) for a given integer n until it reaches 1.

    Parameters:
    n (int): The starting integer for the Collatz sequence.

    Returns:
    list: A list containing the Collatz sequence starting from n and ending at 1.

    Example:
    >>> generate_collatz_sequence(6)
    [6, 3, 10, 5, 16, 8, 4, 2, 1]
    >>> generate_collatz_sequence(1)
    [1]
    >>> generate_collatz_sequence(-5)
    ValueError: Input must be a positive integer.
    >>> generate_collatz_sequence(27)
    [27, 82, 41, 124, 62, 31, 94, 47, 142, 71, 214, 107, 322, 161, 484,
     242, 121, 364, 182, 91, 274, 137, 412, 206, 103, 310, 155,
     466, 233, 700, ... ,1] # (long sequence truncated for brevity)
    """
    if n <= 0:
        raise ValueError("Input must be a positive integer.")

    sequence = []
    while n != 1:
        sequence.append(n)
        if n % 2 == 0:
```



```
def generate_collatz_sequence(n):
    """
    if n <= 0:
        raise ValueError("Input must be a positive integer.")

    sequence = []
    while n != 1:
        sequence.append(n)
        if n % 2 == 0:
            n = n // 2
        else:
            n = 3 * n + 1
    sequence.append(1) # Append the final element '1' to the sequence
    return sequence
# Example usage
n = int(input("Enter a number: "))  # Get user input for the starting number
try:
    collatz_sequence = generate_collatz_sequence(n)  # Generate the Collatz sequence
    print(collatz_sequence)  # Print the generated sequence
except ValueError as e:
    print(e)  # Print the error message if input is invalid
```

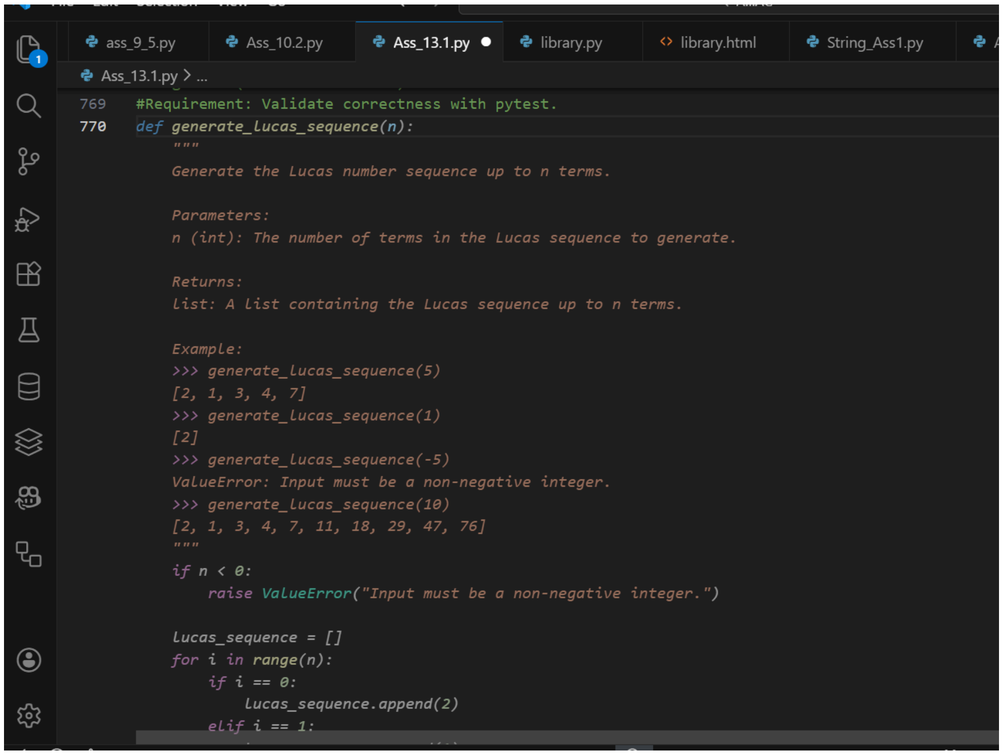
```
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC> & C:/Users/hruth/AppData/Local/Programs/Python/Python312/python.exe c:/Users/hruth/OneDrive/Desktop/A.I.AC/
Enter a number: 155
[155, 466, 233, 700, 350, 175, 526, 263, 790, 395, 1186, 593, 1780, 890, 445, 1336, 668, 334, 167, 502, 251, 754, 377, 1132, 566, 283, 850, 425, 1276,
 638, 319, 958, 479, 1438, 719, 2158, 1079, 3238, 1619, 4858, 2429, 7288, 3644, 1822, 911, 2734, 1367, 4102, 2051, 6154, 3077, 9232, 4616, 2308, 1154,
 577, 1732, 866, 433, 1300, 650, 325, 976, 488, 244, 122, 61, 184, 92, 46, 23, 70, 35, 106, 53, 160, 80, 40, 20, 10, 5, 16, 8, 4, 2, 1]
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC>
```

💡 **Task 14 (Lucas Number Sequence – Test Case Design)**

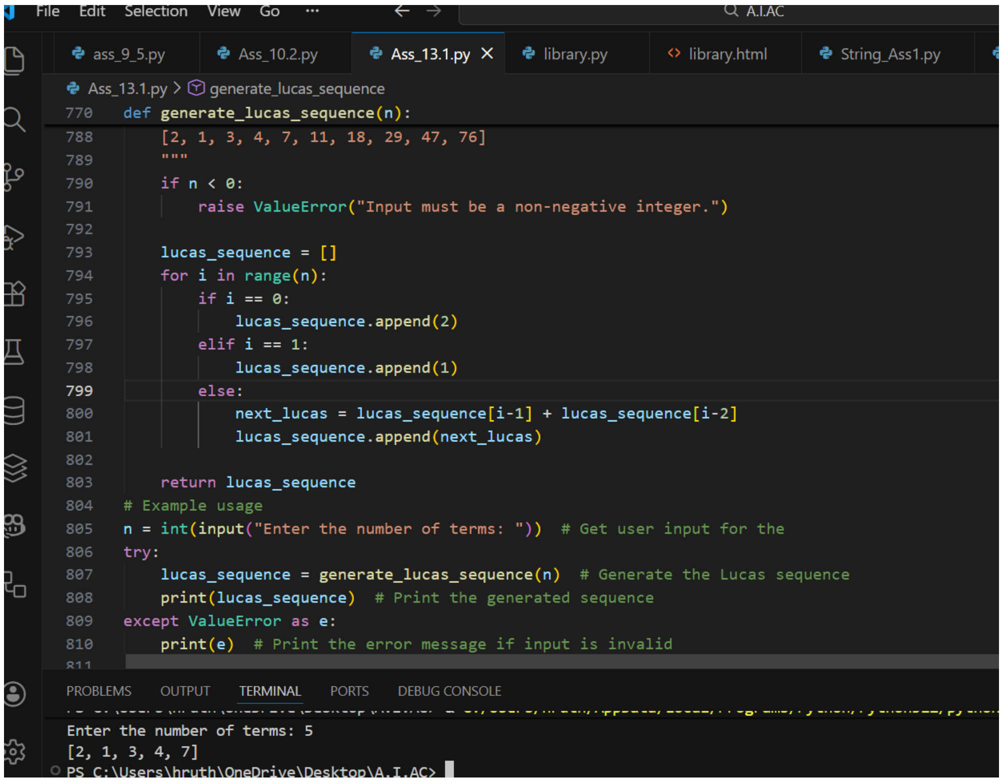
- Function: Generate Lucas sequence up to n terms.(Starts with 2,1, then Fn = Fn-1 + Fn-2)Test Cases to Design:
- Normal: 5 → [2, 1, 3, 4, 7]
- Edge: 1 → [2]
- Negative: -5 → Error
- Large: 10 (last element = 76). Requirement: Validate correctness with pytest.

```
#Task 14 (Lucas Number Sequence – Test Case Design)
#Prompt:Generate Lucas sequence up to n terms.(Starts with 2,1, then Fn = Fn-1 + Fn-2)
#Test Cases to Design:
#Normal: 5 → [2, 1, 3, 4, 7]
#Edge: 1 → [2]
#Negative: -5 → Error
#Large: 10 (last element = 76).
#Requirement: Validate correctness with pytest.
def generate_lucas_sequence(n):
    """
    Generate the Lucas number sequence up to n terms.
    Parameters:
    n (int): The number of terms in the Lucas sequence to generate.
    Returns:
    list: A list containing the Lucas sequence up to n terms.
    Example:
    >>> generate_lucas_sequence(5)
    [2, 1, 3, 4, 7]
    >>> generate_lucas_sequence(1)
    [2]
    >>> generate_lucas_sequence(-5)
    ValueError: Input must be a non-negative integer.
    >>> generate_lucas_sequence(10)
    [2, 1, 3, 4, 7, 11, 18, 29, 47, 76]
    """
    if n < 0:
        raise ValueError("Input must be a non-negative integer.")
    lucas_sequence = []
    for i in range(n):
        if i == 0:
            lucas_sequence.append(2)
        elif i == 1:
            lucas_sequence.append(1)
        else:
            next_lucas = lucas_sequence[i-1] + lucas_sequence[i-2]
            lucas_sequence.append(next_lucas)
    return lucas_sequence
# Example usage
n = int(input("Enter the number of terms: "))  # Get user input for the
```

```
try:
    lucas_sequence = generate_lucas_sequence(n)  # Generate the Lucas sequence
    print(lucas_sequence)  # Print the generated sequence
except ValueError as e:
    print(e)  # Print the error message if input is invalid
```



```
#Requirement: Validate correctness with pytest.
def generate_lucas_sequence(n):
    """
    Generate the Lucas number sequence up to n terms.

    Parameters:
    n (int): The number of terms in the Lucas sequence to generate.

    Returns:
    list: A list containing the Lucas sequence up to n terms.

    Example:
    >>> generate_lucas_sequence(5)
    [2, 1, 3, 4, 7]
    >>> generate_lucas_sequence(1)
    [2]
    >>> generate_lucas_sequence(-5)
    ValueError: Input must be a non-negative integer.
    >>> generate_lucas_sequence(10)
    [2, 1, 3, 4, 7, 11, 18, 29, 47, 76]
    """
    if n < 0:
        raise ValueError("Input must be a non-negative integer.")

    lucas_sequence = []
    for i in range(n):
        if i == 0:
            lucas_sequence.append(2)
        elif i == 1:
```



File Edit Selection View Go ···
A.I.AC
ass_9_5.py
Ass_10.2.py
Ass_13.1.py
library.py
library.html
String_Ass1.py
Ass_13.1.py > generate_lucas_sequence
PROBLEMS OUTPUT TERMINAL PORTS DEBUG CONSOLE

```
def generate_lucas_sequence(n):
    [2, 1, 3, 4, 7, 11, 18, 29, 47, 76]
    """
    if n < 0:
        raise ValueError("Input must be a non-negative integer.")

    lucas_sequence = []
    for i in range(n):
        if i == 0:
            lucas_sequence.append(2)
        elif i == 1:
            lucas_sequence.append(1)
        else:
            next_lucas = lucas_sequence[i-1] + lucas_sequence[i-2]
            lucas_sequence.append(next_lucas)

    return lucas_sequence
# Example usage
n = int(input("Enter the number of terms: "))  # Get user input for the
try:
    lucas_sequence = generate_lucas_sequence(n)  # Generate the Lucas sequence
    print(lucas_sequence)  # Print the generated sequence
except ValueError as e:
    print(e)  # Print the error message if input is invalid
```

```
Enter the number of terms: 5
[2, 1, 3, 4, 7]
PS C:\Users\hruth\OneDrive\Desktop\A.I.AC>
```

💡 **Task 15 (Vowel & Consonant Counter – Test Case Design)**

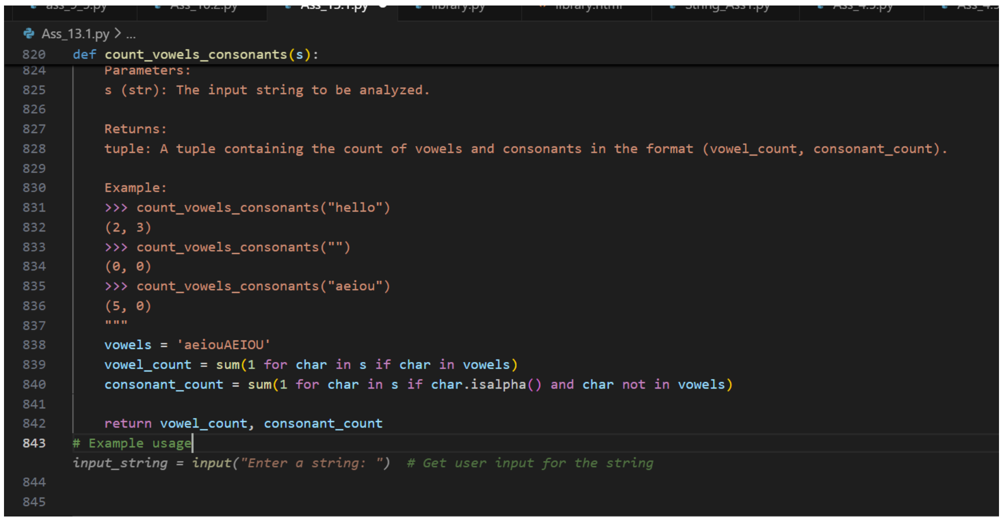
- Function: Count vowels and consonants in string.Test Cases to Design:
- Normal: "hello" → (2,3)
- Edge: "" → (0,0)
- Only vowels: "aeiou" → (5,0)

Large: Long text

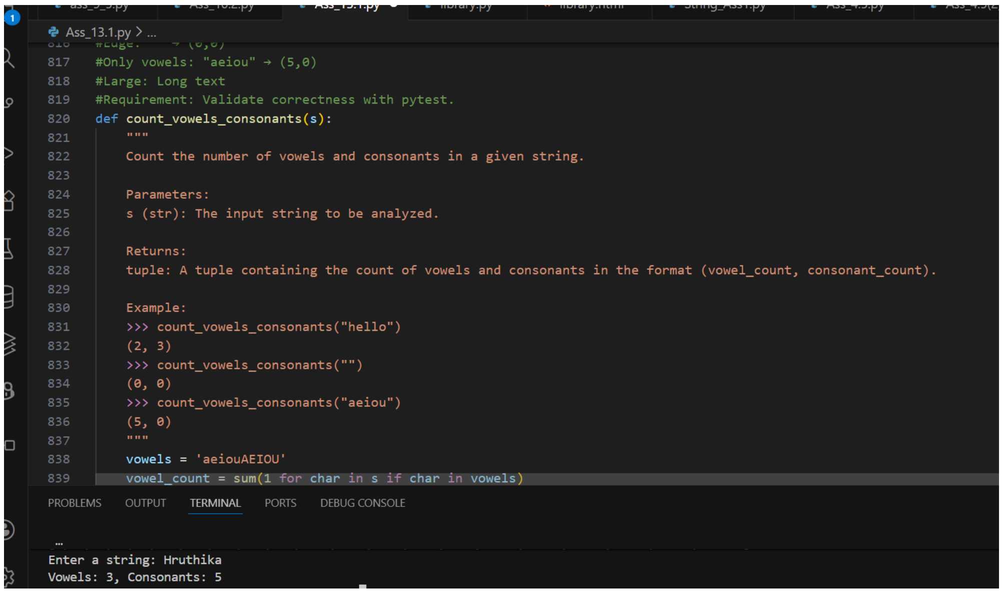
- Requirement: Validate correctness with pytest

```
#Task 15 (Vowel & Consonant Counter – Test Case Design)
#Prompt:Count vowels and consonants in string.
#Test Cases to Design:
#Normal: "hello" → (2,3)
#Edge: "" → (0,0)
#Only vowels: "aeiou" → (5,0)
#Large: Long text
#Requirement: Validate correctness with pytest.
def count_vowels_consonants(s):
    """
    Count the number of vowels and consonants in a given string.
    Parameters:
    s (str): The input string to be analyzed.
    Returns:
```

```
    tuple: A tuple containing the count of vowels and consonants in the format (vowel_cou
nt, consonant_count).
    Example:
    >>> count_vowels_consonants("hello")
    (2, 3)
    >>> count_vowels_consonants("")
    (0, 0)
    >>> count_vowels_consonants("aeiou")
    (5, 0)
    """
    vowels = 'aeiouAEIOU'
    vowel_count = sum(1 for char in s if char in vowels)
    consonant_count = sum(1 for char in s if char.isalpha() and char not in vowels)

    return vowel_count, consonant_count
# Example usage
input_string = input("Enter a string: ")  # Get user input for the string
vowel_count, consonant_count = count_vowels_consonants(input_string)  # Count vowels and
consonants
print(f"Vowels: {vowel_count}, Consonants: {consonant_count}")  # Print the counts
```



```
def count_vowels_consonants(s):
    Parameters:
    s (str): The input string to be analyzed.

    Returns:
    tuple: A tuple containing the count of vowels and consonants in the format (vowel_count, consonant_count).

    Example:
    >>> count_vowels_consonants("hello")
    (2, 3)
    >>> count_vowels_consonants("")
    (0, 0)
    >>> count_vowels_consonants("aeiou")
    (5, 0)
    """
    vowels = 'aeiouAEIOU'
    vowel_count = sum(1 for char in s if char in vowels)
    consonant_count = sum(1 for char in s if char.isalpha() and char not in vowels)

    return vowel_count, consonant_count
# Example usage
input_string = input("Enter a string: ")  # Get user input for the string
```



Ass_13.1.py > ...

```
#Only vowels: "aeiou" → (5,0)
#Large: Long text
#Requirement: Validate correctness with pytest.
def count_vowels_consonants(s):
    """
    Count the number of vowels and consonants in a given string.

    Parameters:
    s (str): The input string to be analyzed.

    Returns:
    tuple: A tuple containing the count of vowels and consonants in the format (vowel_count, consonant_count).

    Example:
    >>> count_vowels_consonants("hello")
    (2, 3)
    >>> count_vowels_consonants("")
    (0, 0)
    >>> count_vowels_consonants("aeiou")
    (5, 0)
    """
    vowels = 'aeiouAEIOU'
    vowel_count = sum(1 for char in s if char in vowels)
```

```
Enter a string: Hruthika
Vowels: 3, Consonants: 5
```