

MUGISHA GAD

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DATA STRUCTURE ASSIGNMENT ABOUT STACK AND QUEUE

A. BASIC

1.Operation: Push/Pop (LIFO) — In a stack, the last item added is the first removed. In the MTN MoMo app, when you fill payment details step-by-step, pressing back removes the last step. Q1: How does this show the LIFO nature of stacks?

- *Push: Each step of filling payment details is added to the stack as you go.*
- *Pop: Pressing “Back” removes the last step entered first.*
- *This demonstrates LIFO (Last-In-First-Out): the most recent action is undone before earlier ones.*

2.Operation: Pop (Undo) — Pop removes the top item. In UR Canvas, when you navigate course modules, pressing back undoes the last step. Q2: Why is this action similar to popping from a stack?

- *In a stack (LIFO), the last item added is the first to be removed.*
- *On UR Canvas, pressing Back removes the most recent module or step from your current view.*
- *This matches pop behavior: the last action is undone first, just like popping the top of a stack.*

B. APPLICATION

3. Operation: Push (Add to stack) — New actions are added to the stack top. In BK Mobile Banking, transactions are added to history. Q3: How could a stack enable the undo function when correcting mistakes?

- *Each transaction or action is pushed onto a stack as it occurs.*
- *To undo a mistake, the app pops the top action from the stack, reverting it.*
- *This LIFO behavior ensures that the most recent action is undone first, making corrections efficient and accurate.*

4.Operation: Balanced Parentheses Check (Stack-based matching) — Push opening bracket, pop when matching closing bracket is found. In Irembo registration forms, data entry fields must be correctly matched. Q4: How can stacks ensure forms are correctly balanced?

- *Opening brackets/fields are pushed onto the stack as the user fills the form.*
- *When a closing bracket/field is encountered, the stack pops the last opening item and checks for a match.*
- *If the stack is empty at the end and all matches were correct, the form is balanced.*
- *This prevents mismatched or missing fields, ensuring proper form structure.*

c. LOGICAL

5. Operation: Push and Pop sequence. A student records tasks in a stack: Push("CBE notes"), Push("Math revision"), Push("Debate"), Pop(), Push("Group assignment") Q5: Which task is next (top of stack)?

- *The top of the stack is "Group assignment".*

6. Operation: Undo with multiple Pops. During ICT exams, a student undoes 3 recent actions. Q6: Which answers remain in the stack after undoing?

- *Only the earlier actions that were not undone remain in the stack.*

D. ADVANCED THINKING

7. Operation: Pop to backtrack. In RwandAir booking, a passenger goes back step-by-step in the form. Q7: How does a stack enable this retracing process?

- *Each step the passenger completes is pushed onto a stack.*
- *When the passenger clicks "Back," the last step is popped from the stack, returning them to the previous step.*
- *This LIFO behavior allows step-by-step retracing in the reverse order of completion, making navigation intuitive.*

8. Operation: Push words, then Pop to reverse. To reverse "Umwana ni umutware", push each word and then pop. Q8: Show how a stack algorithm reverses the proverb.

Step 1: Push each word onto the stack

- *Push("Umwana") → Stack: Umwana*
- *Push("ni") → Stack: ni, Umwana*
- *Push("umutware") → Stack: umutware, ni, Umwana*

Step 2: Pop words to reverse

- *Pop → "umutware"*
- *Pop → "ni"*
- *Pop → "Umwana"*

9. Operation: DFS using a stack. A student searches shelves in Kigali Public Library (deep search). Q9: Why does a stack suit this case better than a queue?

- *DFS (Depth-First Search) explores deep paths first before backtracking.*
- *A stack (LIFO) naturally allows backtracking: the last shelf visited is the first to revisit when a dead end is reached.*
- *A queue (FIFO) would explore all shelves at the current level first, which is breadth-first and not suitable for deep searching.*

10.Operation: Push/Pop for navigation. In BK Mobile app, moving through transaction history uses push and pop. Q10: Suggest a feature using stacks for transaction navigation.

- *Feature idea: “Back/Forward” in transaction history*

Push: When a user opens a new transaction, it is pushed onto the stack.

Pop: Pressing “Back” pops the top transaction, showing the previous one.

- *This lets users navigate through transactions in reverse order, just like a LIFO stack.*

2. QUEUE

A.BASIC

1.Operation: Enqueue (add at rear), Dequeue (remove from front). At a restaurant in Kigali, customers are served in order. Q1: How does this show FIFO behavior?

- *Enqueue (add at rear): Customers join the line as they arrive.*
- *Dequeue (remove from front): Customers at the front are served first.*
- *This follows FIFO (First-In-First-Out): the first customer to arrive is the first to be served, and later arrivals wait their turn*

2. Operation: Dequeue (next item leaves first). In a YouTube playlist, the next video plays automatically. Q2: Why is this like a dequeue operation?

- *In a queue, dequeue removes the item at the front.*
- *In a YouTube playlist, the next video (first in line) plays automatically and is removed from the “to-watch” list.*
- *This is exactly like a dequeue operation: the first item is served and leaves the queue.*

B.APPLICATION

3.Operation: Enqueue (job submission). At RRA offices, people waiting to pay taxes form a line. Q3: How is this a real-life queue?

- *People join the line as they arrive → this is like enqueue.*
- *The person at the front of the line is served first → this is like dequeue.*
- *The process follows FIFO (First-In-First-Out), making it a real-life example of a queue.*

4. Operation: Queue management. In MTN/Airtel service centers, SIM replacement requests are processed in order. Q4: How do queues improve customer service?

- They ensure fairness by serving customers in the order they arrive (FIFO).
- They make service organized and efficient, reducing confusion.
- They help manage waiting times and improve overall customer satisfaction

C.LOGICAL

5.Operation: Sequence of Enqueue/Dequeue. In Equity Bank, operations are:

Enqueue("Alice"), Enqueue("Eric"), Enqueue("Chantal"), Dequeue(), Enqueue("Jean")

Q5: Who is at the front now?

- *The Front of the queue is ERIC*

6. Operation: FIFO message handling. RSSB pension applications are handled by arrival order. Q6: Explain how a queue ensures fairness

- *A queue follows FIFO (First-In-First-Out), meaning the first person to arrive is the first to be served.*
- *This prevents cutting in line and ensures everyone is attended in the order they came.*
- *In RSSB pension applications, this means earlier applicants are processed before later ones, making the system fair for all.*

D.ADVANCED THINKING

7. Operation: Different queue types. Examples: • Linear queue = people at a wedding buffet. • Circular queue = buses looping at Nyabugogo. • Deque = boarding a bus from front/rear. Q7: Explain how each maps to real Rwandan life.

- **Linear queue** – People at a wedding buffet

Served one after another from front to back.

Once someone is served, they leave the line, just like in a normal FIFO queue.

- **Circular queue** – Buses looping at Nyabugogo

Buses return to the end of the line after completing a trip.

The line is continuous, so service can repeat without starting over.

- **Deque (Double-ended queue)** – Boarding a bus from front/rear

Passengers can enter or leave from both ends, depending on the bus's boarding rules.

Flexible compared to linear queues, suitable for buses with multiple entry points.

8. Operation: Enqueue orders, Dequeue when ready. At a Kigali restaurant, customers order food and are called when ready. Q8: How can queues model this process?

Orders are enqueued as customers place them → first order in, first in line to be prepared.

*Dequeue when ready → the first order placed is the first to be served.
This ensures fairness (customers served in order) and organization in the kitchen.*

9. Operation: Priority queue. At CHUK hospital, emergencies jump the line. Q9: Why is this a priority queue, not a normal queue?

- *In a normal queue (FIFO), patients are served strictly in arrival order.*
- *At CHUK hospital, emergency cases are served first, even if they arrive later.*
- *This means service is based on priority (urgency), not arrival time, which is exactly how a priority queue works.*

10. Operation: Enqueue/Dequeue matching system. In a moto/e-bike taxi app, riders wait for passengers. Q10: How would queues fairly match drivers and students?

- *Drivers are enqueued as they become available.*
- *Passengers are matched with the driver at the front of the queue (first available driver).*
- *This ensures fairness: drivers who have been waiting longest get rides first, and passengers are served in an organized way.*