

Cmp Sci 187: Programming with Data Structures

Stacks

1. Package

```
package a.b.c; //1
public class X {} //2

package a.b.c.d; //3
public class X {} //4
```

Are the declarations in lines 1-4 correct?

Suppose the above hierarchy is stored in a base directory called Import. Which directory contains the class X from lines 1-2? And Class X from lines 3-4?

2. Expressions

```
1 + 2 + 3 + 4 //1
1 + (2 * 3) + 4 //2
(1 * 2) + 3 + 4 //3
1 + 2 + (3 * 4) //4

(1 + 2) * 3 + 4 //5
(1 + 2) * (3 + 4) //6
1 * (2 + 3) * 4 //7
1 * 2 * 3 * 4 //8
```

Convert to postfix notation.

Show the stack while evaluating these postfix expressions.

3. Execution Stack

Cmp Sci 187: Programming with Data Structures Stacks

You have used `printStackTrace(OutputStream)` method that is available as part of the `Throwable` class. It prints the method call chain at the point where the exception occurred. This information is provided by the Java run time. Many languages like Java, C++, C use a stack of method frames for execution of method calls. Each method has an associated memory region called a frame which is pushed on a stack when the method is invoked and is popped when it returns.

Suppose we want to view the call chain of our application as it is executing. Using the given class `Global` below, how can you achieve that? For simplicity we will assume that our application has just two classes, `X` and `Y` with one method each and the main method is part of class `X` and that it uses only these three classes, `X`, `Y` and `Global`.

```
public class Global { //1
    private static Stack<String> callstack;
    static {
        callstack = new Stack<String>();
    }
    static void addCall(String name) {}
    static void removeCall () {}
    static void printCallChain () {}
}

public class X { //2
    public void methodOne (Y y) { y.methodTwo(); }
    public static main (String [] args) {
        X x = new X();
        Y y = new Y();
        x.methodOne(y);
    }
}

public class Y { //3
    public void methodTwo () {}
}
```

Cmp Sci 187: Programming with Data Structures

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4. Web Browser

Many web browsers like Netscape, IE, Firefox, Safari have two navigation buttons, previous and next which allow you to navigate through the pages you have visited. Give a skeleton of how these could be implemented. **Hint:** Does Stack fit in here ?

```
public class Page {
    public Page (String url) {}
}

public class History {
    public History () {}
    public Page next () {}
    public Page previous () {}
}
```

5. Push Down Automaton

A push down automaton (PDA) consists of a Finite Automaton (FA) and a Stack. A finite automaton consists of a certain number of states. It looks at the current input and can move to a different state based on the input. It may produce a certain output. The PDA model of computation can perform certain functions which the FA cannot.

Write a program using an FA and a Stack to check if the strings given as input are of the form $a^n b^n$ i.e., have equal number of consecutive **a**'s followed by consecutive **b**'s. The value of n is not known a priori. As you are simulating an FA in your program you can only look at the input and switch states but you cannot count the characters you have seen.

```
public class SequenceAnBnChecker {
    public SequenceAnBnChecker(InputStream is) {}
    public boolean check () {}
}
```