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Date: 23/09/2025

BIT – Data Structures Exercise

Part I – STACK

A. BASICS

Q1: MoMo app and LIFO

When using the MTN MoMo app, each step you take like entering the amount, selecting the recipient, and confirming is placed on top of the previous step. If you decide to press back, the app won’t erase the very first thing you entered, but rather the last action you just made. This mirrors the **Last In, First Out principle**, where the newest action is always the first to be removed.

Q2: UR Canvas navigation as Pop

On UR Canvas, each time you open a new module, it is like pushing that page onto a stack. When you hit the back button, the last module you visited disappears first. This is exactly how a **Pop operation** works because it always removes the most recent item on the stack.

B. APPLICATION

Q3: Undo function in BK Banking app

In applications like BK Mobile Banking, mistakes happen. Suppose you enter a wrong transaction. Instead of starting everything from scratch, the system allows you to undo only the most recent step. That’s how a stack helps: every action goes on top, and undo simply pops it off, leaving earlier steps untouched.

Q4: Checking balance in Irembo forms

When filling forms on Irembo, every open section (like entering a phone number or ID) must eventually be completed. Stacks handle this by keeping track of each “open” until it has a matching “close.” If one remains unmatched, the form is incomplete. Just like balanced brackets in coding, this ensures accuracy and order.

C. LOGICAL

Q5: Which task comes next?

Given the sequence: Push(CBE notes), Push(Math revision), Push(Debate), Pop(), Push(Group assignment).

- After three pushes, the stack is: CBE notes → Math revision → Debate.
- Pop removes "Debate".
- Adding Group assignment puts it on top.

Final stack: CBE notes → Math revision → Group assignment.
So, The next task is **Group assignment.**

Q6: Undoing three steps

When a student undoes three actions in an exam system, it's like calling Pop three times. The three most recent answers disappear, leaving the earlier ones intact. This shows how undo focuses on the latest steps without disturbing the older work.

D. ADVANCED THINKING

Q7: Backtracking in RwandAir booking

Every detail you provide when booking a RwandAir flight like choosing a destination or entering passport details is stacked. If you go back, the app removes the most recent step first. This step-by-step backtracking allows you to retrace your process without starting the booking over.

Q8: Reversing the proverb

To reverse *"Umwana ni umutware"* using a stack:

- Push each word: Umwana, ni, umutware.
- The top word is "umutware," so popping them one by one gives "umutware ni Umwana."

That is how stacks can reverse words or even entire sentences.

Q9: Why stacks work better than queues for DFS

Depth-First Search means exploring as far as possible before turning back. A stack is perfect because it always returns you to the last spot you visited, allowing you to go deep first. In contrast, a queue works in breadth-first style, going level by level. That makes stacks better for searches like exploring shelves in a library.

Q10: A stack feature in BK Mobile

Stacks could help users move through transaction history. Each viewed transaction can be pushed to the stack, and the back button would pop the latest one. If two stacks are used (backward and forward), the user could easily move both directions, just like in internet browsers.

Part II – QUEUE

A. BASICS

Q1: FIFO at a restaurant

In Kigali restaurants, the first person to join the line is the first one to be served. Nobody who came later can be served earlier. This is exactly what **FIFO (First In, First Out)** means in real life.

Q2: YouTube playlist as a queue

When you play a YouTube playlist, the very first video that was added plays first, then the next one, and so on. This is similar to a **Dequeue** operation where the front item leaves first and the rest follow in order.

B. APPLICATION

Q3: RRA office queue

At RRA offices, taxpayers wait in line to pay. Whoever arrives first is helped first, while later arrivals must wait. That's a real-life queue system, working strictly by order of arrival.

Q4: Queues in service centers

Service centers like MTN and Airtel use queues to manage SIM replacements. Without queues, people might fight for who gets served. With queues, each customer is handled in order, creating fairness and efficiency.

C. LOGICAL

Q5: Who is at the front now?

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

- Queue: Alice → Eric → Chantal.
- After Dequeue, Alice leaves: Eric → Chantal.
- Enqueue Jean: Eric → Chantal → Jean.

So, The person at the front is **Eric.**

Q6: Queues and fairness at RSSB

At RSSB, pension applications are processed in order of arrival. This ensures fairness because those who applied earlier are served before those who applied later. Queues prevent bias and maintain transparency.

D. ADVANCED THINKING

Q7: Examples of queue types

- **Linear queue:** Like a wedding buffet where guests line up and get food one by one.
- **Circular queue:** Like Nyabugogo buses that loop back to the station after finishing their routes.
- **Deque:** Like boarding a bus from both the front and back doors, allowing people to enter or leave from either side.

Q8: Restaurant order system

When customers order food in a restaurant, each order is added to the queue for the kitchen. The first order placed is the first one cooked and served. This prevents later orders from being unfairly prioritized.

Q9: Priority queues at CHUK

At CHUK hospital, emergency patients are treated before those with minor issues. This is a **priority queue** because urgent cases skip ahead of regular ones. Without this, lives could be lost if patients with small problems were served before critical ones.

Q10: Matching students and drivers

In moto and e-bike apps, drivers and students are paired using queues. The first driver waiting is assigned to the first student who requests a ride. This ensures a fair and organized system without skipping or favoritism.