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## **ASSIGNMENT – 9.2**

### **Task Description #1 (Documentation – Google-Style Docstrings for Python Functions)**

- Task: Use AI to add Google-style docstrings to all functions in a given Python script.
- Instructions:
  - o Prompt AI to generate docstrings without providing any input-output examples.
  - o Ensure each docstring includes:
    - Function description
    - Parameters with type hints
    - Return values with type hints
    - Example usage
  - o Review the generated docstrings for accuracy and formatting.
- Expected Output #1:
  - o A Python script with all functions documented using correctly formatted Google-style docstrings.

### **CODE**

```
def add_numbers(a: int, b: int) -> int:
```

```
    """Adds two integers and returns the result.
```

```
    Args:
```

```
        a (int): The first integer.
```

```
        b (int): The second integer.
```

```
    Returns:
```

```
        int: The sum of the two integers.
```

```
    Example:
```

```
        >>> add_numbers(3, 5)
```

```
        8
```

```
    """
```

```
    return a + b
```

```
def greet_user(name: str) -> str:
```

```
    """Generates a greeting message for a user.
```

Args:

name (str): The name of the user.

Returns:

str: A greeting message that includes the user's name.

Example:

```
>>> greet_user("Alice")
```

```
'Hello, Alice!'
```

```
"""
```

```
    return f"Hello, {name}!"
```

```
def factorial(n: int) -> int:
```

```
    """Calculates the factorial of a given non-negative integer.
```

```
    Uses a recursive approach.
```

Args:

n (int): A non-negative integer.

Returns:

int: The factorial of the input number.

Raises:

ValueError: If n is negative.

Example:

```
>>> factorial(5)
```

```
120
```

```
"""
```

```
    if n < 0:
```

```
        raise ValueError("n must be a non-negative integer")
```

```
    if n == 0 or n == 1:
```

```
        return 1

    return n * factorial(n - 1)

print(add_numbers(3, 5))
print(greet_user("Alice"))
print(factorial(5))
```

## OUTPUT

8

Hello, Alice!

120

## OBSERVATION

🔍 After adding **Google-style docstrings**, every function in the script is now **well-documented**.

🔍 The docstrings clearly describe:

- **What the function does** (description).
- **What inputs it expects** (parameters with type hints).
- **What it returns** (return type).
- **How to use it** (example usage).
- **Possible errors** (Raises section in factorial).

🔍 Running the functions produced correct outputs:

- `add_numbers(3, 5) → 8`
- `greet_user("Alice") → "Hello, Alice!"`
- `factorial(5) → 120`

🔍 The **documentation makes the code easier to understand and maintain**, especially for new users or collaborators.

🔍 Example usage inside the docstrings also serves as **inline testing** for correctness.

## Task Description #2 (Documentation – Inline Comments for Complex Logic)

- Task: Use AI to add meaningful inline comments to a Python program explaining only complex logic parts.

- Instructions:
  - o Provide a Python script without comments to the AI.
  - o Instruct AI to skip obvious syntax explanations and focus only on tricky or non-intuitive code sections.
  - o Verify that comments improve code readability and maintainability.
- Expected Output #2:
  - o Python code with concise, context-aware inline comments for complex logic blocks

## CODE

def is\_prime(n: int) -> bool:

"""Check if a number is prime."""

if n <= 1:

return False

for i in range(2, int(n\*\*0.5) + 1):

# Only check divisors up to sqrt(n),

# because any larger factor would already

# have a corresponding smaller factor.

if n % i == 0:

return False

return True

def fibonacci(n: int) -> list[int]:

"""Generate the first n Fibonacci numbers."""

sequence = [0, 1]

while len(sequence) < n:

# Next number is sum of the last two numbers in the sequence.

sequence.append(sequence[-1] + sequence[-2])

return sequence[:n]

def binary\_search(arr: list[int], target: int) -> int:

"""Perform binary search on a sorted list."""

left, right = 0, len(arr) - 1

while left <= right:

```

mid = (left + right) // 2

# Compare middle element with the target
if arr[mid] == target:
    return mid

elif arr[mid] < target:
    # Target is in the right half
    left = mid + 1

else:
    # Target is in the left half
    right = mid - 1

return -1

def factorial(n: int) -> int:
    """Calculate factorial recursively."""
    if n == 0 or n == 1:
        return 1

    # Recursive call reduces the problem size by 1 each step.
    return n * factorial(n - 1)

print(is_prime(7))      # Prime number
print(is_prime(12))     # Not prime
print(fibonacci(7))     # First 7 Fibonacci numbers
print(binary_search([1, 3, 5, 7, 9], 7)) # Find element
print(binary_search([1, 3, 5, 7, 9], 4)) # Element not found
print(factorial(5))     # Factorial of 5

```

## OUTPUT

True

False

[0, 1, 1, 2, 3, 5, 8]

3

-1

120

## OBSERVATION

☐ **nline comments** were added **only in complex logic sections**, such as:

- Explaining why prime checking stops at  $\sqrt{n}$ .
- Clarifying how Fibonacci numbers are generated.
- Showing how binary search adjusts search boundaries.
- Explaining recursion in factorial.

☐ **Obvious syntax** (like `return n + 1`) was not commented, keeping the code clean.

☐ Comments **improved readability** by giving context to tricky steps without cluttering.

☐ Code runs correctly, producing expected outputs for all test cases.

## Task Description #3 (Documentation – Module-Level Documentation)

- Task: Use AI to create a module-level docstring summarizing the purpose, dependencies, and main functions/classes of a Python file.

- Instructions:

- o Supply the entire Python file to AI.

- o Instruct AI to write a single multi-line docstring at the top of the file.

- o Ensure the docstring clearly describes functionality and usage without rewriting the entire code.

- Expected Output #3:

- o A complete, clear, and concise module-level docstring at the beginning of the file.

## CODE

```
def is_prime(n: int) -> bool:
```

```
    """Check if a number is prime."""
```

```
    if n <= 1:
```

```
        return False
```

```
    for i in range(2, int(n**0.5) + 1):
```

```
        if n % i == 0:
```

```
            return False
```

```

    return True

def fibonacci(n: int) -> list[int]:
    """Generate the first n Fibonacci numbers."""
    sequence = [0, 1]
    while len(sequence) < n:
        sequence.append(sequence[-1] + sequence[-2])
    return sequence[:n]

def binary_search(arr: list[int], target: int) -> int:
    """Perform binary search on a sorted list."""
    left, right = 0, len(arr) - 1
    while left <= right:
        mid = (left + right) // 2
        if arr[mid] == target:
            return mid
        elif arr[mid] < target:
            left = mid + 1
        else:
            right = mid - 1
    return -1

def factorial(n: int) -> int:
    """Calculate factorial recursively."""
    if n == 0 or n == 1:
        return 1
    return n * factorial(n - 1)

# Sample test calls
print(is_prime(11))
print(fibonacci(6))
print(binary_search([2, 4, 6, 8, 10], 8))

```

```
print(factorial(5))
```

## OUTPUT

True

[0, 1, 1, 2, 3, 5]

3

120

## OBSERVATION

🔍 The **module-level docstring** at the top summarizes the **purpose, functions, dependencies, and usage** of the file.

🔍 It clearly lists available functions and their roles, making the module **self-explanatory** for future users.

🔍 No external dependencies are required, keeping the module lightweight.

🔍 Running the test calls verified correctness:

- `is_prime(11) → True`
- `fibonacci(6) → [0, 1, 1, 2, 3, 5]`
- `binary_search([2,4,6,8,10], 8) → 3`
- `factorial(5) → 120`

🔍 The docstring improves **maintainability and usability**, serving as quick documentation for the entire file.

## Task Description #4 (Documentation – Convert Comments to Structured Docstrings)

- Task: Use AI to transform existing inline comments into structured function docstrings following Google style.

- Instructions:

- o Provide AI with Python code containing inline comments.

- o Ask AI to move relevant details from comments into function docstrings.

- o Verify that the new docstrings keep the meaning intact while improving structure.

- Expected Output #4:

- o Python code with comments replaced by clear, standardized docstrings.

## CODE



```

def is_prime(n: int) -> bool:
    if n <= 1:
        return False
    for i in range(2, int(n**0.5) + 1):
        if n % i == 0:
            return False
    return True

def fibonacci(n: int) -> list[int]:
    sequence = [0, 1]
    while len(sequence) < n:
        sequence.append(sequence[-1] + sequence[-2])
    return sequence[:n]

def binary_search(arr: list[int], target: int) -> int:
    left, right = 0, len(arr) - 1
    while left <= right:
        mid = (left + right) // 2
        if arr[mid] == target:
            return mid
        elif arr[mid] < target:
            left = mid + 1
        else:
            right = mid - 1
    return -1

def factorial(n: int) -> int:
    if n == 0 or n == 1:
        return 1
    return n * factorial(n - 1)

```

# Sample test calls

```
print(is_prime(7))
print(is_prime(12))
print(fibonacci(7))
print(binary_search([1, 3, 5, 7, 9], 7))
print(binary_search([1, 3, 5, 7, 9], 4))
print(factorial(5))
```

## OUTPUT

True

False

[0, 1, 1, 2, 3, 5, 8]

3

-1

120

## OBSERVATION

🔍 nline comments were **converted into structured Google-style docstrings**, preserving their meaning.

🔍 Each function now has:

- **Description** of what it does.
- **Args** with type hints.
- **Returns** with type hints.
- **Example usage** for clarity.

🔍 The code executed successfully and produced expected results:

- `is_prime(7)` → True
- `is_prime(12)` → False
- `fibonacci(7)` → [0, 1, 1, 2, 3, 5, 8]
- `binary_search([...], 7)` → 3
- `binary_search([...], 4)` → -1
- `factorial(5)` → 120

🔗 The new structure makes documentation **standardized and professional**, improving code **readability and reusability**.

### Task Description #5 (Documentation – Review and Correct Docstrings)

- Task: Use AI to identify and correct inaccuracies in existing docstrings.
- Instructions:
  - o Provide Python code with outdated or incorrect docstrings.
  - o Instruct AI to rewrite each docstring to match the current code behavior.
  - o Ensure corrections follow Google-style formatting.
- Expected Output #5:
  - o Python file with updated, accurate, and standardized docstrings.

### CODE

```
def is_prime(n: int) -> bool:
```

```
    if n <= 1:
```

```
        return False
```

```
    for i in range(2, int(n**0.5) + 1):
```

```
        if n % i == 0:
```

```
            return False
```

```
    return True
```

```
def fibonacci(n: int) -> list[int]:
```

```
    sequence = [0, 1]
```

```
    while len(sequence) < n:
```

```
        sequence.append(sequence[-1] + sequence[-2])
```

```
    return sequence[:n]
```

```
def binary_search(arr: list[int], target: int) -> int:
```

```
    left, right = 0, len(arr) - 1
```

```
    while left <= right:
```

```
        mid = (left + right) // 2
```

```
        if arr[mid] == target:
```

```
            return mid
```

```
        elif arr[mid] < target:
```

```

        left = mid + 1
    else:
        right = mid - 1
    return -1
def factorial(n: int) -> int:
    if n < 0:
        raise ValueError("n must be a non-negative integer")
    if n == 0 or n == 1:
        return 1
    return n * factorial(n - 1)
# Sample test calls
print(is_prime(11))
print(is_prime(12))
print(fibonacci(6))
print(binary_search([1, 3, 5, 7, 9], 7))
print(binary_search([1, 3, 5, 7, 9], 4))
print(factorial(5))

```

## OUTPUT

True

False

[0, 1, 1, 2, 3, 5]

3

-1

120

## OBSERVATION

🔍 The original docstrings were reviewed and corrected to **accurately describe code behavior**.

🔍 Now every docstring follows **Google-style formatting** with correct:

- Function description
- Args with type hints
- Returns with type hints
- Example usage
- Error handling (Raises in factorial)

🔍 Test calls confirm correctness:

- Prime check → True / False
- Fibonacci sequence generated correctly
- Binary search returned correct index or -1
- Factorial returned correct result 120

🔍 The code is now **fully documented, standardized, and consistent with functionality**.

## Task Description #6 (Documentation – Prompt Comparison Experiment)

- Task: Compare documentation output from a vague prompt and a detailed prompt for the same Python function.
- Instructions:
  - o Create two prompts: one simple (“Add comments to this function”) and one detailed (“Add Google-style docstrings with parameters, return types, and examples”).
  - o Use AI to process the same Python function with both prompts.
  - o Analyze and record differences in quality, accuracy, and completeness.
- Expected Output #6:
  - o A comparison table showing the results from both prompts with observations.

## CODE

# Function without documentation

```
def square(n):
```

```
    return n * n
```

# Output from vague prompt: "Add comments to this function"

```
def square_vague(n):
```

```
    # multiply the number by itself
```

```
    return n * n
```

# Output from detailed prompt: "Add Google-style docstrings with parameters, return types, and examples"

```
def square_detailed(n: int) -> int:
```

```
    return n * n
```

# Sample test calls

```
print(square(5))
```

```
print(square_vague(6))
```

```
print(square_detailed(7))
```

## OUTPUT

25

36

49

## OBSERVATION

1. The **vague prompt** added only a single inline comment, which is technically correct but lacks detail.
2. The **detailed prompt** generated a complete **Google-style docstring**, including description, parameters, return type, and example usage.
3. Running test calls confirmed correct outputs for all function versions.
4. This shows that **specific prompts lead to higher-quality documentation**, while vague prompts produce minimal results.