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DATA STRUCTURE AND ALGORITHM

Part I – STACK

A. Basics

Q1: How does MTN MoMo app show the LIFO nature of stacks?

In stacks, Last-In-First-Out (LIFO) means the most recent action is undone first.

In the MoMo app, when you're filling details step-by-step (phone number → amount → PIN), the last step you entered is removed first when pressing "back".

This mirrors stack behavior: the last thing pushed is the first thing popped.

Q2: Why is pressing back in UR Canvas like popping from a stack?

Popping removes the top item.

When navigating modules, your current page is on top of the stack. Pressing "back" removes it, and you return to the previous one.

This action reflects how popping removes the most recent state.

B. Application

Q3: How could a stack enable the undo function when correcting mistakes?

Every action (typing, clicking, editing) is pushed onto the stack.

When you press "undo", the latest action is popped, restoring the state before it.

Example: If you typed "Banking", then deleted a letter, undoing will pop the last action and recover the full word.

Q4: How can stacks ensure forms are correctly balanced?

When filling forms like Irembo:

Push an opening element (like start of section).

Pop when the correct closing element (like end of section) is found.

If all pushes and pops match, the form is balanced (correct).

If not, it's incomplete or mismatched (error).

C. Logical

Q5: Which task is next (top of stack)?

Steps:

Push("CBE notes") → [CBE notes]

Push("Math revision") → [CBE notes, Math revision]

Push("Debate") → [CBE notes, Math revision, Debate]

Pop() → removes Debate → [CBE notes, Math revision]

Push("Group assignment") → [CBE notes, Math revision, Group assignment]

☞ Top = Group assignment

Q6: Which answers remain after 3 undos?

If 3 actions are undone (3 pops), the last three pushed actions are removed.

The earlier answers stay in the stack (the oldest actions).

☞ Remaining = the first actions that were not popped.

D. Advanced Thinking

Q7: How does a stack enable retracing in RwandAir booking?

Each booking step is pushed (choose date → passenger → seat).

When you go "back", the last step is popped.

This ensures retracing is step-by-step, not skipping over steps.

Q8: Show stack algorithm for reversing "Umwana ni umutware".

Steps:

Push each word: [Umwana] → [Umwana, ni] → [Umwana, ni, umutware]

Pop in order: umutware → ni → Umwana

☞ Reversed: "umutware ni Umwana"

Q9: Why does DFS use a stack better than a queue?

Depth-First Search (DFS) explores deep before wide.

A stack always gives you the most recent unexplored node.

A queue would force breadth-first search (BFS), which spreads level by level, not deep.

☞ Stack is natural for DFS because of LIFO.

Q10: Suggest a stack-based feature for BK app navigation.

Example: “Backtrack Transaction History” → Each transaction viewed is pushed.

Pressing back pops the latest one, showing the previous.

This gives users a stepwise navigation like undo in transaction browsing.

Part II – QUEUE

A. Basics

Q1: How does a restaurant line show FIFO?

First customer to arrive is the first to be served.

Later arrivals must wait.

☞ Exactly like First-In-First-Out (FIFO) queues.

Q2: Why is a YouTube playlist like a dequeue?

The next video in the front of the queue plays automatically.

Once it plays, it’s removed (dequeued).

☞ Matches how queues process items in order.

B. Application

Q3: How is RRA tax line a real queue?

Each taxpayer arrives and stands at the back.

Officers serve from the front.

☞ Pure FIFO.

Q4: How do queues improve customer service?

They ensure fairness: first request = first served.

Prevents skipping or confusion.

Makes service centers more organized and predictable

C. Logical

Q5: Who is at the front now?

Steps:

Enqueue(Alice) → [Alice]

Enqueue(Eric) → [Alice, Eric]

Enqueue(Chantal) → [Alice, Eric, Chantal]

Dequeue() → removes Alice → [Eric, Chantal]

Enqueue(Jean) → [Eric, Chantal, Jean]

☞ Front = Eric

Q6: How does a queue ensure fairness in RSSB?

Applications are handled in arrival order.

No skipping ahead.

☞ Everyone is treated equally by FIFO.

D. Advanced Thinking

Q7: Explain queue types in Rwandan life.

Linear queue → People waiting for buffet (line doesn't restart).

Circular queue → Buses looping from Nyabugogo back to Nyabugogo.

Deque → Boarding a bus from both front and rear doors.

Q8: How do queues model Kigali restaurant orders?

Orders are enqueued as customers order.

When ready, they're dequeued in the order they entered.

☞ This ensures correct serving order.

Q9: Why is CHUK emergency a priority queue?

In normal queue: FIFO = first arrival first served.

In priority queue: emergencies jump ahead because urgency > order. ☞ Medical priority overrides arrival order.

Q10: How would queues fairly match moto/e-bike drivers and students?

Students request rides → enqueue.

Drivers available → dequeue student request.

FIFO ensures fairness: first student waiting gets the next available driver.