Source File: `~/2336/09/lab09.(C|CPP|cpp|c++|cc|cxx|cp)`
Input: Under control of `main` function
Output: Under control of `main` function
Value: 1

The purpose of this assignment is to become more familiar with the process of providing overloaded operators for a class. The `Rational` class from Labs 02, 03, 05, and 07 will be modified to provide:

- overloaded operators (both prefix and postfix) for incrementing a `Rational` number by one and
- overloaded operators (both prefix and postfix) for decrementing a `Rational` number by one.

A header file is shown in Figure 1, a sample `main` function for testing your implementation is shown in Figure 2, and a sample execution sequence is shown in Figure 3. To use the `Makefile` as distributed in class, add a target of `lab09` to `targets2srcfileswithlibrary`.

```
1  #ifndef LAB09_H
2  #define LAB09_H
3
4  #include <iostream>
5
6  using namespace std;
7
8  class Rational
9  {
10   // overloaded input operator initializes Rational rat from input stream in
11   friend istream& operator>>(istream& in, Rational& rat);
12   // overloaded output operator prints Rational rat to output stream out
13   friend ostream& operator<<(ostream& out, const Rational& rat);
14  public:
15   Rational();                                        // default constructor
16   Rational(int num, int denom);                      // additional constructor
17   void setNumerator(int num);                        // set numerator to num
18   void setDenominator(int denom);                    // set denominator to denom
19   int getNumerator() const;                          // returns numerator
20   int getDenominator() const;                        // returns denominator
21   void reduce();                                     // reduce to lowest terms
22                                                      //   and normalize
23   Rational multiplicativeInverse() const;            // returns multiplicative
24                                                      //   inverse of *this
25
26   Rational& operator=(const Rational& rhs);          // *this = rhs
27   Rational operator+(const Rational& addend) const;// returns *this + addend
28   Rational operator-() const;                        // returns -(*this)
29   Rational operator-(const Rational& subtrahend) const;// returns *this - subtrahend
30   Rational operator*(const Rational& multiplicand) const;// returns *this * multiplicand
31   Rational operator/(const Rational& divisor) const;// returns *this / divisor
32
33   bool operator==(const Rational& rhs) const;     // *this == rhs
34   bool operator!=(const Rational& rhs) const;     // *this != rhs
35   bool operator< (const Rational& rhs) const;     // *this <  rhs
36   bool operator<=(const Rational& rhs) const;     // *this <= rhs
37   bool operator> (const Rational& rhs) const;     // *this >  rhs
38   bool operator>=(const Rational& rhs) const;     // *this >= rhs
39
```

Figure 1. `/usr/local/2336/include/lab09.h` (Part 1 of 2)

```
40    Rational& operator++();                          // preincrement
41    Rational operator++(int);                        // postincrement
42    Rational& operator--();                          // predecrement
43    Rational operator--(int);                        // postdecrement
44
45   private:
46    pair<int, int> data;                             // member first -> numerator
47                                                     // member second -> denominator
48    int gcd(int m, int n) const;                     // returns the greatest
49                                                     //   common divisor of m
50                                                     //   and n
51    int lcm(int m, int n) const;                     // returns the least common
52                                                     //   multiple of m and n
53  };
54
55  #endif
```

Figure 1. `/usr/local/2336/include/lab09.h` (Part 2 of 2)

```
1   #include <lab09.h>
2   #include <iostream>
3
4   using namespace std;
5
6   int main()
7   {
8     Rational rat, temp;
9
10    while (cin >> temp)
11    {
12      rat = temp;
13      cout << "rat = " << rat;
14      cout << " ++rat = " << ++rat << endl;
15
16      rat = temp;
17      cout << "rat = " << rat;
18      cout << " rat++ = " << rat++;
19      cout << " rat = " << rat << endl;
20
21      rat = temp;
22      cout << "rat = " << rat;
23      cout << " --rat = " << --rat << endl;
24
25      rat = temp;
26      cout << "rat = " << rat;
27      cout << " rat-- = " << rat--;
28      cout << " rat = " << rat << endl;
29    }
30
31    return EXIT_SUCCESS;
32  }
```

Figure 2. `/usr/local/2336/src/lab09main.C`

```
newuser@csunix ~> cd 2336
newuser@csunix ~/2336> ./getlab.ksh 09
  * Checking to see if a folder exists for Lab 09. . .No
  * Creating a folder for Lab 09
  * Checking to see if Lab 09 has sample input and output files. . .Yes
  * Copying input and output files for Lab 09
    from folder /usr/local/2336/data/09 to folder ./09
  * Checking to see if /usr/local/2336/src/lab09main.C exists. . .Yes
  * Copying file /usr/local/2336/src/lab09main.C to folder ./09
  * Checking to see if /usr/local/2336/include/lab09.h exists. . .Yes
  * Copying file /usr/local/2336/include/lab09.h to folder ./09
  * Copying file /usr/local/2336/src/Makefile to folder ./09
  * Adding a target of lab09 to targets2srcfileswithlibrary
  * Touching file ./09/lab09.cpp
  * Edit file ./09/lab09.cpp in Notepad++
newuser@csunix ~/2336> cd 09
newuser@csunix ~/2336/09> ls
01.dat       01.out       Makefile     lab09.cpp    lab09.h      lab09main.C
newuser@csunix ~/2336/09> make lab09
g++ -g -Wall -std=c++11 -c lab09main.C -I/usr/local/2336/include -I.
g++ -g -Wall -std=c++11 -c lab09.cpp -I/usr/local/2336/include -I.
g++ -o lab09 lab09main.o lab09.o -L/usr/local/2336/lib \
-Wl,-whole-archive -llab09 -Wl,-no-whole-archive -lm -lbits
newuser@csunix ~/2336/09> cat 01.dat
-3  4  3  4
 3 -4 -3 -4
25 45  8 99
 1  0  2  0
129 6579 1935 249
1331 1651 2301 1079
3 1260 6 198
43 1935 207 6579
5 7 -25 -35
-83 1651 127 -1079
1079 1651 -1651 1079
newuser@csunix ~/2336/09> cat 01.dat | ./lab09
rat = -3/4 ++rat = 1/4
rat = -3/4 rat++ = -3/4 rat = 1/4
rat = -3/4 --rat = -7/4
rat = -3/4 rat-- = -3/4 rat = -7/4
rat = 3/4 ++rat = 7/4
rat = 3/4 rat++ = 3/4 rat = 7/4
rat = 3/4 --rat = -1/4
rat = 3/4 rat-- = 3/4 rat = -1/4
rat = 3/-4 ++rat = 1/4
rat = 3/-4 rat++ = 3/-4 rat = 1/4
rat = 3/-4 --rat = -7/4
rat = 3/-4 rat-- = 3/-4 rat = -7/4
rat = -3/-4 ++rat = 7/4
rat = -3/-4 rat++ = -3/-4 rat = 7/4
rat = -3/-4 --rat = -1/4
rat = -3/-4 rat-- = -3/-4 rat = -1/4
rat = 25/45 ++rat = 14/9
rat = 25/45 rat++ = 25/45 rat = 14/9
```

Figure 3. Commands to Compile, Link, & Run Lab 09 (Part 1 of 2)

```
rat = 25/45 --rat = -4/9
rat = 25/45 --rat = -4/9
rat = 25/45 rat-- = 25/45 rat = -4/9
rat = 8/99 ++rat = 107/99
rat = 8/99 rat++ = 8/99 rat = 107/99
rat = 8/99 --rat = -91/99
rat = 8/99 rat-- = 8/99 rat = -91/99
rat = 1/1 ++rat = 2/1
rat = 1/1 rat++ = 1/1 rat = 2/1
rat = 1/1 --rat = 0/1
rat = 1/1 rat-- = 1/1 rat = 0/1
rat = 2/1 ++rat = 3/1
rat = 2/1 rat++ = 2/1 rat = 3/1
rat = 2/1 --rat = 1/1
rat = 2/1 rat-- = 2/1 rat = 1/1
rat = 129/6579 ++rat = 52/51
rat = 129/6579 rat++ = 129/6579 rat = 52/51
rat = 129/6579 --rat = -50/51
rat = 129/6579 rat-- = 129/6579 rat = -50/51
rat = 1935/249 ++rat = 728/83
rat = 1935/249 rat++ = 1935/249 rat = 728/83
rat = 1935/249 --rat = 562/83
rat = 1935/249 rat-- = 1935/249 rat = 562/83
rat = 1331/1651 ++rat = 2982/1651
rat = 1331/1651 rat++ = 1331/1651 rat = 2982/1651
rat = 1331/1651 --rat = -320/1651
rat = 1331/1651 rat-- = 1331/1651 rat = -320/1651
rat = 2301/1079 ++rat = 260/83
rat = 2301/1079 rat++ = 2301/1079 rat = 260/83
rat = 2301/1079 --rat = 94/83
rat = 2301/1079 rat-- = 2301/1079 rat = 94/83
rat = 3/1260 ++rat = 421/420
rat = 3/1260 rat++ = 3/1260 rat = 421/420
rat = 3/1260 --rat = -419/420
rat = 3/1260 rat-- = 3/1260 rat = -419/420
rat = 6/198 ++rat = 34/33
rat = 6/198 rat++ = 6/198 rat = 34/33
rat = 6/198 --rat = -32/33
rat = 6/198 rat-- = 6/198 rat = -32/33
rat = 43/1935 ++rat = 46/45
rat = 43/1935 rat++ = 43/1935 rat = 46/45
rat = 43/1935 --rat = -44/45
rat = 43/1935 rat-- = 43/1935 rat = -44/45
rat = 207/6579 ++rat = 754/731
rat = 207/6579 rat++ = 207/6579 rat = 754/731
rat = 207/6579 --rat = -708/731
rat = 207/6579 rat-- = 207/6579 rat = -708/731
rat = 5/7 ++rat = 12/7
rat = 5/7 rat++ = 5/7 rat = 12/7
rat = 5/7 --rat = -2/7
rat = 5/7 rat-- = 5/7 rat = -2/7
rat = -25/-35 ++rat = 12/7
rat = -25/-35 rat++ = -25/-35 rat = 12/7
rat = -25/-35 --rat = -2/7
rat = -25/-35 rat-- = -25/-35 rat = -2/7
rat = -83/1651 ++rat = 1568/1651
rat = -83/1651 rat++ = -83/1651 rat = 1568/1651
rat = -83/1651 --rat = -1734/1651
rat = -83/1651 rat-- = -83/1651 rat = -1734/1651
rat = 127/-1079 ++rat = 952/1079
rat = 127/-1079 rat++ = 127/-1079 rat = 952/1079
rat = 127/-1079 --rat = -1206/1079
rat = 127/-1079 rat-- = 127/-1079 rat = -1206/1079
rat = 1079/1651 ++rat = 210/127
rat = 1079/1651 rat++ = 1079/1651 rat = 210/127
rat = 1079/1651 --rat = -44/127
rat = 1079/1651 rat-- = 1079/1651 rat = -44/127
rat = -1651/1079 ++rat = -44/83
rat = -1651/1079 rat++ = -1651/1079 rat = -44/83
rat = -1651/1079 --rat = -210/83
rat = -1651/1079 rat-- = -1651/1079 rat = -210/83
newuser@csunix ~/2336/09> cat 01.dat | ./lab09 > my.out
newuser@csunix ~/2336/09> diff 01.out my.out
newuser@csunix ~/2336/09>
```

Figure 3. Commands to Compile, Link, & Run Lab 09 (Part 2 of 2)