Chulalongkorn University
International School of Engineering
Department of Computer Engineering
2140105 Computer Programming Lab.

Name _____
Student ID _____
Station No. _____
Date _____

Lab 6 – Pre Midterm

Objectives:

- Learn to use Eclipse as Java integrated development environment.
- Practice basic java programming.
- Practice all topics since the beginning of the course.
- Practice for midterm examination.

Definition of a Rational number[1]

In mathematics, a **rational number** is a number which can be expressed as a ratio of two **integers**. Non-integer rational numbers (commonly called fractions) are usually written as the fraction $\frac{a}{b}$, where *b* is not zero.

Each rational number can be written in infinitely many forms, such as $\frac{3}{6} = \frac{2}{4} = \frac{1}{2}$, but is said to be in simplest form is when *a* and *b* have no common divisors except 1. Every non-zero rational number has exactly one simplest form of this type with a positive denominator. A fraction in this simplest form is said to be an *irreducible fraction* or a fraction in *reduced form*.

Class Rational

An object of this class will have two integer numbers: *numerator* and *denominator* (e.g. for an object represents $\frac{a}{b}$ will have *a* as its numerator and *b* as its denominator). Each object will store its value as an *irreducible fraction* (e.g.$\frac{2}{10} \rightarrow \frac{1}{5}$)

This class has three constructors:

- Constructor that has no argument: create an object represents zero ($\frac{0}{1}$)
- Constructor that has two integer arguments: numerator and denominator, create a rational number object in reduced form.
- Constructor that has one Rational argument: create a rational number object which it *numerator* and *denominator* equal to the argument.

And these object methods:

- **`public Rational add(Rational r):`** return new rational number results from this + r.
- **`public Rational subtract(Rational r):`** return new rational number results from this - r.

[1] From Wikipedia, the free encyclopedia.

- **`public Rational multiply(Rational r):`** return new rational number result from this * r.
- **`public Rational divide(Rational r):`** return new rational number result from this / r.
- **`public void toString():`** return "**`(1/5)`**", without double quote, from object representing $\frac{1}{5}$.
- **`public int compareTo(Rational r):`** return 0 if this rational number is equal to r, return positive integer if this rational number is greater than r, and return negative integer if this rational number is less than r.

All zero will be represented with $\frac{0}{1}$.

To write this **`Rational`** class you may need a method to calculate ***`gcd`***.

> In mathematics, the greatest common divisor (gcd), sometimes known as the greatest common factor (gcf) or highest common factor (hcf), of two non-zero integers, is the largest positive integer that divides both numbers.
>
> The greatest common divisor of ***`a`*** and ***`b`*** is written as ***`gcd(a, b)`***. For example, ***`gcd(12, 18) = 6`***, ***`gcd(-4, 14) = 2`*** and ***`gcd(5, 0) = 5`*** respectively.
>
> The code below shows how to implement ***`gcd`*** function recursively.

```
/**
 * Return the greatest common divisor
 */

 public static long gcd(long a, long b) {

   if (b == 0)
     return a;
   else
     return gcd(b, a % b);
 }
```

Lab Exercise

Your turn

Write a Java class, names Rational that represents Rational Numbers following the specification for describe below. You must use JUnit to test your class. For each method, you must test at least 4 cases and one of them must be ***assertFalse*** test. You must write a comment to explain (shortly) what you are testing. You do not have to test ***gcd*** method.

Your test cases **must** include these cases.

$\frac{2}{10} \to \frac{1}{5}$, $\frac{2}{-10} \to \frac{-1}{5}$, $\frac{-2}{10} \to \frac{-1}{5}$, $\frac{-2}{-10} \to \frac{1}{5}$, $\frac{0}{-10} \to \frac{0}{1}$

new Rational() →new Rational(0,1)

toString(5000,10000) → "(1/2)"

$\frac{2^{60}}{147} \times \frac{63}{2^{59}} \to \frac{6}{7}$

$\frac{32}{81} + \frac{45}{72} \to \frac{661}{648}$

$\frac{32}{81} - \frac{45}{72} \to \frac{-149}{648}$

$\frac{2^{60}}{147} \div \frac{2^{59}}{63} \to \frac{6}{7}$

$\frac{32}{81} - \frac{32}{81} \to \frac{0}{1}$

Solution

You can download the solution from http://www.cp.eng.chula.ac.th/~chate/2140105/.

Please note that this solution is not the only way to implement this class. Your answer might be different from the solution. Try to test your implementation with the test cases provided.