BIT Data Structures: Detailed Notes on Stack & Queue (with Relevant Examples)

Part I – STACK

A. Basics

1. Push/Pop (LIFO)

- **Definition:** Last In, First Out principle. The most recent item is removed first.
- **Example (MTN MoMo):** Filling payment details step-by-step. Pressing back removes the last detail.
- **Additional Example:** Browser history – the last visited page is displayed first when pressing back.

2. Pop (Undo)

- **Definition:** Removes the top element.
- **Example (Microsoft Word / Google Docs):** Undo button removes the last typed or deleted text.
- **Additional Example:** Text editors – undoing the last action.

B. Application

3. Push (Add to Stack)

- **Definition:** Adding new items on top of stack.
- **Example (Photo Editing Apps – Photoshop, Canva):** Each action like brush stroke, filter, or adjustment is added to the stack, allowing multiple undos.
- **Additional Example:** Gaming apps – moves saved for undo/replay.

4. Form Input Validation Using Stack

- **Definition:** Stack ensures data correctness and logical order.
- **Example (Web Form Validation – Irembo):** Each user input or field is pushed onto a stack. Validation checks are performed to ensure all required steps are completed and in order.
- **Additional Example:** Password entry systems checking character types and sequence, or code editors highlighting mismatched tags/brackets using stack-based checks.

C. Logical Operations

5. Push/Pop Sequence

- **Sequence:** Push("CBE notes"), Push("Math revision"), Push("Debate"), Pop(), Push("Group assignment")
- **Top:** Group assignment

- **Additional Example:** Task list apps – last added task can be removed first.

6. Undo with Multiple Pops

- **Example:** Undo last 3 edits in a document; earlier edits remain.
- **Additional Example:** Drawing apps – remove last strokes first.

D. Advanced Thinking

7. Pop to Backtrack

- **Example (RwandAir booking):** Undo steps to previous stage.
- **Additional Example:** ATM menu navigation – returning to previous menu.

8. Reverse Using Stack

- **Sentence:** "Umwana ni umutware" → Push each word, pop to reverse → "umutware ni Umwana"
- **Additional Example:** Reversing a playlist order in music apps.

9. Depth-First Search (DFS)

- **Example:** Searching library shelves deeply.
- **Additional Example:** Maze solving apps – track path using stack.

10. Transaction Navigation

- **Example (Email Clients – Gmail, Outlook):** Undo/redo navigation in sent/received email history.
- **Additional Example:** Navigating command history in a terminal.

Part II – QUEUE

A. Basics

1. Enqueue/Dequeue (FIFO)

- **Definition:** First In, First Out principle.
- **Example (Restaurant Kigali):** Customers served in order.
- **Additional Example:** Bank teller service lines.

2. Dequeue (Next Item Leaves First)

- **Example:** YouTube playlist – next video plays automatically.
- **Additional Example:** Ticket booking apps – first request processed first.

B. Application

3. Enqueue (Job Submission)

- **Example:** RRA tax payment queue.
- **Additional Example:** Print jobs sent to a printer in order.

4. Queue Management

- **Example:** MTN/Airtel SIM replacement requests.
- **Additional Example:** Customer support call center queues.

C. Logical Operations

5. Enqueue/Dequeue Sequence

- **Sequence:** Enqueue("Alice"), Enqueue("Eric"), Enqueue("Chantal"), Dequeue(), Enqueue("Jean")
- **Front:** Eric
- **Additional Example:** Hospital registration queue – first patient remains at front after one leaves.

6. FIFO Message Handling

- **Example:** RSSB pension applications.
- **Additional Example:** Chat apps – messages delivered in sent order.

D. Advanced Thinking

7. Queue Types in Rwanda

- **Linear Queue:** Wedding buffet line.
- **Circular Queue:** Buses looping at Nyabugogo.
- **Deque:** Boarding bus from front/rear.
- **Additional Examples:**
- Linear: School lunch line.
- Circular: Taxi rotation at a hub.
- Deque: Loading/unloading cargo trucks from both ends.

8. Enqueue Orders/Dequeue When Ready

- **Example:** Kigali restaurant orders.
- **Additional Example:** Online food delivery apps – orders placed are served in order when ready.

9. Priority Queue

- **Example:** CHUK hospital emergencies.

- **Additional Example:** Airport check-in priority for business class passengers.

10. Matching System Using Queue

- **Example:** Moto/e-bike taxi app.
- **Additional Example:** Ride-hailing apps like Uber – first driver in queue gets passenger request.

Summary Table: Stack vs Queue

Feature	Stack (LIFO)	Queue (FIFO)
Order	Last In, First Out	First In, First Out
Operations	Push, Pop	Enqueue, Dequeue
Undo Feature	Yes (via Pop)	No
Examples	Undo in apps, DFS	Customer lines, playlists
Application	Backtracking, reverse	Fair service, scheduling

Key Takeaways

- **Stacks:** Undo, backtracking, reversing data, DFS.
- **Queues:** Fairness, scheduling, order processing.
- **Comparison:** LIFO vs FIFO is essential for mapping real-world processes to data structures.

End of Detailed Notes with Relevant Examples