MODULE TITLE: DATA STRUCTURE AND ALGORITHM

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BIT ASSIGNMENT 2:

QUESTIONS AND ANSWERS.

BIT Data Structure Exercise answers for both Part I: Stack and Part II: Queue.

Part I: STACK

A. Basics

Q1: How does this show the LIFO nature of stacks?

*The MTN MoMo app's "**back**" button removes the last step entered (e.g., payment details) first, following the Last-In-First-Out (LIFO) principle of a stack. Each step is pushed onto the stack as you progress, and pressing "**back**" pops the most recent step, undoing it in reverse order.*

Q2: Why is this action similar to popping from a stack?

*In UR Canvas, pressing "**back**" removes the most recently visited course module, doing the pop operation of a stack. The navigation history is stored as a stack, and popping retrieves the last module visited, following LIFO.*

B. Application

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

In BK Mobile Banking, each transaction is pushed onto a stack as it occurs. To undo a mistake, the app can pop the most recent transaction from the stack, reversing the last action (e.g., canceling a payment), leveraging the LIFO nature to access the latest entry.

Q4: How can stacks ensure forms are correctly balanced in irembo registration?

Stacks can verify balanced parentheses in Irembo forms by pushing each opening bracket (e.g., for a field group) onto the stack and popping it when a matching closing bracket is found. If the stack is empty at the end and all brackets match, the form is balanced; otherwise, it's invalid.

C. Logical

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

Initial stack: empty

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 of stack: “Group assignment”

Answer**: **The next task is Group assignment.

Q6: Which answers remain in the stack after undoing?

If the stack contains actions [A1, A2, A3, A4, A5] (A5 being the most recent), undoing 3 actions means popping A5, A4, and A3. The stack now contains [A1, A2]. The exact answers depend on the initial stack, but only the first two actions remain.

D. Advanced Thinking.

Q7: How does a stack enable this retracing process?

In RwandAir’s booking process, each step (e.g., selecting flight, entering passenger details) is pushed onto a stack. To retrace, the app pops the top step, returning to the previous one, following LIFO to navigate backward through the sequence of actions.

Q8: Show how a stack algorithm reverses the proverb?

Split the proverb into words: [“Umwana”, “ni”, “umutware”].

Push each word onto a stack: [Umwana, ni, umutware] (umutware on top).

Pop each word: umutware → ni → Umwana.

Resulting sequence: “umutware ni Umwana”.

Answe**r: **The stack reverses the proverb by popping words in reverse order, yielding “umutware ni Umwana”.

***Q9.* Why does a stack suit this case better than a queue?**

Depth-First Search (DFS) explores one branch deeply before backtracking, which aligns with a stack's LIFO behavior. In Kigali Public Library, a student searching shelves pushes each new shelf (or book category) onto a stack and pops to backtrack to the previous shelf, unlike a queue's FIFO, which would explore all shelves at one level first (Breadth-First Search).

Q10: Suggest a feature using stacks for transaction navigation in BK Mobile app.

A "Recent Transactions Undo/Redo" feature could use two stacks: one for transaction history (push each transaction) and another for undone actions. Popping from the history stack undoes a transaction, pushing it to the redo stack. Popping from the redo stack re-applies the transaction, allowing seamless navigation and correction.

Part II: QUEUE

A. Basics

Q1: How does a restaurant in Kigali serving customers in order show FIFO behavior?

Customers at a Kigali restaurant are served in the order they arrive, following the First-In-FirstOut (FIFO) principle of a queue. The first customer to join the line (enqueue) is the first served (dequeue), ensuring orderly processing.

Q2: Why is YouTube's playlist auto-play like a dequeue operation?

In a YouTube playlist, the next video plays in the order it was added, mimicking a dequeue operation. The queue holds videos in sequence, and dequeuing removes and plays the first video, maintaining FIFO.

B. Application

Q3: How is the line at RRA offices for tax payments a real-life queue?

At RRA offices, people waiting to pay taxes form a queue where the first person to arrive (enqueue) is served first (dequeue). This FIFO structure ensures orderly and fair processing of tax payments.

Q4: How do queues improve customer service at MTN/Airtel service centers?

Queues ensure SIM replacement requests are processed in the order received (FIFO), reducing wait time disputes and ensuring fairness. This organized approach improves efficiency and customer satisfaction by maintaining a predictable service flow.

C. Logical

Q5: After Enqueue(“Alice”), Enqueue(“Eric”), Enqueue(“Chantal”), Dequeue (), Enqueue(“Jean”), who is at the front now?

Initial queue: empty

Enqueue(“Alice”): [Alice]

Enqueue(“Eric”): [Alice, Eric]

Enqueue(“Chantal”): [Alice, Eric, Chantal]

Dequeue (): Removes Alice → [Eric, Chantal]

Enqueue(“Jean”): [Eric, Chantal, Jean]

Front of queue: Eric

*Answer: **Eric is at the front.***

Q6: Explain how a queue ensures fairness?

A queue processes RSSB pension applications in the order they are received (FIFO), ensuring that earlier applicants are handled before later ones. This prevents favoritism or skipping, promoting fairness by respecting arrival time.

D. Advanced Thinking

Q7: Explain how linear queue, circular queue, and deque map to Rwandan life.

***Linear Queue:** At a wedding buffet, guests line up and are served in order (FIFO). Once served, they don’t rejoin, like a linear queue with a single front and rear.*

***Circular Queue:** Buses at Nyabugogo loop through routes (e.g., Kigali to Remera and back). When the queue is full, the oldest bus (front) leaves, and a new one joins at the rear, reusing space like a circular queue.*

***Deque:** Boarding a bus from the front or rear allows passengers to enter/exit at either end, similar to a double-ended queue (deque) where elements can be added or removed from both front and rear.*

Q8: How can queues model the process at a Kigali restaurant?

At a Kigali restaurant, customers enqueue their orders (added to the rear of the queue). When food is ready, the kitchen dequeues the first order (FIFO), ensuring orders are prepared and served in the sequence they were received, maintaining fairness and efficiency.

Q9: Why is CHUK hospital's emergency handling a priority queue, not a normal queue?

At CHUK hospital, emergencies are prioritized over regular cases, even if they arrive later. A priority queue assigns higher priority to urgent cases, dequeuing them first, unlike a normal queue's strict FIFO, which would process patients only by arrival order.

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

In a moto/e-bike taxi app, a queue can manage riders by enqueuing them as they become available. Students requesting rides are matched with the driver at the front (dequeue), ensuring the longest-waiting driver gets the next ride. This FIFO approach ensures fairness by prioritizing drivers based on waiting time.

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