2024

# Assignment 3

COMP 2230_02

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# COMP 2230 – Data Structures and Algorithm Analysis

Assignment #3: Linked Stacks

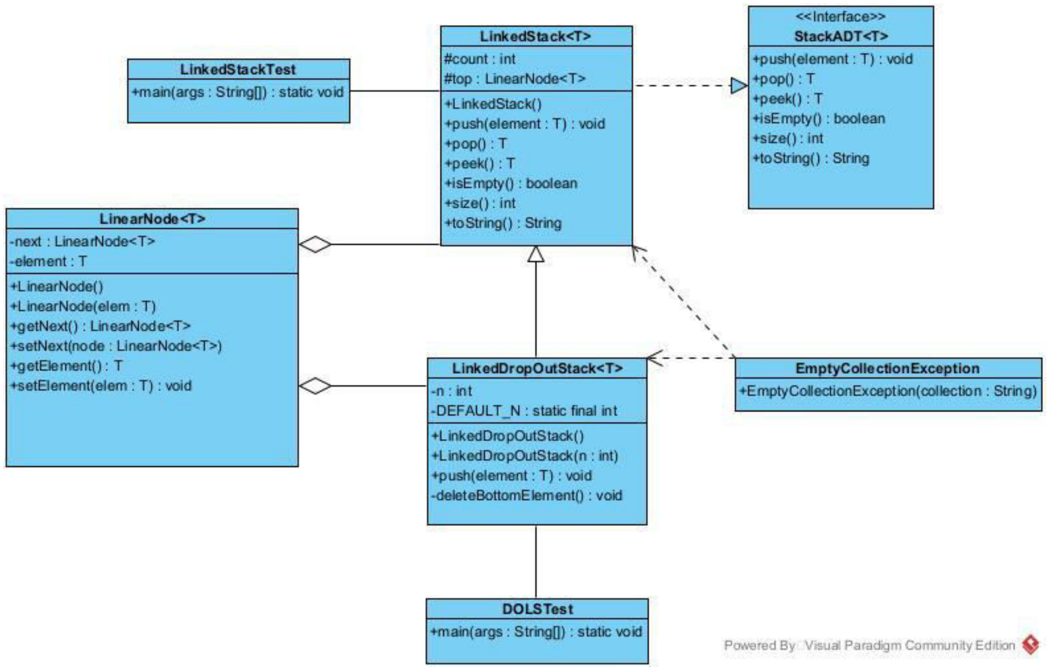
Due Date: Section 01 - Sept. 26th 2024 Section 02 Sept 27th 2024

## Chapter 13

**Problem 1**:
Implementation of the Size(), isEmpty(), and toString() methods into the LinkedStack class.

**Problem 2**:
Override the push method to allow for a drop out mechanism with a linked stack

**UML:**



**Problem 1 Code**

**LinkedStack.java**

```
package Ass3_2230;

import Ass3_2230.exceptions.*;

/**
 * Represents a linked implementation of a stack.
 *
 * @author Java Foundations
 * @version 4.0
 */
public class LinkedStack<T> implements StackADT<T>
{
	protected int count;
	protected LinearNode<T> top;

	/**
	 * Creates an empty stack.
	 */
	public LinkedStack()
	{
		count = 0;
		top = null;
	}

	/**
	 * Adds the specified element to the top of this stack.
	 * @param element element to be pushed on stack
	 */
	public void push(T element)
	{
		LinearNode<T> temp = new LinearNode<T>(element);

		temp.setNext(top);
		top = temp;
		count++;
	}

	/**
	 * Removes the element at the top of this stack and returns a
	 * reference to it.
	 * @return element from top of stack
	 * @throws EmptyCollectionException if the stack is empty
	 */
	public T pop() throws EmptyCollectionException
	{
		if (isEmpty())
			throw new EmptyCollectionException("stack");

		T result = top.getElement();
		top = top.getNext();
		count--;

		return result;
	}

	/**
	 * Returns a reference to the element at the top of this stack.
	 * The element is not removed from the stack.
	 * @return element on top of stack
	 * @throws EmptyCollectionException if the stack is empty
	 */
	public T peek() throws EmptyCollectionException
	{
		if(isEmpty()){
			throw new EmptyCollectionException("Linked Stack");
		}

		return top.getElement();  // temp
	}

	/**
	 * Returns true if this stack is empty and false otherwise.
	 * @return true if stack is empty
	 */
```

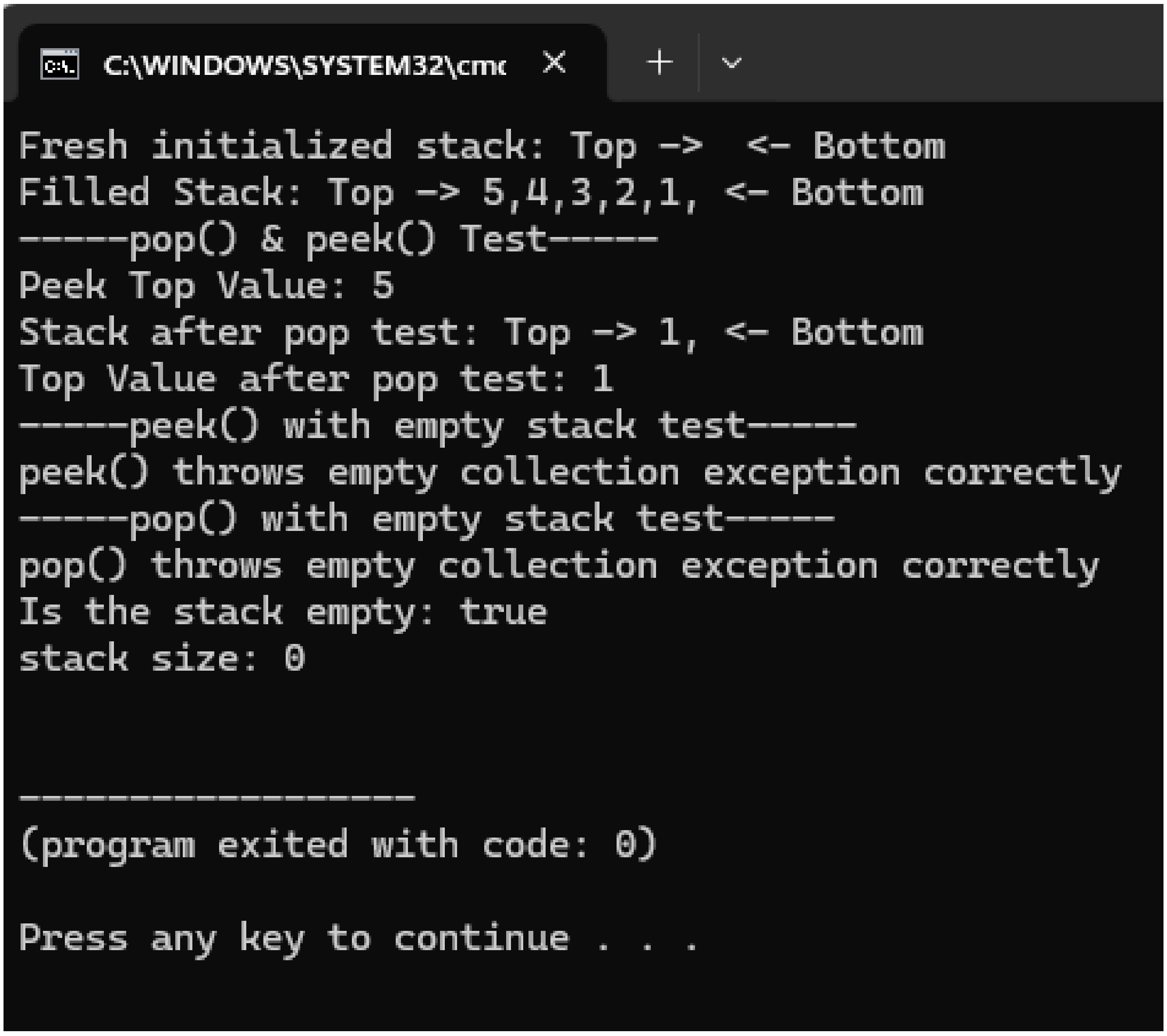
```
      public boolean isEmpty()
      {
           return count == 0;
      }

      /**
       * Returns the number of elements in this stack.
       * @return number of elements in the stack
       */
      public int size()
      {
           return count;
      }

      /**
       * Returns a string representation of this stack.
       * @return string representation of the stack
       */
      @Override
      public String toString()
      {
        String result = "";
        LinearNode<T> current = top;
           for (int i = 1; i <= count; i++) {
            result += current.getElement() + ",";
            current = current.getNext();
        }

           return result;
      }
}
```

**LinkedStackTest.java**

```
package Ass3_2230;

import Ass2_2230.ArrayStack;
import Ass2_2230.exceptions.EmptyCollectionException;
```

```
public class LinkedStackTest {
    public static void main(String[] args){
        LinkedStack<Integer> linkStack = new LinkedStack<>();
        //empty stack initialization
        System.out.println("Fresh initialized stack: " + "Top -> " +
linkStack.toString() + " <- Bottom");
        for(int i = 1; i < 6; i++){
            linkStack.push(i);


        }
        System.out.println("Filled Stack: " + "Top -> " +
linkStack.toString() + " <- Bottom");

        //test pop and peek
        System.out.println("-----pop() & peek() Test-----");
        System.out.println("Peek Top Value: " + linkStack.peek());
        for (int i = 1; i < 5; i++) {
            linkStack.pop();
        }
        System.out.println("Stack after pop test: " + "Top -> " +
linkStack.toString() + " <- Bottom");
        System.out.println("Top Value after pop test: " +
linkStack.peek());
        linkStack.pop();

        //test peek with empty method
        System.out.println("-----peek() with empty stack test-----");
        try{
            linkStack.peek();
        } catch (EmptyCollectionException e) {
            System.out.println("peek() throws empty collection exception
correctly");
        }

        //test pop with empty stack
        System.out.println("-----pop() with empty stack test-----");
        try {
            linkStack.pop();
        } catch (EmptyCollectionException e) {
            System.out.println("pop() throws empty collection exception
correctly");
        }
        System.out.println("Is the stack empty: " + linkStack.isEmpty());
        System.out.println("stack size: " + linkStack.size());

    }
}
```

**Test Output**



```
Fresh initialized stack: Top ->  <- Bottom
Filled Stack: Top -> 5,4,3,2,1, <- Bottom
-----pop() & peek() Test-----
Peek Top Value: 5
Stack after pop test: Top -> 1, <- Bottom
Top Value after pop test: 1
-----peek() with empty stack test-----
peek() throws empty collection exception correctly
-----pop() with empty stack test-----
pop() throws empty collection exception correctly
Is the stack empty: true
stack size: 0



------------------
(program exited with code: 0)

Press any key to continue . . .
```

**Problem 2 Code**

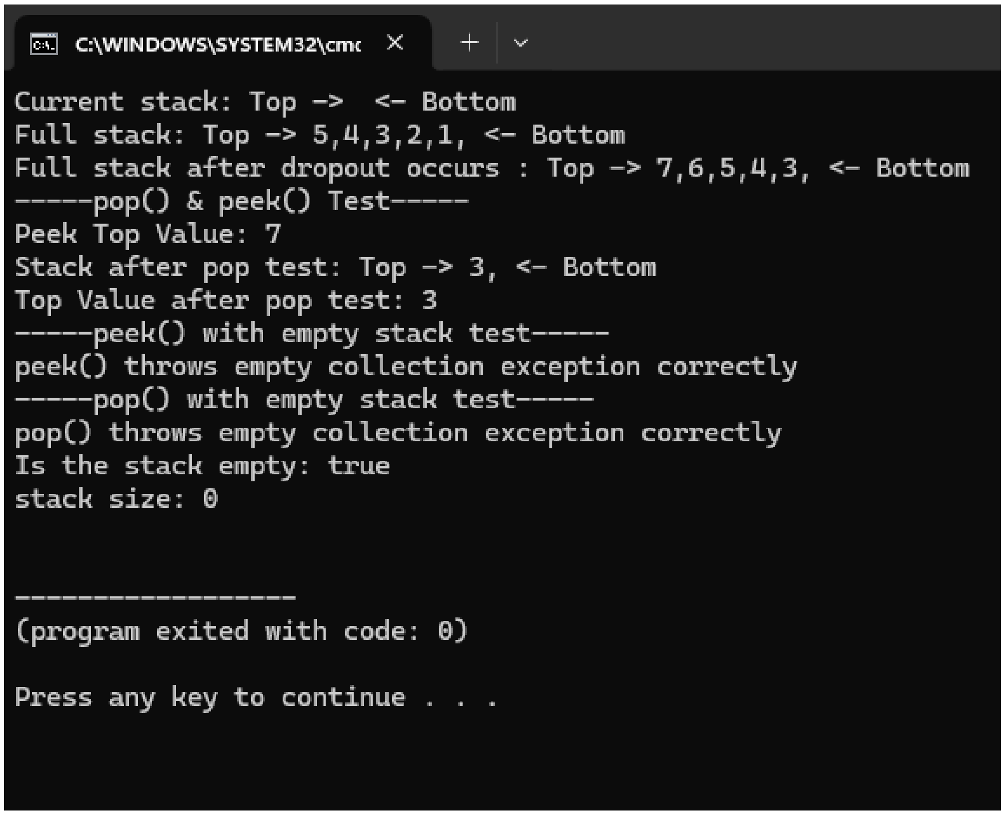
**LinkedDropOutStack.java**

```
package Ass3_2230;

public class LinkedDropOutStack<T> extends LinkedStack<T> {

    private int n;
    private static final int DEFAULT_N = 100;

    LinkedDropOutStack() {
        this(DEFAULT_N);
    }

    LinkedDropOutStack(int n) {
        super();
        this.n = n;
    }

    public void push(T element) {
        super.push(element);

        if (size() > n) {
            deleteBottomElement();
        }
    }

    private void deleteBottomElement() {

        LinearNode<T> newBottomNode = top;
           for (int i = 1; i < size()-1; i++) {
            newBottomNode = newBottomNode.getNext();
        }
        newBottomNode.setNext(null);
        count--;
    }
}
```

**DOLSTest.java**

```
package Ass3_2230;

import Ass2_2230.ArrayStack;
import Ass2_2230.DropOutArrayStack;
import Ass2_2230.exceptions.EmptyCollectionException;

public class DOLSTest {
    public static void main(String[] args){

        LinkedDropOutStack<Integer> dols = new LinkedDropOutStack<>(5);
        //initialization with null values and capacity 5
        System.out.println("Current stack: " + "Top -> " +
dols.toString() + " <- Bottom");

        //populate stack to fill the initial capacity
        for (int i = 1; i < 6; i++) {
            dols.push(i);
        }
        System.out.println("Full stack: " + "Top -> " + dols.toString() +
" <- Bottom");
        dols.push(6);
        dols.push(7);
        System.out.println("Full stack after dropout occurs : " + "Top ->
" + dols.toString() + " <- Bottom");

        //test pop and peek
        System.out.println("-----pop() & peek() Test-----");
        System.out.println("Peek Top Value: " + dols.peek());
        for (int i = 1; i < 5; i++) {
            dols.pop();
        }
        System.out.println("Stack after pop test: " + "Top -> " +
dols.toString() + " <- Bottom");
        System.out.println("Top Value after pop test: " + dols.peek());
        dols.pop();

        //test peek with empty method
        System.out.println("-----peek() with empty stack test-----");
        try{
            dols.peek();
        } catch (EmptyCollectionException e) {
            System.out.println("peek() throws empty collection exception
correctly");
        }

        //test pop with empty stack
        System.out.println("-----pop() with empty stack test-----");
        try {
            dols.pop();
        } catch (EmptyCollectionException e) {
            System.out.println("pop() throws empty collection exception
correctly");
        }
        System.out.println("Is the stack empty: " + dols.isEmpty());
        System.out.println("stack size: " + dols.size());
    }
}
```

**Test Output**



```
Current stack: Top ->  <- Bottom
Full stack: Top -> 5,4,3,2,1, <- Bottom
Full stack after dropout occurs : Top -> 7,6,5,4,3, <- Bottom
-----pop() & peek() Test-----
Peek Top Value: 7
Stack after pop test: Top -> 3, <- Bottom
Top Value after pop test: 3
-----peek() with empty stack test-----
peek() throws empty collection exception correctly
-----pop() with empty stack test-----
pop() throws empty collection exception correctly
Is the stack empty: true
stack size: 0


------------------
(program exited with code: 0)

Press any key to continue . . .
```