

## DATA STRUCTURE &ALGORITHMS

No	Names	level	Reg No	SUBJECT
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### Page 1 – Understanding Stacks (LIFO)

#### 1. Basics

Definition:

A stack is a Last In, First Out (LIFO) data structure. The last element pushed is the first to be popped.

Clarification:

Think of stacking plates — the last plate placed on top is the first you remove.

Examples:

- MTN MoMo App: Filling payment details step by step → pressing “Back” removes the last entered step → shows LIFO. When filling steps, the last entered detail (e.g., payment amount) is removed first when pressing Back. This matches stack behavior: Last In, First Out.

UR Canvas navigation (Pop operation)

Pressing back undoes the last opened module. This is like popping the top of a stack — the most recent action is removed first.

#### 2. Applications of Stacks

Undo Function: Mistakes can be corrected by removing the latest actions first.

Example: In BK Mobile Banking, last transaction attempts can be undone. Undo

function in BK Mobile Banking, stacks allow mistakes to be corrected by popping the most recent actions, restoring the earlier correct state.

Balanced Parentheses: A stack ensures that every opening bracket has a matching closing bracket. Opening sections are pushed on the stack. Each closing section pops the matching opening. If all match, the form is balanced.

Example: In Irembo forms, each opened data section must close properly.

## Page 2 – Logical & Advanced Stack Uses

### 3. Logical Questions

Push/Pop Sequence Example:

- Push("CBE notes"), Push("Math revision"), Push("Debate"), Pop(), Push("Group assignment").

→ Top = Group assignment. After the sequence, the top of the stack is "Group assignment." This is the next task. Undo with Pops: If a student undoes 3 steps, only the earlier answers remain in the stack. Undoing three actions means the last three answers are popped off, leaving only the earlier saved answers in the stack.

### 4. Advanced Thinking

Backtracking:

In RwandAir booking, pressing back retraces steps → stack pops previous entries.

Stacks help retrace steps by popping off the most recent step until reaching the needed stage.

Reversing Words:

Input: "Umwana ni umutware" → Push each word → Pop all → Output: "umutware ni Umwana". Push words: [Umwana, ni, umutware] → Pop outputs in reverse: "umutware ni Umwana."

DFS (Depth-First Search):

When searching books in Kigali Public Library, you explore deep into one shelf before moving to others → stack suits because it tracks the latest deep step. A stack

is better than a queue because DFS explores deeply by keeping track of the most recent shelf first — exactly how LIFO works.

Navigation History:

In BK Mobile app, moving forward pushes transactions, moving back pops → stack maintains history. Feature idea: Use a stack to move back and forth in transaction history — each move forward is pushed, each back action pops.

## Page 3 – Understanding Queues (FIFO)

### 1. Basics

Definition:

A queue is First In, First Out (FIFO). The first element added is the first to leave.

Clarification:

Think of people in a bank line → first person is served first.

Examples:

- Restaurant Service in Kigali: Customers are served in the order they arrive → FIFO.

The first customer to arrive is served first. This is First In, First Out.

- YouTube Playlist: The next video (front of queue) plays automatically. The next video in the line plays automatically. Like a dequeue, the front item is removed first.

### 2. Applications of Queues

Tax Payments at RRA: People wait in a line → modeled as enqueue/dequeue. People waiting form a line. Each new arrival joins the rear (enqueue), and the first to arrive leaves first (dequeue).

SIM Replacement (MTN/Airtel): Requests are processed in order of arrival → ensures fairness. Requests are handled in the order received, reducing confusion and improving fairness.

## Page 4 – Logical & Advanced Queue Uses

### 3. Logical Questions

Enqueue/Dequeue Example:

- Enqueue(Alice), Enqueue(Eric), Enqueue(Chantal), Dequeue(), Enqueue(Jean).

→ Front = Eric.

Fairness in Pension Applications (RSSB): Applications handled in arrival order → no one is skipped. Applications are processed in the order they come. No skipping, ensuring equal treatment

### 4. Advanced Thinking

Queue Types in Real Life:

- Linear Queue: Wedding buffet line → people wait in a straight line.

- Circular Queue: Buses looping at Nyabugogo → after last, they restart.

- Deque: Boarding a bus from front or rear → double entry.

Restaurant Orders:

Customers enqueue orders, chef dequeues when ready → ensures order.

Priority Queue (CHUK Hospital):

Emergency cases jump the line → not FIFO but priority-based.

Moto/E-Bike Apps:

Students request rides → drivers are dequeued fairly in order → ensures balance.