

SCHOOL OF COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE		DEPARTMENT OF COMPUTER SCIENCE ENGINEERING	
Program Name: B. Tech		Assignment Type: Lab	Academic Year:2025-2026
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Course Code	24CS002PC215	Course Title	AI Assisted Coding
Year/Sem	II/I	Regulation	R24
Date and Day of Assignment	Week6 - Monday	Time(s)	
Duration	2 Hours	Applicable to Batches	
AssignmentNumber:11.1(Present assignment number)/24(Total number of assignments)			
Q.No.	Question		Expected Time to complete
1	Lab 11 – Data Structures with AI: Implementing Fundamental Structures Lab Objectives <ul style="list-style-type: none">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.		Week6 - Monday

- 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
```

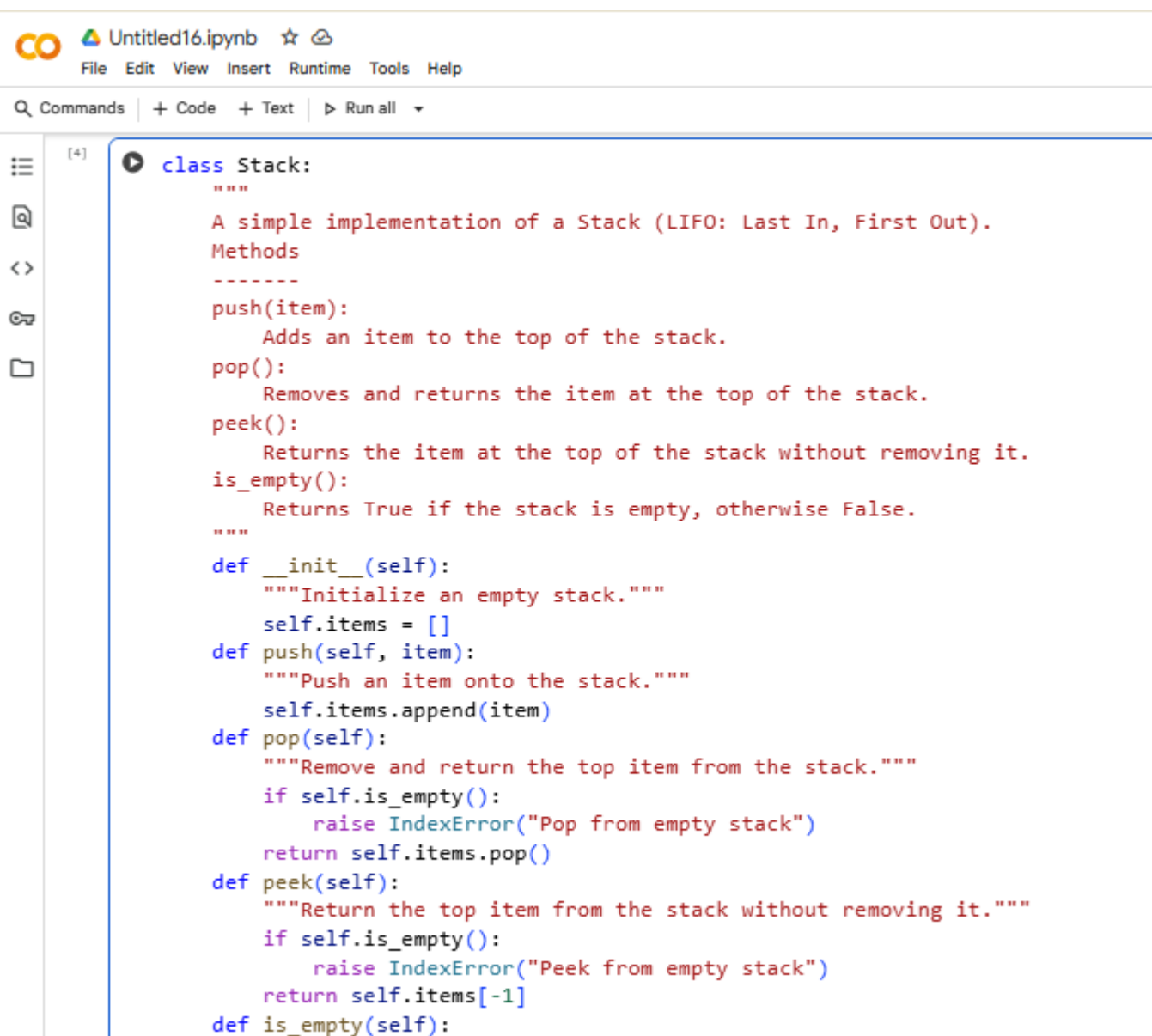
Expected Output:

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


Prompt :

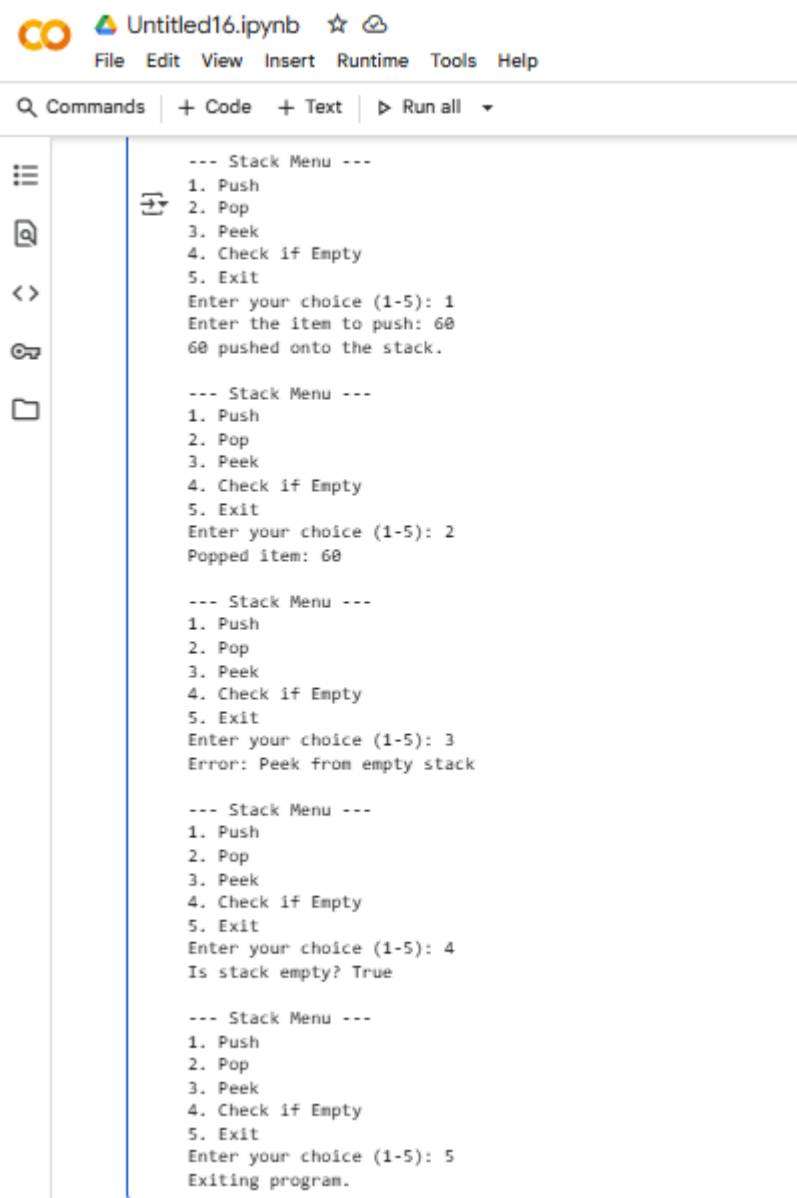
Create a Python class named Stack with methods: push, pop, peek, and is_empty with user input

Code:



```
class Stack:
    """
    A simple implementation of a Stack (LIFO: Last In, First Out).
    Methods
    -----
    push(item):
        Adds an item to the top of the stack.
    pop():
        Removes and returns the item at the top of the stack.
    peek():
        Returns the item at the top of the stack without removing it.
    is_empty():
        Returns True if the stack is empty, otherwise False.
    """
    def __init__(self):
        """Initialize an empty stack."""
        self.items = []
    def push(self, item):
        """Push an item onto the stack."""
        self.items.append(item)
    def pop(self):
        """Remove and return the top item from the stack."""
        if self.is_empty():
            raise IndexError("Pop from empty stack")
        return self.items.pop()
    def peek(self):
        """Return the top item from the stack without removing it."""
        if self.is_empty():
            raise IndexError("Peek from empty stack")
        return self.items[-1]
    def is_empty(self):
```

```
[4]  """Check whether the stack is empty."""  
    return len(self.items) == 0  
if __name__ == "__main__":  
    stack = Stack()  
    while True:  
        print("\n--- Stack Menu ---")  
        print("1. Push")  
        print("2. Pop")  
        print("3. Peek")  
        print("4. Check if Empty")  
        print("5. Exit")  
        choice = input("Enter your choice (1-5): ")  
        if choice == "1":  
            item = input("Enter the item to push: ")  
            stack.push(item)  
            print(f"{item} pushed onto the stack.")  
        elif choice == "2":  
            try:  
                print("Popped item:", stack.pop())  
            except IndexError as e:  
                print("Error:", e)  
        elif choice == "3":  
            try:  
                print("Top item:", stack.peek())  
            except IndexError as e:  
                print("Error:", e)  
        elif choice == "4":  
            print("Is stack empty?", stack.is_empty())  
        elif choice == "5":  
            print("Exiting program.")  
            break  
    else:
```



The image shows a Jupyter Notebook interface with a file named 'Untitled16.ipynb'. The interface includes a top menu bar with 'File', 'Edit', 'View', 'Insert', 'Runtime', 'Tools', and 'Help'. Below the menu bar is a toolbar with 'Commands', '+ Code', '+ Text', and 'Run all'. The notebook contains a single code cell with the following text:

```
--- Stack Menu ---
1. Push
2. Pop
3. Peek
4. Check if Empty
5. Exit
Enter your choice (1-5): 1
Enter the item to push: 60
60 pushed onto the stack.

--- Stack Menu ---
1. Push
2. Pop
3. Peek
4. Check if Empty
5. Exit
Enter your choice (1-5): 2
Popped item: 60

--- Stack Menu ---
1. Push
2. Pop
3. Peek
4. Check if Empty
5. Exit
Enter your choice (1-5): 3
Error: Peek from empty stack

--- Stack Menu ---
1. Push
2. Pop
3. Peek
4. Check if Empty
5. Exit
Enter your choice (1-5): 4
Is stack empty? True

--- Stack Menu ---
1. Push
2. Pop
3. Peek
4. Check if Empty
5. Exit
Enter your choice (1-5): 5
Exiting program.
```

observations and code expalnation

- Defined Stack class with a list to store elements.
- `push(item)` → adds an element to the top of stack.
- `pop()` → removes and returns the top element; handles empty stack.
- `peek()` → shows top element without removing it.
- `is_empty()` → checks if stack is empty.
- Interactive code asks for number of elements → pushes elements from user input.

Task Description #2 – Queue Implementation

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

Sample Input Code:

```
class Queue:
    pass
```

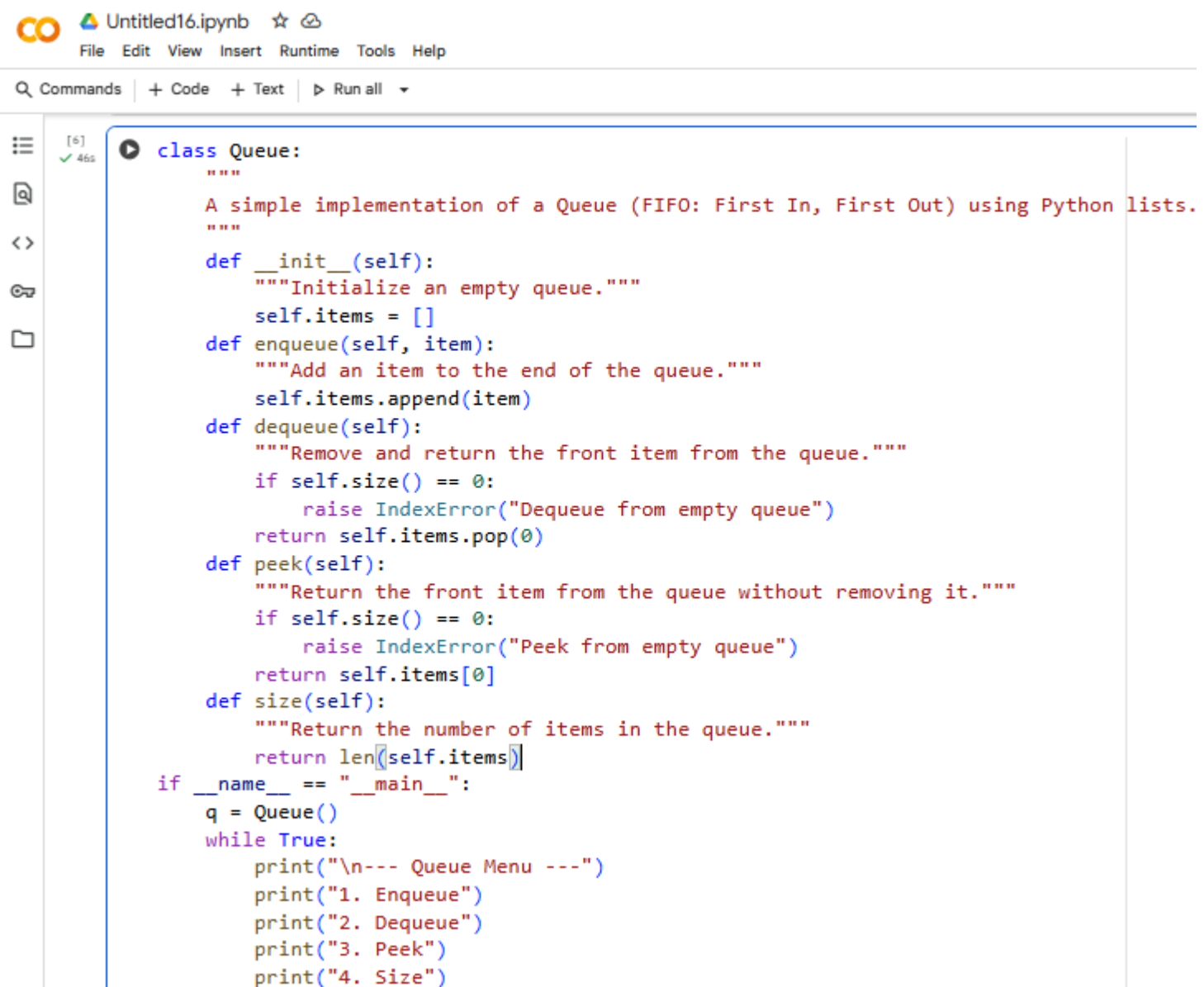
Expected Output:

- FIFO-based queue class with enqueue, dequeue, peek, and size methods.

prompt :

Create a Python class named Queue using list. Include methods: enqueue, dequeue, peek, and size with user input.

code:



```
class Queue:
    """
    A simple implementation of a Queue (FIFO: First In, First Out) using Python lists.
    """
    def __init__(self):
        """Initialize an empty queue."""
        self.items = []
    def enqueue(self, item):
        """Add an item to the end of the queue."""
        self.items.append(item)
    def dequeue(self):
        """Remove and return the front item from the queue."""
        if self.size() == 0:
            raise IndexError("Dequeue from empty queue")
        return self.items.pop(0)
    def peek(self):
        """Return the front item from the queue without removing it."""
        if self.size() == 0:
            raise IndexError("Peek from empty queue")
        return self.items[0]
    def size(self):
        """Return the number of items in the queue."""
        return len(self.items)

if __name__ == "__main__":
    q = Queue()
    while True:
        print("\n--- Queue Menu ---")
        print("1. Enqueue")
        print("2. Dequeue")
        print("3. Peek")
        print("4. Size")
```

```
[5] ✓ 46s
print("5. Exit")
choice = input("Enter your choice (1-5): ")
if choice == "1":
    item = input("Enter the item to enqueue: ")
    q.enqueue(item)
    print(f"{item} added to the queue.")
elif choice == "2":
    try:
        print("Dequeued item:", q.dequeue())
    except IndexError as e:
        print("Error:", e)
elif choice == "3":
    try:
        print("Front item:", q.peek())
    except IndexError as e:
        print("Error:", e)
elif choice == "4":
    print("Queue size:", q.size())
elif choice == "5":
    print("Exiting program.")
    break
else:
    print("Invalid choice! Please try again.")
```

```
↕
--- Queue Menu ---
1. Enqueue
2. Dequeue
3. Peek
4. Size
5. Exit
Enter your choice (1-5): 1
Enter the item to enqueue: A
A added to the queue.
```

```
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Q Commands | + Code | + Text | ▶ Run all ▼

--- Queue Menu ---
1. Enqueue
2. Dequeue
3. Peek
4. Size
5. Exit
Enter your choice (1-5): 1
Enter the item to enqueue: B
B added to the queue.

--- Queue Menu ---
1. Enqueue
2. Dequeue
3. Peek
4. Size
5. Exit
Enter your choice (1-5): 3
Front item: A

--- Queue Menu ---
1. Enqueue
2. Dequeue
3. Peek
4. Size
5. Exit
Enter your choice (1-5): 2
Dequeued item: A

--- Queue Menu ---
1. Enqueue
2. Dequeue
3. Peek
4. Size
5. Exit
Enter your choice (1-5): 4
Queue size: 1

--- Queue Menu ---
1. Enqueue
2. Dequeue
3. Peek
4. Size
5. Exit
Enter your choice (1-5): 5
Exiting program.
```

observations and code expalnation :

- Queue class stores elements in a list.
- enqueue(item) → adds element at the rear.
- dequeue() → removes element from front; prints message if empty.
- peek() → shows front element.
- size() → returns number of elements.
- User input used to enqueue multiple elements; then displays front and dequeued element.

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
```

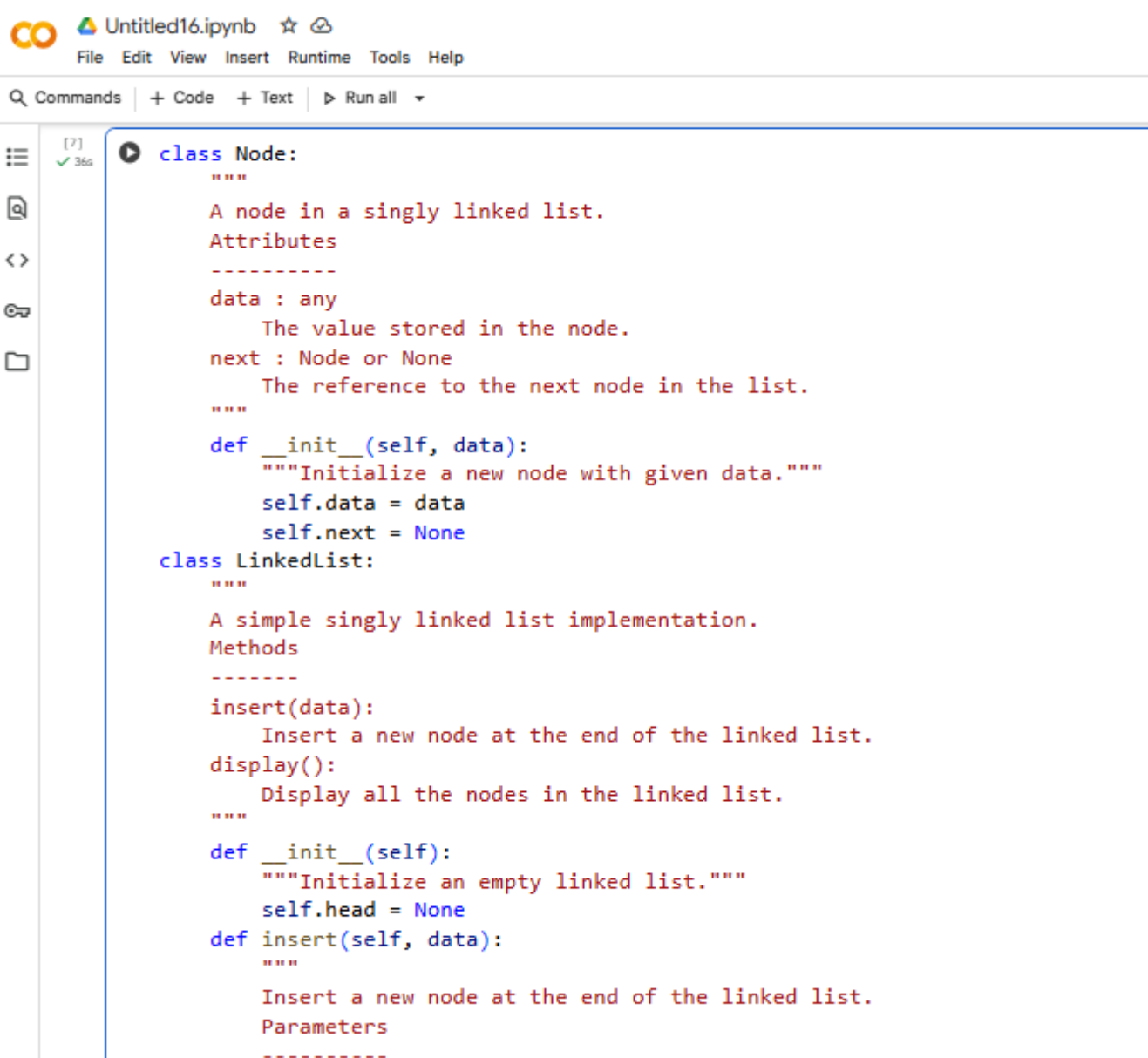
Expected Output:

- A working linked list implementation with clear method documentation.

Prompt :

Create a Python Singly Linked List with Node class. Include insert and display methods with user input.

Code:



The screenshot shows a Jupyter Notebook titled 'Untitled16.ipynb'. The interface includes a top menu bar with 'File', 'Edit', 'View', 'Insert', 'Runtime', 'Tools', and 'Help'. Below the menu is a toolbar with 'Commands', '+ Code', '+ Text', and 'Run all'. The main area displays Python code for a Singly Linked List implementation. The code defines a 'Node' class and a 'LinkedList' class. The 'Node' class has attributes 'data' and 'next', and an '.__init__' method. The 'LinkedList' class has methods 'insert(data)' and 'display()', and an '.__init__' method. The code is written in a monospaced font with syntax highlighting.

```
[?] 36s
class Node:
    """
    A node in a singly linked list.
    Attributes
    -----
    data : any
        The value stored in the node.
    next : Node or None
        The reference to the next node in the list.
    """
    def __init__(self, data):
        """Initialize a new node with given data."""
        self.data = data
        self.next = None
class LinkedList:
    """
    A simple singly linked list implementation.
    Methods
    -----
    insert(data):
        Insert a new node at the end of the linked list.
    display():
        Display all the nodes in the linked list.
    """
    def __init__(self):
        """Initialize an empty linked list."""
        self.head = None
    def insert(self, data):
        """
        Insert a new node at the end of the linked list.
        Parameters
        -----

```



```
[?] 36s
data : any
    The data to store in the new node.
"""
new_node = Node(data)
if self.head is None:
    self.head = new_node
    return
current = self.head
while current.next:
    current = current.next
current.next = new_node
def display(self):
    """
    Display all the nodes in the linked list.
    """
    if self.head is None:
        print("The linked list is empty.")
        return
    current = self.head
    while current:
        print(current.data, end=" -> ")
        current = current.next
    print("None")
if __name__ == "__main__":
    linked_list = LinkedList()
    while True:
        print("\n--- Singly Linked List Menu ---")
        print("1. Insert")
        print("2. Display")
        print("3. Exit")

        choice = input("Enter your choice (1-3): ")
```



```
[7]: choice = input("Enter your choice (1-3): ")
    if choice == "1":
        item = input("Enter the item to insert: ")
        linked_list.insert(item)
        print(f"{item} inserted into the linked list.")
    elif choice == "2":
        print("Linked List contents:")
        linked_list.display()
    elif choice == "3":
        print("Exiting program.")
        break
    else:
        print("Invalid choice! Please try again.")
```



```
--- Singly Linked List Menu ---
1. Insert
2. Display
3. Exit
Enter your choice (1-3): 1
Enter the item to insert: 10
10 inserted into the linked list.

--- Singly Linked List Menu ---
1. Insert
2. Display
3. Exit
Enter your choice (1-3): 1
Enter the item to insert: 20
20 inserted into the linked list.

--- Singly Linked List Menu ---
1. Insert
2. Display
3. Exit
Enter your choice (1-3): 2
Linked List contents:
10 -> 20 -> None
```

Code explanation and observations :

- Node class stores data and next pointer.
- LinkedList class has head pointer.
- insert(data) → adds new node at end.
- display() → prints all nodes in order.
- User inputs number of nodes → program inserts each one and displays list.

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
```

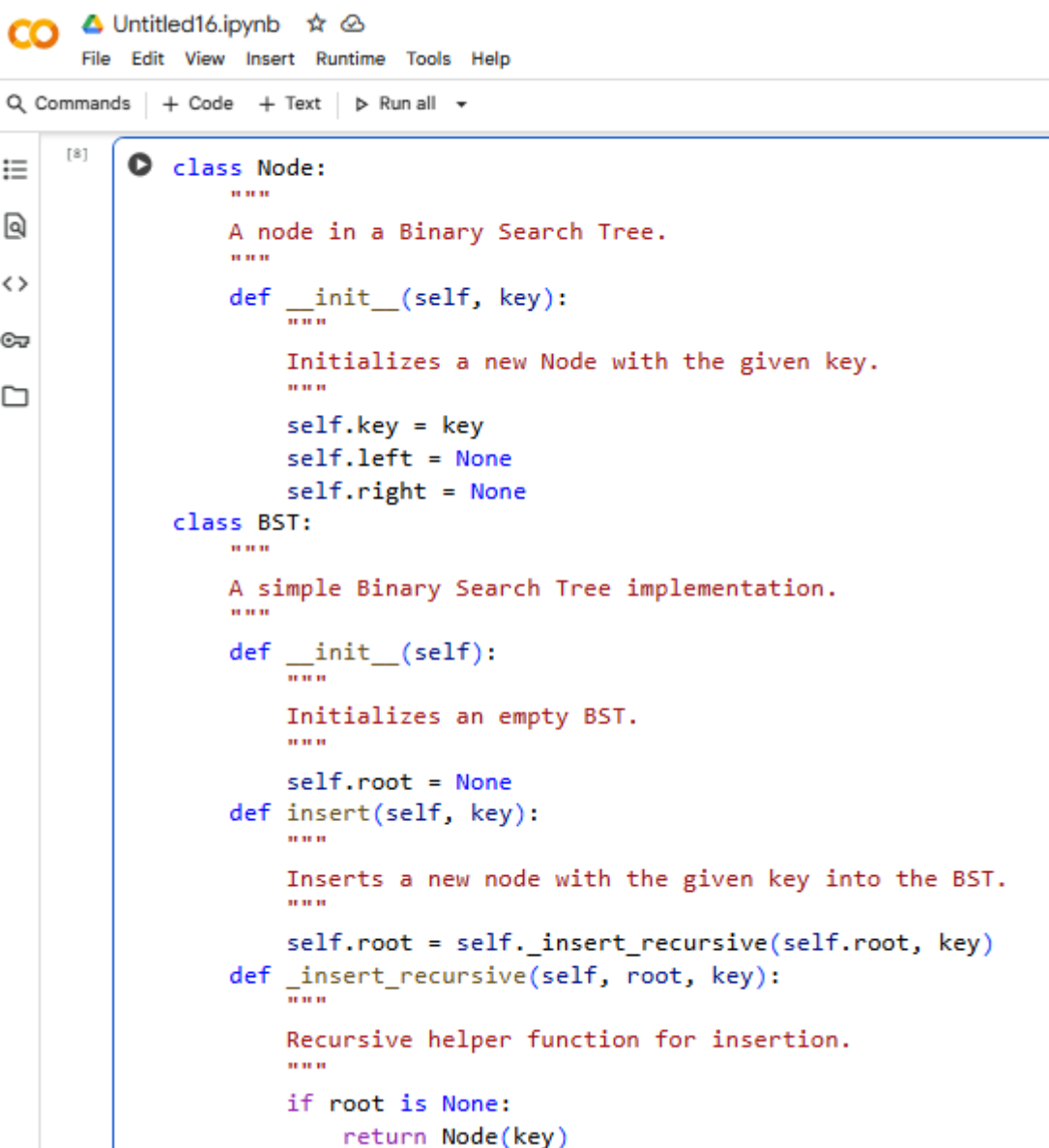
Expected Output:

- BST implementation with recursive insert and traversal methods.

Prompt :

Create a Python BST class with insert and inorder traversal methods. Make it interactive for user input.

Code :



```
[8] class Node:
    """
    A node in a Binary Search Tree.
    """
    def __init__(self, key):
        """
        Initializes a new Node with the given key.
        """
        self.key = key
        self.left = None
        self.right = None

class BST:
    """
    A simple Binary Search Tree implementation.
    """
    def __init__(self):
        """
        Initializes an empty BST.
        """
        self.root = None
    def insert(self, key):
        """
        Inserts a new node with the given key into the BST.
        """
        self.root = self._insert_recursive(self.root, key)
    def _insert_recursive(self, root, key):
        """
        Recursive helper function for insertion.
        """
        if root is None:
            return Node(key)
```



```
[8] ▶
    if key < root.key:
        root.left = self._insert_recursive(root.left, key)
    elif key > root.key:
        root.right = self._insert_recursive(root.right, key)
    return root
def inorder_traversal(self):
    """
    Performs an in-order traversal of the BST and returns a list of keys.
    """
    result = []
    self._inorder_recursive(self.root, result)
    return result
def _inorder_recursive(self, root, result):
    """
    Recursive helper function for in-order traversal.
    """
    if root:
        self._inorder_recursive(root.left, result)
        result.append(root.key)
        self._inorder_recursive(root.right, result)
if __name__ == "__main__":
    bst = BST()
    while True:
        print("\n--- BST Menu ---")
        print("1. Insert")
        print("2. In-order Traversal")
        print("3. Exit")
        choice = input("Enter your choice (1-3): ")
        if choice == "1":
            try:
                key = int(input("Enter the key to insert: "))
                bst.insert(key)
```



[8]



```
        print(f"{key} inserted into the BST.")
    except ValueError:
        print("Invalid input. Please enter an integer.")
    elif choice == "2":
        print("In-order Traversal:", bst.inorder_traversal())
    elif choice == "3":
        print("Exiting program.")
        break
    else:
        print("Invalid choice. Please try again.")
```



```
--- BST Menu ---
1. Insert
2. In-order Traversal
3. Exit
Enter your choice (1-3): 1
Enter the key to insert: 45
45 inserted into the BST.

--- BST Menu ---
1. Insert
2. In-order Traversal
3. Exit
Enter your choice (1-3): 1
Enter the key to insert: 90
90 inserted into the BST.

--- BST Menu ---
1. Insert
2. In-order Traversal
3. Exit
Enter your choice (1-3): 2
In-order Traversal: [45, 90]

--- BST Menu ---
1. Insert
2. In-order Traversal
3. Exit
Enter your choice (1-3): 3
Exiting program.
```

observations and code expalnation

- ◆ BST node has data, left, right.
- ◆ insert(data) → recursively places node in correct position. inorder() → returns elements in sorted order.
- ◆ Program asks for root, then number of elements → inserts each. Prints inorder traversal to verify BST structure.

	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: <ul style="list-style-type: none">• Collision handling using chaining, with well-commented methods.	

Prompts :

Create a Python Hash Table class with insert, search, and delete methods. Handle collisions using chaining with user input.

Code:

```
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class HashTable:
    """
    A simple implementation of a Hash Table using chaining.
    """
    def __init__(self, size):
        """
        Initializes a new HashTable with the given size.
        """
        self.size = size
        self.table = [[] for _ in range(self.size)]
    def _hash_function(self, key):
        """
        Calculates the hash value for a given key.
        """
        return hash(key) % self.size
    def insert(self, key, value):
        """
        Inserts a key-value pair into the hash table.
        If the key already exists, the value is updated.
        """
        index = self._hash_function(key)
        for i, (k, v) in enumerate(self.table[index]):
            if k == key:
                self.table[index][i] = (key, value) # Update value if key exists
                print(f"Updated value for key '{key}'.")
                return
        self.table[index].append((key, value)) # Add new key-value pair
        print(f"Inserted key-value pair: ('{key}', '{value}').")
    def search(self, key):
        """
        Searches for a key in the hash table and returns its value.
        Returns None if the key is not found.
        """
        index = self._hash_function(key)
        for k, v in self.table[index]:
            if k == key:
                return v
        return None
    def delete(self, key):
        """
        Deletes a key-value pair from the hash table.
        Returns True if the key was found and deleted, False otherwise.
        """
        index = self._hash_function(key)
```

```
[9]
for i, (k, v) in enumerate(self.table[index]):
    if k == key:
        del self.table[index][i]
        print(f"Deleted key '{key}'.")
        return True
    print(f"Key '{key}' not found.")
    return False
if __name__ == "__main__":
    # Get hash table size from user
    while True:
        try:
            size = int(input("Enter the size of the hash table: "))
            if size > 0:
                hash_table = HashTable(size)
                break
            else:
                print("Size must be a positive integer.")
        except ValueError:
            print("Invalid input. Please enter an integer.")
    while True:
        print("\n--- Hash Table Menu ---")
        print("1. Insert")
        print("2. Search")
        print("3. Delete")
        print("4. Exit")
        choice = input("Enter your choice (1-4): ")
        if choice == "1":
            key = input("Enter the key: ")
            value = input("Enter the value: ")
            hash_table.insert(key, value)
        elif choice == "2":
            key = input("Enter the key to search: ")
            result = hash_table.search(key)
            if result is not None:
                print(f"Value for key '{key}': {result}")
            else:
                print(f"Key '{key}' not found.")
        elif choice == "3":
            key = input("Enter the key to delete: ")
            hash_table.delete(key)
        elif choice == "4":
            print("Exiting program.")
            break
        else:
            print("Invalid choice. Please try again.")
```


Untitled16.ipynb

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Q Commands + Code + Text Run all

[9] print(+value for key {key}: {result}) else: print(f"Key '{key}' not found.") elif choice == "3": key = input("Enter the key to delete: ") hash_table.delete(key) elif choice == "4": print("Exiting program.") break else: print("Invalid choice. Please try again.")

Enter the size of the hash table: 1

--- Hash Table Menu ---
1. Insert
2. Search
3. Delete
4. Exit
Enter your choice (1-4): 1
Enter the key: 55
Enter the value: 3
Inserted key-value pair: ('55', '3')

--- Hash Table Menu ---
1. Insert
2. Search
3. Delete
4. Exit
Enter your choice (1-4): 1
Enter the key: 67
Enter the value: 89
Inserted key-value pair: ('67', '89')

--- Hash Table Menu ---
1. Insert
2. Search
3. Delete
4. Exit
Enter your choice (1-4): 2
Enter the key to search: 55
Value for key '55': 3

--- Hash Table Menu ---
1. Insert
2. Search
3. Delete
4. Exit
Enter your choice (1-4): 3
Enter the key to delete: 55
Deleted key '55'.

--- Hash Table Menu ---
1. Insert
2. Search
3. Delete
4. Exit
Enter your choice (1-4): 4
Exiting program.

Observation and code explanation

- ◆ Uses a list of lists (buckets) for collision chaining. insert(key, value) → hashes key → appends to bucket.
- ◆ search(key) → looks for key in bucket → returns value or None. delete(key) → removes key-value pair if exists.
- ◆ User enters number of key-value pairs → program inserts → searches and prints result.

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.

Prompt :

Create a Python Graph class using adjacency list. Include methods: add_vertex, add_edge, display with user input

Code:

```
[10]
class Graph:
    """
    A simple graph implementation using an adjacency list.
    """
    def __init__(self):
        """
        Initializes an empty graph.
        The adjacency list is a dictionary where keys are vertices
        and values are lists of adjacent vertices.
        """
        self.adjacency_list = {}
    def add_vertex(self, vertex):
        """
        Adds a vertex to the graph if it doesn't already exist.
        """
        if vertex not in self.adjacency_list:
            self.adjacency_list[vertex] = []
            print(f"Vertex '{vertex}' added to the graph.")
        else:
            print(f"Vertex '{vertex}' already exists in the graph.")
    def add_edge(self, vertex1, vertex2):
        """
        Adds an edge between two vertices.
        Creates vertices if they don't exist.
        Assumes an undirected graph (adds edge in both directions).
        """
        # Add vertices if they don't exist
        self.add_vertex(vertex1)
        self.add_vertex(vertex2)
        # Add edge (undirected)
        if vertex2 not in self.adjacency_list[vertex1]:
            self.adjacency_list[vertex1].append(vertex2)
            print(f"Edge added between '{vertex1}' and '{vertex2}'.")
        else:
            print(f"Edge already exists between '{vertex1}' and '{vertex2}'.")
        if vertex1 not in self.adjacency_list[vertex2]:
            self.adjacency_list[vertex2].append(vertex1)
    def display(self):
        """
        Displays the graph's adjacency list.
        """
        if not self.adjacency_list:
            print("The graph is empty.")
            return
```

Untitled16.ipynb

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Commands Code Text Run all

```
[10]: print("Graph Adjacency List:")
      for vertex, neighbors in self.adjacency_list.items():
          print(f"{vertex}: {neighbors}")
if __name__ == "__main__":
    graph = Graph()
    while True:
        print("\n--- Graph Menu (Adjacency List) ---")
        print("1. Add Vertex")
        print("2. Add Edge")
        print("3. Display Graph")
        print("4. Exit")
        choice = input("Enter your choice (1-4): ")
        if choice == "1":
            vertex = input("Enter the vertex to add: ")
            graph.add_vertex(vertex)
        elif choice == "2":
            vertex1 = input("Enter the first vertex of the edge: ")
            vertex2 = input("Enter the second vertex of the edge: ")
            graph.add_edge(vertex1, vertex2)
        elif choice == "3":
            graph.display()
        elif choice == "4":
            print("Exiting program.")
            break
        else:
            print("Invalid choice. Please try again.")
```

--- Graph Menu (Adjacency List) ---
1. Add Vertex
2. Add Edge
3. Display Graph
4. Exit
Enter your choice (1-4): 1
Enter the vertex to add: 2
Vertex '2' added to the graph.

--- Graph Menu (Adjacency List) ---
1. Add Vertex
2. Add Edge
3. Display Graph
4. Exit
Enter your choice (1-4): 1
Enter the vertex to add: 6
Vertex '6' added to the graph.

--- Graph Menu (Adjacency List) ---
1. Add Vertex
2. Add Edge
3. Display Graph
4. Exit
Enter your choice (1-4): 2
Enter the first vertex of the edge: 3

```

--- Graph Menu (Adjacency List) ---
1. Add Vertex
2. Add Edge
3. Display Graph
4. Exit
Enter your choice (1-4): 1
Enter the vertex to add: 2
Vertex '2' added to the graph.

--- Graph Menu (Adjacency List) ---
1. Add Vertex
2. Add Edge
3. Display Graph
4. Exit
Enter your choice (1-4): 1
Enter the vertex to add: 6
Vertex '6' added to the graph.

--- Graph Menu (Adjacency List) ---
1. Add Vertex
2. Add Edge
3. Display Graph
4. Exit
Enter your choice (1-4): 2
Enter the first vertex of the edge: 3
Enter the second vertex of the edge: 5
Vertex '3' added to the graph.
Vertex '5' added to the graph.
Edge added between '3' and '5'.

--- Graph Menu (Adjacency List) ---
1. Add Vertex
2. Add Edge
3. Display Graph
4. Exit
Enter your choice (1-4): 3
Graph Adjacency List:
2: []
6: []
3: ['5']
5: ['3']

--- Graph Menu (Adjacency List) ---
1. Add Vertex
2. Add Edge
3. Display Graph
4. Exit
Enter your choice (1-4): 4
Exiting program.

```

Code explanation and Observation :

- Dictionary stores adjacency list.
- `add_vertex(v)` → adds vertex if not exist.
- `add_edge(v1, v2)` → adds edge (undirected) between two vertices.
- `display()` → prints adjacency list.
- Program asks number of vertices and edges → user enters each → displays graph.

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.

Prompt :

Create a Python Priority Queue class using `heapq`. Include `enqueue (priority)`, `dequeue (highest priority)`, and `display` methods. With user input.

Code:

```
Untitled16.ipynb
File Edit View Insert Runtime Tools Help

[11]
✓ 2m
import heapq
class PriorityQueue:
    """
    A simple implementation of a Priority Queue using Python's heapq module.
    """
    def __init__(self):
        """
        Initializes an empty Priority Queue.
        The queue is implemented as a list to be used with heapq.
        """
        self._queue = []
    def push(self, item, priority):
        """
        Adds an item to the priority queue with a given priority.
        The priority is used to determine the order of items. Lower priority values
        are processed first (min-heap).
        Args:
            item: The item to be added.
            priority: The priority of the item (lower is higher priority).
        """
        # Items are stored as tuples (priority, item)
        heapq.heappush(self._queue, (priority, item))
        print(f"Added '{item}' with priority {priority} to the queue.")
    def pop(self):
        """
        Removes and returns the item with the highest priority (lowest priority value).
        Returns:
            The item with the highest priority.
        Raises:
            IndexError: If the priority queue is empty.
        """
        if not self.is_empty():
            priority, item = heapq.heappop(self._queue)
            return item
        else:
            raise IndexError("pop from empty priority queue")
    def peek(self):
        """
        Returns the item with the highest priority without removing it.
        Returns:
            The item with the highest priority.
        Raises:
            IndexError: If the priority queue is empty.
        """
```

```
[11]
✓ 2m
if not self.is_empty():
    priority, item = self._queue[0]
    return item
else:
    raise IndexError("peek from empty priority queue")
def is_empty(self):
    """
    Checks if the priority queue is empty.
    Returns:
        True if the priority queue is empty, False otherwise.
    """
    return len(self._queue) == 0
def size(self):
    """
    Returns the number of items in the priority queue.
    Returns:
        The number of items in the priority queue.
    """
    return len(self._queue)
if __name__ == "__main__":
    pq = PriorityQueue()
    while True:
        print("\n--- Priority Queue Menu ---")
        print("1. Push")
        print("2. Pop")
        print("3. Peek")
        print("4. Check if Empty")
        print("5. Size")
        print("6. Exit")
        choice = input("Enter your choice (1-6): ")
        if choice == "1":
            item = input("Enter the item to push: ")
            try:
                priority = int(input("Enter the priority (lower is higher priority): "))
                pq.push(item, priority)
            except ValueError:
                print("Invalid priority. Please enter an integer.")
        elif choice == "2":
            try:
                print("Popped item:", pq.pop())
            except IndexError as e:
                print("Error:", e)
        elif choice == "3":
            try:
```



```

    try:
        print("Top priority item:", pq.peak())
    except IndexError as e:
        print("Error:", e)
    elif choice == "4":
        print("Is priority queue empty?", pq.is_empty())
    elif choice == "5":
        print("Priority queue size:", pq.size())
    elif choice == "6":
        print("Exiting program.")
        break
    else:
        print("Invalid choice! Please try again.")

```

```

--- Priority Queue Menu ---
1. Push
2. Pop
3. Peek
4. Check if Empty
5. Size
6. Exit
Enter your choice (1-6): 1
Enter the item to push: 20
Enter the priority (lower is higher priority): 2
Added '20' with priority 2 to the queue.

--- Priority Queue Menu ---
1. Push
2. Pop
3. Peek
4. Check if Empty
5. Size
6. Exit
Enter your choice (1-6): 1
Enter the item to push: 22
Enter the priority (lower is higher priority): 1
Added '22' with priority 1 to the queue.

--- Priority Queue Menu ---
1. Push
2. Pop
3. Peek
4. Check if Empty
5. Size
6. Exit
Enter your choice (1-6): 3
Top priority item: 22

--- Priority Queue Menu ---
1. Push
2. Pop
3. Peek
4. Check if Empty
5. Size
6. Exit
Enter your choice (1-6): 4
Is priority queue empty? False

```

Observation and code explanation:

- ◆ Uses heapq for priority management. enqueue(priority, item) → pushes tuple (priority, item). dequeue() → pops element with smallest priority value. display() → shows queue.
- ◆ User enters items with priority → program enqueues → dequeues highest priority → displays queue.
- ◆

Task Description #8 – Deque

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

Sample Input Code:

```
class DequeDS:
```

```
    pass
```

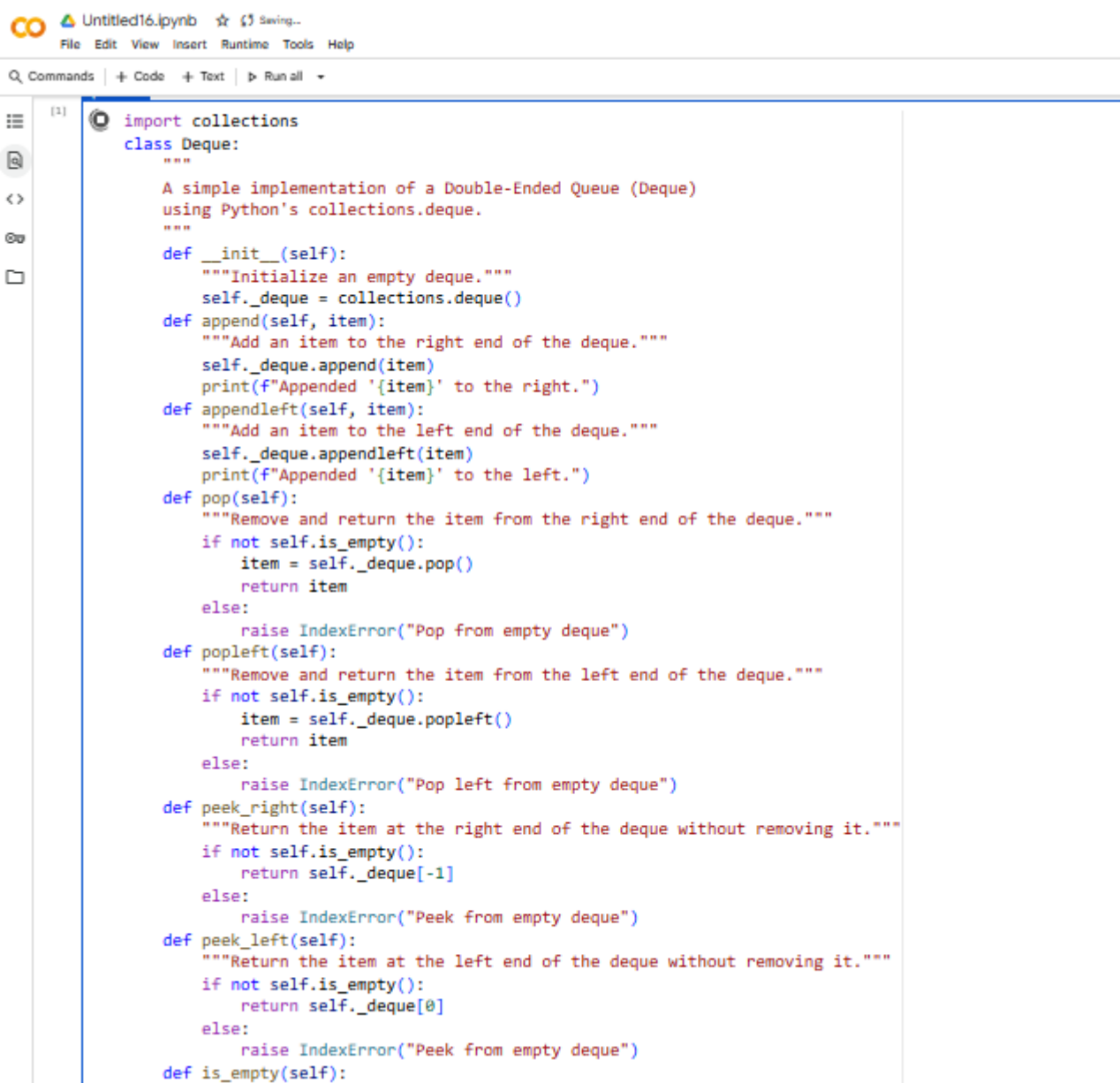
Expected Output:

- Insert and remove from both ends with docstrings.

Prompt :

Create a Python Deque class using collections.deque. Include methods: insert_front, insert_rear, remove_front, remove_rear, display. Interactive input.


Code :



The screenshot shows a Jupyter Notebook window titled 'Untitled16.ipynb'. The interface includes a top bar with 'File', 'Edit', 'View', 'Insert', 'Runtime', 'Tools', and 'Help' menus. Below the menu bar is a search bar and a 'Run all' button. The main area displays a Python code cell with the following content:

```
[1] import collections
class Deque:
    """
    A simple implementation of a Double-Ended Queue (Deque)
    using Python's collections.deque.
    """
    def __init__(self):
        """Initialize an empty deque."""
        self._deque = collections.deque()
    def append(self, item):
        """Add an item to the right end of the deque."""
        self._deque.append(item)
        print(f"Appended '{item}' to the right.")
    def appendleft(self, item):
        """Add an item to the left end of the deque."""
        self._deque.appendleft(item)
        print(f"Appended '{item}' to the left.")
    def pop(self):
        """Remove and return the item from the right end of the deque."""
        if not self.is_empty():
            item = self._deque.pop()
            return item
        else:
            raise IndexError("Pop from empty deque")
    def popleft(self):
        """Remove and return the item from the left end of the deque."""
        if not self.is_empty():
            item = self._deque.popleft()
            return item
        else:
            raise IndexError("Pop left from empty deque")
    def peek_right(self):
        """Return the item at the right end of the deque without removing it."""
        if not self.is_empty():
            return self._deque[-1]
        else:
            raise IndexError("Peek from empty deque")
    def peek_left(self):
        """Return the item at the left end of the deque without removing it."""
        if not self.is_empty():
            return self._deque[0]
        else:
            raise IndexError("Peek from empty deque")
    def is_empty(self):
```

```

[1] 
"""Check if the deque is empty."""
return len(self._deque) == 0
def size(self):
    """Return the number of items in the deque."""
    return len(self._deque)
def display(self):
    """Display the contents of the deque."""
    if self.is_empty():
        print("The deque is empty.")
    else:
        print("Deque contents:", list(self._deque))
if __name__ == "__main__":
    dq = Deque()
    while True:
        print("\n--- Deque Menu ---")
        print("1. Append Right")
        print("2. Append Left")
        print("3. Pop Right")
        print("4. Pop Left")
        print("5. Peek Right")
        print("6. Peek Left")
        print("7. Check if Empty")
        print("8. Size")
        print("9. Display")
        print("10. Exit")
        choice = input("Enter your choice (1-10): ")
        if choice == "1":
            item = input("Enter the item to append right: ")
            dq.append(item)
        elif choice == "2":
            item = input("Enter the item to append left: ")
            dq.appendleft(item)
        elif choice == "3":
            try:
                print("Popped item from right:", dq.pop())
            except IndexError as e:
                print("Error:", e)
        elif choice == "4":
            try:
                print("Popped item from left:", dq.popleft())
            except IndexError as e:
                print("Error:", e)
        elif choice == "5":
            try:

```

```
[1] print("Exiting program.")
    break
else:
    print("Invalid choice! Please try again.")

---
--- Deque Menu ---
1. Append Right
2. Append Left
3. Pop Right
4. Pop Left
5. Peek Right
6. Peek Left
7. Check if Empty
8. Size
9. Display
10. Exit
Enter your choice (1-10): 1
Enter the item to append right: 67
Appended '67' to the right.

--- Deque Menu ---
1. Append Right
2. Append Left
3. Pop Right
4. Pop Left
5. Peek Right
6. Peek Left
7. Check if Empty
8. Size
9. Display
10. Exit
Enter your choice (1-10): 2
Enter the item to append left: 45
Appended '45' to the left.

--- Deque Menu ---
1. Append Right
2. Append Left
3. Pop Right
4. Pop Left
5. Peek Right
6. Peek Left
7. Check if Empty
8. Size
9. Display
10. Exit
Enter your choice (1-10): 5
Rightmost item: 67

--- Deque Menu ---
1. Append Right
2. Append Left
3. Pop Right
4. Pop Left
5. Peek Right
6. Peek Left
7. Check if Empty
8. Size
9. Display
10. Exit
Enter your choice (1-10): 6
-----
```

Observation and code explation

- collections.deque allows fast insertion/removal at both ends.
- insert_front(item) → adds to front.
- insert_rear(item) → adds to rear.
- remove_front() / remove_rear() → removes from respective end.
- display() → prints deque.
- User inputs number of elements → inserts → removes → displays deque.

Task Description #9 – AI-Generated Data Structure Comparisons

Task: Use AI to generate a comparison table of different data structures (stack, queue, linked list, etc.) including time complexities.

Sample Input Code:

No code, prompt AI for a data structure comparison table

Expected Output:

- A markdown table with structure names, operations, and complexities.

Prompt :

Generate a python code for comparison table of different data structures (stack,queue,linked list).

Table :

Comparison of Data Structures and Time Complexities:

	Data Structure	Access	Search	Insertion	Deletion
0	Stack	$O(n)$	$O(n)$	$O(1)$	$O(1)$
1	Queue	$O(n)$	$O(n)$	$O(1)$	$O(1)$
2	Singly Linked List	$O(n)$	$O(n)$	$O(1)$ at head, $O(n)$ at tail	$O(1)$ at head, $O(n)$ at tail
3	Doubly Linked List	$O(n)$	$O(n)$	$O(1)$ at ends, $O(n)$ in middle	$O(1)$ at ends, $O(n)$ in middle
4	Hash Table	Average: $O(1)$, Worst: $O(n)$	Average: $O(1)$, Worst: $O(n)$	Average: $O(1)$, Worst: $O(n)$	Average: $O(1)$, Worst: $O(n)$
5	Binary Search Tree	Average: $O(\log n)$, Worst: $O(n)$	Average: $O(\log n)$, Worst: $O(n)$	Average: $O(\log n)$, Worst: $O(n)$	Average: $O(\log n)$, Worst: $O(n)$
6	Graph (Adjacency List)	$O(V)$	$O(V + E)$	$O(1)$	$O(V + E)$
7	Graph (Adjacency Matrix)	$O(1)$	$O(V ^2)$	$O(1)$	$O(1)$
8	Heap (Priority Queue)	$O(n)$	$O(n)$	$O(\log n)$	$O(\log n)$

Task Description #10 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:
 - Stack
 - Queue
 - Priority Queue
 - Linked List
 - Binary Search Tree (BST)
 - Graph
 - Hash Table
 - 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.

□ Deliverables (For All Tasks)

1. AI-generated prompts for code and test case generation.
2. At least 3 assert test cases for each task.
3. AI-generated initial code and execution screenshots.
4. Analysis of whether code passes all tests.
5. Improved final version with inline comments and explanation.
6. Compiled report (Word/PDF) with prompts, test cases, assertions, code, and output.

Prompt :

Create a Python menu-driven Queue for cafeteria orders. Include methods: place_order, serve_order, next_order, queue_size. Use user input to interact.

Code:

```
Untitled16.ipynb
File Edit View Insert Runtime Tools Help

[4]
import collections
# Assume the Queue class definition from cell B-W1LR2Bz77b is available in the environment
class Queue:
    """
    A simple implementation of a Queue (FIFO: First In, First Out) using Python lists.
    """
    def __init__(self):
        """Initialize an empty queue."""
        self.items = []
    def enqueue(self, item):
        """Add an item to the end of the queue."""
        self.items.append(item)
    def dequeue(self):
        """Remove and return the front item from the queue."""
        if self.size() == 0:
            raise IndexError("Dequeue from empty queue")
        return self.items.pop(0)
    def peek(self):
        """Return the front item from the queue without removing it."""
        if self.size() == 0:
            raise IndexError("Peek from empty queue")
        return self.items[0]
    def size(self):
        """Return the number of items in the queue."""
        return len(self.items)
class CafeteriaOrderQueue:
    """
    Manages cafeteria orders using a Queue (FIFO).
    """
    def __init__(self):
        """Initialize an empty cafeteria order queue."""
        self.order_queue = Queue()
        print("Cafeteria Order Queue initialized.")
    def place_order(self, order_details):
        """
        Adds an order to the queue.
        Args:
            order_details: Details of the order (e.g., a string or dictionary).
        """
        self.order_queue.enqueue(order_details)
        print(f"Order placed: {order_details}")
    def process_order(self):
        """
        Removes and returns the next order to be processed from the queue.
        """
```


Untitled16.ipynb

File Edit View Insert Runtime Tools Help

Q Commands + Code + Text ▶ Run all

```
[4]
Returns:
    The details of the processed order.
Raises:
    IndexError: If the queue is empty.
"""
try:
    processed_order = self.order_queue.dequeue()
    print(f"Order processed: {processed_order}")
    return processed_order
except IndexError:
    print("No orders to process.")
    raise IndexError("No orders to process.") # Re-raise to be consistent with Queue.dequeue
def view_next_order(self):
    """
    Returns the details of the next order without removing it.
    Returns:
        The details of the next order.
    Raises:
        IndexError: If the queue is empty.
    """
    try:
        next_order = self.order_queue.peek()
        print(f"Next order to process: {next_order}")
        return next_order
    except IndexError:
        print("No orders in the queue.")
        raise IndexError("No orders in the queue.") # Re-raise to be consistent with Queue.peek
def get_queue_size(self):
    """
    Returns the number of orders currently in the queue.
    """
    size = self.order_queue.size()
    print(f"Current queue size: {size}")
    return size
def is_queue_empty(self):
    """
    Checks if the order queue is empty.
    """
    is_empty = self.order_queue.is_empty()
    print(f"Is queue empty? {is_empty}")
    return is_empty
if __name__ == "__main__":
    cafeteria_queue = CafeteriaOrderQueue()
    while True:
        print("\n--- Cafeteria Order Menu ---")
```



```
[4] ▶ cafeteria_queue.get_queue_size()

elif choice == "5":
    cafeteria_queue.is_queue_empty()
elif choice == "6":
    print("Exiting Cafeteria Order System.")
    break
else:
    print("Invalid choice! Please try again.")
```

Cafeteria Order Queue initialized.

--- Cafeteria Order Menu ---

```
1. Place Order
2. Process Order
3. View Next Order
4. Check Queue Size
5. Check If Queue is Empty
6. Exit
Enter your choice (1-6): 1
Enter order details: biscuit
Order placed: biscuit
```

--- Cafeteria Order Menu ---

```
1. Place Order
2. Process Order
3. View Next Order
4. Check Queue Size
5. Check If Queue is Empty
6. Exit
Enter your choice (1-6): 2
Order processed: biscuit
```

--- Cafeteria Order Menu ---

```
1. Place Order
2. Process Order
3. View Next Order
4. Check Queue Size
5. Check If Queue is Empty
6. Exit
Enter your choice (1-6): 3
No orders in the queue.
```

--- Cafeteria Order Menu ---

```
1. Place Order
2. Process Order
3. View Next Order
4. Check Queue Size
5. Check If Queue is Empty
6. Exit
Enter your choice (1-6): 4
Current queue size: 0
```

--- Cafeteria Order Menu ---

```
1. Place Order
2. Process Order
3. View Next Order
4. Check Queue Size
5. Check If Queue is Empty
6. Exit
Enter your choice (1-6): 6
Exiting Cafeteria Order System.
```

Observations and Code Explanation:

- ♦ CafeteriaOrderQueue uses circular queue array.
- ♦ place_order(student_name) → adds student; handles full queue. serve_order() → serves front student; handles empty queue. next_order() → shows next order without removing. queue_size() → displays number of orders.
- ♦ Menu allows user to place, serve, peek, check size, exit interactively.
- ♦