BIT - Data Structure Exercise - Number 2

Part I - STACK

A. Basics

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

A stack follows the Last In First Out (LIFO) principle. In the MTN MoMo app, when you fill payment details step-by-step, pressing back removes the most recent step entered. This demonstrates LIFO because the last action is the first one undone.

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

In UR Canvas, when you navigate course modules, pressing back undoes the last module visited. This is similar to popping from a stack since the most recent action (top of the stack) is removed first.

B. Application

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

In BK Mobile Banking, each transaction is pushed onto the stack. When correcting mistakes, popping the stack removes the most recent action, enabling the undo function.

Q4: How can stacks ensure forms are correctly balanced?

In Irembo registration forms, opening brackets are pushed onto the stack and matching closing brackets cause a pop. If all brackets are matched and the stack is empty at the end, the form fields are correctly balanced.

C. Logical

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

Sequence: Push("CBE notes"), Push("Math revision"), Push("Debate"), Pop(), Push("Group assignment").

The top of the stack is 'Group assignment'.

Q6: Which answers remain in the stack after undoing?

If a student undoes 3 recent actions during ICT exams, the last three pushed items are popped. Only the earlier answers remain in the stack.

D. Advanced Thinking

Q7: How does a stack enable this retracing process?

In RwandAir booking, each completed step is pushed onto the stack. When a passenger goes back, steps are popped one by one, allowing retracing.

Q8: Show how a stack algorithm reverses the proverb.

To reverse 'Umwana ni umutware', push each word onto the stack. Popping the words gives: 'umutware ni Umwana'.

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

In Kigali Public Library, a deep search (DFS) explores one shelf completely before moving back. Stacks are suitable because they allow backtracking step-by-step.

Q10: Suggest a feature using stacks for transaction navigation.

In the BK Mobile app, stacks can be used to navigate transaction history forward and backward. Users could push new transactions as they occur and pop to revisit previous transactions.

Part II - QUEUE

A. Basics

Q1: How does this show FIFO behavior?

At a restaurant in Kigali, customers are served in the order they arrive. The first customer to arrive is the first to be served. This is FIFO.

Q2: Why is this like a dequeue operation?

In a YouTube playlist, the next video plays automatically from the front of the list. This is like dequeue since the front item is removed first.

B. Application

Q3: How is this a real-life queue?

At RRA offices, people paying taxes line up in order. This forms a queue where the first person to arrive is served first.

Q4: How do queues improve customer service?

In MTN/Airtel service centers, SIM replacement requests are processed in arrival order. This ensures fairness and improves customer satisfaction.

C. Logical

Q5: Who is at the front now?

Sequence: Enqueue("Alice"), Enqueue("Eric"), Enqueue("Chantal"), Dequeue(), Enqueue("Jean").

After dequeuing Alice, Eric is now at the front.

Q6: Explain how a queue ensures fairness.

In RSSB pension applications, requests are handled in arrival order. This guarantees fairness since no one can skip the line.

D. Advanced Thinking

Q7: Explain how each maps to real Rwandan life.

- Linear queue: People at a wedding buffet wait in a straight line.
- Circular queue: Buses at Nyabugogo station loop back after finishing a trip.
- Deque: Boarding a bus where passengers can enter from both the front and rear.

Q8: How can queues model this process?

At a Kigali restaurant, customers place orders (enqueue). When food is ready, the order is called (dequeue). This models food service.

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

At CHUK hospital, emergency patients are treated before others regardless of arrival time. This is a priority queue because it gives priority to urgent cases.

Q10: How would queues fairly match drivers and students?

In a moto/e-bike taxi app, drivers enqueue as available and students enqueue as riders. The system dequeues both to match the first available driver with the first waiting student.