Programming Assignment

Course #: PROG 2100

**Assignment #2 (“Rational Number Calculator”)**

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Define a class for rational numbers. A rational number is a number that can be represented as the quotient of two integers. For example, ½, ¾, 64/2, and so forth are all rational numbers. (By ½ and so on we mean the everyday fraction, not the integer division this expression would produce in a C++ program.) Represent rational numbers as two values of type int, one for the numerator and one for the denominator. Call the class Rational. Include a constructor with two arguments that can be used to set the member variables of an object to any legitimate values. Also include a constructor that has only a single parameter of type int; call this single parameter whole Number and define the constructor so that the object will be initialized to the rational number whole Number/1. Include a default constructor that initializes an object to 0 (that is, to 0/1). Overload the output operator <<. Numbers are to be input and output in the form ½, 15/32, 300/400, and so forth. Note that the numerator, the denominator, or both may contain a minus sign, so -1/2, 15/-32, and -300 / -401 are also possible inputs. Overload all the following operators so that they correctly apply to the type Rational: ==, <, >, +, -, \*, and /. Write a test program to test your class that loops after each calculation is complete.

**Notes:**

* Your solution must actually use the operators with rational objects when you do the operations. E.g. RationalNumObj = RationalNumObj#1 + RationalNumObject#2.
* The user may not enter decimal numbers as either the numerator or denominator e.g. “1.2/3.6” nor may the solutions be expressed as decimal numbers.
* There is no specific need for a string constructor as this functionality may be done in the overloaded >> operator.
* Inside the code of the overridden >> operator, have it call a validation method before it constructs an object. If the validation method returns invalid, execute a cin.fail and loop back for more input.

**Hints:**

* Two rational numbers a/b and c/d are equal if a\*d equals c\*b. If b and d are positive rational numbers, a/b is less than c/d provided a\*d is less than c\*b.
* You should include a function to normalize the values stored so that, after normalization, the denominator is positive and the numerator and denominator are as small as possible. For example, after normalization 4/-8 would be represented the same as -1/2.
* Since division is normally calculated by flipping one of the rational numbers and then multiplying the two rational numbers together, consider the effect of dividing by 0/#.

**Interface description (i.e. how the user interacts with your program):**

* User inputs entire first fraction (or whole number) as a string.
* User inputs entire second fraction (or whole number) as a string.
* Do **not** ask the user for the operations i.e. +,-,\*,/,==,<,> (this does not apply to bonus)
* Output for the non-bonus solution should list **all the operations** required in the assignment with only the right side of the equation (the answer) displayed normalized.

\*Any Research Component must be implemented (coded), not just “researched” to be graded and it will not affect your “Project functions to specification” mark if it is not included.

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Source: Modified from **Savitch Absolute C++**

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