AIAC-Ass-11.3

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Batch:05

Prompt: Task 1: Smart Contact Manager (Arrays & Linked Lists)

Scenario

SR University's student club requires a simple Contact Manager Application to store members' names and phone numbers. The system should support efficient addition, searching, and deletion of contacts.

Tasks

1. Implement the contact manager using arrays (lists).
2. Implement the same functionality using a linked list for dynamic memory allocation.
3. Implement the following operations in both approaches:
o Add a contact
o Search for a contact
o Delete a contact
4. Use GitHub Copilot to assist in generating search and delete methods.
5. Compare array vs. linked list approaches with respect to:
o Insertion efficiency
o Deletion efficiency

Expected Outcome

• Two working implementations (array-based and linked-list-based).
• A brief comparison explaining performance differences.

Code:

```
class ContactManagerArray:
    def __init__(self):
        self.contacts = []
```

```
    def add_contact(self, name, phone):
        self.contacts.append((name, phone))

    def search_contact(self, name):
        for contact in self.contacts:
            if contact[0] == name:
                return contact[1]
        return None

    def delete_contact(self, name):
        for i, contact in enumerate(self.contacts):
            if contact[0] == name:
                del self.contacts[i]
                return True
        return False
# Linked list implementation
class ContactNode:
    def __init__(self, name, phone):
        self.name = name
        self.phone = phone
        self.next = None
class ContactManagerLinkedList:
    def __init__(self):
        self.head = None

    def add_contact(self, name, phone):
        new_node = ContactNode(name, phone)
```

```
        new_node.next = self.head
        self.head = new_node

    def search_contact(self, name):
        current = self.head
        while current:
            if current.name == name:
                return current.phone
            current = current.next
        return None

    def delete_contact(self, name):
        current = self.head
        prev = None
        while current:
            if current.name == name:
                if prev:
                    prev.next = current.next
                else:
                    self.head = current.next
                return True
            prev = current
            current = current.next
        return False
 #example usage
contact_manager_array = ContactManagerArray()
contact_manager_array.add_contact("Alice", "123-456-7890")
contact_manager_array.add_contact("Bob", "987-654-3210")
```

print(contact_manager_array.search_contact("Alice")) # Output: 123-456-7890

contact_manager_array.delete_contact("Bob")

print(contact_manager_array.search_contact("Bob")) # Output: None

contact_manager_linked_list = ContactManagerLinkedList()

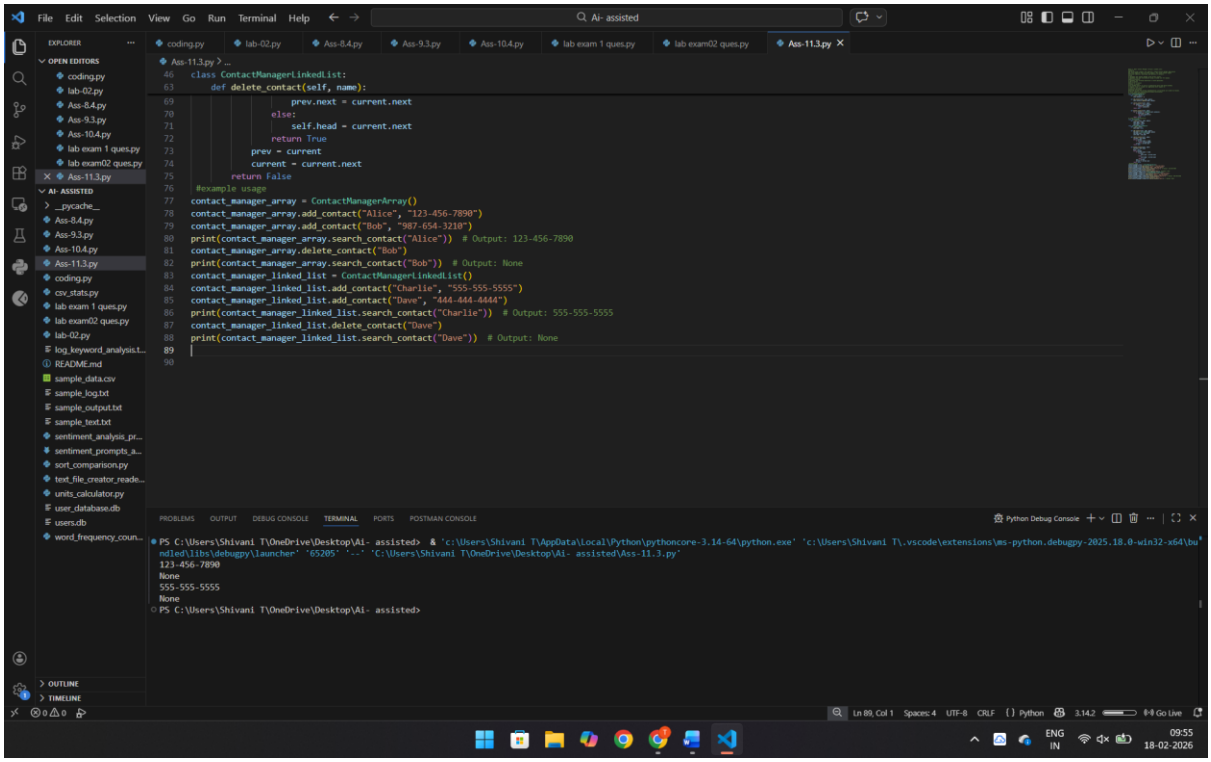
contact_manager_linked_list.add_contact("Charlie", "555-555-5555")

contact_manager_linked_list.add_contact("Dave", "444-444-4444")

print(contact_manager_linked_list.search_contact("Charlie")) # Output: 555-555-5555

contact_manager_linked_list.delete_contact("Dave")

print(contact_manager_linked_list.search_contact("Dave")) # Output: None



Comparison: Performance Comparison

Insertion Efficiency:

- Array-based: O(1) for appending a contact.

- Linked List-based: O(1) for adding a contact at the head.

Deletion Efficiency:

- Array-based: O(n) in the worst case (if the contact is at the end).

- Linked List-based: O(n) in the worst case (if the contact is atthe end), but O(1) if the contact is at the head**.**

Conclusion:

Both implementations have similar insertion efficiency, but the linkedlist can be more efficient for deletions if the contact is near the head,while the array may require shifting elements, leading to O(n) time complexity.

Explanation: Array-based approach is simpler and more efficient for searching and deleting elements in a small to medium-sized list, but it has fixed size and requires shifting elements during insertion/deletion. Linked list approach is more flexible for dynamic data, but it uses more memory due to storing pointers and has slower search times.

Prompt: #Task 2: Library Book Search System (Queues & Priority Queues)

#Scenario

#The SRU Library manages book borrow requests. Students and faculty submit

#requests, but faculty requests must be prioritized over student requests.

#Tasks

#1. Implement a Queue (FIFO) to manage book requests.

#2. Extend the system to a Priority Queue, prioritizing faculty requests.

#3. Use GitHub Copilot to assist in generating:

enqueue() method

#o dequeue() method

#4. Test the system with a mix of student and faculty requests.

#Expected Outcome

#• Working queue and priority queue implementations.

#• Correct prioritization of faculty requests.

Queue implementation

Code: from collections import deque

```
class BookRequestQueue:
    def __init__(self):
        self.queue = deque()
```

```
    def enqueue(self, request):
        self.queue.append(request)

    def dequeue(self):
        if self.queue:
            return self.queue.popleft()
        return None
# Priority Queue implementation
class BookRequestPriorityQueue:
    def __init__(self):
        self.faculty_queue = deque()
        self.student_queue = deque()

    def enqueue(self, request, is_faculty=False):
        if is_faculty:
            self.faculty_queue.append(request)
        else:
            self.student_queue.append(request)

    def dequeue(self):
        if self.faculty_queue:
            return self.faculty_queue.popleft()
        elif self.student_queue:
            return self.student_queue.popleft()
        return None
# Example usage
book_request_queue = BookRequestQueue()
```

book_request_queue.enqueue("Student Request 1")

book_request_queue.enqueue("Faculty Request 1")

print(book_request_queue.dequeue()) # Output: Student Request 1

print(book_request_queue.dequeue()) # Output: Faculty Request 1

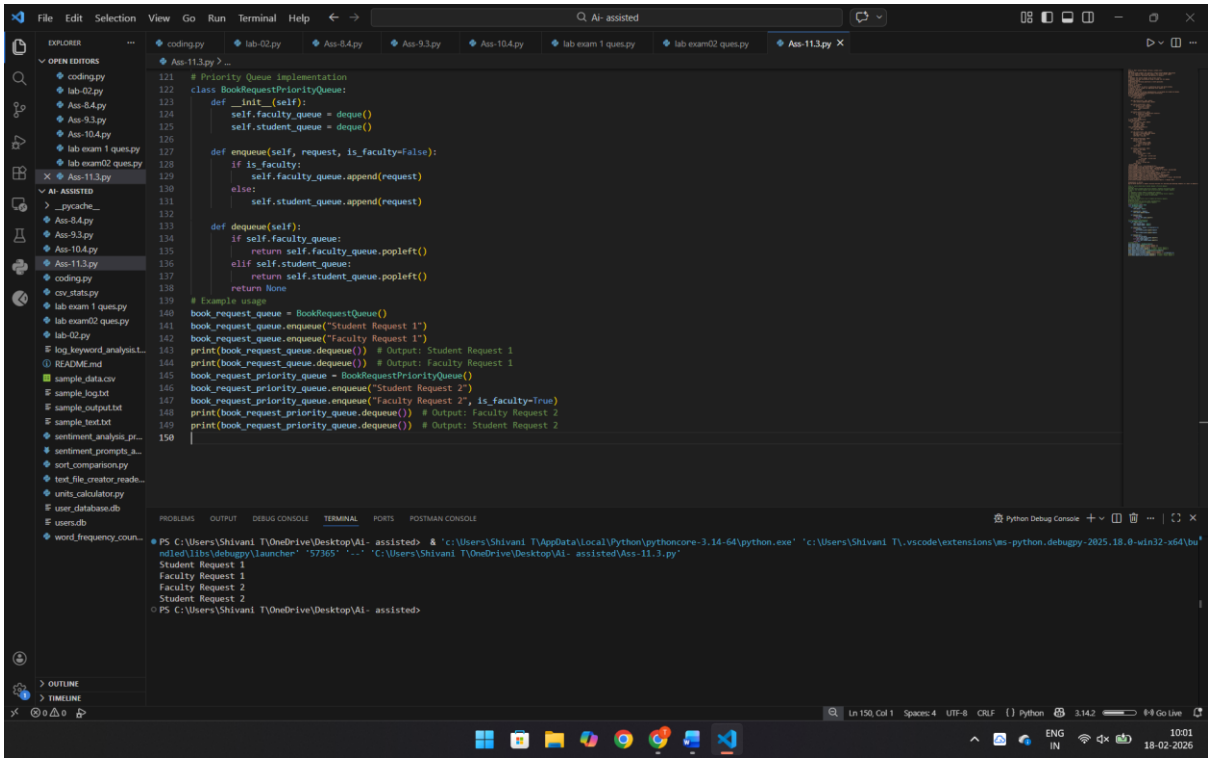
book_request_priority_queue = BookRequestPriorityQueue()

book_request_priority_queue.enqueue("Student Request 2")

book_request_priority_queue.enqueue("Faculty Request 2", is_faculty=True)

print(book_request_priority_queue.dequeue()) # Output: Faculty Request 2

print(book_request_priority_queue.dequeue()) # Output: Student Request 2



Explanation: The queue implementation manages requests in a first-in-first-out manner, while the priority queue implementation ensures that faculty requests are processed before student requests, regardless of their order of arrival.

Prompt: #Task 3: Emergency Help Desk (Stack Implementation)

#Scenario

#SR University’s IT Help Desk receives technical support tickets from students

#and staff. While tickets are received sequentially, issue escalation follows a

#ast-In, First-Out (LIFO) approach.

#Tasks

#1. Implement a Stack to manage support tickets.

#2. Provide the following operations:

#o push(ticket)

#o pop()

#o peek()

#3. Simulate at least five tickets being raised and resolved.

#4. Use GitHub Copilot to suggest additional stack operations such as:

#o Checking whether the stack is empty

#o Checking whether the stack is full (if applicable)

#Expected Outcome

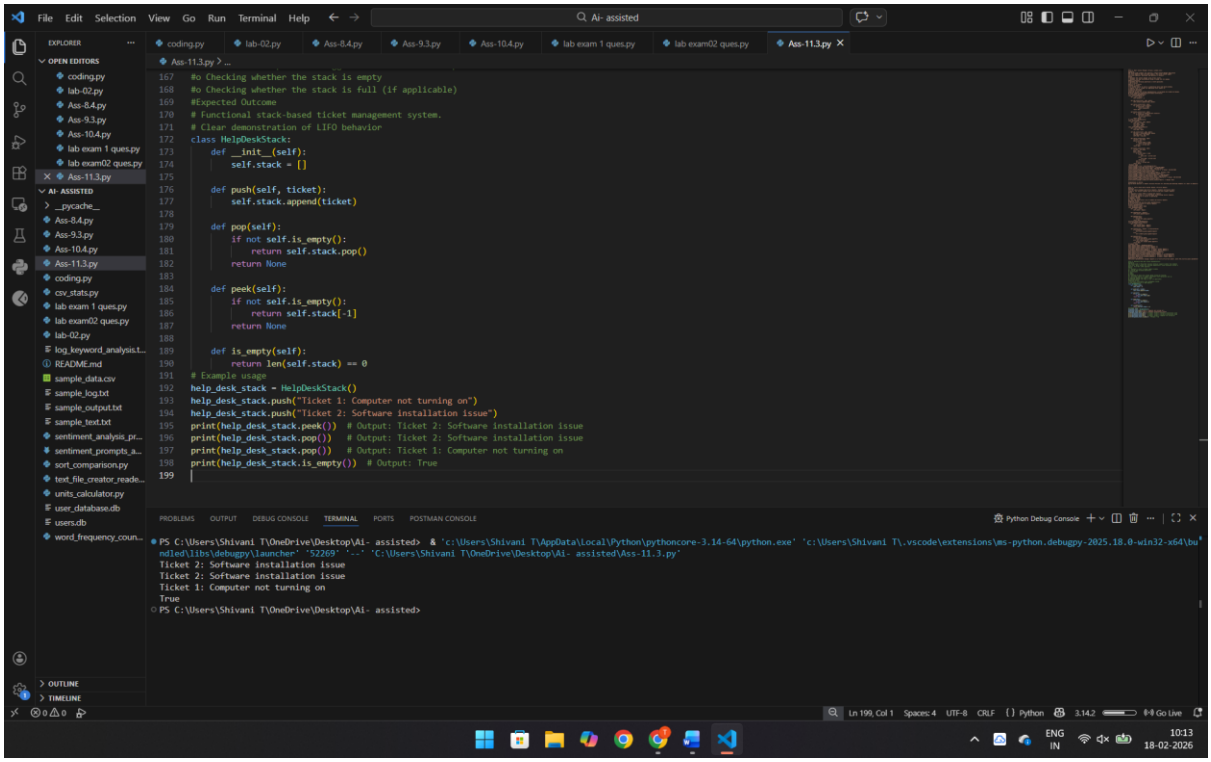
Functional stack-based ticket management system.

Clear demonstration of LIFO behavior

Code: class HelpDeskStack:

```
    def __init__(self):
        self.stack = []

    def push(self, ticket):
        self.stack.append(ticket)

    def pop(self):
        if not self.is_empty():
            return self.stack.pop()
        return None

    def peek(self):
```

```
        if not self.is_empty():
            return self.stack[-1]
        return None

    def is_empty(self):
        return len(self.stack) == 0
# Example usage
help_desk_stack = HelpDeskStack()
help_desk_stack.push("Ticket 1: Computer not turning on")
help_desk_stack.push("Ticket 2: Software installation issue")
print(help_desk_stack.peek())
print(help_desk_stack.pop())
print(help_desk_stack.pop())
print(help_desk_stack.is_empty())
```



Explanation: The stack implementation allows for managing support tickets in a last-in-first-out manner, ensuring that the most recently raised ticket is addressed first. The additional operations provide functionality to check the top ticket and whether the stack is empty.

Prompt: To implement a Hash Table and understand collision handling.

to generate a hash table with:

insert

Search

Delete

Starter Code

class HashTable:

pass

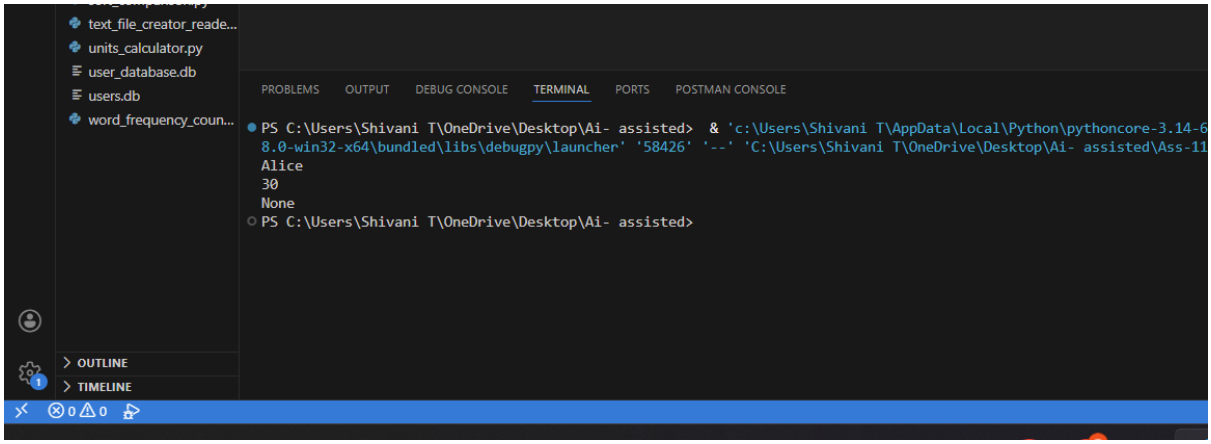
Collision handling using chaining

Well-commented methods

Code: class HashTable:

```
    def __init__(self, size=10):
        self.size = size
        self.table = [[] for _ in range(size)]

    def _hash(self, key):
        return hash(key) % self.size

    def insert(self, key, value):
        index = self._hash(key)
        for i, (k, v) in enumerate(self.table[index]):
            if k == key:
                self.table[index][i] = (key, value)  # Update existing key
                return
        self.table[index].append((key, value))  # Insert new key-value pair

    def search(self, key):
        index = self._hash(key)
```

```
        for k, v in self.table[index]:
            if k == key:
                return v
        return None  # Key not found

    def delete(self, key):
        index = self._hash(key)
        for i, (k, v) in enumerate(self.table[index]):
            if k == key:
                del self.table[index][i]  # Remove the key-value pair
                return True
        return False  # Key not found
# Example usage
hash_table = HashTable()
hash_table.insert("name", "Alice")
hash_table.insert("age", 30)
print(hash_table.search("name"))
print(hash_table.search("age"))
hash_table.delete("name")
print(hash_table.search("name"))
```



Explanation: The hash table implementation uses chaining to handle collisions, allowing multiple key-value pairs to be stored at the same index. The insert method adds or update

key-value pairs, the search method retrieves values based on keys, and the delete method removes key-value pairs from the table.

Prompt: Real-Time Application Challenge

Scenario

Design a Campus Resource Management System with the following

features:

• Student Attendance Tracking

• Event Registration System

• Library Book Borrowing

• Bus Scheduling System

• Cafeteria Order Queue

Choose the most appropriate data structure for each feature.

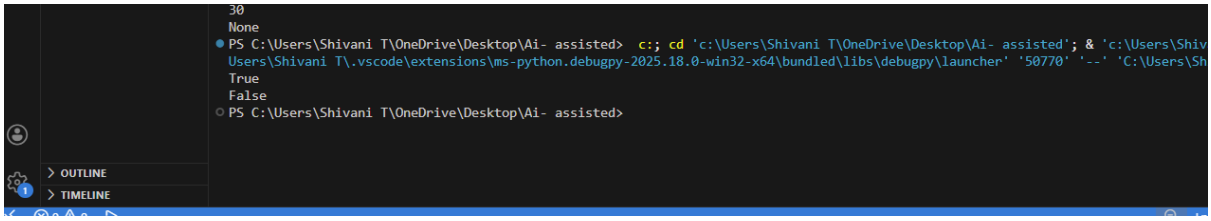
Justify your choice in 2–3 sentences.

Implement one selected feature

Code: class AttendanceTracker:

```
    def __init__(self):
        self.attendance = {}

    def mark_attendance(self, student_id):
        self.attendance[student_id] = True

    def check_attendance(self, student_id):
        return self.attendance.get(student_id, False)
# Example usage
tracker = AttendanceTracker()
tracker.mark_attendance("S12345")
print(tracker.check_attendance("S12345"))
```

print(tracker.check_attendance("S54321"))



Explanation: The Attendance Tracker uses a hash table (dictionary) to store student IDs and their attendance status. This allows for efficient insertion and lookup operations, making it easy to mark and check attendance for a large number of students.