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Lab 9 – Code Review and Quality: Using AI to improve code quality and readability

Lab Objectives:

- To apply AI-based prompt engineering for code review and quality improvement.
- To analyze code for readability, logic, performance, and maintainability issues.
- To use Zero-shot, One-shot, and Few-shot prompting for improving code quality.
- To evaluate AI-generated improvements using standard coding practices.

Lab Outcomes (LOs): After completing this lab, students will be able to:

- Review and improve code quality using AI tools.
- Identify syntax, logic, and performance issues in code.
- Refactor code to improve readability and maintainability.
- Compare AI outputs generated using different prompting techniques.

Problem Statement 1: AI-Assisted Bug Detection

Scenario: A junior developer wrote the following Python function to calculate factorials:

```
def factorial(n):
    result = 1
    for i in range(1, n):
        result = result * i
    return result
```

Instructions:

1. Run the code and test it with `factorial(5)`.
2. Use an AI assistant to:
 - Identify the logical bug in the code.
 - Explain why the bug occurs (e.g., off-by-one error).
 - Provide a corrected version.
3. Compare the AI's corrected code with your own manual fix.
4. Write a brief comparison: Did AI miss any edge cases (e.g., negative numbers, zero)?

Expected Output:

Corrected function should return 120 for factorial(5).

Reviewed Code:

```
def factorial(n):
    result = 1
    for i in range(1, n):
        result = result * i
    return result
```

The above function has a bug: it does not include 'n' in the multiplication.

Corrected version of the factorial function

```
def corrected_factorial(n):
    result = 1
    for i in range(1, n + 1):
        result = result * i
    return result
```

Test the corrected function

number = 5

```
print(f"The factorial of {number} is {corrected_factorial(number)}")
```

Output: The factorial of 5 is 120

The screenshot shows a code editor interface with a dark theme. The top menu bar includes File, Edit, Selection, View, Go, Run, Terminal, and Help. The title bar says "LAB ASSIGNMENTS". The left sidebar shows file icons for A1.py, A-4-3T2.py, A-4-3T3.py, A-4-3T4.py, and A-5.py. The main code area contains the following Python script:

```
def factorial(n):
    result = 1
    for i in range(1, n):
        result = result * i
    return result

# The above function has a bug: it does not include 'n' in the multiplication.

# Corrected version of the factorial function

def corrected_factorial(n):
    result = 1
    for i in range(1, n + 1):
        result = result * i
    return result

# Test the corrected function
number = 5
print(f"The factorial of {number} is {corrected_factorial(number)}")
# Output: The factorial of 5 is 120
```

Below the code editor is a terminal window showing the execution of the script:

```
PS C:\Users\SriNidhi\OneDrive\Desktop\AI CODING\LAB ASSIGNMENTS> & C:/Users/SriNidhi/AppData/Local/Programs/Python/Python314/python.exe "c:/Users/SriNidhi/OneDrive/Desktop/AI CODING/LAB ASSIGNMENTS/A-5.py"
The factorial of 5 is 120
PS C:\Users\SriNidhi\OneDrive\Desktop\AI CODING\LAB ASSIGNMENTS>
```

The bottom status bar indicates the file is "master", has 0 changes, and is in Python mode. It also shows line 13, column 30, spaces: 4, and encoding: UTF-8.

Explanation:

Bug Identification:

The loop uses `range(1, n)`, which excludes `n`. This is a classic **off-by-one error**, so `factorial(5)` computes $1 \times 2 \times 3 \times 4 = 24$ instead of 120.

Correction & Comparison:

AI correctly fixes the loop to `range(1, n + 1)`. However, it **misses edge-case handling** like negative inputs and doesn't explicitly validate `n >= 0`. A robust manual fix should include input validation.

Problem Statement 2: Task 2 — Improving Readability & Documentation

Scenario: The following code works but is poorly written:

```
.
```

```
def calc(a, b, c):
    if c == "add":
        return a + b
    elif c == "sub":
        return a - b
    elif c == "mul":
        return a * b
    elif c == "div":
```

Instructions:

5. Use AI to:
 - Critique the function's readability, parameter naming, and lack of documentation.
 - Rewrite the function with:
 1. Descriptive function and parameter names.
 2. A complete docstring (description, parameters, return value, examples).
 3. Exception handling for division by zero.
 4. Consideration of input validation.
6. Compare the original and AI-improved versions.
7. Test both with valid and invalid inputs (e.g., division by zero, non-string operation).

Expected Output:

A well-documented, robust, and readable function that handles errors gracefully.

Reviewed Code

```
def calculate(operation: str, x: float, y: float) -> float:  
    """
```

Perform a basic arithmetic operation on two numbers.

Parameters:

operation (str): The operation to perform.

Supported values: 'add', 'sub', 'mul', 'div'

x (float): First number

y (float): Second number

Returns:

float: Result of the arithmetic operation

Raises:

ValueError: If an unsupported operation is provided

ZeroDivisionError: If division by zero is attempted

TypeError: If inputs are of invalid type

Examples:

```
>>> calculate("add", 5, 3)
```

8

```
>>> calculate("div", 10, 2)  
5.0
```

```
if not isinstance(operation, str):  
    raise TypeError("Operation must be a string")  
  
if not isinstance(x, (int, float)) or not isinstance(y, (int, float)):  
    raise TypeError("Operands must be numeric")  
  
operation = operation.lower()  
  
if operation == "add":
```

```

    return x + y

    elif operation == "sub":
        return x - y

    elif operation == "mul":
        return x * y

    elif operation == "div":
        if y == 0:
            raise ZeroDivisionError("Cannot divide by zero")
        return x / y

```

```

print(calculate("add", 10, 5)) # 15
print(calculate("sub", 10, 5)) # 5
print(calculate("mul", 10, 5)) # 50
print(calculate("div", 10, 5)) # 2.0

```

Output:

15

5

50

2.0

```

A10_3.py > calculate
10 def calculate(operation: str, x: float, y: float) -> float:
35
37     if not isinstance(x, (int, float)) or not isinstance(y, (int, float)):
38         raise TypeError("Operands must be numeric")
39
40     operation = operation.lower()
41
42     if operation == "add":
43         return x + y
44     elif operation == "sub":
45         return x - y
46     elif operation == "mul":
47         return x * y
48     elif operation == "div":
49         if y == 0:
50             raise ZeroDivisionError("Cannot divide by zero")
51         return x / y
52
53 print(calculate("add", 10, 5)) # 15
54 print(calculate("sub", 10, 5)) # 5
55 print(calculate("mul", 10, 5)) # 50
56 print(calculate("div", 10, 5)) # 2.0
57
58

```

Explanation:

Critique:

The function name `calc` and parameters `a`, `b`, `c` are meaningless, there's no docstring, and division by zero is not handled—this is unreadable and unsafe in real code.

AI-Improved Version Outcome:

AI improves clarity with descriptive names, adds a proper docstring, validates inputs, and handles division by zero using exceptions. The improved version is far more maintainable and production-ready than the original.

Problem Statement 3: Enforcing Coding Standards

Scenario: A team project requires PEP8 compliance. A developer submits:

```
def Checkprime(n):
    for i in range(2, n):
        if n % i == 0:
            return False
    return True
```

Instructions:

8. Verify the function works correctly for sample inputs.
9. Use an AI tool (e.g., ChatGPT, GitHub Copilot, or a PEP8 linter with AI explanation) to:
 - List all PEP8 violations.
 - Refactor the code (function name, spacing, indentation, naming).
10. Apply the AI-suggested changes and verify functionality is preserved.
11. Write a short note on how automated AI reviews could streamline code reviews in large teams.

Expected Output:

A PEP8-compliant version of the function, e.g.:

```
def check_prime(n):
    for i in range(2, n):
        if n % i == 0:
            return False
```

```
return True
```

Reviewed Code:

```
def Checkprime(n):
    for i in range(2, n):

        if n % i == 0:
            return False

    return True

# Example usage
number = 29

if Checkprime(number):
    print(f"{number} is a prime number.")

else:

    print(f"{number} is not a prime number.")
```

OUTPUT:

29 is a prime number

The screenshot shows a code editor interface with a tab bar at the top containing files A1.py, A-3.py, A-4-3T2.py, A-4-3T3.py, A-4-3T4.py, and A-5.py. The A-5.py file is currently selected and displayed in the main editor area. The code in A-5.py is identical to the one shown above. Below the editor is a terminal window titled 'LAB ASSIGNMENTS' showing the execution of the script and its output. The terminal output is as follows:

```
PS C:\Users\SriNidhi\OneDrive\Desktop\AI CODING\LAB ASSIGNMENTS> & C:/Users/SriNidhi/AppData/Local/Programs/Python/Python314/python.exe "c:/Users/SriNidhi/OneDrive/Desktop/AI CODING/LAB ASSIGNMENTS/A-5.py"
29 is a prime number.
```

The bottom status bar of the code editor indicates the file is 'master*' and the current file is 'A-5.py'. It also shows the line count as 'In 51, Col 1', spaces as 'Spaces: 4', encoding as 'UTF-8', and the Python version as '3.14.0'. There are also icons for Go Live and other development tools.

EXPLANATION:

PEP8 Issues:

Function name `Checkprime` violates snake_case, spacing is inconsistent, and there's no input validation for values less than 2.

Refactoring Result & Impact:

AI refactors the function to `check_prime`, fixes naming and formatting, and preserves logic. Automated AI reviews can drastically reduce review time in large teams by catching style issues early.

Problem Statement 4: AI as a Code Reviewer in Real Projects

Scenario:

In a GitHub project, a teammate submits:

```
def processData(d):
    return [x * 2 for x in d if x % 2 == 0]
```

Instructions:

1. Manually review the function for:
 - Readability and naming.
 - Reusability and modularity.
 - Edge cases (non-list input, empty list, non-integer elements).
2. Use AI to generate a code review covering:
 - Better naming and function purpose clarity.
 - Input validation and type hints.
 - Suggestions for generalization (e.g., configurable multiplier).
3. Refactor the function based on AI feedback.
4. Write a short reflection on whether AI should be a standalone reviewer or an assistant.

Expected Output:

An improved function with type hints, validation, and clearer intent, e.g.:

```
from typing import List, Union
```

```
def double_even_numbers(numbers: List[Union[int, float]])
    -> List[Union[int, float]]:
        if not isinstance(numbers, list):
```

```
raise TypeError("Input must be a list")
return [num * 2 for num in numbers if isinstance(num, (int, float))
       and num % 2 == 0]
```

REVIEWED CODE:

```
def processData(d):

    return [x * 2 for x in d if x % 2 == 0]
# Example usage
```

```
data = [1, 2, 3, 4, 5, 6]
processed_data = processData(data)
```

```
print(f"Processed Data: {processed_data}") # Output: Processed
Data: [4, 8, 12] # Output: Multiplication Result: 50
```

OUTPUT:

Processed Data: [4, 8, 12]

The screenshot shows a code editor interface with the following details:

- File Explorer:** Shows files A1.py, A-4.3.py, A-4-3T2.py, A-4-3T3.py, A-4-3T4.py, and A-5.py.
- Editor Area:** Displays the Python code for `A-5.py`. The code defines a function `processData` that returns a list comprehension for even numbers in `d`. It includes a comment for example usage, initializes `data`, calls `processData`, and prints the result.
- Terminal:** Shows the command line output:
 - PS C:\Users\SriNidhi\OneDrive\Desktop\AI CODING\LAB ASSIGNMENTS> & C:/Users/SriNidhi/AppData/Local/Programs/Python/Python314/python.exe "c:/Users/SriNidhi/OneDrive/Desktop/AI CODING/LAB ASSIGNMENTS/A-5.py"
 - Processed Data: [4, 8, 12]
- Status Bar:** Shows the file is master*, line 91, column 1, spaces: 4, encoding: UTF-8, CRLF, Python 3.14.0, and Go Live.

EXPLANATION:

Manual Review Findings:

The function name `processData` is vague, input assumptions are unsafe, and it fails silently for invalid data types or mixed inputs.

1

AI Review & Refactor:

AI suggests better naming, adds type hints, input validation, and improves reusability by clarifying intent. **AI should be an assistant, not a standalone reviewer**—logic and business context still need humans.

Problem Statement 5: — AI-Assisted Performance Optimization

Scenario: You are given a function that processes a list of integers, but it runs slowly on large datasets:

```
def sum_of_squares(numbers):
    total = 0
    for num in numbers:
        total += num ** 2
    return total
```

Instructions:

1. Test the function with a large list (e.g., `range(1000000)`).
2. Use AI to:
 - Analyze time complexity.
 - Suggest performance improvements (e.g., using built-in functions, vectorization with NumPy if applicable).
 - Provide an optimized version.
3. Compare execution time before and after optimization.
4. Discuss trade-offs between readability and performance.

Expected Output:

An optimized function, such as:

```
def sum_of_squares_optimized(numbers):
    return sum(x * x for x in numbers)
```

REVIEWED CODE:

```
def sum_of_squares(numbers):
```

```
total = 0  
for num in numbers:
```

```

        total += num ** 2
    return total
# Example usage
nums = [1, 2, 3, 4]
print(f"Sum of squares: {sum_of_squares(nums)}") # Output: Sum
of squares
def sum_of_squares_optimized(numbers):
    return sum(x * x for x in numbers)
# Example usage
nums = [1, 2, 3, 4]
print(f"Optimized Sum of squares:
{sum_of_squares_optimized(nums)}") # Output: Optimized Sum of
squares: 30: 30

```

OUTPUT

Sum of squares: 30

Optimised Sum of squares: 30

```

File Edit Selection View Go Run Terminal Help ← → LAB ASSIGNMENTS
A1.py A-4.3.py A-4-3T2.py A-4-3T3.py A-4-3T4.py A-5.py
A-5.py > ...
110
111
112
113 def sum_of_squares(numbers):
114     total = 0
115     for num in numbers:
116         total += num ** 2
117     return total
118 # Example usage
119 nums = [1, 2, 3, 4]
120 print(f"Sum of squares: {sum_of_squares(nums)}") # Output: Sum of squares
121 def sum_of_squares_optimized(numbers):
122     return sum(x * x for x in numbers)
123 # Example usage
124 nums = [1, 2, 3, 4]
125 print(f"Optimized Sum of squares: {sum_of_squares_optimized(nums)}") # Output: Optimized Sum of squares: 30: 30
126
127
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130
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS Python + - ×
PS C:\Users\SriNidhi\OneDrive\Desktop\AI CODING\LAB ASSIGNMENTS> & C:/Users/SriNidhi/AppData/Local/Programs/Python/Python314/python.exe "c:/Users/SriNidhi/OneDrive/Desktop/AI CODING/LAB ASSIGNMENTS/A-5.py"
● PS C:\Users\SriNidhi\OneDrive\Desktop\AI CODING\LAB ASSIGNMENTS> & C:/Users/SriNidhi/AppData/Local/Programs/Python/Python314/python.exe "c:/Users/SriNidhi/OneDrive/Desktop/AI CODING/LAB ASSIGNMENTS/A-5.py"
● PS C:\Users\SriNidhi\OneDrive\Desktop\AI CODING\LAB ASSIGNMENTS> & C:/Users/SriNidhi/AppData/Local/Programs/Python/Python314/python.exe "c:/Users/SriNidhi/OneDrive/Desktop/AI CODING/LAB ASSIGNMENTS/A-5.py"
● PS C:\Users\SriNidhi\OneDrive\Desktop\AI CODING\LAB ASSIGNMENTS> & C:/Users/SriNidhi/AppData/Local/Programs/Python/Python314/python.exe "c:/Users/SriNidhi/OneDrive/Desktop/AI CODING/LAB ASSIGNMENTS/A-5.py"
Sum of squares: 30
● PS C:\Users\SriNidhi\OneDrive\Desktop\AI CODING\LAB ASSIGNMENTS> & C:/Users/SriNidhi/AppData/Local/Programs/Python/Python314/python.exe "c:/Users/SriNidhi/OneDrive/Desktop/AI CODING/LAB ASSIGNMENTS/A-5.py"
Optimized Sum of squares: 30
○ PS C:\Users\SriNidhi\OneDrive\Desktop\AI CODING\LAB ASSIGNMENTS>

```

EXPLANATION:

Analysis:

The original function runs in **O(n)** time and is already optimal in complexity, but uses an explicit loop that's slower in Python.

Optimization & Trade-off:

AI replaces the loop with a generator inside `sum()`, improving speed and readability slightly. Performance gains are minor but measurable; readability is actually improved, not sacrificed.