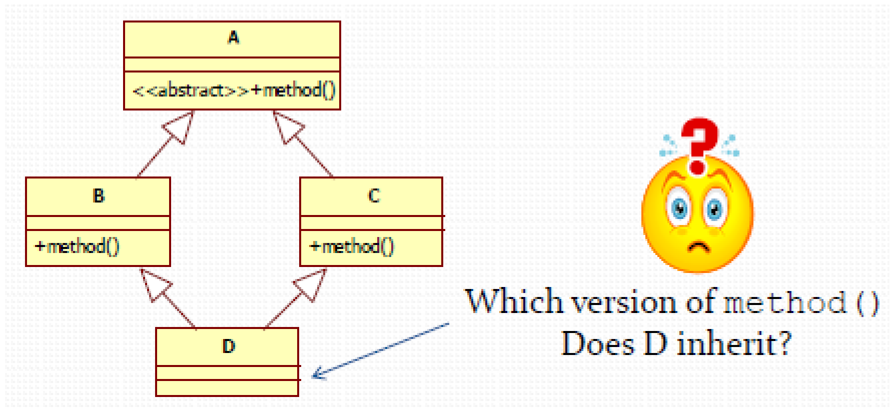
Lab 7

1. Short Answer
   A. In the slides it was mentioned that Java's `ArrayList` implements 6 interfaces and extends one class. What are they?

   Parts B – D of this Problem refer to code in package `lesson7.labs.prob1`, in which you are trying to remove duplicates from a List and then test that your output is correct. All three attempts to solve this problem are incorrect in some way (when you run the code, output message indicates that the procedure fails). Explain, in each case, what is wrong with the solution. Place each of your answers in a text file in the relevant package.

   E. Lesson 5 introduced the Diamond Problem that must be handled by any language that supports multiple inheritance. Java SE 8 now supports "behavioral" multiple inheritance (but not "data" multiple inheritance). Explain how features of Java 8 handle the Diamond Problem by considering two scenarios:

      i. When the type D is a class
      ii. When the type D is an interface.



2. The Lesson 5 Demo in `lesson5.lecture.intfaces2` shows how to polymorphically compute the average perimeter of a list of geometric objects by requiring each to implement the `ClosedCurve` interface. Notice that when a closed curve happens to be a polygon, computing the perimeter is especially easy – you just add up the lengths of the sides.

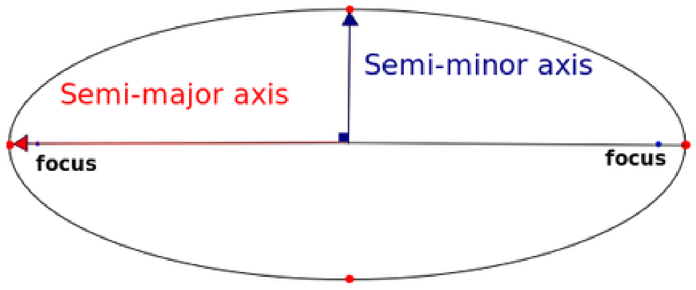
   If we create an interface `Polygon` having method `double[] getSides()` (which will return the length of each side of the polygon in an array), we could replace `ClosedCurve` in our example with `Polygon` – *if* we didn't have to take into account the computation of the perimeter of *non-*polygons, like `Circles`.

   Copy the classes/interfaces from lesson5.lecture.intfaces2 into a new package for this Lab problem, and create a new `Polygon` interface. Then think of a way to make use of both `ClosedCurve` and

`Polygon` so that, when `computeAveragePerimeter` is called on a `ClosedCurve` that implements the `Polygon` interface, the side lengths are added up, but when the object is not a polygon, a different computation of perimeter is done (as in the case of a circle). *Hint.* Create a `default` method in `Polygon`.

Try out your approach by adding two new `ClosedCurve`s to your package: `EquilateralTriangle` and `Ellipse` (an equilateral triangle is a triangle in which all side lengths are equal). Modify `DataMiner` so that it includes in the `objects` list instances of these new classes.

Hint. The perimeter (or circumference) of an ellipse is *4aE* where *a* is the length of the semi-major axis and *E* is the value of the elliptic integral evaluated at the ellipse's eccentricity. You do not need to know these technical concepts; just include *a* and *E* as instance variables in your class, of type `double`, and include them as arguments to the `Ellipse` constructor.



3. The code for Lab7 Prob3 includes the following classes/interfaces: Cache, StaticStorage, along with a driver class Main and a Customer class. StaticStorage is intended to store data that becomes available during the execution of the application, and this data needs to be accessible throughout the application for a certain period of time. It is reasonable to make StaticStorage a singleton. Since StaticStorage is going to play the role of a *cache*, it is also natural for StaticStorage to inherit from Cache. For simplicity, we have only one method in Cache: timeout(). This tells how long items will be allowed to stay in the cache. For this problem, refactor Cache and StaticStorage so that
    a. StaticStorage is a singleton (by making it an enum)
    b. The method timeout() can be accessed by StaticStorage through "inheritance" (and the static keyword is removed)

   Draw a class diagram of the classes in your updated package.

4. In the lesson7.lab4.prob4 package, there is a class called ForEachExample that specifies, in its main method, a list of Strings. Use the Java 8 forEach method within the main method to print out the list so that *all Strings are in upper case*. To do this, you will need to define your own implementation of the Consumer interface.

5. Rework the Duck Application of Lab 5, Problem 1 so that Flyable and Quackable interfaces *are* used after all, but now use Java 8 interfaces. Rewrite your code with this approach.