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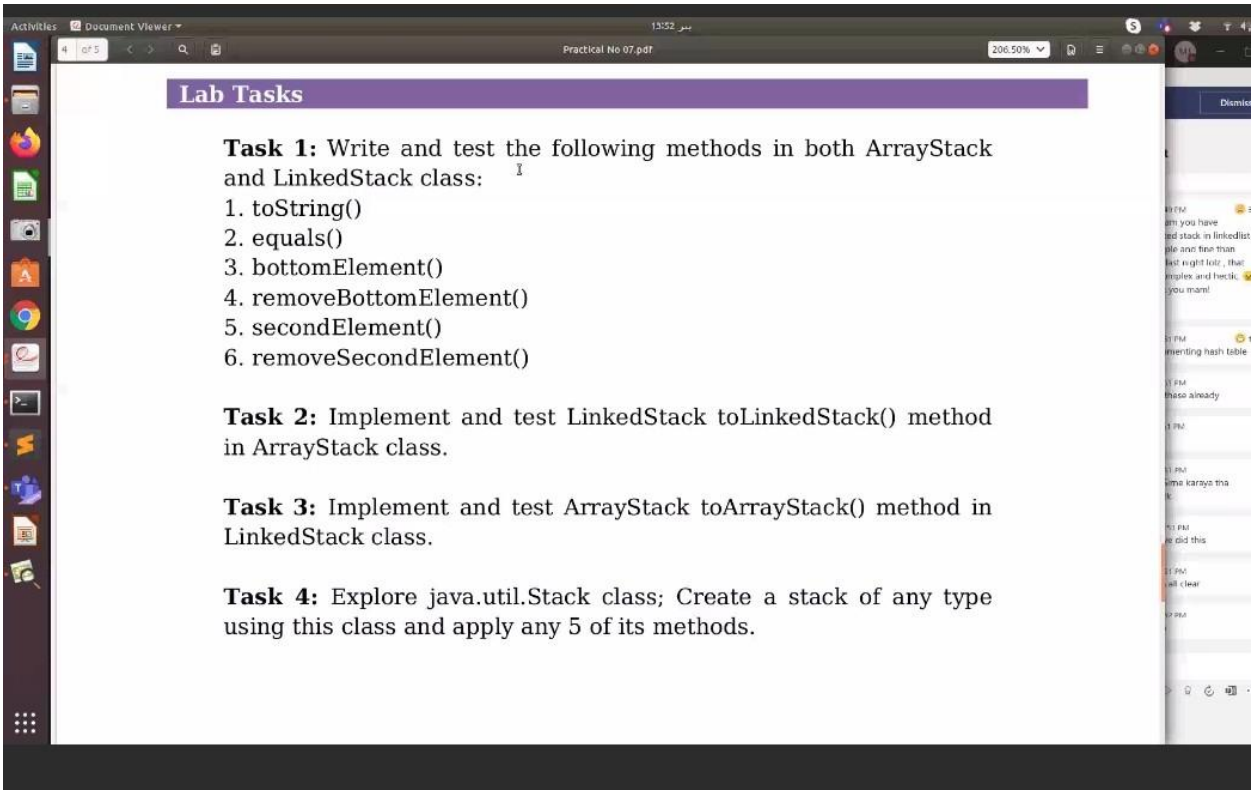
Subject: DSA



Lab Tasks

Task 1: Write and test the following methods in both ArrayStack and LinkedStack class:

1. toString()
2. equals()
3. bottomElement()
4. removeBottomElement()
5. secondElement()
6. removeSecondElement()

Task 2: Implement and test LinkedStack toLinkedStack() method in ArrayStack class.

Task 3: Implement and test ArrayStack toArrayStack() method in LinkedStack class.

Task 4: Explore java.util.Stack class; Create a stack of any type using this class and apply any 5 of its methods.

Task#1, Task#2, Task3:

ANS:

1. <u>Stack:</u>

```
public interface Stack {
      public Object peek();
      public Object pop();
      public boolean push(Object object);
      public int size();
      public boolean isEmpty();
      public String toString();
}
```

2. <u>ArrayStack:</u>

```
import java.util.Arrays;
import java.util.NoSuchElementException;

public class ArrayStack implements Stack {
      private int size;
```

```java
    private Object array[];

    public ArrayStack() {

    }

    public ArrayStack(int capacity) {
        array = new Object[capacity];
    }

    @Override
    public Object peek() {
        if (this.isEmpty())
            throw new NoSuchElementException("Stack is empty!");
        return array[size - 1];
    }

    @Override
    public Object pop() {
        if (this.isEmpty())
            throw new NoSuchElementException("Stack is empty!");
        Object obj = array[--size];
        array[size] = null;
        return obj;
    }

    @Override
    public boolean push(Object object) {
        if (size == array.length)
            array = Arrays.copyOf(array, array.length * 2);
        array[size++] = object;
        return true;
    }

    @Override
    public int size() {
        return size;
    }

    @Override
    public boolean isEmpty() {
        return size == 0;
    }

//////////////////Method to Convert the ArrayStack to an string
    @Override
```

```java
	public String toString() {
		if (this.isEmpty())
			return "[]";

		String buffer = "[";
		for (int i = size - 1; i >= 0; i--)
			buffer += array[i] + ",";
		buffer = buffer.substring(0, buffer.length() - 1);
		return (buffer + "]");

	}

//////////////////Method to check if two ArrayStacks are equal
	public boolean equals(ArrayStack stack) {
		if (this.isEmpty() && stack.isEmpty())
			return true;
		if (this.isEmpty() || stack.isEmpty())
			return false;
		if (this.size() != stack.size())
			return false;
		for (int i = 0; i < size(); i++) {
			if (!array[i].equals(stack.array[i]))
				return false;
		}
		return true;
	}

//////////////////Method to return bottom element
	public Object bottomElement() {
		if (this.isEmpty())
			throw new NoSuchElementException("Stack is empty!");
		return array[0];
	}

//////////////////Method to remove+return bottom element
	public Object removeBottomElement() {
		if (this.isEmpty())
			throw new NoSuchElementException("Stack is empty!");
		Object object = array[0];
		System.arraycopy(array, 1, array, 0, --size);
		return object;
	}

//////////////////Method to return second element
	public Object secondElement() {
		if (this.isEmpty())
```

```
                throw new NoSuchElementException("Stack is empty!");
            return array[size - 2];
        }

//////////////////Method to remove+return second element
        public Object removeSecondElement() {
            if (this.isEmpty())
                throw new NoSuchElementException("Stack is empty!");
            Object object = array[size - 2];
            array[size - 2] = array[size - 1];
            array[--size] = null;
            return object;
        }

//////////////////Method to convert current ArrayStack to equivalent
LinkedStack
        public LinkedStack toLinkedStack() {
            if (this.isEmpty())
                throw new NoSuchElementException("Stack is empty!");
            LinkedStack stack = new LinkedStack();
            for (int i = 0; i < size(); i++) {
                stack.push(array[i]);
            }
            return stack;
        }

        public static void main(String[] args) {
            ArrayStack stack = new ArrayStack(4);
            stack.push(2);
            stack.push(50);
            stack.push("Hello");
            stack.push(20);

            ArrayStack stack2 = new ArrayStack(4);
            stack2.push(2);
            stack2.push(50);
            stack2.push("Hello");
            stack2.push(20);

            System.out.println("stack.toString()             : " +
stack.toString());
            System.out.println("stack2.toString()            : " +
stack2.toString());
            System.out.println("\nstack.equals(stack2)         : " +
stack.equals(stack2));
```

```
            System.out.println("\nstack.removeBottomElement() : " +
stack.removeBottomElement());
            System.out.println("stack.bottomElement()       : " +
stack.bottomElement());
            System.out.println("\nstack.removeSecondElement()      : " +
stack.removeSecondElement());
            System.out.println("stack.secondElement()            : " +
stack.secondElement());
            System.out.println("stack.size()                     : " +
stack.size());
            System.out.println("stack.toString()                 : " +
stack.toString());

            System.out.println("stack.toLinkedStack().toString() : " +
stack.toLinkedStack().toString());
        }
    }
```

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```
<terminated> ArrayStack [Java Application] C:\Program Files\Java\jre1.8.0_261\bin\java
stack.toString()            : [20,Hello,50,2]
stack2.toString()           : [20,Hello,50,2]

stack.equals(stack2)        : true

stack.removeBottomElement() : 2
stack.bottomElement()       : 50

stack.removeSecondElement()      : Hello
stack.secondElement()            : 50
stack.size()                     : 2
stack.toString()                 : [20,50]
stack.toLinkedStack().toString() : [20,50]
```

3. LinkedStack:

```java
import java.util.NoSuchElementException;

public class LinkedStack implements Stack {
	private int size;
	private Node top;

	private class Node {
		private Object data;
		private Node next;

		public Node(Object data, Node next) {
			this.data = data;
			this.next = next;
		}
	}

	@Override
	public Object peek() {
		if (this.isEmpty())
			throw new NoSuchElementException("Stack is empty!");
		return top.data;
	}

	@Override
	public Object pop() {
		if (this.isEmpty())
			throw new NoSuchElementException("Stack is empty!");
		Object object = top.data;
		top = top.next;
		size--;
		return object;
	}

	@Override
	public boolean push(Object object) {
		top = new Node(object, top);
		size++;
		return true;
	}

	@Override
	public int size() {
		return size;
	}
```

```java
	@Override
	public boolean isEmpty() {
		return size == 0;
	}

	//////////////////// Method to Convert the LinkedStack to an
string
	@Override
	public String toString() {
		if (this.isEmpty())
			throw new NoSuchElementException("Stack is empty!");
		Node start = top;
		String buffer = "[";
		while (start != null) {
			buffer += start.data + ",";
			start = start.next;
		}
		buffer = buffer.substring(0, buffer.length() - 1);

		return buffer + "]";
	}

////////////////////Method to check if two ArrayStacks are equal
	public boolean equals(LinkedStack stack) {
		if (this.isEmpty() && stack.isEmpty())
			return true;
		if (this.isEmpty() || stack.isEmpty())
			return false;
		if (this.size() != stack.size())
			return false;
		Node p1 = this.top;
		Node p2 = stack.top;
		while (p1 != null) {
			if (!p1.data.equals(p2.data))
				return false;
			p1 = p1.next;
			p2 = p2.next;
		}
		return true;
	}

////////////////////Method to return bottom element
	public Object bottomElement() {
		if (this.isEmpty())
			throw new NoSuchElementException("Stack is empty!");
```

```
            Node p = top;
            while (p.next != null) {
                  p = p.next;
            }
            return p.data;
      }

//////////////////Method to remove+return bottom element
      public Object removeBottomElement() {
            if (this.isEmpty())
                  throw new NoSuchElementException("Stack is empty!");
            Node p = top;
            while (p.next.next != null) {
                  p = p.next;
            }
            Object obj = p.next.data;
            p.next = null;
            --size;
            return obj;
      }

//////////////////Method to return second element
      public Object secondElement() {
            if (this.isEmpty())
                  throw new NoSuchElementException("Stack is empty!");
            return top.next.data;
      }

//////////////////Method to remove+return second element
      public Object removeSecondElement() {
            if (this.isEmpty())
                  throw new NoSuchElementException("Stack is empty!");
            Object object = top.next.data;
            top.next = top.next.next;
            --size;
            return object;
}

//////////////////Method to convert current ArrayStack to equivalent
LinkedStack
      public ArrayStack toArrayStack() {
            if (this.isEmpty())
                  throw new NoSuchElementException("Stack is empty!");
            ArrayStack stack = new ArrayStack(this.size());
            Object array[] = new Object[size()];
            int index = 0;
```

```
            for (Node i = top; i != null; i = i.next)
                  array[index++] = i.data;
            while (--index >= 0)
                  stack.push(array[index]); // for preserving same order
that's why storing elements in an Object array

            return stack;
      }

      public static void main(String[] args) {
            LinkedStack stack = new LinkedStack();
            stack.push(2);
            stack.push(50);
            stack.push("Hello");
            stack.push(20);
            stack.push(60);
            stack.push(45);
            stack.push(80);
            LinkedStack stack2 = new LinkedStack();
            stack2.push(2);
            stack2.push(50);
            stack2.push("Hello");
            stack2.push(20);

            System.out.println("stack.toString()            : " +
stack.toString());
            System.out.println("stack2.toString()           : " +
stack2.toString());
            System.out.println("\nstack.equals(stack2)        : " +
stack.equals(stack2));
            System.out.println("\nstack.removeBottomElement() : " +
stack.removeBottomElement());
            System.out.println("stack.bottomElement()       : " +
stack.bottomElement());
            System.out.println("\nstack.removeSecondElement()      : " +
stack.removeSecondElement());
            System.out.println("stack.secondElement()            : " +
stack.secondElement());
            System.out.println("stack.size()                     : " +
stack.size());
            System.out.println("stack.toString()                 : " +
stack.toString());

            System.out.println("stack.toArrayStack().toString()  : " +
stack.toArrayStack().toString());
      }
```

```
}
```

```
<terminated> LinkedStack [Java Application] C:\Program Files\Java\jre1.8.0_261\bin\javaw.exe (Feb
stack.toString()              : [80,45,60,20,Hello,50,2]
stack2.toString()             : [20,Hello,50,2]

stack.equals(stack2)          : false

stack.removeBottomElement() : 2
stack.bottomElement()         : 50

stack.removeSecondElement()       : 45
stack.secondElement()             : 60
stack.size()                      : 5
stack.toString()                  : [80,60,20,Hello,50]
stack.toArrayStack().toString()   : [80,60,20,Hello,50]
```

Task#4

Code:

```
import java.util.Stack;

public class StackTask2 {

	public static void main(String[] args) {
		Stack<String> nameStack = new Stack<String>();
		nameStack.push("Zohaib"); // #1
		nameStack.push("Syed Ahmad");
		nameStack.push("Uzair");
		nameStack.push("Noman");

		System.out.println("nameStack.toString(): " +
nameStack.toString()); // #2
		System.out.println("nameStack.peek()    : " +
nameStack.peek()); // #3
		System.out.println("nameStack.pop()     : " +
nameStack.pop()); // #4
```

```
            System.out.println("nameStack.capacity(): " +
nameStack.capacity()); // #5
            System.out.println("nameStack.isEmpty() : " +
nameStack.isEmpty()); // #6

        }

}
```

OUTPUT:

```
Problems  Javadoc  Declaration  Search  Console  Coverage
<terminated> StackTask2 [Java Application] C:\Program Files\Java\jre1.8.0_261\bin\javaw.exe  (Feb 9
nameStack.toString(): [Zohaib, Syed Ahmad, Uzair, Noman]
nameStack.peek()    : Noman
nameStack.pop()     : Noman
nameStack.capacity(): 10
nameStack.isEmpty() : false
```