BIT LEVEL; 2

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Data structure and algorthime

Assignment :2

Part I: STACK

A. Basics

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

In the MTN MoMo app, pressing the back button removes the last entered payment detail.

This demonstrates the Last-In-First-Out (LIFO) principle of stacks, where the most recent item added is the first to be removed.

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

In UR Canvas, pressing the back button undoes the last navigation step.

This mirrors the stack operation "pop," which removes the top item, allowing the user to retrace their steps in reverse order.

B. Application

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

In BK Mobile Banking, each transaction can be pushed onto a stack.

When a user wants to undo an action, the top transaction is popped from the stack, effectively reversing the last operation.

Q4: How can stacks ensure forms are correctly balanced?

In Irembo registration forms, stacks can be used to match opening and closing brackets.

Each opening bracket is pushed onto the stack, and when a closing bracket is encountered, it is matched with the top item of the stack. If they match, the bracket is popped; otherwise, the form is unbalanced.

C. Logical

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

Given the sequence: Push("CBE notes"), Push("Math revision"), Push("Debate"), Pop(), Push("Group assignment"), the stack contains: ["CBE notes", "Math revision", "Group assignment"]. The next task is "Group assignment."

Q6: Which answers remain in the stack after undoing?

If a student undoes 3 recent actions, the remaining answers depend on the initial stack.

Assuming the stack was: ["Answer 1", "Answer 2", "Answer 3", "Answer 4"], after 3 pops, "Answer 4" remains.

D. Advanced Thinking

Q7: How does a stack enable this retracing process?

In RwandAir booking, a stack allows the passenger to retrace steps by popping the most recent action, effectively going back through the booking process step-by-step.

Q8: Show how a stack algorithm reverses the proverb.

To reverse the phrase "Umwana ni umutware" using a stack:

1. Push each word onto the stack: ["Umwana", "ni", "umutware"]
2. Pop each word and append to the result: "umutware ni Umwana"

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

In Kigali Public Library, a stack is better suited for deep searches because it explores one path fully before backtracking, allowing for efficient depth-first search (DFS).

A queue would explore all paths level by level, which is breadth-first search (BFS).

Q10: Suggest a feature using stacks for transaction navigation.

In BK Mobile app, a stack can be used to navigate transaction history. Each transaction is pushed onto the stack, and pressing back pops the last transaction, allowing users to retrace their steps.

Part II: QUEUE

A. Basics

Q1: How does this show FIFO behavior?

In a Kigali restaurant, customers are served in order. The first customer to arrive is the first to be served, demonstrating the First-In-First-Out (FIFO) principle of queues.

Q2: Why is this like a dequeue operation?

In a YouTube playlist, the next video plays automatically.

This is similar to a dequeue operation, where the front item is removed and processed next.

B. Application

Q3: How is this a real-life queue?

At RRA offices, people waiting to pay taxes form a line.

The first person to arrive is the first to be served, exemplifying a real-life queue.

Q4: How do queues improve customer service?

In MTN/Airtel service centers, SIM replacement requests are processed in order.

Queues ensure that each customer is served fairly and in the order of their arrival, improving service efficiency.

C. Logical

Q5: Who is at the front now?

Given the sequence: Enqueue("Alice"), Enqueue("Eric"), Enqueue("Chantal"), Dequeue(), Enqueue("Jean"), the queue contains: ["Eric", "Chantal", "Jean"]. "Eric" is at the front.

Q6: Explain how a queue ensures fairness.

In RSSB pension applications, handling applications in the order they are received ensures fairness, as each applicant is processed in the sequence of their arrival, preventing favoritism.

D. Advanced Thinking

Q7: Explain how each maps to real Rwandan life.

- **Linear Queue**: People at a wedding buffet line up in order to serve themselves.
- **Circular Queue**: Buses looping at Nyabugogo pick up passengers in a circular route, ensuring no one is left out.
- **Deque**: Boarding a bus from the front/rear allows passengers to enter or exit from either side, facilitating smooth flow.

Q8: How can queues model this process?

In a Kigali restaurant, customers order food and are called when ready. Orders are enqueued, and when ready, they are dequeued and served, ensuring a fair and orderly process.

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

At CHUK hospital, emergencies jump the line.

This is a priority queue, where certain tasks (emergencies) are dequeued before others, regardless of their arrival order.

Q10: How would queues fairly match drivers and students?

In a moto/e-bike taxi app, riders wait for passengers.

A queue can match drivers and students by dequeuing the first available driver and pairing them with the next student, ensuring fair and timely service.
