UNIVERSITY OF RWANDA

COLLEGE OF BUSINESS AND ECONOMICS

BUSINESS INFORMATION TECHNOLOGY

MODULE NAME: DATA STRUCTURE AND ALGORITHM

ASSIGNMENT 2

QUESTIONS AND ANSWERS

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DATA STRUCTURE AND ALGORITHM

YEAR 2

Part I - STACK

A. Basics

1. Operation: Push/Pop (LIFO)

Stack: A stack is like a stack of plates. You put a new plate on top (called "push") and take the top plate off first (called "pop"). This is LIFO (Last In, First Out)

Q1: In the MTN MoMo app, when you fill payment details step-by-step, pressing back removes the last step. How does this show the LIFO nature of stacks?

LIFO means the last thing you add is the first to go. In MTN MoMo, if you enter ***182#** , then press **1**, then **1** again, and then **enter number** pressing back removes the **number** first. This is like a stack because the last step you did is undone first.

Pressing back in the MTN MoMo app removes the most recently entered payment detail, mirroring LIFO where the last item pushed (added) is the first popped (removed).

2. Operation: Pop (Undo)

Q2: In UR Canvas, when you navigate course modules, pressing back undoes the last step. Why is this action similar to popping from a stack?

Popping removes the top item from a stack. In UR Canvas, pressing back takes you back to the last module you opened, like removing the top step from a stack. It keeps the order of what you did before.

B. Application

3. Operation: Push (Add to stack)

Q3: In BK Mobile Banking, transactions are added to history.How could a stack enable the undo function when correcting mistakes?

Each transaction or action can be pushed onto a stack as it's performed. To undo a mistake, pop the last action to revert to the previous state, letting you fix it step by step. without losing the entire history.

4. Operation: Balanced Parentheses Check

Q4: In Irembo registration forms, data entry fields must be correctly matched. How can stacks ensure forms are correctly balanced?

A stack can add an opening field (like a bracket) and remove it when a closing field matches. If everything matches and the stack is empty at the end, the form is correct. If not, it shows a mistake.

C. Logical

5. Operation: Push and Pop sequence

Q5: A student records tasks in a stack: Push("CBE notes"), Push("Math revision"), Push("Debate"), Pop(), Push("Group assignment"). **Which task is next (top of stack)?**

- Start with nothing.

- Add "CBE notes" (top: "CBE notes").

- Add "Math revision" (top: "Math revision").

- Add "Debate" (top: "Debate").

- Remove "Debate" (top: "Math revision").

- Add "Group assignment" (top: "Group assignment").

The next task is "Group assignment".

6. Operation: Undo with multiple Pops

Q6: During ICT exams, a student undoes 3 recent actions.Which answers remain in the stack after undoing?

If answers are added to a stack, undoing 3 actions removes the last 3. The older answers stay in the stack. For example, if you had 5 answers, only the first 2 remain after undoing 3.

D. Advanced Thinking

7. Operation: Pop to backtrack

Q7: In RwandAir booking, a passenger goes back step-by-step in the form. How does a stack enable this retracing process?

Each step is added to a stack. Going back removes the last step, taking you to the one before. This lets you move back easily, like undoing a form step by step.

8. Operation: Push words, then Pop to reverse

Q8: To reverse “Umwana ni umutware”, push each word and then pop. Show how a stack algorithm reverses the proverb.

- Push "Umwana" (stack: "Umwana").

- Push "ni" (stack: "Umwana”, “ni").

- Push "umutware" (stack: "Umwana”, “ni”, “umutware").

- Pop "umutware", Pop "ni", Pop "Umwana" → "umutware ni Umwana".

Reversed "umutware ni Umwana".

The stack flips the order.

9. Operation: DFS using a stack

Q9: A student searches shelves in Kigali Public Library (deep search). Why does a stack suit this case better than a queue?

A stack helps you go deep into one shelf before moving to another, like DFS. A queue would check all shelves at once, which is slower for deep searches.

10. Operation: Push/Pop for navigation

Q10: In BK Mobile app, moving through transaction history uses push and pop. Suggest a feature using stacks for transaction navigation.

Add a "go back" button that uses a stack. Each time you view a transaction, add it to the stack. Pressing back removes it, letting you see the previous one.

Part II - QUEUE

A. Basics

1. Operation: Enqueue (add at rear), Dequeue (remove from front)

Queue: A queue is like a line of people waiting, such as at a restaurant. New people join at the back (called "enqueue") and leave from the front (called "dequeue"). This is FIFO (First In, First Out), meaning the first person in line is served first.

Q1:At a restaurant in Kigali, customers are served in order. How does this show FIFO behavior?

FIFO means the first to join the line is served first. At the restaurant, the first customer waits and is served next, the person is served first, like a queue.

2. Operation: Dequeue (next item leaves first)

Q2: In a YouTube playlist, the next video plays automatically. Why is this like a dequeue operation?

A queue removes the first video to play it, just like dequeue. The next one moves up, keeping the order.

B. Application

3. Operation: Enqueue (job submission)

Q3: At RRA offices, people waiting to pay taxes form a line. How is this a real-life queue?

People join at the end and wait to be served from the front, like a queue. It keeps things fair and orderly.

4. Operation: Queue management

Q4: In MTN/Airtel service centers, SIM replacement requests are processed in order. How do queues improve customer service?

Queues make sure everyone is helped in order, reducing fights and waiting time. It keeps things fair and organized.

C. Logical

5. Operation: Sequence of Enqueue/Dequeue

Q5: In Equity Bank, operations are: Enqueue("Alice"), Enqueue("Eric"), Enqueue("Chantal"), Dequeue(), Enqueue("Jean"). Who is at the front now?

- Add "Alice" (front: "Alice").
- Add "Eric" (front: "Alice").
- Add "Chantal" (front: "Alice").
- Remove "Alice" (front: "Eric").
- Add "Jean" (front: "Eric").

The front is "Eric".

6. Operation: FIFO message handling

Q6: RSSB pension applications are handled by arrival order. Explain how a queue ensures fairness.

A queue helps the first application get checked first. This means no one jumps ahead, making it fair for everyone.

D. Advanced Thinking

7. Operation: Different queue types

Examples:

- Linear queue = people at a wedding buffet.

- Circular queue = buses looping at Nyabugogo.

- Deque = boarding a bus from front/rear.

Explain how each maps to real Rwandan life.

Linear queue: At a wedding buffet in Rwanda, people stand in a straight line. The first person in line gets food first, and new people join at the back. This is like a linear queue because it moves forward in a simple, straight order, and there's no looping back.

Circular queue: Buses at Nyabugogo station keep coming and going in a loop. When one bus leaves, the next one takes its place, and the line wraps around. This is like a circular queue because it reuses the same space, making it efficient for busy places like bus stations in Kigali.

Deque: When boarding a bus in Rwanda, people can enter from the front or the back doors. This is like a deque because you can add or remove passengers from both ends, which helps when the bus is crowded or stops are quick.

8. Operation: Enqueue orders, Dequeue when ready

Q8: At a Kigali restaurant, customers order food and are called when ready. How can queues model this process?

Orders go in at the end. When food is ready, the first order is removed and the customer is called.

9. Operation: Priority queue

Q9: At CHUK hospital, emergencies jump the line.Why is this a priority queue, not a normal queue?

A priority queue lets urgent cases go first. A normal queue waits for the first person, which isn't good for emergencies.

10. Operation: Enqueue/Dequeue matching system

Q10: In a moto/e-bike taxi app, riders wait for passengers. How would queues fairly match drivers and students?

Drivers wait in a queue. The first driver gets the next student, so everyone gets a turn fairly.