Let’s start building up an inventory of simple classes that might be useful components for future work.

1. One of the libraries that instructors in the current CSC 151 course have been supplying to their students implements an abstract data type called counter. You can think of a counter as a simulation of those old-fashioned hand-held clickers that people used to use to count attendees at a county fair as they pass through the turnstile at the entrance gate or to tally cars as they cross a bridge. Such a clicker is basically a numerical display with a tally button that increments the number displayed and a reset button to reset that number to zero.

The implementation of this data type in CSC 151 provides a constructor (counter-new), an accessor (counter-get), and restricted mutation procedures for incrementing the internal tally and resetting it to zero (counter-increment! and counter-reset!).

Reimplement this ADT as a Java class, Counter, and test your implementation.

2. In the implementation of counters in CSC 151, each counter produced by the constructor actually carries around a name which is specified as a string argument to the constructor. This name is supposed to be immutable, since none of the ADT procedures modify it, and it is used only by a counter-print procedure that displays the internal state of the counter.

Add a private name field to your Counter class. Add a String argument to the constructor that you wrote for the preceding exercise, and makes it the name of the counter. Add a toString method that constructs and returns a String consisting the counter’s name, a colon, a space, and the current tally. Test the new features of your implementation.

3. A slightly more sophisticated device is the averager, which allows the user to add any number, not just 1, to a running total that it maintains, and also keeps track of the number of addends that it has received since it was created or last reset. The averager can divide its running total by its running tally of addends to report the arithmetic mean of all of those addends.

For a minimal implementation, you’ll need a constructor, a mutator that takes a numerical argument and adds it to the running total (simultaneously incrementing the addend tally behind the scenes), a mutator that resets both the running total and the addend tally to 0, and an accessor that gives you the average of the addends.

The arithmetic mean is undefined when the addend tally is 0. In this special case, the accessor method should return 0 after printing a brief error report to System.err, which is a PrintStream analogous to C’s stderr file descriptor.

Implement and test an Averager class.

4. Other potentially useful features for averagers include separate accessors for the running total and the addend tally, toString and equals methods, accessors for the maximum and minimum values among the addends seen so far, and a method that takes another Averager as argument and combines its running total and addend tally with the running total and addend tally inside this.

A little thought should suggest other, more innovative features and extensions. Choose some of them, implement them, and test your revised implementation.