COE528 (Fall 2016)
Lab3

General Lab Rules
All the necessary files of this lab should be in lab3 directory.
All the java files in this lab should have the following package declaration:

```
package coe528.lab3;
```

Duration: one week.

Objectives

- Use Java interface
- Use abstract class

In this lab, you will design and implement few classes that model an odometer. An odometer is a counter with a specified number of digits. There is no *a priori* limit on the number of digits an odometer can have. The count can be incremented or decremented by one. If all digits are 9, incrementing will cause all digits to become 0. If all digits are 0, decrementing will cause all digits to become 9. The commands an odometer must support are *increment*, *decrement*, and *reset*. A query *count* provides the current value.

Design:

Since there is no limit on the number of digits, we cannot use a simple integer counter. In fact, we cannot return the value of the odometer as an *int*. We'll return the value of the odometer as a *String*, with high-order 0's suppressed.

The odometer is designed as a sequence of digits, each with a value in the range 0 through 9. When the odometer is incremented, if the right-most digit is less than 9, it is incremented by 1. If that digit is 9, it is set to zero and process repeated for the next digit.

For any given digit, the increment algorithm will be:

```
void increment () {
     if (value < 9)
         value = value + 1;
     else {
         value = 0;
         increment digit to the left
     }
}
```

Decrement is similar:

```
void decrement () {
     if (value > 0)
         value = value - 1;
```

```
    else {
        value = 9;
        decrement digit to the left
    }
}
```

Two questions need to be addressed:

- how is a digit represented?
- what happens with the left-most digit?

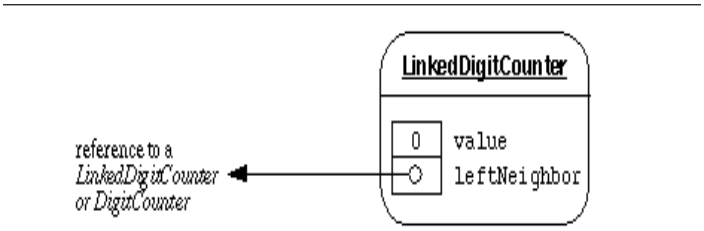
A digit can be represented as a counter that counts from zero to nine, and has essentially the same operations as an odometer: commands *reset*, *increment*, and *decrement*, and a *String*-returning query *count*. We name the class representing digits *LinkedDigitCounter*.

The left-most digit behaves just as the others, except that it never references the "digit to the left." We need a class to model this kind of digit: that is, a digit with no left neighbor. We call it *DigitCounter*.

How do we put the digits together to form an odometer? The answer to this will simply be based on what a *LinkedDigitCounter* should know:

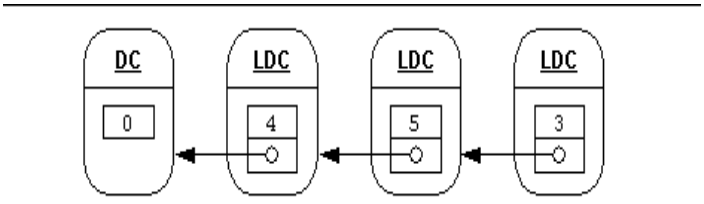
- it must know its current value;
- it must know its left neighbor.

A *LinkedDigitCounter* will look like this:



A *DigitCounter*, on the other hand, need only know its current value.

A four-digit odometer, for instance, will consist of three *LinkedDigitCounter* instances, and one *DigitCounter*:



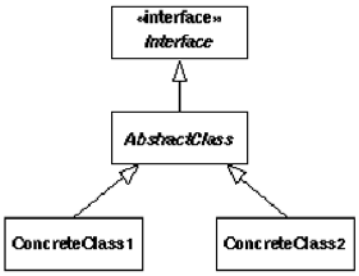
The above grouping represents the value 0453.

DigitCounter, *LinkedDigitCounter*, and *Odometer* have the same functionality. We can specify the functionality using an interface.

```
/* A basic up/down counter. */
public interface Counter {
   /* The current value of this Counter as a String of digits. */
    String count();

    /* Increment this Counter.   */
    void increment();

    /* Decrement this Counter.  */
    void decrement();

    /* Reset this Counter.  */
    void reset();
}
```

Implementing the classes:

A common structural pattern is to define an abstract class that implements an interface, defines data common to all interface implementations, and provides some default method implementations. Concrete classes can then extend the abstract class:



We will define an abstract class *AbstractCounter* that implements the abstract methods of the interface *Counter* and defines an *int* component variable to contain the value of the counter. The abstract class also defines a constructor that initializes the value to 0. The classes *DigitCounter* and *LinkedDigit-Counter* will both extend this abstract class.

In the Netbeans program, click on Project > New Project and save it as "Ex1" on your lab3 direc-tory.

In this lab, you will have one interface (*Counter* interface) and five classes (*AbstractCounter*, *Digit-Counter*, *LinkedDigitCounter*, *Odometer*, *OdometerTUIStart*).

- Implement the class *AbstractCounter*. Be aware that the data will be shared by its subclasses, and those subclasses should be able to modify it.
- Implement the classes *DigitCounter* and *LinkedDigitCounter*. The class *LinkedDigitCounter* adds a new attribute, *leftNeighbor*. The value of *leftNeighbor* might reference a *LinkedDigit-Counter* or a *DigitCounter*. Its type should be *Counter*, and the *LinkedDigitCounter* constructor should require a *Counter* as an argument.
- Implement the class *Odometer*. An n-digit odometer contains (n-1) *LinkedDigitCounter* instances, and one *DigitCounter* instance. We should be able to specify n while creating an *Odometer* instance.
- Compile and test your implementation. A test driver, *OdometerTUIStart* class that contains the *main* method, should be implemented.

Submitting your lab

You must submit your lab electronically at least 24 hours prior to the start of your scheduled lab period for Lab 4.

You must include the duly filled and signed standard cover page with your submission. The cover page can be found on the departmental web site: Standard Assignment/Lab Cover Page

If you did the lab on a Departmental computer, you can do the following:

```
cd coe528
zip -r lab3.zip lab3
submit coe528 lab3 lab3.zip
```

If you did the lab on your own computer, zip the lab3 folder (remember to do this recursively so that all sub-folders are included), then transfer the zip file to a Departmental machine, logon to a Departmental machine which can be done remotely) and type in the submit command:

```
submit coe528 lab3 lab3.zip
```