



DATA STRUCTURES LAB

ENCS253

LAB PRACTICALS

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EXPERIMENT – 1 : INVENTORY MANAGEMENT SYSTEM

AIM:

To implement an inventory management system in Python that allows insertion of new products and display of all products using ArrayList.

Question:

Write a menu-driven program to store product details (SKU, name, quantity) in an inventory. The program should allow the user to insert new products after validating quantity and to display the complete inventory in tabular form.

Introduction:

Inventory management keeps track of items available in stock. Using a list in Python, we can store a dynamic list of products where each product is represented as an object containing SKU, name and quantity.

Algorithm:

- Start.
- Create a `Product` class with fields `sku`, `name` and `quantity`.
- Use a Python list to store all product records.
- Display menu with options:
 1. Insert product
 2. Display inventory
 3. Exit
- For insertion: read `sku`, `name` and `quantity`; validate that `quantity` is positive and `sku` does not already exist; then add new `Product` object to list.
- For display: if list is empty, show message; otherwise print all products in table form.
- Repeat menu until user selects Exit.
- Stop.

Code:-

```
inventory = []

def insert_product():
    sku = input("Enter SKU: ")

    for item in inventory:
        if item['sku'] == sku:
            print("Product with this SKU already exists!")
            return
    name = input("Enter Product Name: ")
    try:
        quantity = int(input("Enter Quantity: "))
    except ValueError:
        print("Invalid input. Quantity must be a number.")
        return
    product = {'sku': sku, 'name': name, 'quantity': quantity}
    inventory.append(product)
    print("Product inserted successfully.")

def display_inventory():
    if not inventory:
        print("Inventory is empty.")
        return
    print("\nCurrent Inventory:")
    print("SKU\t\tProduct Name\t\tQuantity")
    print("-----")
    for item in inventory:
        print(f'{item["sku"]}\t\t{item["name"]}\t\t{item["quantity"]}')
    print()

def main():
    while True:
        print("\nInventory Stock Manager")
        print("1. Insert New Product")
        print("2. Display Inventory")
```

```
print("3. Exit")
choice = input("Enter your choice (1-3): ")
if choice == '1':
    insert_product()
elif choice == '2':
    display_inventory()
elif choice == '3':
    print("Exiting Inventory Manager.")
    break
else:
    print("Invalid choice. Please select from 1 to 3.")

# Start the program
main()
```

EXPERIMENT -2 : Inventory Stock Manager -Process Sales &Zero Stock

AIM:

To implement an inventory stock manager that processes sales for a given SKU and identifies items with zero stock.

Question:

Write a program that maintains a list of items (SKU and quantity). Implement a method to process a sale given SKU and quantity sold, updating stock if available or showing appropriate error messages. Also implement a method to list all SKUs whose quantity becomes zero.

Code:-

```

class Item:
    def __init__(self, sku, quantity):
        self.sku = sku
        self.quantity = quantity

def process_sale(inventory, sku, qty_sold):
    found = False
    for item in inventory:
        if item.sku == sku:
            found = True
            if item.quantity >= qty_sold:
                item.quantity -= qty_sold
                print(f'Sale processed: {qty_sold} units of SKU {sku}')
            else:
                print(f'Insufficient stock for SKU {sku}. Available: {item.quantity}')
            break

    if not found:
        print(f'SKU {sku} not found in inventory.')

def identify_zero_stock(inventory):
    zero_list = [item.sku for item in inventory if item.quantity == 0]
    if not zero_list:
        print("No zero stock items found.")
    else:
        print("Zero stock SKUs:", zero_list)
    return zero_list

def main():
    inventory = [
        Item(101, 50),
        Item(102, 20),
        Item(103, 0)
    ]

```

```

]

process_sale(inventory, 101, 30) # normal sale
process_sale(inventory, 102, 25) # insufficient stock
process_sale(inventory, 104, 10) # SKU not found

identify_zero_stock(inventory)

print("Updated Inventory:", [(item.sku, item.quantity) for item in inventory])

if __name__ == '__main__':
    main()

```

EXPERIMENT – 3 : Insertion in Circular Linked List (Beginning &End)

AIM:

To implement insertion at beginning and at end in a circular linked list.

Question:

Write a program to create a circular linked list and perform insertion of nodes at the beginning and at the end, displaying the list after each operation.

Code:-

```

class Node:
    def __init__(self, data):
        self.data = data
        self.next = None

```

```
class CircularLinkedList:
    def __init__(self):
        self.head = None

    def insert_at_end(self, data):
        new_node = Node(data)
        if self.head is None:
            self.head = new_node
            new_node.next = self.head
            return
        temp = self.head
        while temp.next != self.head:
            temp = temp.next
        temp.next = new_node
        new_node.next = self.head

    def insert_at_beginning(self, data):
        new_node = Node(data)
        if self.head is None:
            self.head = new_node
            new_node.next = self.head
            return
        temp = self.head
        while temp.next != self.head:
            temp = temp.next
        new_node.next = self.head
        temp.next = new_node
        self.head = new_node

    def display(self):
        if self.head is None:
            print("List is empty")
            return
        temp = self.head
        while True:
            print(temp.data, end=" -> ")
            temp = temp.next
```

```

        if temp == self.head:
            break
        print("(back to head)")

if __name__ == "__main__":
    cll = CircularLinkedList()

    cll.insert_at_end(10)
    cll.insert_at_end(20)
    cll.insert_at_end(30)
    print("Original list:")
    cll.display()

    cll.insert_at_beginning(5)
    print("\nAfter inserting 5 at beginning:")
    cll.display()

    cll.insert_at_end(40)
    print("\nAfter inserting 40 at end:")
    cll.display()

```

EXPERIMENT -4 : Deletion in Circular Linked List (Beginning & End)

AIM:

To delete a node from the beginning and from the end of a circular linked list.

Code:-

```

class CNode:
    def __init__(self, data):
        self.data = data

```

```
self.next = None
```

```
class CircularLinkedListDelete:
```

```
    def __init__(self):  
        self.head = None
```

```
    def insert(self, data):  
        new_node = CNode(data)  
        if self.head is None:  
            self.head = new_node  
            new_node.next = self.head  
        return
```

```
        temp = self.head  
        while temp.next != self.head:  
            temp = temp.next
```

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

```
    def delete_from_beginning(self):  
        if self.head is None:  
            print("List is empty, nothing to delete.")  
            return
```

```
        if self.head.next == self.head:  
            self.head = None  
            print("Deleted the only node in the list.")  
            return
```

```
        last = self.head  
        while last.next != self.head:  
            last = last.next
```

```
        self.head = self.head.next  
        last.next = self.head
```

```

print("Node deleted from beginning.")

def delete_from_end(self):
    if self.head is None:
        print("List is empty, nothing to delete.")
        return

    if self.head.next == self.head:
        self.head = None
        print("Deleted the only node in the list.")
        return

    prev = None
    temp = self.head

    while temp.next != self.head:
        prev = temp
        temp = temp.next

    prev.next = self.head
    print("Node deleted from end.")

def display(self):
    if self.head is None:
        print("List is empty")
        return

    temp = self.head
    print("Circular List:", end=" ")

    while True:
        print(f'{temp.data} ->', end=" ")
        temp = temp.next
        if temp == self.head:
            break

    print("(back to head)")

```

```

def main():
    cll = CircularLinkedListDelete()

    cll.insert(10)
    cll.insert(20)
    cll.insert(30)
    cll.insert(40)

    print("Initial list:")
    cll.display()

    cll.delete_from_beginning()
    cll.display()

    cll.delete_from_end()
    cll.display()

if __name__ == "__main__":
    main()

```

EXPERIMENT -5 : Deletion from Singly Linked List (Beginning & End)

AIM:

To implement deletion of nodes from the beginning and end of a singly linked list.

Code:-

```

class Node:
    def __init__(self, data):
        self.data = data
        self.next = None

```

```

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

    def insert(self, data):
        new_node = Node(data)
        if self.head is None:
            self.head = new_node
            return
        temp = self.head
        while temp.next:
            temp = temp.next
        temp.next = new_node

    def delete_from_beginning(self):
        if self.head is None:
            print("List is empty! Cannot delete.")
            return
        deleted_data = self.head.data
        self.head = self.head.next
        print(f"Node with data {deleted_data} deleted from beginning.")

    def delete_from_end(self):
        if self.head is None:
            print("List is empty! Cannot delete.")
            return
        if self.head.next is None:
            deleted_data = self.head.data
            self.head = None
            print(f"Node with data {deleted_data} deleted from end.")
            return
        temp = self.head

```

```
while temp.next.next:
    temp = temp.next
deleted_data = temp.next.data
temp.next = None
print(f'Node with data {deleted_data} deleted from end.')
```

```
def display(self):
    if self.head is None:
        print("List is empty!")
        return
    temp = self.head
    while temp:
        print(temp.data, end=" -> ")
        temp = temp.next
    print("None")
```

```
if __name__ == "__main__":
    ll = LinkedList()
```

```
ll.insert(10)
ll.insert(20)
ll.insert(30)
ll.insert(40)
```

```
print("Original List:")
ll.display()
```

```
ll.delete_from_beginning()
print("After deleting from beginning:")
ll.display()
```

```
ll.delete_from_end()
```

```
print("After deleting from end:")  
ll.display()
```

EXPERIMENT -6 : Circular Queue using Array

AIM:-

To implement a circular queue using array with enqueue, dequeue and display operations.

Code:-

```
class CircularQueue:  
    def __init__(self, capacity):  
        self.arr = [None] * capacity  
        self.front = -1  
        self.rear = -1  
        self.size = capacity  
    def is_empty(self):  
        return self.front == -1  
  
    def is_full(self):  
        return (self.front == 0 and self.rear == self.size - 1) or \  
            (self.rear + 1 == self.front)  
  
    def enqueue(self, value):  
        if self.is_full():  
            print("Queue is full.")  
            return  
  
        if self.front == -1:  
            self.front = 0  
  
        self.rear = (self.rear + 1) % self.size  
        self.arr[self.rear] = value
```

```

    print("Enqueued:", value)

def dequeue(self):
    if self.is_empty():
        print("Queue is empty.")
        return None

    element = self.arr[self.front]

    if self.front == self.rear: # Only one element
        self.front = self.rear = -1
    else:
        self.front = (self.front + 1) % self.size

    print("Dequeued:", element)
    return element

def display(self):
    if self.is_empty():
        print("Queue is empty.")
        return

    print("Elements in queue:", end=" ")
    i = self.front

    while True:
        print(self.arr[i], end=" ")
        if i == self.rear:
            break
        i = (i + 1) % self.size

    print()

def main():
    q = CircularQueue(5)

    q.enqueue(10)

```

```
q.enqueue(20)
q.enqueue(30)
q.enqueue(40)
```

```
q.display()
```

```
q.dequeue()
q.dequeue()
```

```
q.display()
```

```
q.enqueue(50)
q.enqueue(60)
```

```
q.display()
```

```
if __name__ == "__main__":
    main()
```

EXPERIMENT -7 : Stack using Array (Push, Pop, Peek, Display)

AIM:

To implement stack operations push, pop, peek and display using array.

Code:-

```
class ArrayStack:
    def __init__(self, capacity):
        self.capacity = capacity
        self.stack = [None] * capacity
        self.top = -1
```

```

def is_empty(self):
    return self.top == -1

def is_full(self):
    return self.top == self.capacity - 1

def push(self, item):
    if self.is_full():
        print("Stack overflow.")
        return
    self.top += 1
    self.stack[self.top] = item
    print("Pushed", item)

def pop(self):
    if self.is_empty():
        print("Stack underflow.")
        return None
    item = self.stack[self.top]
    self.top -= 1
    print("Popped", item)
    return item

def peek(self):
    if self.is_empty():
        print("Stack is empty.")
        return None
    print("Top element is", self.stack[self.top])
    return self.stack[self.top]

def display(self):
    if self.is_empty():
        print("Stack is empty.")
        return
    print("Stack elements:", end=" ")
    for i in range(self.top + 1):

```

```
        print(self.stack[i], end=" ")
    print()
```

```
def main():
    st = ArrayStack(10)

    while True:
        print("\n1. Push 2. Pop 3. Peek 4. Display 5. Exit")
        ch = input("Enter your choice: ").strip()

        if ch == "1":
            x = int(input("Enter element: "))
            st.push(x)

        elif ch == "2":
            st.pop()

        elif ch == "3":
            st.peek()

        elif ch == "4":
            st.display()

        elif ch == "5":
            print("Exiting.")
            break

        else:
            print("Invalid choice.")

if __name__ == "__main__":
    main()
```

EXPERIMENT -8 : Evaluate Postfix Expression using Stack

AIM:

To evaluate a postfix arithmetic expression using stack.

Code:-

```
def apply_operation(op1, op2, operator):
    if operator == '+':
        return op1 + op2
    if operator == '-':
        return op1 - op2
    if operator == '*':
        return op1 * op2
    if operator == '/':
        return int(op1 / op2) # integer division
    raise ValueError("Invalid operator")

def evaluate_postfix(expression):
    stack = []
    tokens = expression.split()

    for token in tokens:
        if token.isdigit():
            stack.append(int(token))
        else:
            op2 = stack.pop()
            op1 = stack.pop()
            result = apply_operation(op1, op2, token)
            stack.append(result)

    return stack.pop()
```

```
def main():
    expr = input("Enter postfix expression (space separated): ")
    result = evaluate_postfix(expr)
    print("Result =", result)

if __name__ == "__main__":
    main()
```

EXPERIMENT -9 : Browser Back Button Simulation using Stack

AIM:

To simulate a browser back button using stack.

Question:

Write a program that allows the user to visit pages, go back to the previous page and show history using stack operations.

Code:-

```
back_stack = []
forward_stack = []
current_page = None

def visit_page(page):
    global current_page
    if current_page is not None:
        back_stack.append(current_page)
    current_page = page
    forward_stack.clear()
    print(f"Visited: {current_page}")

def go_back():
    global current_page
    if not back_stack:
```

```

    print("No previous pages.")
    return
if current_page is not None:
    forward_stack.append(current_page)
current_page = back_stack.pop()
print(f'Back to: {current_page}')

def go_forward():
    global current_page
    if not forward_stack:
        print("No forward pages.")
        return
    if current_page is not None:
        back_stack.append(current_page)
    current_page = forward_stack.pop()
    print(f'Forward to: {current_page}')

def delete_page():
    global current_page
    page = input("Enter page name to delete from history: ").strip()
    if page in back_stack:
        back_stack.remove(page)
        print(f'Deleted {page} from back history.')
    elif page in forward_stack:
        forward_stack.remove(page)
        print(f'Deleted {page} from forward history.')
    elif page == current_page:
        print(f'Deleted current page: {current_page}')
        current_page = None
    else:
        print("Page not found in history.")

def show_history():
    print("\n--- Browser History ---")
    print("Back Stack :", " -> ".join(back_stack) if back_stack else "Empty")
    print("Current   :", current_page if current_page else "None")
    print("Forward    :", " -> ".join(forward_stack) if forward_stack else "Empty")

```

```

print("-----\n")

def main():
    while True:
        print("\n1. Visit Page")
        print("2. Back")
        print("3. Forward")
        print("4. Delete Page")
        print("5. Show History")
        print("6. Exit")
        choice = input("Enter choice: ").strip()
        if choice == "1":
            page = input("Enter page name (e.g. Google, GitHub): ").strip()
            visit_page(page)
        elif choice == "2":
            go_back()
        elif choice == "3":
            go_forward()
        elif choice == "4":
            delete_page()
        elif choice == "5":
            show_history()
        elif choice == "6":
            print("Exiting browser simulation.")
            break
        else:
            print("Invalid choice.")

if __name__ == "__main__":
    main()

```

EXPERIMENT-10 : Bubble Sort

AIM:

To implement bubble sort and analyse its time complexity.

Question:

Write a program to sort an array of integers using bubble sort technique and display the sorted array.

Code:-

```
def bubble_sort(arr):
    n = len(arr)
    for i in range(n - 1):
        swapped = False
        for j in range(n - 1 - i):
            if arr[j] > arr[j + 1]:
                swapped = True
                arr[j], arr[j + 1] = arr[j + 1], arr[j]
        if not swapped:
            break

def main():
    n = int(input("Enter number of elements: "))
    arr = []

    print(f"Enter {n} elements:")
    for _ in range(n):
        arr.append(int(input()))

    bubble_sort(arr)

    print("Sorted array:")
    for x in arr:
        print(x, end=" ")
    print()

if __name__ == "__main__":
    main()
```

EXPERIMENT-11 : Binary Search

AIM:

To implement binary search and analyse its time complexity.

Question:

Write a program to perform binary search on a sorted array of integers and find the position of a given key element.

Code:-

```
def binary_search(arr, key):
    low = 0
    high = len(arr) - 1

    while low <= high:
        mid = (low + high) // 2

        if arr[mid] == key:
            return mid
        elif arr[mid] < key:
            low = mid + 1
        else:
            high = mid - 1

    return -1

def main():
    n = int(input("Enter number of elements: "))
    arr = []

    print(f"Enter {n} sorted elements:")
    for _ in range(n):
        arr.append(int(input()))
```

```
key = int(input("Enter key to search: "))
```

```
index = binary_search(arr, key)
```

```
if index == -1:
```

```
    print("Element not found.")
```

```
else:
```

```
    print("Element found at index:", index)
```

```
if __name__ == "__main__":
```

```
    main()
```