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BIT – Data Structure Exercise

MODULE: DATA STRUCTURE AND ALOGARITHM

Part I – STACK

A. Basics

Stack: is a type of data structure that stores element in a particular order and allows access in a last in, first out (lifo)

- Q1: Operation: Push/Pop (LIFO).
  In the momo app, when you enter payment details step by step, pressing back removes the last step you added. This shows LIFO (Last In, First Out) because the most recent step is always removed first.

- Q2: Operation: Pop (Undo).
  Pop removes the most recent action. Just like when typing text and pressing Undo, the system removes the last word/letter typed, not the first.

B. Application

Q3. A stack allows actions to be under one by popping the most recent action first (LIFO).

For example, in BK mobile banking, if a wrong transaction step is added, pressing undo will remove the last action from the top of the stack, restoring the system to the previous state.

Q4.the ways stacks ensure forms in correctly balanced:

When filling irembo forms, every opening brackets/ field(like (,{,[) is pushed into the stack.

c. logical

Q5. Push and pop sequence

Seqwence:

- Push (“CBE notes”) it give us stack=[CBE notes]
- Pop() allow removes “debate” allow stack=[CBEnotes, math revision group assignment

Q6. The first older(older) answers remain after undoing 3 actions.

Advanced Thinking

- Q7: Operation: Pop to backtrack.
  In RwandAir booking, each step filled in the form is pushed onto a stack. If the passenger wants to go back, the last step is popped, making it easy to retrace step by step.

- Q8: Operation: Push words, then Pop to reverse.
  To reverse the proverb "Umwana ni umutware":
  - Push(Umwana), Push(ni), Push(umutware) → Stack = [Umwana, ni, umutware]
  - Pop → umutware, Pop → ni, Pop → Umwana
  📌 Reversed: "umutware ni Umwana".

- Q9: Operation: DFS using a stack.
  A student in Kigali Public Library uses DFS to search shelves. A stack is better than a queue because DFS explores deep paths first, and the stack allows backtracking by popping when a dead end is reached.

- Q10: Operation: Push/Pop for navigation.
  In the BK Mobile app, each transaction detail is pushed when opened. If the user presses Back, the last detail is popped, showing the previous transaction.
  Suggested feature: "Back to Previous Transaction" for smooth navigation.

Part II – QUEUE

A. Basics

Queue: is another type of linear data structure that works differently from a stack.

- It follows the rule first in, first out. This means that the first element added is the first to be removed.

  - Q1: Operation: Enqueue/Dequeue (FIFO).
    In a Kigali restaurant, customers are served in the order they arrive. This is FIFO (First In, First Out) because the earliest arrival is served first.

  - Q2: Operation: Dequeue (next item leaves first).
    In a YouTube playlist, the next video is played first. The video at the front of the queue is removed, just like a dequeue.

❖ Q3: Operation: Enqueue (job submission).
At RRA offices, people line up to pay taxes. Each taxpayer joins at the back (enqueue) and is served in order.

❖ Q4: Operation: Queue management.
In MTN/Airtel service centers, SIM replacement requests are processed in order.
- This improves customer service by:
  - Ensuring fairness (first come, first served).
  - Avoiding confusion/conflict.
  - Making waiting predictable.
  - Increasing efficiency.

C. Logical

Q5: Sequence of Enqueue/Dequeue.
Operations:
- Enqueue(ineza) → [ineza]
- Enqueue(elie) → [ineza, Elie]
- Enqueue(emmerance) → [ineza, Elie, emmerance]
- Dequeue() → remove ineza → [Elie, emmerance]
- Enqueue(Jcloude) → [Elie, emmerance, cloude]
  elie is now at the front.

✓ Q6: FIFO message handling.
In RSSB pension applications, requests are handled in arrival order. A queue ensures fairness because the first applicant is the first served, preventing favoritism.

D. Advanced Thinking

Q7: Different queue types.
- Linear queue (wedding buffet): People join one line and move forward until served.
- Circular queue (Nyabugogo buses): After buses complete a route, they return and loop again.
- Deque (bus boarding front/rear): Passengers can enter or leave from either end, like a double-ended queue.

- Q8: Enqueue orders, Dequeue when ready.
  In a Kigali restaurant, orders are enqueued when placed and dequeued when food is ready. This ensures fairness and order.

- Q9: Priority queue (CHUK hospital).
  At CHUK hospital, emergencies jump the line. This is a priority queue because patients are served by urgency, not arrival time.

- Q10: Enqueue/Dequeue matching (moto/e-bike app).
  In a moto/e-bike app:
  - Riders are enqueued as they wait.
  - Students/customers are also enqueued.
  - The first rider is matched with the first student, ensuring fair and organized pairing.