

## Programming Practice: Rational Number

This assignment is to design and implement a C programming project of rational numbers. Suppose a rational number  $p/q$  is represented by two relatively prime integers  $p$  and  $q$ , where  $q$  is a non-zero positive integer. In the case of  $p/0$ , set this number to rational number  $0/1$ . The followings are rational number operations you will define and implement:

1. Addition:  $a/b + c/d = (ad + bc) / bd$ .
2. Subtraction:  $a/b - c/d = (ad - bc) / bd$ .
3. Multiplication:  $a/b \times c/d = ac/bd$ .
4. Division:  $a/b \div c/d = ad/bc$ .
5. Absolute value:  $|a/b| = |a|/|b|$ .
6. Rational conversion from two integers:  $(p, q)$  to  $p/q$ .
7. Rational conversion from an integer:  $(p)$  to  $p/1$ .
8. Print a rational number.

If rational number  $p/q$  that  $p$  and  $q$  are not relatively prime, simplify  $p/q$  by dividing both  $p$  and  $q$  by their greatest common division. If  $p/q$  is a negative rational number, simplify the rational number as  $p < 0$  and  $q > 0$ . Euclidean algorithm for computing the great common divisor of two integers  $m$  and  $n$  is given below for your reference:

```
// GCD: greatest common divisor
int gcd(int m, int n) {
    m = abs(m);
    n = abs(n);
    if (m % n == 0) return n;
    else return gcd(n, m % n);
}
```

1. Use rational number library and write a main program to declare and input four rational number variables  $a$ ,  $b$ ,  $c$ , and  $d$  and compute the following expressions:
  - a.  $a + b$
  - b.  $a - b$
  - c.  $a \times b$
  - d.  $a \div b$
  - e.  $|a|$
  - f.  $a \times |d - b| - (b + c \div a) \div |b + a - c \times d|$

Execution Example: (next page)

```
d:\>rational_number
Enter the numerator and denominator of a: 1 -3
Rational number a: -1/3

Enter the numerator and denominator of b: 4 3
Rational number b: 4/3

Enter the numerator and denominator of c: 14 27
Rational number c: 14/27

Enter the numerator and denominator of d: -15 2
Rational number d: -15/2

a + b = 1/1
a - b = -5/3
a * b = -4/9
a / b = -1/4
|a| = 1/3
a * |d - b| - (b + c / a) / |b + a - c * d| = -287/99
```

2. Use rational number and complex number libraries and write a main program to compute roots a quadratic equation. (No solution provided.)