

ASSIGNMENT - 5.5

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Task Description #1 (Transparency in Algorithm Optimization)

Task: Use AI to generate two solutions for checking prime numbers:

- Naive approach(basic)
- Optimized approach

Prompt:

“Generate Python code for two prime-checking methods and explain how the optimized version improves performance.”

Approach - 1 : Naive approach(basic)

Code :

```
1 #Generate Python code for two prime-checking methods
2 def is_prime_basic(n):
3     if n <= 1:
4         return False
5     for i in range(2, n):
6         if n % i == 0:
7             return False
8     return True
9 n = 29
10 print(f"Basic method: Is {n} prime? {is_prime_basic(n)}")
```

Output :

```
PS C:\Users\Apple\OneDrive\Desktop\Ai Assisting> & C:/Users/Apple/AppData/Local/Microsoft/WindowsApps/python3.12.exe "c:/Users/Apple/OneDrive/Desktop/Ai Assisting/prime.py"
Basic method: Is 29 prime? True
PS C:\Users\Apple\OneDrive\Desktop\Ai Assisting>
```

Approach - 2 : Optimized approach

Code :

```
def is_prime_optimized(n):
    if n <= 1:
        return False
    if n <= 3:
        return True
    if n % 2 == 0 or n % 3 == 0:
        return False
    i = 5
    while i * i <= n:
        if n % i == 0 or n % (i + 2) == 0:
            return False
        i += 6
    return True
n = 29
print(f"Optimized method: Is {n} prime? {is_prime_optimized(n)}")
```

Output :

```
PS C:\Users\Apple\OneDrive\Desktop\Ai Assisting> & C:/Users/Apple/AppData/Local/Microsoft/WindowsApps/python3.12.exe "c:/Users/Apple/OneDrive/Desktop/Ai Assisting/prime.py"
Optimized method: Is 29 prime? True
PS C:\Users\Apple\OneDrive\Desktop\Ai Assisting>
```

Code Explanation:

The basic prime checking method tests whether a number n is divisible by any integer from 2 to $n-1$. If it finds a divisor, the number is not prime; otherwise, it is prime. This approach is simple but inefficient because it performs many unnecessary checks, especially for large numbers, resulting in a time complexity of $O(n)$. The optimized prime checking method improves efficiency by first handling small cases, eliminating even numbers and multiples of 3, and then checking divisibility only up to the square root of n . It further reduces checks by testing only numbers of the form $6k \pm 1$, which are the only possible candidates for primes greater than 3. This significantly reduces the number of iterations, giving a faster time complexity of $O(\sqrt{n})$, making it suitable for larger inputs.

Task Description #2 (Transparency in Recursive Algorithms)

Objective: Use AI to generate a recursive function to calculate Fibonacci numbers.

Code :

```
#Generate a recursive function to calculate Fibonacci numbers and add clear comments ex:  
def fibonacci(n):  
    # Base case: the first two Fibonacci numbers are 0 and 1  
    if n == 0:  
        return 0  
    elif n == 1:  
        return 1  
    # Recursive case: sum of the two preceding Fibonacci numbers  
    else:  
        return fibonacci(n - 1) + fibonacci(n - 2)  
n = 10  
print(f"The {n}th Fibonacci number is {fibonacci(n)}")
```

Output :

```
PS C:\Users\Apple\OneDrive\Desktop\Ai Assisting> & C:/Users/Apple/AppData/Local/Microsoft/WindowsApps/python3.12.exe "c:/Users/Apple/OneDrive/Desktop/Ai Assisting/prime.py"  
The 10th Fibonacci number is 55  
PS C:\Users\Apple\OneDrive\Desktop\Ai Assisting> []
```

Code Explanation :

This Fibonacci function uses recursion to find the nth Fibonacci number. The function first checks the base cases: if `n` is `0`, it returns `0`, and if `n` is `1`, it returns `1`, since these are the first two Fibonacci numbers. For any other value of `n`, the function calls itself recursively to compute the sum of the previous two Fibonacci numbers, `fibonacci(n-1)` and `fibonacci(n-2)`. This follows the Fibonacci definition where each number is the sum of the two before it. Finally, when `n = 10`, the function calculates and prints the 10th Fibonacci number.

Task Description #3 (Transparency in Error Handling)

Task: Use AI to generate a Python program that reads a file and processes data.

Prompt:

“Generate code with proper error handling and clear explanations for each exception.”

Code :

```
#Generate a Python program that reads data from a file and processes it. Include proper error handling and clearly
def read_and_process_file(filename):
    try:
        # Try to open the file in read mode
        with open(filename, 'r') as file:
            lines = file.readlines()

        # Process the data: remove newline characters and print each line
        print("File contents:")
        for line in lines:
            print(line.strip())

    except FileNotFoundError:
        # This exception occurs if the file does not exist
        print("Error: The file was not found. Please check the file name or path.")

    except PermissionError:
        # This exception occurs if the program does not have permission to read the file
        print("Error: You do not have permission to read this file.")

    except IOError:
        # This exception occurs for general input/output errors
        print("Error: An I/O error occurred while reading the file.")

    except Exception as e:
        # This catches any other unexpected errors
        print("Unexpected error:", e)

    else:
        # This runs if no exceptions occur
        print("File read and processed successfully.")

    finally:
        # This block always runs, whether an error occurred or not
        print("Program execution completed.")

# Call the function
read_and_process_file("data.txt")
```

Output :

```
PS C:\Users\Apple\OneDrive\Desktop\Ai Assisting> & C:/Users/Apple/AppData/Local/Microsoft/WindowsApps/python3.12.exe "c:/Users/Apple/OneDrive/Desktop/Ai Assisting/prime.py"
Error: The file was not found. Please check the file name or path.
Program execution completed.
PS C:\Users\Apple\OneDrive\Desktop\Ai Assisting> []
```

Code Explanation :

This program reads and processes a file using proper exception handling to ensure safe execution. Inside the `try` block, the function attempts to open the given file in read mode and reads all lines from it. Each line is then printed after removing extra newline characters using `strip()`. If the file does not exist, a `FileNotFoundException` is raised, and the program displays a message asking the user to verify the file name or path. If the file exists but the program does not have permission to read it, a `PermissionError` is handled with a clear error message. The `IOError`

block catches general input/output errors that may occur during file operations. Any other unexpected issues are handled by the generic `Exception` block, which prints the error details. If the file is read successfully without any exceptions, the `else` block confirms successful processing. Finally, the `finally` block always executes, ensuring that the program reports completion regardless of whether an error occurred or not.

Task Description #4 (Security in User Authentication)

Task: Use an AI tool to generate a Python-based login system.

Prompt : Generate test cases for a secure Python-based login system that uses hashed passwords and hidden password input. Include valid and invalid login scenarios, edge cases, and expected outputs.

Code :

```
#Generate test cases for a secure Python-based login system that uses hashed passwords and hidden password input. I
import hashlib

# Simulated database (username : hashed_password)
users_db = {
    "admin": hashlib.sha256("Admin@123".encode()).hexdigest(),
    "user1": hashlib.sha256("User@123".encode()).hexdigest()
}

def hash_password(password):
    """
    Converts a plain password into a hashed password
    """
    return hashlib.sha256(password.encode()).hexdigest()

def login():
    username = input("Enter username: ")
    password = input("Enter password: ") # Password is not printed anywhere

    # Check if username exists
    if username in users_db:
        hashed_input_password = hash_password(password)

        # Check if password matches stored hashed password
        if users_db[username] == hashed_input_password:
            print("Login successful! Welcome to the system.")
        else:
            print("Invalid password. Access denied.")
    else:
        print("Username does not exist. Access denied.")

# Run login system
login()
```

Output :

```
PS C:\Users\Apple\OneDrive\Desktop\AI Assisting> & C:/Users/Apple/AppData/Local/Microsoft/WindowsApps/python3.12.exe "C:/Users/Apple/OneDrive/Desktop/AI Assisting/prime.py"
Enter username: admin
Enter password: Admin@123
Login successful! Welcome to the system.
PS C:\Users\Apple\OneDrive\Desktop\AI Assisting>
```

Code Explanation :

This program improves login security by using password hashing instead of plain-text passwords, which prevents attackers from seeing real passwords even if the database is leaked. It also checks whether a username exists before validating the password, avoiding weak validation. The hashed input password is compared with the stored hash, not the original password. As a best practice, secure authentication systems should always hash (and salt) passwords, never display or store passwords in plain text, and validate user input properly to reduce security risks.

Task Description #5 (Privacy in Data Logging)

Task: Use an AI tool to generate a Python script that logs user activity (username, IP address, timestamp).

Prompt : Generate a Python script to log user activity (username, IP address, timestamp). Analyze whether any sensitive data is logged unnecessarily or insecurely.

Code :

```
#Generate a Python script to log user activity (username, IP address, timestamp).Analyze whether any sensitive data
import logging
from datetime import datetime

# Configure logging (log file, format, and level)
logging.basicConfig(
    filename="user_activity.log",
    level=logging.INFO,
    format="%(asctime)s - Username: %(message)s"
)

def log_user_activity(username, ip_address):
    """
    Logs user activity with username, IP address, and timestamp.
    Avoids logging sensitive data like passwords.
    """
    timestamp = datetime.now().strftime("%Y-%m-%d %H:%M:%S")
    logging.info(f"{username}, IP: {ip_address}, Time: {timestamp}")

# Example usage
log_user_activity("admin", "192.168.1.10")
log_user_activity("user1", "192.168.1.15")

print("User activity logged successfully.")
```

Output :

```
PS C:\Users\Apple\OneDrive\Desktop\AI Assisting> & C:/Users/Apple/AppData/Local/Microsoft/WindowsApps/python3.12.exe "C:/Users/Apple/OneDrive/Desktop/AI Assisting/prime.py"
User activity logged successfully.
PS C:\Users\Apple\OneDrive\Desktop\AI Assisting> 
```

Code Explanation :

This program logs usernames and IP addresses, which can create privacy risks if log files are exposed. A better approach is to log minimal or masked information (for example, hiding part of the IP address) and avoid personal details. Privacy-aware logging follows the rule of log only what is necessary, never log sensitive data, and protect log files from unauthorized access.