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B.I.T- Data Structure Exercise - Number 2

Part I - STACK

A. Basics

Q1: How is this showing the LIFO property of stacks?

When you use MTN MoMo, the latest input payment details you entered like the amount are the first to be erased when you press back. This is exactly LIFO (Last-In, First-Out) because the most recent move is reversed first.

Q2: Why is this operation equivalent to popping from a stack?

In UR Canvas, a back key reverses the previous navigation step, just like Pop() removes the top object from a stack. You always reverse the last one first.

B. Application

Q3: How can a stack enable the undo function and correct errors?

A new action (typing, clicking) is pushed onto a stack. When you undo, the system removes the last action. In this manner, errors are correctible step-by-step in the reverse direction.

Q4: How do stacks ensure forms are well-balanced?

For each opening field/bracket pushed, there exists a corresponding closing field/bracket popped. If the stack is empty upon termination, the form is balanced. Otherwise, something is lacking (e.g., forgetting to close an interval).

C. Logical

Q5: What is next action (top of stack)?

Steps:

Push("CBE notes")

Push("Math revision")

Push("Debate")

\operatorname{Pop()} \rightarrow deletes "Debate"

Push("Group assignment")

Top of stack = "Group assignment"

Q6: What answers are present in the stack after undoing?

If a student performs an undo of 3 steps, the most recent \mathbf{3} pushed items get popped. Only the earlier steps remain in the stack.

D. Advanced Thinking

Q7: How does a stack enable such retracing to take place?

Each booking step is pushed into a stack. When a passenger presses back, the system pops the latest step, moving them step-by-step backwards.

Q8: Illustrate how a stack algorithm reverses the proverb "Umwana ni umutware".

Push "Umwana" → Push "ni" → Push "umutware"

Pop → "umutware"

Pop → "ni"

Pop → "Umwana"

Reversed output: "umutware ni Umwana"

Q9: Why does a stack suit this example more than a queue?

In DFS, you must go deep first before backtracking. A stack is perfect because it lets you go back step-by-step (last explored shelf first), unlike a queue which is breadth-first.

Q10: Suggest a feature that uses stacks for navigation in transactions.

A "Back" and "Forward" navigation feature in BK Mobile, where each transaction displayed gets pushed, and users can pop to go back step-by-step through their history.

Part II - QUEUE

A. Basics

Q1: How is this FIFO behavior?

The first customer in a restaurant in Kigali gets served first. This is FIFO (First-In, First-Out), like a queue.

Q2: Why is this the same as a dequeue operation?

Adding a video to a YouTube playlist allows the first one added to play first and then remove it (dequeued) so the next can play.

B. Application

Q3: How is this really a queue?

At RRA, people join the line in order of arrival (enqueue), and whoever is first in line receives service first (dequeue). That's a straight queue.

Q4: How do queues improve customer service?

Queues make it equitable by providing service in order of arrival. No one gets jumped, and it prevents things from getting clogged and disorganized.

C. Logical

Q5: Who is in front now?

Steps:

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

Dequeue() \rightarrow removes "Alice"

Enqueue("Jean")

Queue = [Eric, Chantal, Jean]

Front = Eric

Q6: Describe how a queue provides fairness.

Every pension application is added to the queue in arrival order and removed from the queue in the same order. No one can cut in line, providing fair and equal treatment.

D. Higher Level Thinking

Q7: Describe how each corresponds to real Rwandan life.

Linear queue → Wedding buffet: individuals advance once food is served.

Circular queue → Nyabugogo buses: when a bus discharges passengers, it again goes back to the queue and waits.

Deque → Boarding a bus: customers can board through front or rear doors.

Q8: How can queues emulate this process?

Orders are called in (enqueue). When served, the head of the queue is called out (dequeue). This ensures first-come, first-served eating.

Q9: Why is this a priority queue, rather than a normal queue?

Emergency cases are prioritized first in CHUK hospital, regardless of the time of arrival. FIFO order is broken here and critical cases are prioritized instead.

Q10: How would queues efficiently pair drivers and students equally?

Riders and students are both in the queue. When there is a driver available, the front-most student in the queue is taken out and paired, and this is done equally without skipping.