**CMPSCI 187 (Spring 2018) Lab 03: Stacks and Parameter Passing**

The goal of this lab is to: understand parameter passing, stacks and exceptions.

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* When you are done, go to ***File -> Download As -> PDF Document.*** You must select PDF, as Gradescope does not accept other formats.
* **Submit your PDF in** [Gradescope](https://gradescope.com/) **under Lab**. Note: submit to Lab, **not** to Project!
* There is NO starter code for this lab -- you should work on the exercises without using any Java IDE or compiler. This is the same during exams.

**Section A: Parameter passing**

Defined below is a class **Account,** which stores balance in a person’s bank account. Carefully read the three **swap** functions defined in this class and answer the questions that follow.

**public class Account{**

**public int bal**; // this store the balance amount in the account

**public Account(int initialBalance)**

**{**

bal = initialBalance;

**}**

**public static void swap\_1(int num1, int num2)**

**{**

int temp = num1;

num1 = num2;

num2 = temp;

**}**

**public static void swap\_2(Account acc1, Account acc2)**

**{**

int temp = acc1.bal;

acc1.bal = acc2.bal;

acc2.bal = temp;

**}**

**public static void swap\_3(Account acc1, Account acc2)**

**{**

Account temp = acc1;

acc1 = acc2;

acc2 = temp;

**}**

**}**

Now, different students tried to use different **swap\_\*()** methods to swap the balances in their friends’ bank accounts. Predict the output of each of the following code snippets [**1 pts each**]

**(a)** Account tom = new Account(100);

Account jim = new Account(2000);

System.out.println(“1.Tom has $” + tom.bal + “Jim has $” + jim.bal);

swap\_1(tom.bal, jim.bal);

System.out.println(“2.Tom has $” + tom.bal + “Jim has $” + jim.bal);

|  |
| --- |
| 1. Tom has $100Jim has $2000 2. Tom has $100Jim has $2000 |

**(b)** Account tom = new Account(100);

Account jim = new Account(2000);

System.out.println(“1.Tom has $” + tom.bal + “Jim has $” + jim.bal);

swap\_2(tom, jim);

System.out.println(“2.Tom has $” + tom.bal + “Jim has $” + jim.bal);

|  |
| --- |
| 1. Tom has $100Jim has $2000 2. Tom has $2000Jim has $100 |

**(c)** Account tom = new Account(100);

Account jim = new Account(2000);

System.out.println(“1.Tom has $” + tom.bal + “Jim has $” + jim.bal);

swap\_3(tom, jim);

System.out.println(“2.Tom has $” + tom.bal + “Jim has $” + jim.bal);

|  |
| --- |
| 1. Tom has $100Jim has $2000 2. Tom has $100Jim has $2000 |

**Section B: Fun with stacks [2 pts each question]**

Consider a generic **Stack** class implemented using linked list with the following methods:

* **public boolean isEmpty()**, which returns true *if and only if* the stack is empty;
* **public T pop() throws StackUnderflowException**, which removes and returns the top element of the stack (if the stack is empty, it throws StackUnderflowException);
* **public T peek() throws StackUnderflowException**, which returns the top element of the stack (but does not remove it; it throws exception if stack is empty);
* **public void push(T element)**, which pushes an element onto the stack

**Predict the output of each of the following code snippets**

(a) Stack<Integer> s = new Stack<Integer>();

**try**{

s.push(5);

s.push(10);

System.out.println(s.peek());

System.out.println(s.pop());

s.push(20);

System.out.println(s.pop());

}  
 **catch**(Exception e) { System.out.print(“An exception was thrown”); }

|  |
| --- |
| 10  10  20 |

(b) Stack<Integer> s = new Stack<Integer>();

**try**{

s.push(5);

s.push(50);

System.out.println(s.pop());

System.out.println(s.pop());

System.out.println(s.peek());

s.push(30);

}  
**catch**(Exception e) { System.out.println(“An exception was thrown”); }

|  |
| --- |
| 50  5  An exception was thrown |

(c) Stack<Integer> s = new Stack<Integer>();

**try**{

s.push(5);

System.out.println(s.pop());

System.out.println(s.isEmpty());

s.push(10);

s.push(43);

s.push(s.pop());

System.out.println(s.peek());

} **catch**(Exception e) {

System.out.println(“An exception was thrown”);

**}**

|  |
| --- |
| 5  True  43 |

(d) Stack<Integer> s = new Stack<Integer>();

**try** {

s.push(5);

s.push(10);

while(!s.isEmpty())

{

System.out.println(s.peek());

}

}  
**catch**(Exception e) { System.out.println(“An exception was thrown”); }

|  |
| --- |
| 10  10  10  10  10  10  .  .  .  (It is an infinite loop) |

**Section C: Implementing Stack using Linked List**

In this section, you will implement a generic Stack class implemented using linked list. Assume the linked list node class is already defined as below:  
 public class **LLNode<T>** {  
 **public** LLNode<T> link;

**public** T info;

**public** LLNode(T in) { info = in; link = null; }

}

Note that both class variables are public so any outside class can access them directly. Also assume that class StackUnderflowException has been defined that inherits Java’s Exception class. Your task is to implement four methods in the generic class LinkedListStack<T>.

public class LinkedListStack<T> {

private **LLNode<T> head;** *// head of linked list, also stack top pointer*

public **LinkedListStack**() { head = null; } *// constructor*

public **boolean isEmpty**() { **// [1 pts]**

*// TODO: return true if stack is empty, false otherwise*

*// NO MORE THAN 1 LINE OF CODE!*

return (head == null);

}

public **void push(T element)** { **// [2 pts]**

*// TODO: push an element to the stack*

*// NO MORE THAN 3 LINES of CODE!*

LLNode<T> temp = new LLNode<T>(element);

temp.link = head;

head = temp;

}

public **T peek() throws StackUnderflowException** { **// [2 pts]**

*// TODO: return the top element of the stack (but do NOT  
 // remove it). NO MORE THAN 4 LINES of CODE!*

if(isEmpty()){

throw new StackUnderflowException(“underflow”);

}

return head.info;

}

public **T pop() throws StackUnderflowException** { **// [3 pts]**

*// TODO: remove and return the top element of the stack*

*// It throws StackUnderflowException if stack is empty*

*// NO MORE THAN 6 LINES of CODE!*

if(isEmpty()){

throw new StackUnderflowException(“underflow”);

}

T newInfo = head.info;

head = head.link;

return newInfo;

}