ASSIGNMENT – 11.1

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BATCH:47-A

Lab 11 – Data Structures with AI: Implementing Fundamental Structures

Lab Objectives

• Use AI to assist in designing and implementing fundamental data structures in Python.

• Learn how to prompt AI for structure creation, optimization, and documentation.

• Improve understanding of Lists, Stacks, Queues, Linked Lists, Trees, Graphs, and Hash Tables.

• Enhance code quality with AI-generated comments and performance suggestions.

Task Description #1 – Stack Implementation

Task: Use AI to generate a Stack class with push, pop, peek, and is_empty methods.

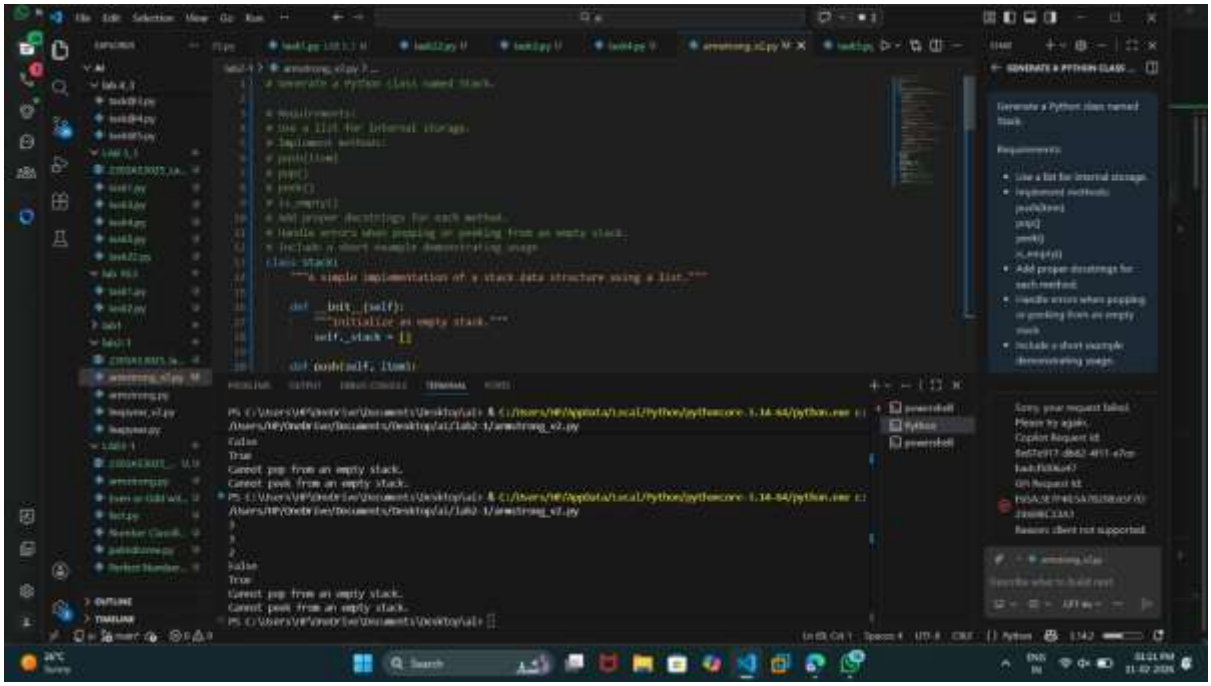
Sample Input Code:

class Stack:

pass

Expected Output:

• A functional stack implementation with all required methods and docstrings.



Task Description #2 – Queue Implementation

Task: Use AI to implement a Queue using Python lists.

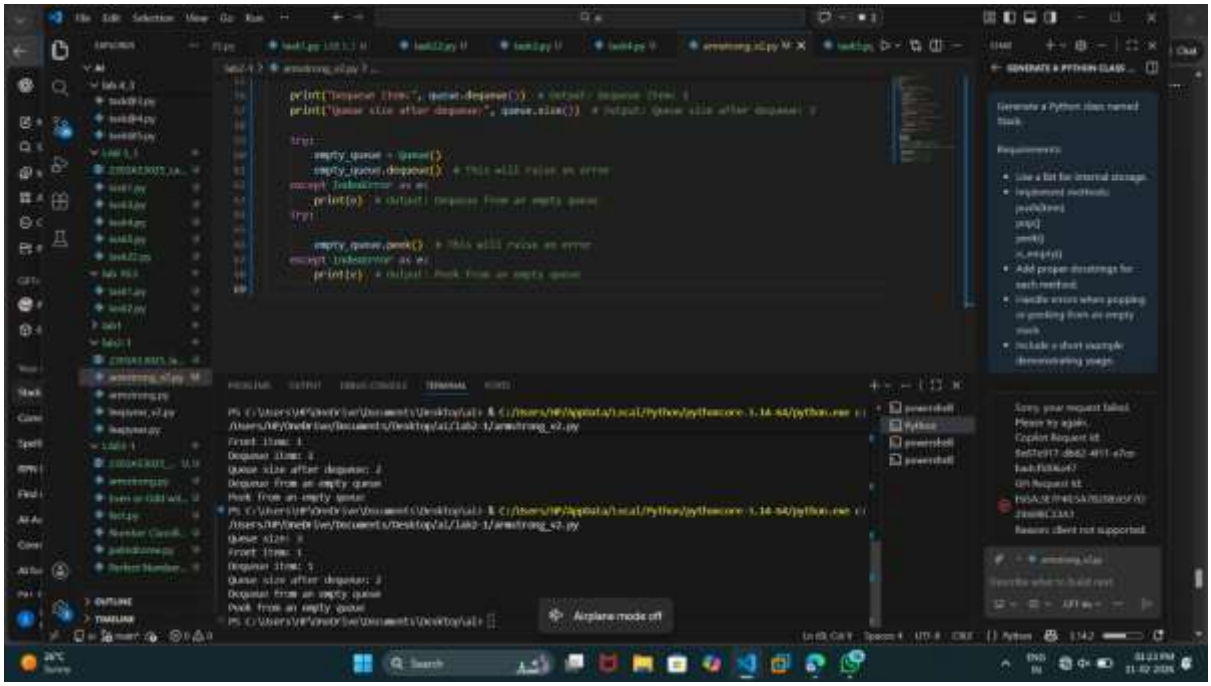
Sample Input Code:

class Queue:

pass

Expected Output:

• FIFO-based queue class with enqueue, dequeue, peek, and size Methods



Task Description #3 – Linked List

Task: Use AI to generate a Singly Linked List with insert and display methods.

Sample Input Code:

class Node:

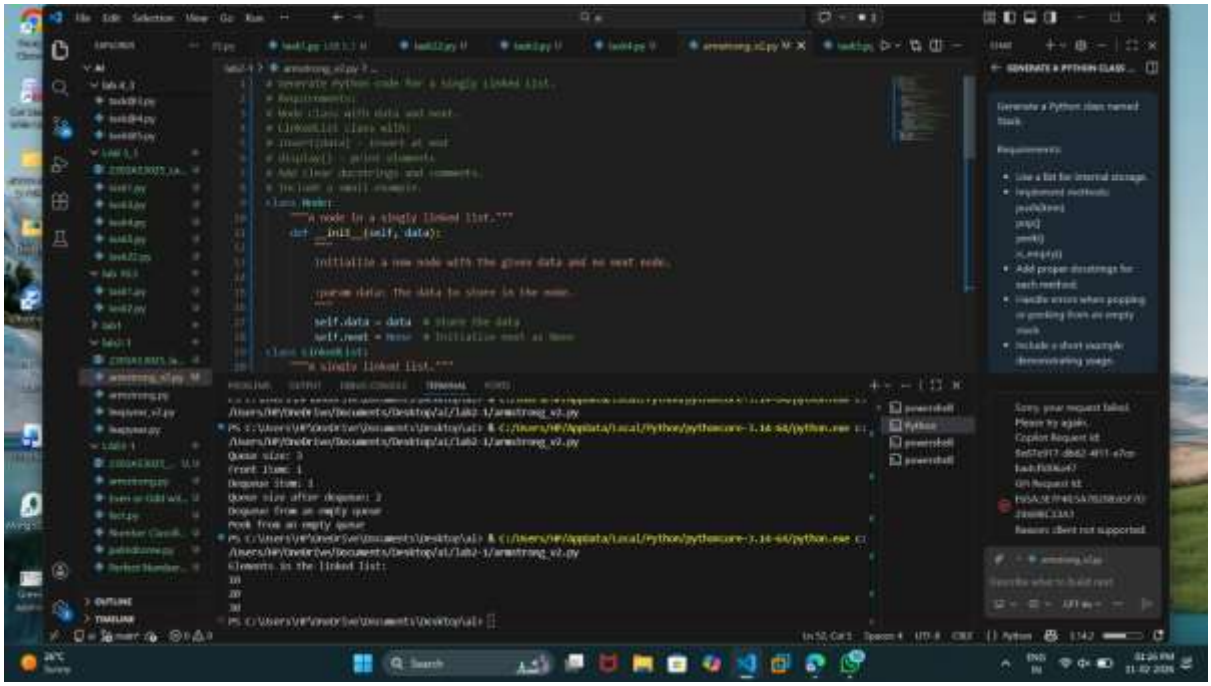
pass

class LinkedList:

pass

Expected Output:

• A working linked list implementation with clear method documentation.



Task Description #4 – Binary Search Tree (BST)

Task: Use AI to create a BST with insert and in-order traversal methods.

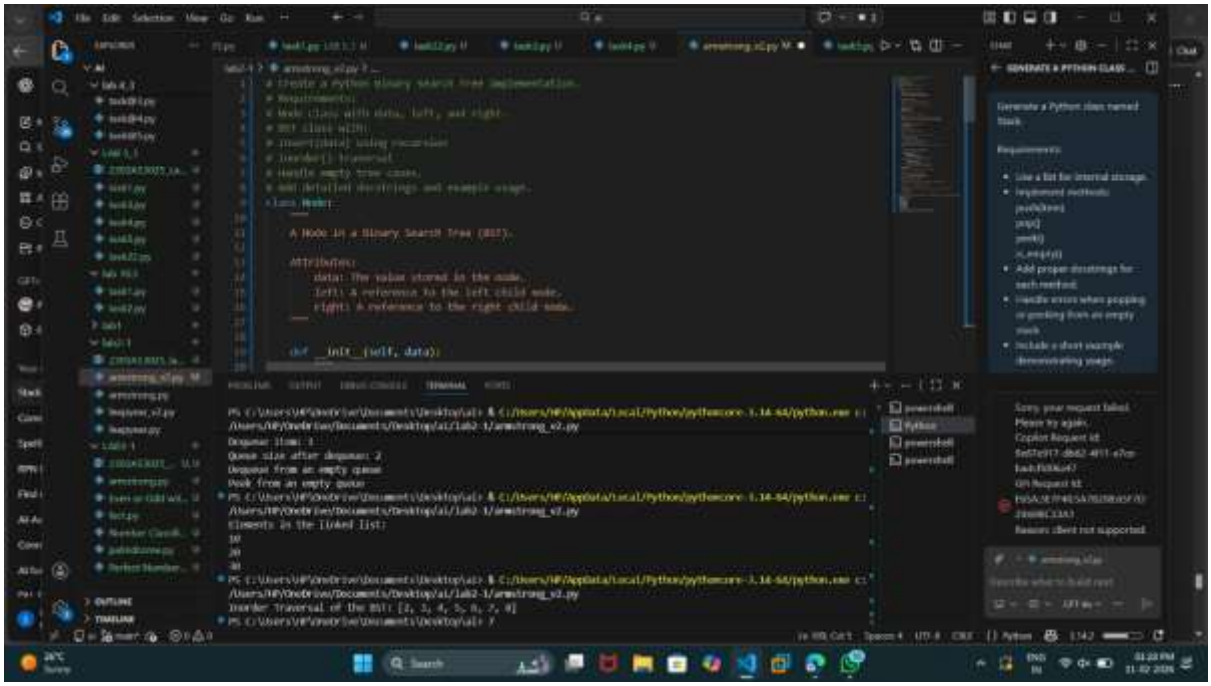
Sample Input Code:

class BST:

pass

Expected Output:

• BST implementation with recursive insert and traversal method



Task Description #5 – Hash Table

Task: Use AI to implement a hash table with basic insert, search, and delete methods.

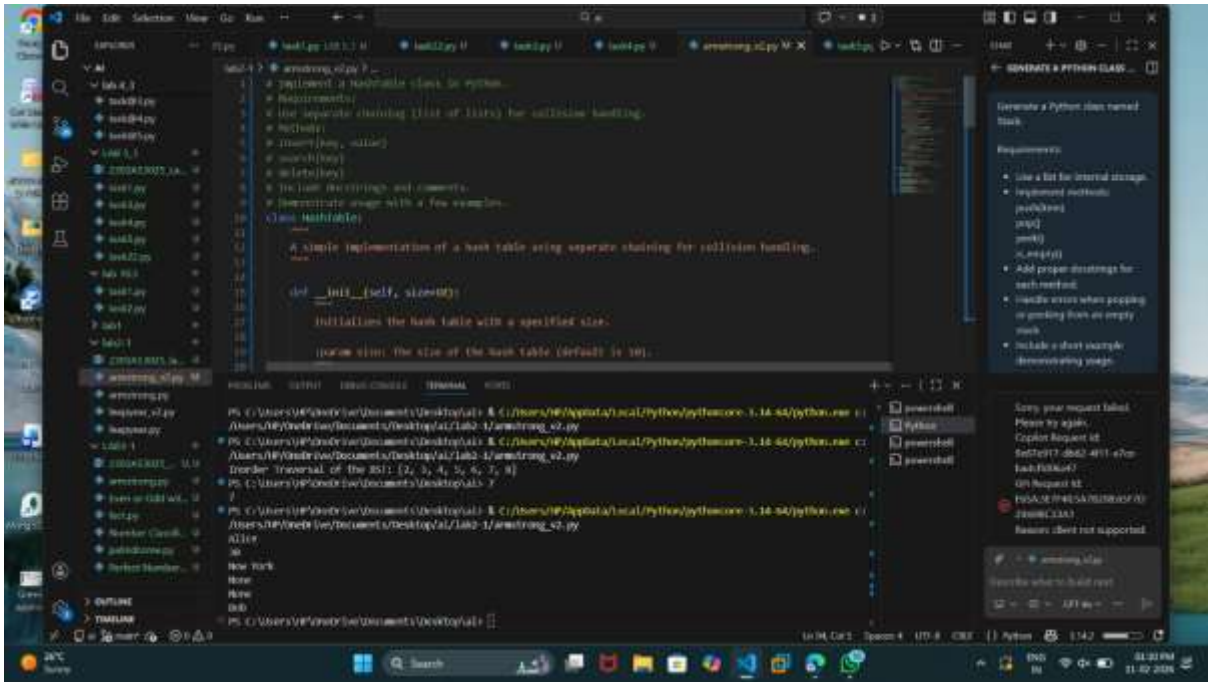
Sample Input Code:

class HashTable:

pass

Expected Output:

• Collision handling using chaining, with well-commented methods.



Task Description #6 – Graph Representation

Task: Use AI to implement a graph using an adjacency list.

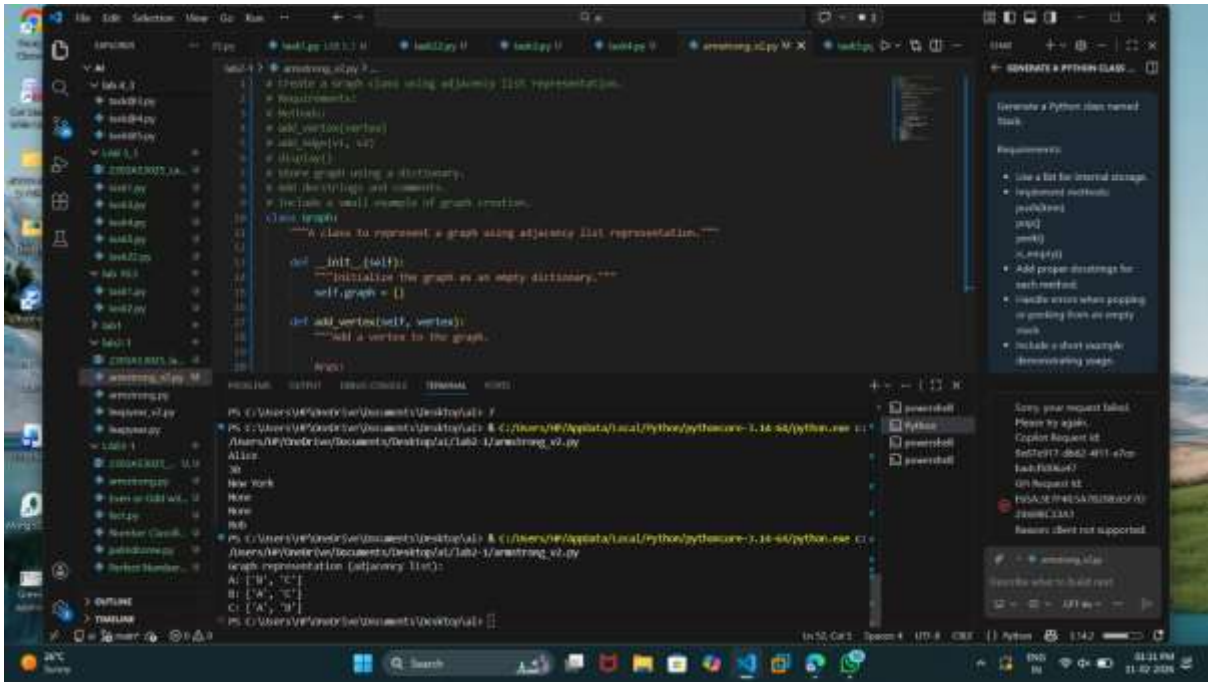
Sample Input Code:

class Graph:

pass

Expected Output:

• Graph with methods to add vertices, add edges, and display connections.



Task Description #7 – Priority Queue

Task: Use AI to implement a priority queue using Python's heapq module.

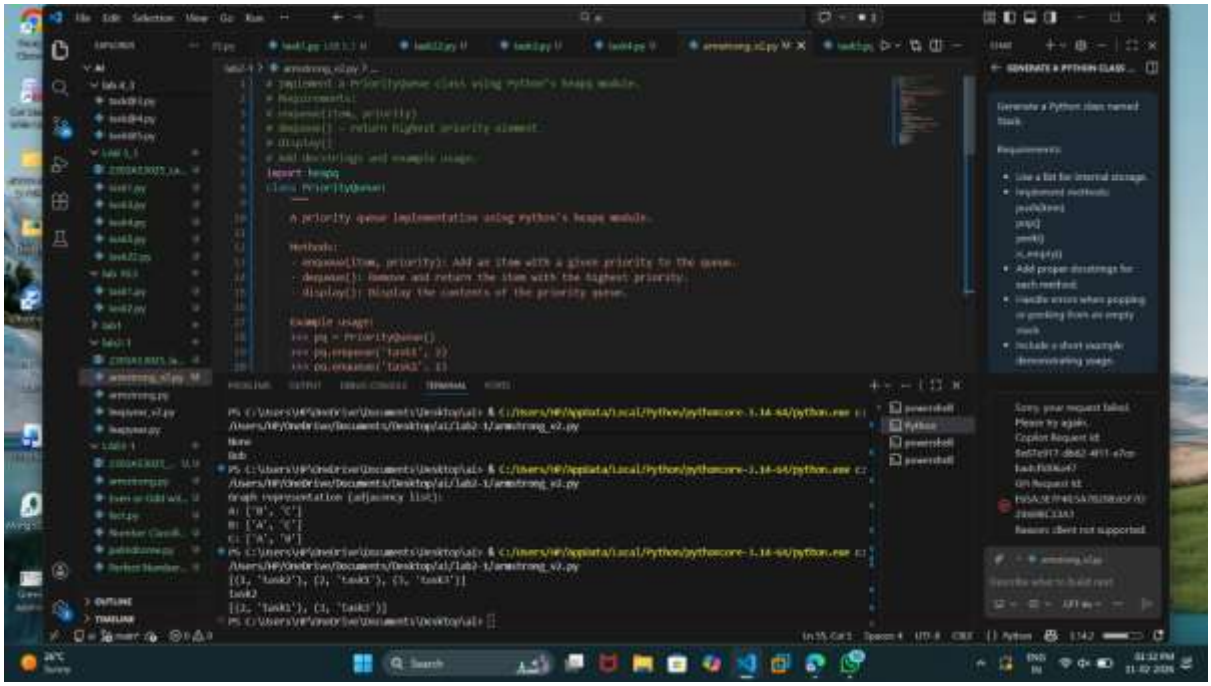
Sample Input Code:

class PriorityQueue:

pass

Expected Output:

• Implementation with enqueue (priority), dequeue (highest priority), and display methods.



Task Description #8 – Deque

Task: Use AI to implement a double-ended queue using collections.deque.

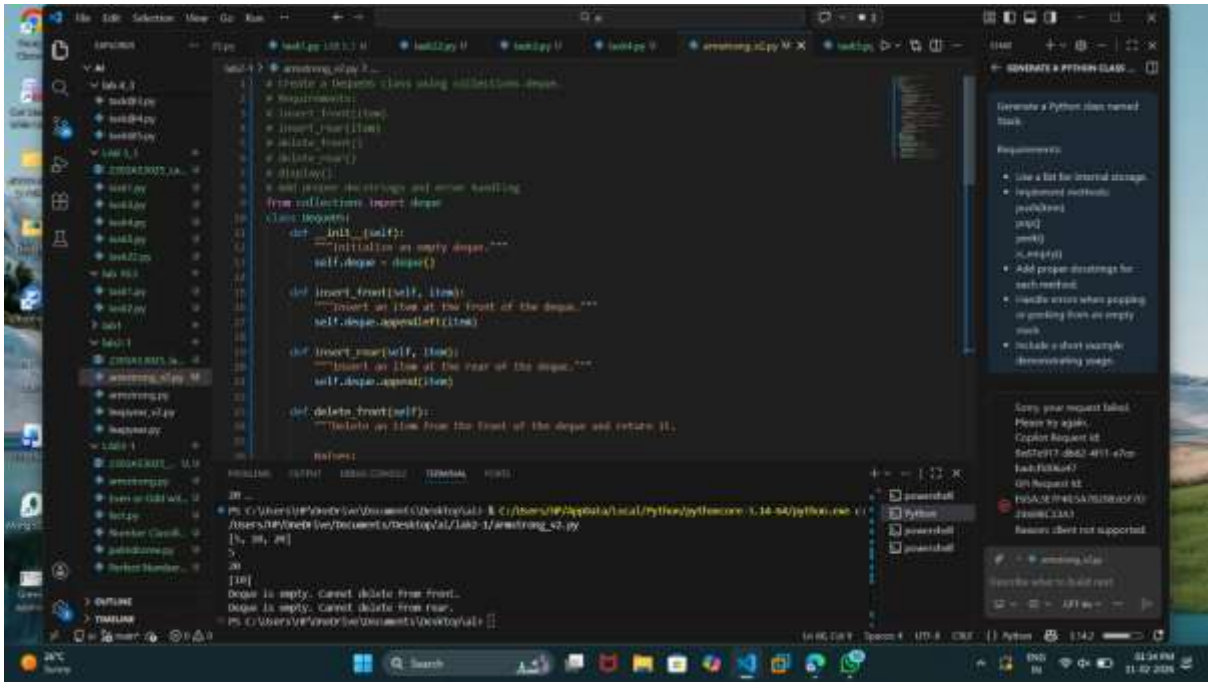
Sample Input Code:

class DequeDS:

pass

Expected Output:

• Insert and remove from both ends with docstrings.



Task Description #9 Real-Time Application Challenge – Choose the Right Data Structure

Scenario:

Your college wants to develop a Campus Resource Management System that handles:

1. Student Attendance Tracking – Daily log of students entering/exiting the campus.

2. Event Registration System – Manage participants in events with quick search and removal.

3. Library Book Borrowing – Keep track of available books and their due dates.

4. Bus Scheduling System – Maintain bus routes and stop connections.

5. Cafeteria Order Queue – Serve students in the order they arrive.

Student Task:

• For each feature, select the most appropriate data structure from the list below:

o Stack

o Queue

o Priority Queue

o Linked List

o Binary Search Tree (BST)

o Graph

o Hash Table

o Deque

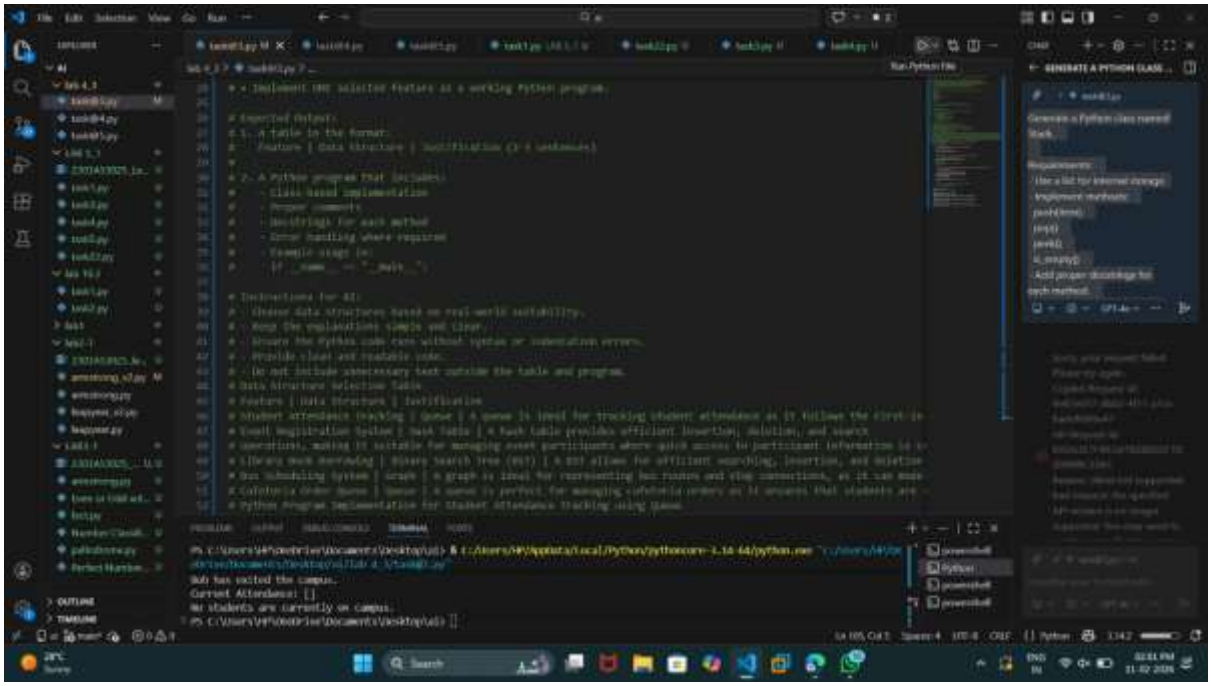
• Justify your choice in 2–3 sentences per feature.

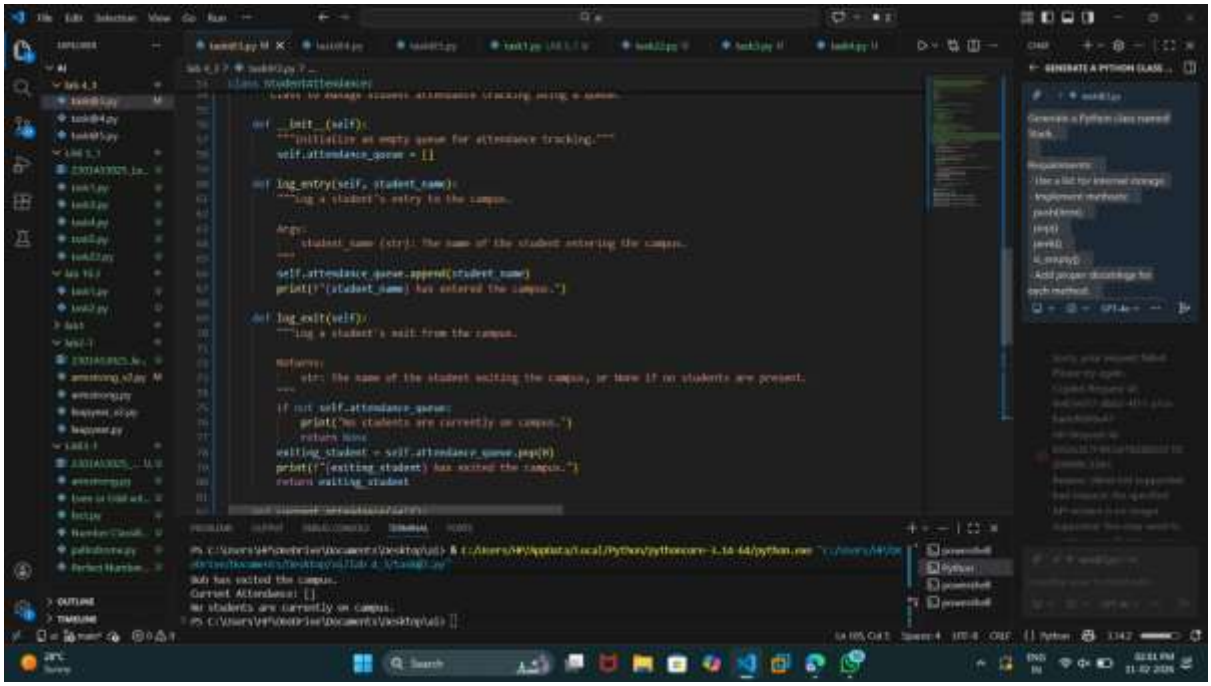
• Implement one selected feature as a working Python program with AI-assisted code generation.

Expected Output:

• A table mapping feature → chosen data structure → justification.

• A functional Python program implementing the chosen feature with comments and docstrings.





Task Description #10: Smart E-Commerce Platform – Data Structure Challenge

An e-commerce company wants to build a Smart Online Shopping System

with:

1. Shopping Cart Management – Add and remove products dynamically.
2. Order Processing System – Orders processed in the order they are placed.
3. Top-Selling Products Tracker – Products ranked by sales count.
4. Product Search Engine – Fast lookup of products using product ID.
5. Delivery Route Planning – Connect warehouses and delivery locations.

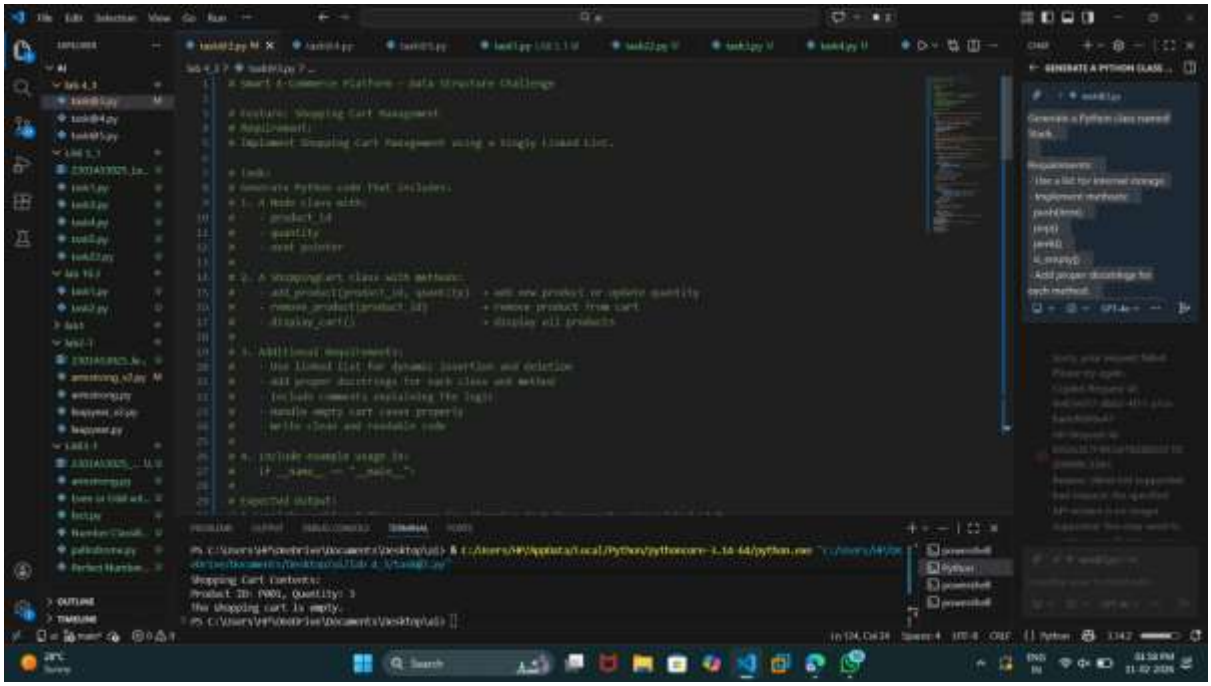
Student Task:

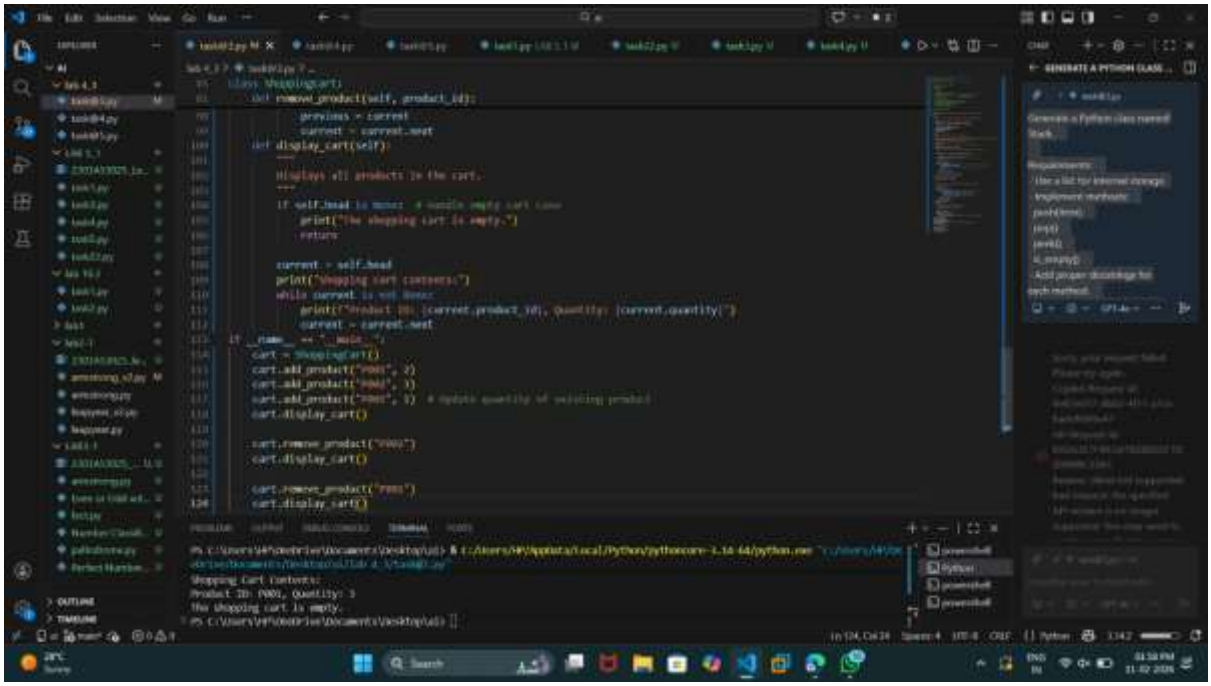
- For each feature, select the most appropriate data structure from the list below:
  - o Stack
  - o Queue
  - o Priority Queue
  - o Linked List
  - o Binary Search Tree (BST)
  - o Graph
  - o Hash Table
  - o Deque
- Justify your choice in 2–3 sentences per feature.
- Implement one selected feature as a working Python program with AI-assisted code generation.

Expected Output:

- A table mapping feature → chosen data structure → justification.
- A functional Python program implementing the chosen feature

with comments and docstrings.




def remove_product(self, product_id):
previous = current
current = current.next
def display_cart(self):
Displays all products in the cart.
if self.head is None: # Handle empty cart case
print("The shopping cart is empty.")
return
current = self.head
print("Shopping cart contents:")
while current is not None:
print(f"Product ID: {current.product_id}, Quantity: {current.quantity}")
current = current.next
if __name__ == "__main__":
cart = ShoppingCart()
cart.add_product("P001", 2)
cart.add_product("P002", 1)
cart.add_product("P001", 3) # Update quantity of existing product
cart.display_cart()
cart.remove_product("P002")
cart.display_cart()
cart.remove_product("P001")
cart.display_cart()
Shopping Cart contents:
Product ID: P001, Quantity: 5
Product ID: P002, Quantity: 1
Shopping Cart contents:
Product ID: P001, Quantity: 5
The shopping cart is empty.