Lab 7

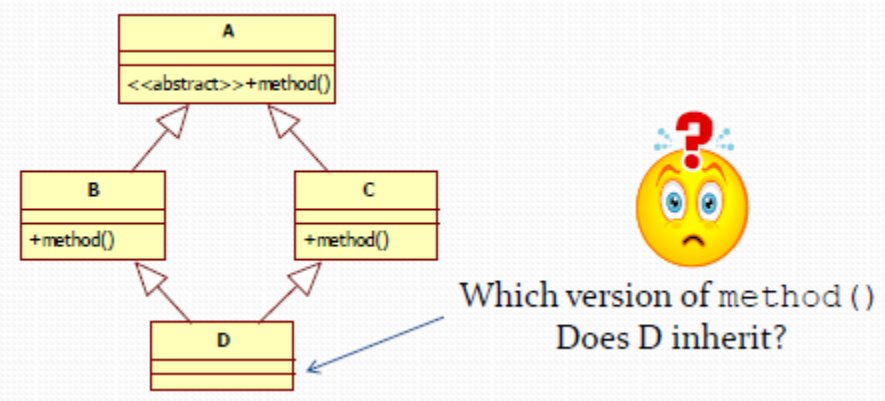
1. Short Answer

   A. In an earlier lesson, 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.



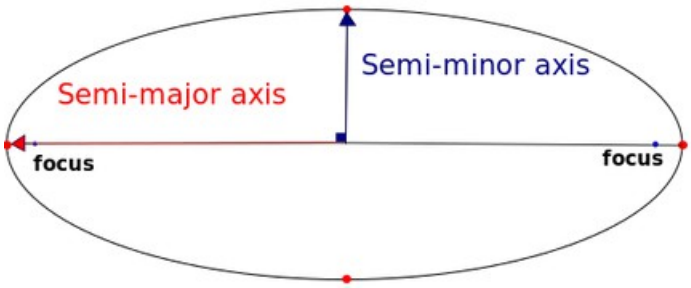
2. The Lesson 5 Demo in `lesson5.lecture.intfaces2` shows how to polymorphically compute the average perimeter of a list of geometric objects by requiring each to implement the `ClosedCurve` interface. Notice that when a closed curve happens to be a polygon, computing the perimeter is especially easy – 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 an interface `Polygon` – *if* we didn't have to take into account the computation of the perimeter of *non*-polygons, like `Circles`. In this problem, you will find a way to make use of both `ClosedCurve` and `Polygon`.

Startup code for this problem is in the package lesson7.labs.prob2; it contains classes Circle and Rectangle, the interface ClosedCurve, and a DataMiner class that contains a main method that loads a few of these geometric objects into an array and computes the averagePerimeter. Begin by creating a new `Polygon` interface. Then think of a way to make use of both `ClosedCurve` and `Polygon` so that, when `computePerimeter` is called on one of the geometric objects that implements the `Polygon` interface (like `Rectangle`), 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`. The idea is that you try to use the generic computation for computing perimeter, available in Polygon, whenever it is possible.

Expand your code 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. In the lesson7.labs.prob3 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.