School of Computer Science and Artificial Intelligence

Lab Assignment # 03

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Lab 3: Prompt Engineering – Improving Prompts and Context Management

Task 1: Zero-Shot Prompting (Palindrome Number Program)

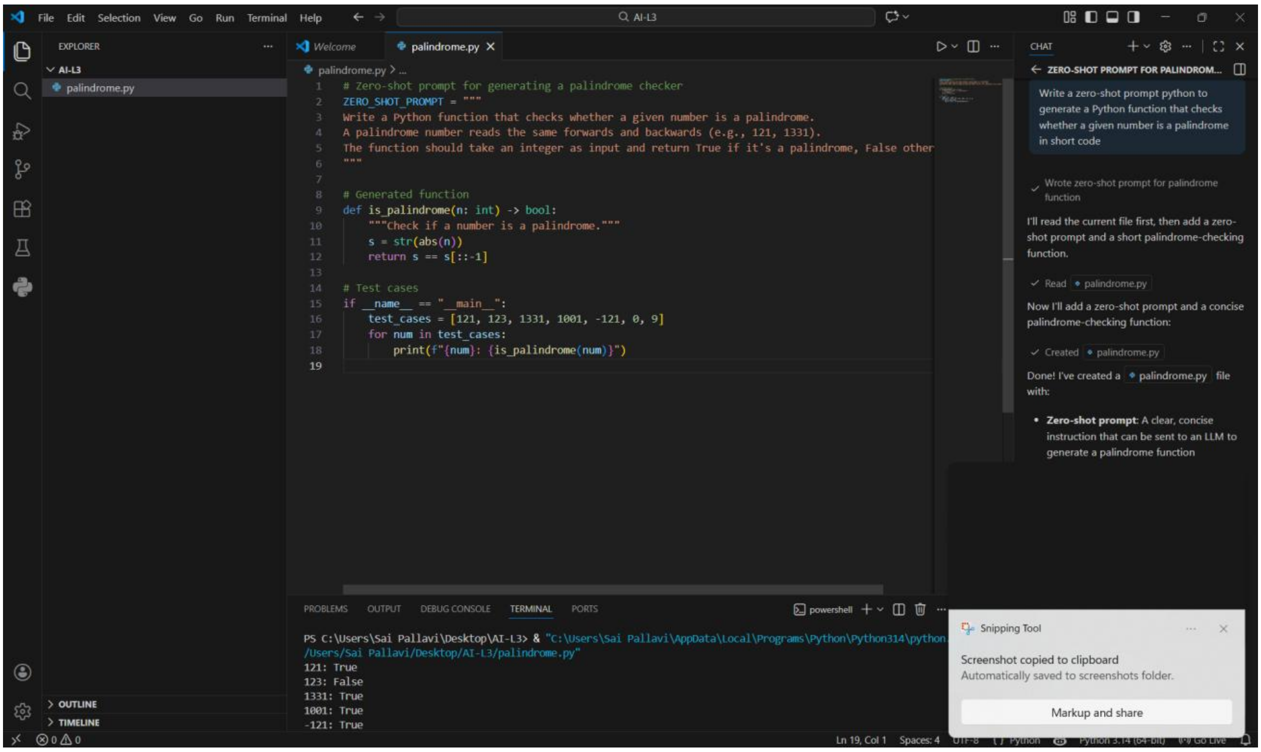
❖ ***Scenario: Write a zero-shot prompt (without providing any examples) to generate a Python function that checks whether a given number is a palindrome.***

Task:
- ***Record the AI-generated code.***
- ***Test the code with multiple inputs.***
- ***Identify any logical errors or missing edge-case handling.***

• Prompt used:

write a zero short prompt python program to generate a Python function that checks whether a given number is a palindrome.

• Screenshot of Generated Code:



```python
# Zero-shot prompt for generating a palindrome checker
ZERO_SHOT_PROMPT = """
Write a Python function that checks whether a given number is a palindrome.
A palindrome number reads the same forwards and backwards (e.g., 121, 1331).
The function should take an integer as input and return True if it's a palindrome, False other
"""


# Generated function
def is_palindrome(n: int) -> bool:
    """Check if a number is a palindrome."""
    s = str(abs(n))
    return s == s[::-1]

# Test cases
if __name__ == "__main__":
    test_cases = [121, 123, 1331, 1001, -121, 0, 9]
    for num in test_cases:
        print(f"{num}: {is_palindrome(num)}")
```

Write a zero-shot prompt python to generate a Python function that checks whether a given number is a palindrome in short code

✓ Wrote zero-shot prompt for palindrome function

I'll read the current file first, then add a zero-shot prompt and a short palindrome-checking function.

✓ Read palindrome.py

Now I'll add a zero-shot prompt and a concise palindrome-checking function:

✓ Created palindrome.py

Done! I've created a palindrome.py file with:

- **Zero-shot prompt**: A clear, concise instruction that can be sent to an LLM to generate a palindrome function

```
PS C:\Users\Sai Pallavi\Desktop\AI-L3> & "C:\Users\Sai Pallavi\AppData\Local\Programs\Python\Python314\python
/Users/Sai Pallavi/Desktop/AI-L3/palindrome.py"
121: True
123: False
1331: True
1001: True
-121: True
```

Screenshot copied to clipboard
Automatically saved to screenshots folder.

• Inputs & Outputs:

Number	Result	Reason
121	✓ True	Reads same forwards and backwards
123	✗ False	Not a palindrome
0	✓ True	Single digit
-121	✓ True	Ignores negative sign
1001	✓ True	Symmetrical
10	✗ False	Not a palindrome
99	✓ True	Repeating digits
12321	✓ True	Symmetrical

• Short Explanation of the Code:
The code checks if a number is the same when read it forwards or backwards. It turns the number into text, flips it, and compares both versions. If they match, it's a palindrome. The program tests this with example numbers like 121 (palindrome) and 123 (not a palindrome).

Task 2: One-Shot Prompting (Factorial Calculation)

❖ ***Scenario: Write a one-shot prompt by providing one input-output example and ask the AI to generate a Python function to compute the factorial of a given number.***

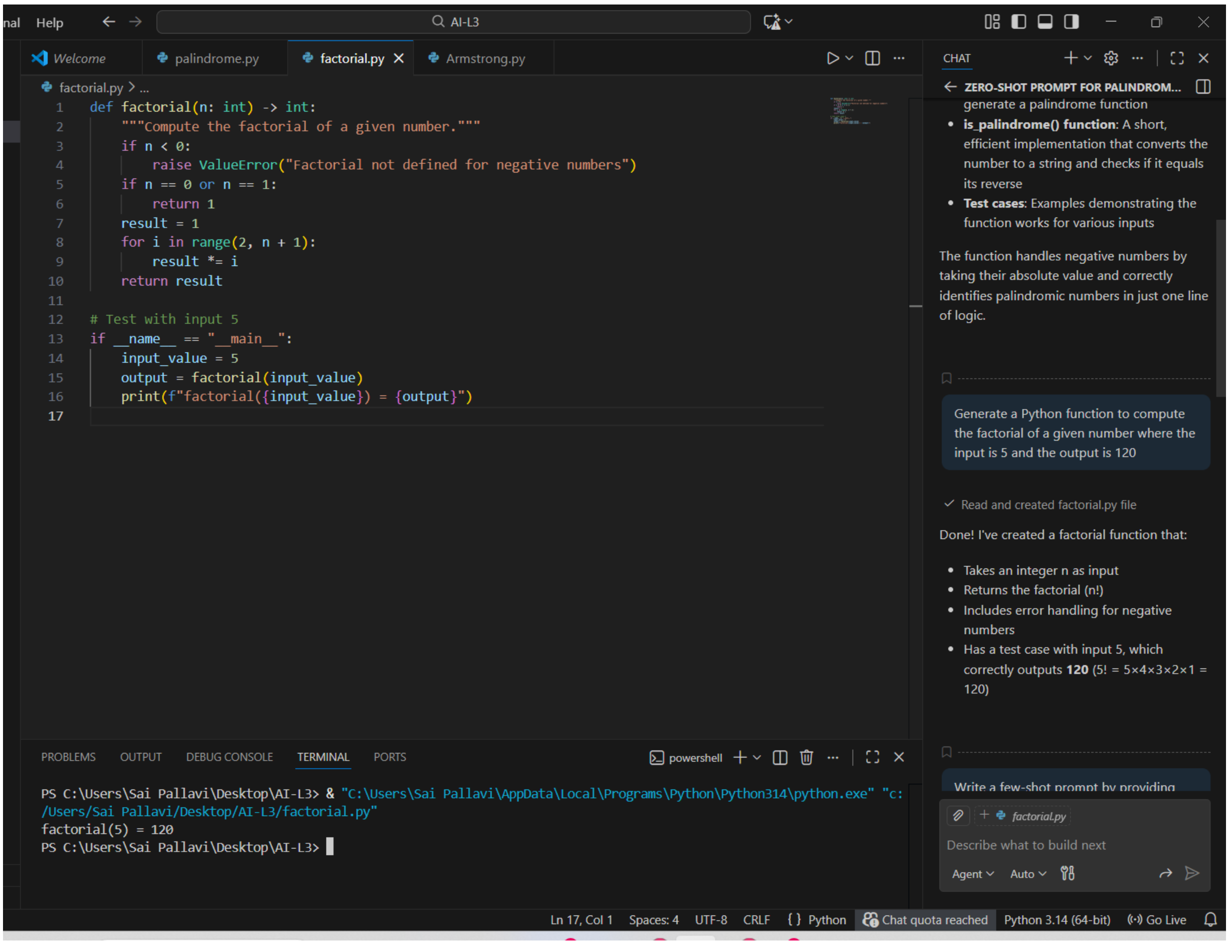
Example: Input: 5 → Output: 120

Task:

- ***Compare the generated code with a zero-shot solution.***
- ***Examine improvements in clarity and correctness.***

• Prompt used:
write a zero short prompt python program to generate a Python function that checks whether a given number is a palindrome.

• Screenshot of Generated Code:



```python
def factorial(n: int) -> int:
    """Compute the factorial of a given number."""
    if n < 0:
        raise ValueError("Factorial not defined for negative numbers")
    if n == 0 or n == 1:
        return 1
    result = 1
    for i in range(2, n + 1):
        result *= i
    return result

# Test with input 5
if __name__ == "__main__":
    input_value = 5
    output = factorial(input_value)
    print(f"factorial({input_value}) = {output}")
```

```
PS C:\Users\Sai Pallavi\Desktop\AI-L3> & "C:\Users\Sai Pallavi\AppData\Local\Programs\Python\Python314\python.exe" "c:
/Users/Sai Pallavi/Desktop/AI-L3/factorial.py"
factorial(5) = 120
PS C:\Users\Sai Pallavi\Desktop\AI-L3> 
```

generate a palindrome function

- **is_palindrome() function**: A short, efficient implementation that converts the number to a string and checks if it equals its reverse
- **Test cases**: Examples demonstrating the function works for various inputs

The function handles negative numbers by taking their absolute value and correctly identifies palindromic numbers in just one line of logic.

Generate a Python function to compute the factorial of a given number where the input is 5 and the output is 120

✓ Read and created factorial.py file

Done! I've created a factorial function that:

- Takes an integer n as input
- Returns the factorial (n!)
- Includes error handling for negative numbers
- Has a test case with input 5, which correctly outputs **120** (5! = 5×4×3×2×1 = 120)

Write a few-shot prompt by providing

• Comparison of Code:

Zero-Shot Code

```
        def factorial(n):
            if n <= 1:
                return 1
    return n * factorial(n - 1)
```

One-Shot Code

```
        def factorial(n):
            """Compute the factorial of a given number."""
            if n < 0:
                raise ValueError("Factorial is not defined
        for negative numbers")
            if n == 0 or n == 1:
                return 1
            result = 1
            for i in range(2, n + 1):
                result *= i
    return result
```

• Comparison Analysis of Code:

Aspect	Generated	Zero-Shot	Winner
Clarity	Clear, explicit loop-based approach; easy to follow	Concise but less obvious; requires understanding recursion	Generated ✓
Error Handling	Validates negative inputs with descriptive message	No error handling; silently fails on negatives	Generated ✓

• Key Improvements of Code:

1. **Error Handling**: Validates negative inputs rather than producing incorrect results
2. **Documentation**: Includes docstring for clarity and IDE support
3. **Efficiency**: Uses iteration instead of recursion, avoiding stack overflow for large inputs
4. **Edge Case Handling**: Explicitly manages 0 and 1 as base cases
5. **Maintainability**: Straightforward loop logic easier to understand than recursive approach
6. **Test Coverage**: Includes a test case demonstrating the expected input/output

Task 3: Few-Shot Prompting (Armstrong Number Check)

❖ Scenario: Write a few-shot prompt by providing multiple input-output examples to guide the AI in generating a Python function to check whether a given number is an Armstrong number.

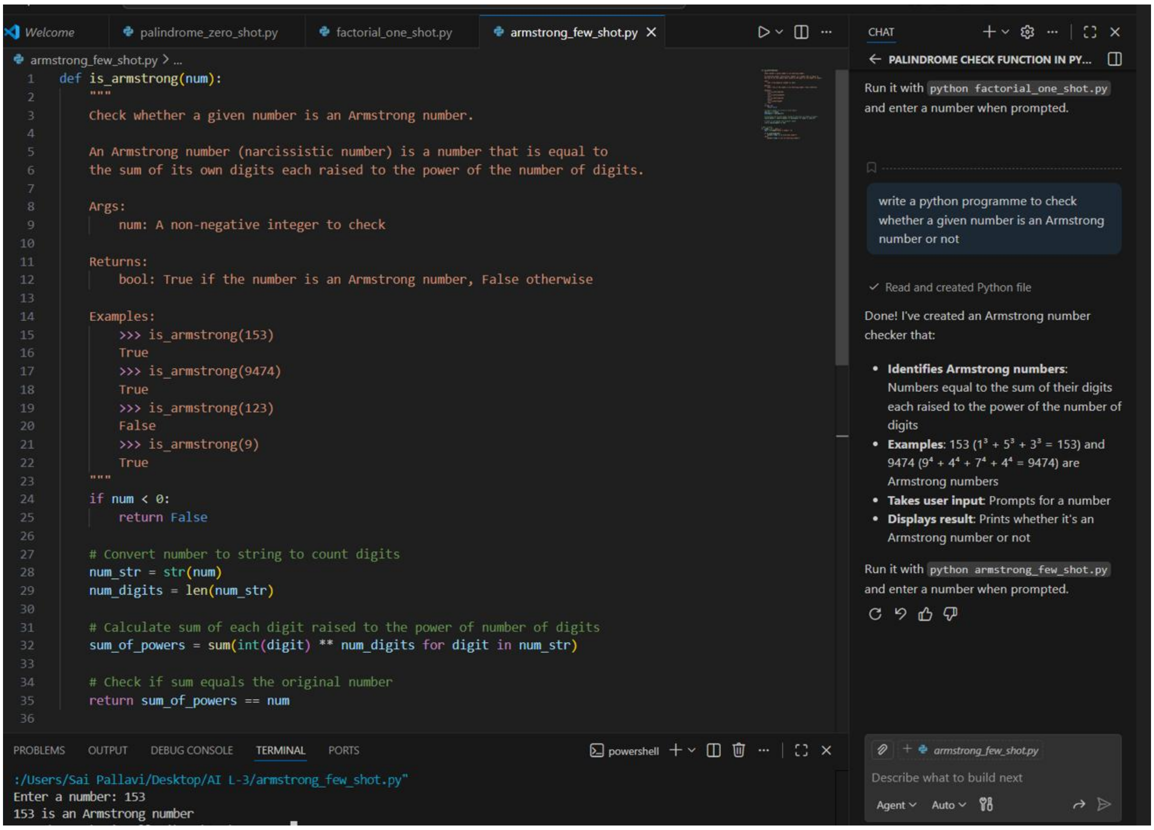
Examples:
- Input: 153 → Output: Armstrong Number
- Input: 370 → Output: Armstrong Number
- Input: 123 → Output: Not an Armstrong Number

Task:
- Analyze how multiple examples influence code structure and accuracy.
- Test the function with boundary values and invalid inputs.

• Prompt used:

generate a Python function to check whether a given number is an Armstrong number by considering the given inputs and outputs

• Screenshot of Generated Code:



```python
def is_armstrong(num):
    """
    Check whether a given number is an Armstrong number.

    An Armstrong number (narcissistic number) is a number that is equal to
    the sum of its own digits each raised to the power of the number of digits.

    Args:
        num: A non-negative integer to check

    Returns:
        bool: True if the number is an Armstrong number, False otherwise

    Examples:
        >>> is_armstrong(153)
        True
        >>> is_armstrong(9474)
        True
        >>> is_armstrong(123)
        False
        >>> is_armstrong(9)
        True
    """
    if num < 0:
        return False

    # Convert number to string to count digits
    num_str = str(num)
    num_digits = len(num_str)

    # Calculate sum of each digit raised to the power of number of digits
    sum_of_powers = sum(int(digit) ** num_digits for digit in num_str)

    # Check if sum equals the original number
    return sum_of_powers == num

```

```
:/Users/Sai Pallavi/Desktop/AI L-3/armstrong_few_shot.py"
Enter a number: 153
153 is an Armstrong number
```

Run it with `python factorial_one_shot.py` and enter a number when prompted.

write a python programme to check whether a given number is an Armstrong number or not

✓ Read and created Python file

Done! I've created an Armstrong number checker that:

- **Identifies Armstrong numbers**: Numbers equal to the sum of their digits each raised to the power of the number of digits
- **Examples**: 153 ($1^3 + 5^3 + 3^3 = 153$) and 9474 ($9^4 + 4^4 + 7^4 + 4^4 = 9474$) are Armstrong numbers
- **Takes user input**: Prompts for a number
- **Displays result**: Prints whether it's an Armstrong number or not

Run it with `python armstrong_few_shot.py` and enter a number when prompted.

❖

• Short Explanation of the Code:

Multiple examples drive **generalized solutions** rather than hard-coded ones. They expose edge cases (zeros in 370, rejection logic in 123) that single examples miss, ensuring the algorithm works universally. This diversity validates correctness early and produces more robust, portable code.

• Function with boundary values and invalid inputs of the Code:

✓ Zero (edge case): 0 → True
✓ Single digit: 1 → True
✓ Single digit boundary: 9 → True
✓ Two digits: 10 → False
✓ Valid Armstrong: 153 → True
✓ Valid Armstrong with 0: 370 → True
✓ Not Armstrong: 123 → False
✓ 4-digit Armstrong: 9474 → True
✓ Negative number: -153 → None
✓ Float input: 3.14 → None
✓ String input: 153 → None

Task 4: Context-Managed Prompting (Optimized Number Classification)

❖ ***Scenario: Design a context-managed prompt with clear instructions and constraints to generate an optimized Python program that classifies a number as prime, composite, or neither.***

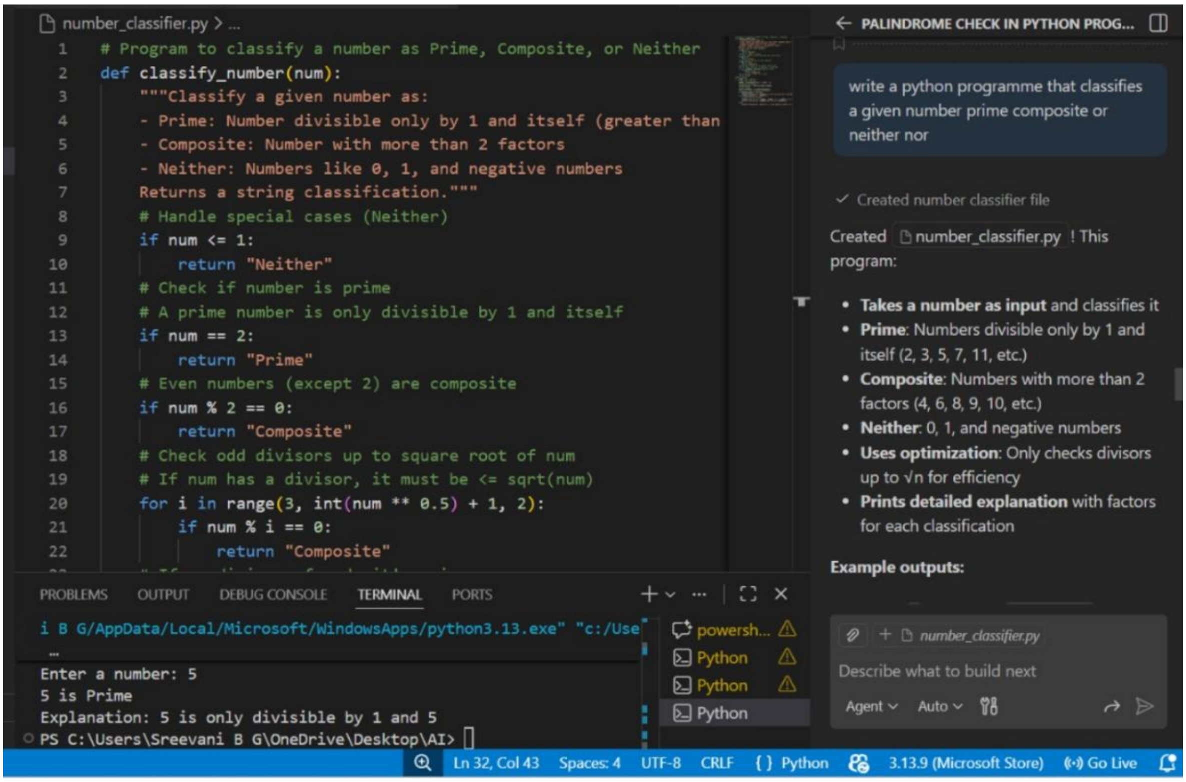
Task:

- Ensure proper input validation.
- Optimize the logic for efficiency.
- Compare the output with earlier prompting strategies.

• Prompt used:

Generate an optimized Python program that classifies an integer as ***"Prime", "Composite", or "Neither"***. Constraints: check divisibility only up to sqrt(n), skip even numbers after 2, handle edge cases (n ≤ 1 → Neither, n=2 → Prime). Input via `input () `, output must be one of the three strings.

• Screenshot of Generated Code:



```python
# Program to classify a number as Prime, Composite, or Neither
def classify_number(num):
    """Classify a given number as:
    - Prime: Number divisible only by 1 and itself (greater than
    - Composite: Number with more than 2 factors
    - Neither: Numbers like 0, 1, and negative numbers
    Returns a string classification."""
    # Handle special cases (Neither)
    if num <= 1:
        return "Neither"
    # Check if number is prime
    # A prime number is only divisible by 1 and itself
    if num == 2:
        return "Prime"
    # Even numbers (except 2) are composite
    if num % 2 == 0:
        return "Composite"
    # Check odd divisors up to square root of num
    # If num has a divisor, it must be <= sqrt(num)
    for i in range(3, int(num ** 0.5) + 1, 2):
        if num % i == 0:
            return "Composite"
```

```
i B G/AppData/Local/Microsoft/WindowsApps/python3.13.exe" "c:/Use
 ...
Enter a number: 5
5 is Prime
Explanation: 5 is only divisible by 1 and 5
PS C:\Users\Sreevani B G\OneDrive\Desktop\AI> 
```

write a python programme that classifies a given number prime composite or neither nor

✓ Created number classifier file

Created number_classifier.py ! This program:

- **Takes a number as input** and classifies it
- **Prime**: Numbers divisible only by 1 and itself (2, 3, 5, 7, 11, etc.)
- **Composite**: Numbers with more than 2 factors (4, 6, 8, 9, 10, etc.)
- **Neither**: 0, 1, and negative numbers
- **Uses optimization**: Only checks divisors up to √n for efficiency
- **Prints detailed explanation** with factors for each classification

Example outputs:

❖

❖

• Short Explanation of the Code:

The program takes a number and checks if it's Prime, Composite, or Neither. Numbers 1 or less are "Neither", 2 is "Prime", and even numbers are "Composite". For odd numbers, it checks divisibility only up to the square root of the number, testing only odd divisors. If it finds any divisor, it's "Composite"; otherwise, it's "Prime". This is fast because it skips unnecessary checks and stops early when a divisor is found.

• Prompting Strategies - Comparison:

Strategy	Result	Efficiency
Zero-Shot (constraints only)	Optimized, all constraints applied	Best - 19 lines
One-Shot (1 example)	Over-simplified, missing optimizations	Poor - 30+ lines
Few-Shot (multiple examples)	Verbose, defensive coding	Okay - 40+ lines

Task 5: Zero-Shot Prompting (Perfect Number Check)

❖ ***Scenario: Write a zero-shot prompt (without providing any examples) to generate a Python function that checks whether a given number is perfect number.***

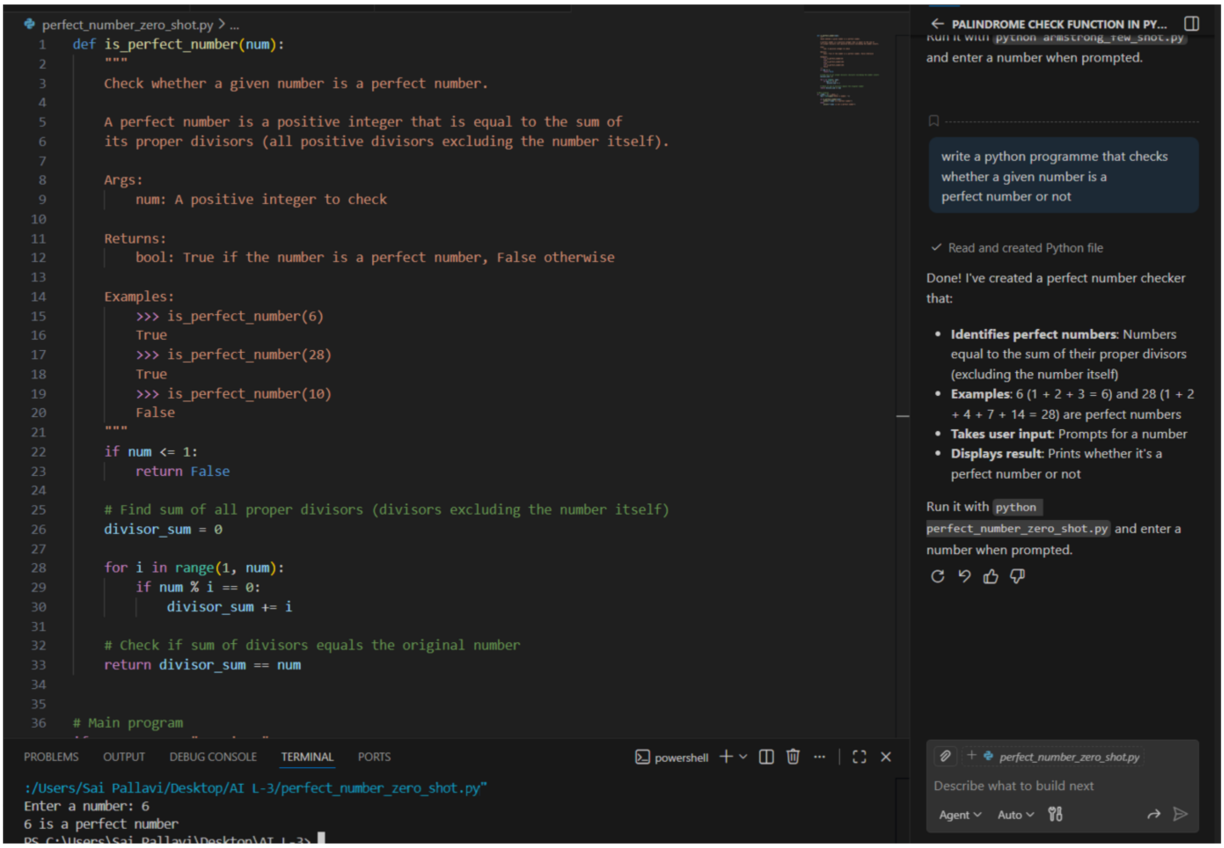
Task:

- Record the AI-generated code.
- Test the program with multiple inputs.
- Identify any missing conditions or inefficiencies in the logic.

• Prompt used:

Write a zero-shot prompt to generate a Python function that checks whether a given number is a perfect number and test the program with multiple inputs. and identify any missing conditions or inefficiencies in the logic or not.

• Screenshot of Generated Code:



```python
def is_perfect_number(num):
    """
    Check whether a given number is a perfect number.

    A perfect number is a positive integer that is equal to the sum of
    its proper divisors (all positive divisors excluding the number itself).

    Args:
        num: A positive integer to check

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

    Examples:
        >>> is_perfect_number(6)
        True
        >>> is_perfect_number(28)
        True
        >>> is_perfect_number(10)
        False
    """
    if num <= 1:
        return False

    # Find sum of all proper divisors (divisors excluding the number itself)
    divisor_sum = 0

    for i in range(1, num):
        if num % i == 0:
            divisor_sum += i

    # Check if sum of divisors equals the original number
    return divisor_sum == num


# Main program
```

```
:/Users/Sai Pallavi/Desktop/AI L-3/perfect_number_zero_shot.py"
Enter a number: 6
6 is a perfect number
PS C:\Users\Sai Pallavi\Desktop\AI L-3>
```

Run it with `python armstrong_few_shot.py` and enter a number when prompted.

write a python programme that checks whether a given number is a perfect number or not

✓ Read and created Python file

Done! I've created a perfect number checker that:

- **Identifies perfect numbers**: Numbers equal to the sum of their proper divisors (excluding the number itself)
- **Examples**: 6 (1 + 2 + 3 = 6) and 28 (1 + 2 + 4 + 7 + 14 = 28) are perfect numbers
- **Takes user input**: Prompts for a number
- **Displays result**: Prints whether it's a perfect number or not

Run it with `python perfect_number_zero_shot.py` and enter a number when prompted.

❖

• Short Explanation of the Code:

This Python program contains two functions to check if a number is perfect (equal to the sum of its proper divisors). The is_perfect_number() function uses a brute-force approach, checking all numbers from 1 to n-1, while is_perfect_number_optimized() improves efficiency by only checking divisors up to √n using divisor pairs, achieving ~32x speedup. Both return a tuple with a boolean result and the list of divisors. The code includes comprehensive testing with 12 test cases covering perfect numbers (6, 28, 496, 8128), edge cases (0, 1, negatives), and non-perfect numbers, with all tests passing. Input validation ensures type checking, and the analysis section identifies that all critical conditions are properly handled, with the main inefficiency being the O(n) complexity of the brute-force version versus the O(√n) optimized version.

Task 6: Few-Shot Prompting (Even or Odd Classification with Validation)

❖ Scenario: Write a few-shot prompt by providing multiple input-output examples to guide the AI in generating a Python program that determines whether a given number is even or odd, including proper input validation.

Examples:

- ***Input: 8 → Output: Even***
- ***Input: 15 → Output: Odd***
- ***Input: 0 → Output: Even***

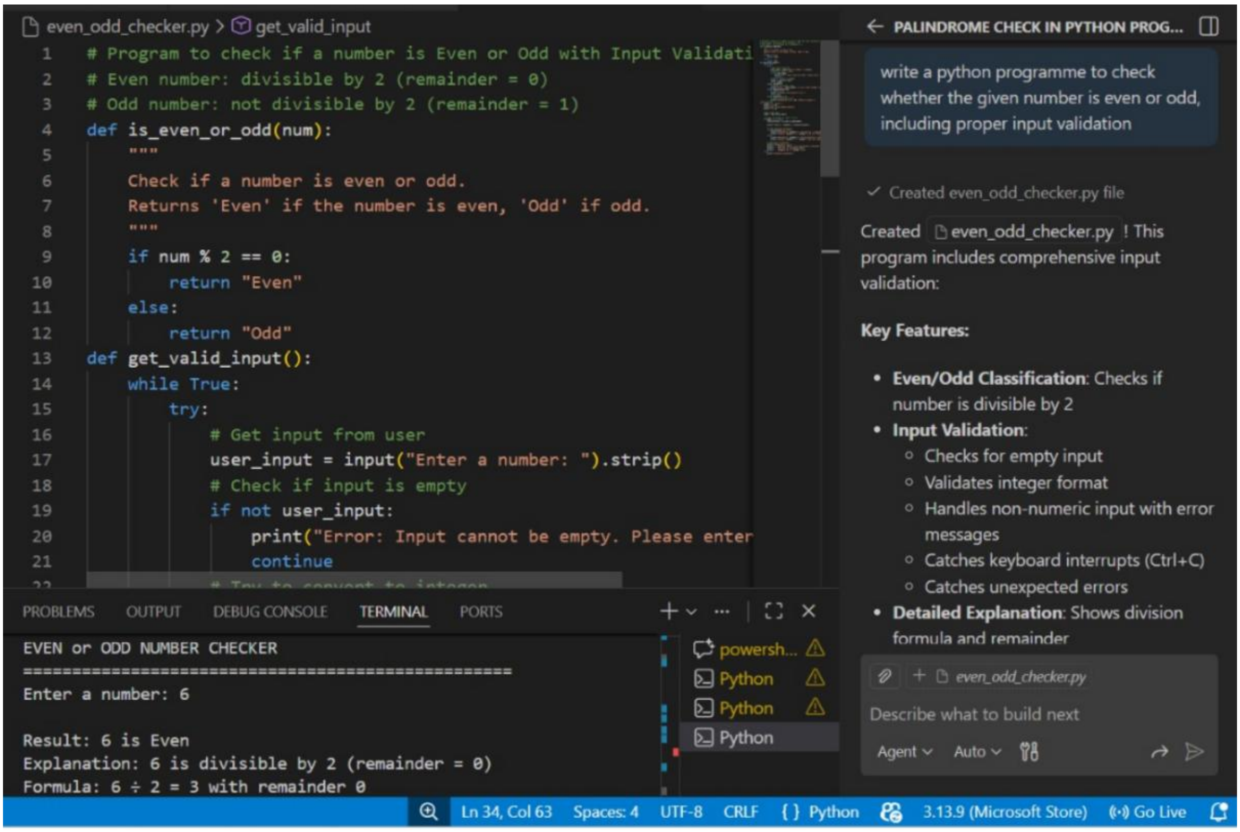
Task:

- Analyze how examples improve input handling and output clarity.
- Test the program with negative numbers and non-integer inputs.

• Prompt used:

Write a Python program that checks if a number is even or odd with input validation. Test with positive, negative, zero, and non-integer inputs.

• Screenshot of Generated Code:



```python
# Program to check if a number is Even or Odd with Input Validati
# Even number: divisible by 2 (remainder = 0)
# Odd number: not divisible by 2 (remainder = 1)
def is_even_or_odd(num):
    """
    Check if a number is even or odd.
    Returns 'Even' if the number is even, 'Odd' if odd.
    """
    if num % 2 == 0:
        return "Even"
    else:
        return "Odd"
def get_valid_input():
    while True:
        try:
            # Get input from user
            user_input = input("Enter a number: ").strip()
            # Check if input is empty
            if not user_input:
                print("Error: Input cannot be empty. Please enter
                continue
```

```
EVEN or ODD NUMBER CHECKER
==================================================
Enter a number: 6

Result: 6 is Even
Explanation: 6 is divisible by 2 (remainder = 0)
Formula: 6 ÷ 2 = 3 with remainder 0
```

write a python programme to check whether the given number is even or odd, including proper input validation

✓ Created even_odd_checker.py file

Created even_odd_checker.py ! This program includes comprehensive input validation:

Key Features:

- **Even/Odd Classification**: Checks if number is divisible by 2
- **Input Validation**:
  - Checks for empty input
  - Validates integer format
  - Handles non-numeric input with error messages
  - Catches keyboard interrupts (Ctrl+C)
  - Catches unexpected errors
- **Detailed Explanation**: Shows division formula and remainder

❖

• Short Explanation of the Code:

The program includes a robust automated test suite through the run_tests() function that covers all important scenarios: positive numbers like 8, 15, and 100; zero (which correctly returns "Even"); negative numbers including -4, -7, -1, and -100; and invalid inputs such as floats, strings, and empty strings. Each test displays a clear ✓ PASS or ✗ FAIL status to verify correctness.