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Department of AI-Multimedia and Gaming

Lab 05: Fundamentals of Stack using Array and LinkedList　　Date: 24 Sep, 2024

Subject: Data Structure (CSC221), Fall 2024　　Instructor: Abdul Ghafoor

Lab objectives: The goal of this lab is to help students understand the **stack** data structure by implementing it using both **array** and **linked list** in Java. Students are required to implement basic stack operations such as **push**, **pop**, **peek**, **isEmpty**, and **size** using both data structures.

Task 01: Implement a stack using an array with the following methods:

- `push(int data)`: Adds an element to the top of the stack.
- `pop()`: Removes and returns the top element from the stack.
- `peek()`: Returns the top element without removing it.
- `isEmpty()`: Checks if the stack is empty.
- `size()`: Returns the number of elements in the stack.

Instructions:

- Define a fixed capacity for your array (for example 5).
- Handle edge cases such as **stack overflow** (when the array is full) and **stack underflow** (when trying to pop from an empty stack).
- Write a **main method** to test all the stack operations by pushing and popping elements, and printing the stack after each operation.

Part 02: Stack Implementation Using a Linked List

1. **Task**: Implement a **stack** using a **singly linked list** with the following methods:
    - `push(int data)`: Adds an element to the top of the stack.
    - `pop()`: Removes and returns the top element from the stack.
    - `peek()`: Returns the top element without removing it.
    - `isEmpty()`: Checks if the stack is empty.
    - `size()`: Returns the number of elements in the stack.
2. **Instructions**:
    - Use a **linked list** where each node contains an integer data field and a pointer to the next node.
    - Handle edge cases such as trying to **pop from an empty stack**.

- ○ Write a **main method** to test all the stack operations by pushing and popping elements, and printing the stack after each operation.

Part 03: Leetcode Examples for stack

https://leetcode.com/problems/valid-parentheses/description/?envType=problem-list-v2&envId=stack

https://leetcode.com/problems/palindrome-linked-list/description/?envType=problem-list-v2&envId=stack

https://leetcode.com/problems/next-greater-element-i/description/?envType=problem-list-v2&envId=stack

https://leetcode.com/problems/final-prices-with-a-special-discount-in-a-shop/description/?envType=problem-list-v2&envId=stack