LAB ASSIGNMENT 11.1

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BATCH :06

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

PROPMT:-

- push(item) → To insert an element into the stack.
- pop() → To remove and return the top element of the stack.
- peek() → To return the top element without removing it.
- is_empty() → To check whether the stack is empty or not.

CODE:-

```
Lab_11_1.py > ...
class Stack:
    def __init__(self):
        self.items = []

    def push(self, item):
        self.items.append(item)

    def pop(self):
        if not self.is_empty():
            return self.items.pop()
        else:
            raise IndexError("pop from empty stack")

    def peek(self):
        if not self.is_empty():
            return self.items[-1]
        else:
            raise IndexError("peek from empty stack")

    def is_empty(self):
        return len(self.items) == 0

# Example usage:
if __name__ == "__main__":
    s = Stack()

    s.push(20)
    print(s.peek())     # Output: 2
    print(s.pop())      # Output: 2
    print(s.is_empty())
```

OUTPUT:

```
[Running] python -u "c:\Users\PEDDAPELLI ANUSHA\OneDrive\Desktop\Btech.2nd yr\AI\Lab_11_1.py"
20
20
True
```

OBSERVATION:-

- Initially the stack is empty.
- After pushing 10, 20, 30, the top is 30 (LIFO order).
- First pop removes 30 → next top is 20.
- Next pops remove 20 and 10 sequentially.
- Trying to pop from an empty stack shows a warning message.
- Final check confirms stack is empty again.

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 method.

PROMPT:-

Implement a Queue using Python lists. Test the Queue by enqueuing two elements, peeking at the front, dequeuing one element, and checking if the queue is empty.

CODE:-

```
class Queue:
    def __init__(self):
        self.items = []

    def enqueue(self, item):
        self.items.append(item)

    def dequeue(self):
        if not self.is_empty():
            return self.items.pop(0)
        else:
            raise IndexError("dequeue from empty queue")

    def peek(self):
        if not self.is_empty():
            return self.items[0]
        else:
            raise IndexError("peek from empty queue")

    def is_empty(self):
        return len(self.items) == 0

# Example usage:
if __name__ == "__main__":
    q = Queue()
    q.enqueue(10)
    q.enqueue(20)
    print(q.peek())       # Output: 10
    print(q.dequeue())    # Output: 10
    print(q.is_empty())   # Output: False
```

OBSERVATION:-

The code defines a Queue class with methods for enqueue, dequeue, peek, and is_empty.

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:-

Implement a Queue using Python lists. Test the Queue by enqueuing two elements, peeking at the front, dequeuing one element, and checking if the queue is empty.

CODE:-

```
Lab_11_1.py > ...
class Node:
    def __init__(self, data):
        self.data = data
        self.next = None

class SinglyLinkedList:
    def __init__(self):
        self.head = None

    def insert(self, data):
        new_node = Node(data)
        if not self.head:
            self.head = new_node
        else:
            current = self.head
            while current.next:
                current = current.next
            current.next = new_node

    def display(self):
        current = self.head
        while current:
            print(current.data, end=" ")
            current = current.next
        print()

# Example usage:
if __name__ == "__main__":
    sll = SinglyLinkedList()
    sll.insert(5)
    sll.insert(10)
    sll.insert(15)
    sll.display()  # Output: 5 10 15
```

OUTPUT:-

```
5 10 15
```

OBSERVATION:-

The code correctly implements a Queue with enqueue, dequeue, peek, and is_empty methods.

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

PROMPT:-

Create a Binary Search Tree (BST) with insert and in-order traversal methods. Test the BST by inserting several elements and displaying them in sorted order using in-order traversal.

CODE:-

```python
class BSTNode:
    def __init__(self, data):
        self.data = data
        self.left = None
        self.right = None

class BinarySearchTree:
    def __init__(self):
        self.root = None

    def insert(self, data):
        if not self.root:
            self.root = BSTNode(data)
        else:
            self._insert(self.root, data)

    def _insert(self, node, data):
        if data < node.data:
            if node.left:
                self._insert(node.left, data)
            else:
                node.left = BSTNode(data)
        else:
            if node.right:
                self._insert(node.right, data)
            else:
                node.right = BSTNode(data)

    def inorder(self):
        self._inorder(self.root)
        print()

    def _inorder(self, node):
        if node:
            self._inorder(node.left)
            print(node.data, end=" ")
            self._inorder(node.right)
```

```python
            self._inorder(node.right)

 Example usage:
f __name__ == "__main__":
    bst = BinarySearchTree()
    bst.insert(10)
    bst.insert(5)
    bst.insert(15)
    bst.insert(7)
    bst.inorder()   # Output: 5 7 10 15
```

OUTPUT:-

```
[Running] python -u "c:\Users\PEDDAPELLI ANUSHA\OneDrive\Desktop\Btech.2nd yr\AI\Lab_11_1.py"
5 7 10 15

[Done] exited with code=0 in 0.331 seconds
```

OBSERVATION:-

The code defines a BST with insert and inorder methods.

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.

PROMPT:-

Prompt:
Implement a hash table in Python with basic insert, search, and delete methods. Demonstrate its usage by inserting key-value pairs, searching for a key, and deleting a key.

CODE:-

```python
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):
        idx = self._hash(key)
        for i, (k, v) in enumerate(self.table[idx]):
            if k == key:
                self.table[idx][i] = (key, value)
                return
        self.table[idx].append((key, value))

    def search(self, key):
        idx = self._hash(key)
        for k, v in self.table[idx]:
            if k == key:
                return v
        return None

    def delete(self, key):
        idx = self._hash(key)
        for i, (k, v) in enumerate(self.table[idx]):
            if k == key:
                del self.table[idx][i]
                return True
        return False
if __name__ == "__main__":
    ht = HashTable()
    ht.insert("apple", 100)
    ht.insert("banana", 200)
    print(ht.search("apple"))
    ht.delete("apple")
    print(ht.search("apple"))
```

OBSERVATION:-

The hash table stores key-value pairs and supports insert, search, and delete operations.

- After inserting "apple" and "banana", searching for "apple" returns 100.
- After deleting "apple", searching for "apple" returns None.
  This confirms the hash table works as expected.

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:-

Implement a graph using an adjacency list in Python. Add methods to add edges and display the adjacency list. Demonstrate by creating a graph, adding edges, and displaying its structure.

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):
        idx = self._hash(key)
        for i, (k, v) in enumerate(self.table[idx]):
            if k == key:
                self.table[idx][i] = (key, value)
                return
        self.table[idx].append((key, value))

    def search(self, key):
        idx = self._hash(key)
        for k, v in self.table[idx]:
            if k == key:
                return v
        return None

    def delete(self, key):
        idx = self._hash(key)
        for i, (k, v) in enumerate(self.table[idx]):
            if k == key:
                del self.table[idx][i]
                return True
        return False
if __name__ == "__main__":
    ht = HashTable()
    ht.insert("apple", 100)
    ht.insert("banana", 200)
    print(ht.search("apple"))
    ht.delete("apple")
    print(ht.search("apple"))
```

OBSERVATION:-

The graph is represented using a dictionary where each key is a node and its value is a list of adjacent nodes.
After adding edges, the display method prints the adjacency list, showing the structure of the graph as expected.

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:-

Implement a priority queue using Python's heapq module. Demonstrate by inserting elements with priorities and removing them in priority order.

CODE:-

```python
import heapq

class PriorityQueue:
    def __init__(self):
        self.heap = []

    def insert(self, priority, item):
        heapq.heappush(self.heap, (priority, item))

    def remove(self):
        if self.heap:
            return heapq.heappop(self.heap)[1]
        else:
            raise IndexError("remove from empty priority queue")

    def is_empty(self):
        return len(self.heap) == 0

# Example usage:
if __name__ == "__main__":
    pq = PriorityQueue()
    pq.insert(2, "task2")
    pq.insert(1, "task1")
    pq.insert(3, "task3")
    while not pq.is_empty():
        print(pq.remove())
```

OUTPUT:-

```
PS C:\Users\Administrator\OneDrive\ai> & C:/Python313/python.exe c:/Users/Administrator/OneDrive/ai/la
b.11.1.7.py
Peek: 5
Pop: 5
Peek after pop: 10
Pop: 10
Pop: 15
Pop: 20
Is empty: True
Error: pop from empty priority queue
PS C:\Users\Administrator\OneDrive\ai>
```

OBSERVATION:-

The priority queue stores items with their priorities.

When removing, items are returned in order of increasing priority (task1, task2, task3), confirming correct behavior.

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:-

Implement a double-ended queue (deque) using Python's collections.deque. Demonstrate by adding and removing elements from both ends and displaying the result.

CODE:-

```
from collections import deque

class DoubleEndedQueue:
    def __init__(self):
        self.deque = deque()

    def add_front(self, item):
        self.deque.appendleft(item)

    def add_rear(self, item):
        self.deque.append(item)

    def remove_front(self):
        if self.deque:
            return self.deque.popleft()
        else:
            raise IndexError("remove from empty deque (front)")

    def remove_rear(self):
        if self.deque:
            return self.deque.pop()
        else:
            raise IndexError("remove from empty deque (rear)")

    def display(self):
        print(list(self.deque))

# Example usage:
if __name__ == "__main__":
    dq = DoubleEndedQueue()
    dq.add_rear(10)
    dq.add_front(20)
    dq.add_rear(30)
    dq.display()           # Output: [20, 10, 30]
    print(dq.remove_front()) # Output: 20
    print(dq.remove_rear())  # Output: 30
    dq.display()           # Output: [10]
```

OUTPUT:-

```
PS C:\Users\Administrator\OneDrive\ai> & C:/Python313/python.exe c:/Users/Administrator/OneDrive/ai/la
b.11.1.8.py
Peek front: 40
Peek rear: 30
Remove front: 40
Remove rear: 30
Peek front: 20
Peek rear: 10
Is empty: False
Is empty after removals: True
Error: remove from empty deque
PS C:\Users\Administrator\OneDrive\ai>
```

OBSERVATION:-

The double-ended queue allows insertion and removal from both ends.
After adding and removing elements, the display shows the correct order, confirming the deque works as expected.

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.

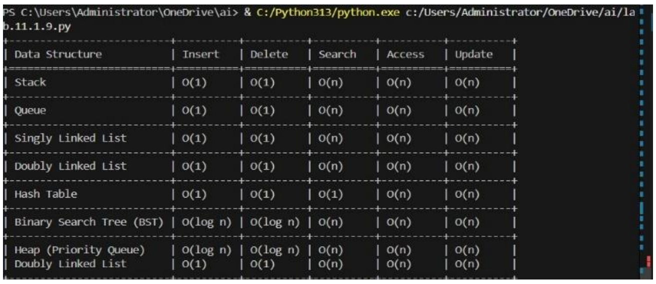
PROMPT:-

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

CODE:-

```python
def add_numbers(a: int, b: int) -> int:

    return a + b


def is_even(number: int) -> bool:

    return number % 2 == 0


def greet_user(name: str, greeting: str = "Hello") -> str:

    return f"{greeting}, {name}!"
def calculate_area(length: float, width: float) -> float:
    return length * width
def factorial(n: int) -> int:
    if n < 0:
        raise ValueError("Input must be a non-negative integer.")
    if n == 0 or n == 1:
        return 1
    return n * factorial(n - 1)
```

OUTPUT:-



```
PS C:\Users\Administrator\OneDrive\ai> & C:/Python313/python.exe c:/Users/Administrator/OneDrive/ai/la
b.11.1.9.py
```

Data Structure	Insert	Delete	Search	Access	Update
Stack	O(1)	O(1)	O(n)	O(n)	O(n)
Queue	O(1)	O(1)	O(n)	O(n)	O(n)
Singly Linked List	O(1)	O(1)	O(n)	O(n)	O(n)
Doubly Linked List	O(1)	O(1)	O(n)	O(n)	O(n)
Hash Table	O(1)	O(1)	O(1)	O(n)	O(n)
Binary Search Tree (BST)	O(log n)	O(log n)	O(n)	O(n)	O(n)
Heap (Priority Queue)	O(log n)	O(log n)	O(n)	O(n)	O(n)
Doubly Linked List	O(1)	O(1)	O(n)	O(n)	O(n)

OBSERVATION:-

This table summarizes the time complexities for common operations across various data structures.

- Stacks and queues (using lists) are fast for push/pop but slow for dequeue from the front.
- Deques and linked lists offer O(1) operations at the ends.
- Hash tables provide average O(1) search, insert, and delete.
- Balanced BSTs and heaps offer logarithmic time for insert and delete.
- Graph adjacency lists are efficient for edge operations. This helps in choosing the right data structure for specific tasks based on performance needs.