Lab Assignment: Priority Queue for Preferential Customer Service

Objective

To implement a Priority Queue to simulate the customer service system in a post office where different customer categories receive preferential treatment based on priority.

Problem Statement

The General Post Office wishes to provide preferential treatment to its customers. The customers are categorized into four types:

1. Differently Abled
2. Senior Citizen
3. Defence Personnel
4. Ordinary Person

The customers are to be served in the decreasing order of preference as follows:

$$\text{Differently Abled} > \text{Senior Citizen} > \text{Defence Personnel} > \text{Ordinary Person}$$

Implement a system that maintains this priority order during service. When customers arrive, they are added to the queue based on their category, and service is provided according to their priority rather than arrival order.

Function Signatures

```
void enqueue(struct PriorityQueue* pq, char* name, int category);
void dequeue(struct PriorityQueue* pq);
void display(struct PriorityQueue* pq);
```

Details

- Assign numerical priorities to each category:

  $$\text{Differently Abled} = 1, \quad \text{Senior Citizen} = 2, \quad \text{Defence Personnel} = 3, \quad \text{Ordinary Person} = 4$$

- When a customer arrives, insert them into the queue with their associated priority.
- The dequeue operation should always remove and return the customer with the highest priority (smallest priority number).
- You may use:
  - A single array-based or linked-list-based priority queue, or
  - Multiple queues (one for each category), served in order of priority.

Example Walkthrough

Input Sequence:

$$\text{Ordinary}, \text{Defence}, \text{Senior Citizen}, \text{Differently Abled}, \text{Ordinary}, \text{Senior Citizen}$$

Processing Order:

$$\text{Differently Abled} \rightarrow \text{Senior Citizen} \rightarrow \text{Senior Citizen} \rightarrow \text{Defence} \rightarrow \text{Ordinary} \rightarrow \text{Ordinary}$$

Explanation: Even though the Ordinary customer arrived first, the Differently Abled and Senior Citizens are served first because of their higher priority.

Expected Output

The program should correctly maintain and process customers based on their priority, printing the order of service accordingly.