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DEPARTMENT OF BIT

MODULE OF DATA STRUCTURE AND ARGOLITHM

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sBIT - Data Structure Exercise

Part I - STACK

A. Basics

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

A1: In the MTN MoMo app, when you go through steps to make a payment, the last detail you entered is the first one removed when you press the back button. This is the Last-In-First-Out rule because the most recent action is undone first.

Q2: Why is this action similar to popping from a stack? A2: In UR Canvas, when you move backward, you undo the last page or module you opened. This mirrors the pop operation of a stack where the most recent item is taken out first.

B. Application

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

A3: Each new transaction or action is pushed onto the stack. If a mistake happens, the system can pop the most recent actions to return to the earlier correct state.

Q4: How can stacks ensure forms are correctly balanced? A4: Just like matching brackets, forms have fields that need to pair correctly. Whenever a new field is opened, it is pushed onto the stack, and when it is closed, it is popped. If all fields match properly, the stack becomes empty, showing the form is valid.

C. Logical

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

A5: After pushing 'CBE notes', 'Math revision', and 'Debate', then popping 'Debate', and finally pushing 'Group assignment', the top is 'Group assignment'.

Q6: Which answers remain in the stack after undoing? A6: If the student undoes the last three actions, the most recent three items are popped. The earlier actions remain in the stack, preserving what was done first.

D. Advanced Thinking

Q7: How does a stack enable this retracing process?
A7: In RwandAir booking, each form step is pushed onto a stack. When a passenger presses back, the last step is popped, allowing retracing in reverse order.

Q8: Show how a stack algorithm reverses the proverb.
A8: Words are pushed in order: [Umwana, ni, umutware]. Popping them gives: [umutware, ni, Umwana], which is the reverse.

Q9: Why does a stack suit this case better than a queue? A9: In depth-first search, you go as deep as possible before backtracking. A stack is perfect because it remembers the last branch taken, unlike a queue which works level by level.

Q10: Suggest a feature using stacks for transaction navigation.
A10: A useful feature would be a 'back' option in BK Mobile that pops recent transactions viewed, so a user can retrace their navigation history quickly.

Part II - QUEUE

A. Basics

Q1: How does this show FIFO behavior?

A1: In a Kigali restaurant, the first customer to arrive is the first to be served. This follows First-In-First-Out order, just like a queue.

Q2: Why is this like a dequeue operation?

A2: In a YouTube playlist, the first video in the list plays first and is removed. This mirrors a dequeue where the front item is taken out.

B. Application

Q3: How is this a real-life queue?

A3: At RRA, people line up for services. The person who entered first is helped first, just like items leaving from the front of a queue.

Q4: How do queues improve customer service?

A4: Queues ensure order and fairness by serving people in the sequence they arrive, which reduces confusion and conflict.

C. Logical

Q5: Who is at the front now?

A5: After enqueuing Alice, Eric, and Chantal, then dequeuing Alice, the new front becomes Eric. After enqueuing Jean, the front remains Eric.

Q6: Explain how a queue ensures fairness.

A6: Since applications are handled in the order they arrive, everyone gets equal treatment without skipping or favoritism.

D. Advanced Thinking

Q7: Explain how each maps to real Rwandan life.

A7: In a wedding buffet, people are served in a straight line like a linear queue. In Nyabugogo bus station, buses move in a circular route like a circular queue. When boarding a bus from either the front or back, it acts like a deque where both ends are accessible.

Q8: How can queues model this process?

A8: Customers place food orders which are enqueued. When the food is ready, the order is dequeued and served, ensuring fairness.

Q9: Why is this a priority queue, not a normal queue?

A9: At CHUK hospital, emergencies are handled first regardless of arrival time. This is a priority queue because urgency is more important than order of arrival.

Q10: How would queues fairly match drivers and students? A10: In a moto/e-bike app, riders wait in a queue while students request rides. The system dequeues the first available rider and matches them with the next student request, ensuring fairness for both parties.