

Source File: ~/1337/67/lab67.(C|CPP|cpp|c++|cc|cxx|cp)
Input: Under control of main function
Output: Under control of main function
Value: 3

Extend the `Rational` class from Labs 64 and 66. In this assignment you will add functions for performing comparisons with rational numbers.

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 `lab67` to `targets2srcfileswithlibrary`.

```

1  #ifndef LAB67_H
2  #define LAB67_H
3
4  #include <iostream>
5
6  using namespace std;
7
8  class Rational
9  {
10 public:
11     Rational(); // default constructor
12     Rational(int num, int denom); // additional constructor
13     void setNumerator(int num); // set numerator to num
14     void setDenominator(int denom); // set denominator to denom
15     int getNumerator() const; // returns numerator
16     int getDenominator() const; // returns denominator
17     void reduce(); // reduce to lowest terms
18                     // and normalize
19     Rational add(const Rational& addend) const; // addition
20     Rational additiveInverse() const; // given a/b, returns -a/b
21     Rational subtract(const Rational& subtrahend) const; // subtraction
22     Rational multiply(const Rational& multiplicand) const; // multiplication
23     Rational multiplicativeInverse() const; // given a/b, returns b/a
24     Rational divide(const Rational& divisor) const; // division
25     ostream& print(ostream& os) const; // print Rational to output
26                                         // stream
27     istream& read(istream& is); // read Rational from input
28                                     // stream
29     bool equal(const Rational& second) const; // ==
30     bool notEqual(const Rational& second) const; // !=
31     bool lessThan(const Rational& second) const; // <
32     bool lessThanOrEqual(const Rational& second) const; // <=
33     bool greaterThan(const Rational& second) const; // >
34     bool greaterThanOrEqual(const Rational& second) const; // >=
35 private:
36     int numerator;
37     int denominator;
38     int gcd(int u, int v) const; // returns the greatest
39                                     // common divisor of u
40                                     // and v

```

Figure 1. `/usr/local/1337/include/lab67.h` (Part 1 of 2)

```
41     int lcm(int u, int v) const;           // returns the least common
42                                           // multiple of u and v
43 };
44
45 #endif
```

Figure 1. /usr/local/1337/include/lab67.h (Part 2 of 2)

```
1  #include <lab67.h>
2  #include <string>
3  #include <iomanip>
4  #include <cstdlib>
5
6  using namespace std;
7
8  int main()
9  {
10     Rational first, second;
11     string operators[6] = {"==", "!=", "< ", "<=", "> ", ">="};
12     uint i;
13
14     cout << boolalpha;
15     while (first.read(cin) && second.read(cin))
16     {
17         for (i = 0; i < 6; ++i)
18         {
19             first.print(cout);
20             cout << ' ' << operators[i] << ' ';
21             second.print(cout);
22             cout << " = ";
23             switch (i)
24             {
25                 case 0: cout << first.equal(second); break;
26                 case 1: cout << first.notEqual(second); break;
27                 case 2: cout << first.lessThan(second); break;
28                 case 3: cout << first.lessThanOrEqual(second); break;
29                 case 4: cout << first.greaterThan(second); break;
30                 case 5: cout << first.greaterThanOrEqual(second); break;
31                 default: cerr << "Error. Unknown operator. Exiting." << endl;
32                         exit(EXIT_FAILURE);
33             }
34             cout << endl;
35         }
36     }
37
38     return EXIT_SUCCESS;
39 }
```

Figure 2. /usr/local/1337/src/lab67main.C

```

1  newuser@csunix ~> cd 1337
2  newuser@csunix ~/1337> mkdir 67
3  newuser@csunix ~/1337> cd 67
4  newuser@csunix ~/1337/67> cp /usr/local/1337/data/67/* .
5  newuser@csunix ~/1337/67> cp /usr/local/1337/include/lab67.h .
6  newuser@csunix ~/1337/67> cp /usr/local/1337/src/lab67main.C .
7  newuser@csunix ~/1337/67> cp /usr/local/1337/src/Makefile .
8  newuser@csunix ~/1337/67> touch lab67.cpp
9  newuser@csunix ~/1337/67> # Edit Makefile and lab67.cpp
10 newuser@csunix ~/1337/67> make lab67
11 g++ -g -Wall -std=c++11 -c lab67main.C -I/usr/local/1337/include -I.
12 g++ -g -Wall -std=c++11 -c lab67.cpp -I/usr/local/1337/include -I.
13 g++ -o lab67 lab67main.o lab67.o -L/usr/local/1337/lib -lm -lbits \
14 -Wl,-whole-archive -llab67 -Wl,-no-whole-archive

15 newuser@csunix ~/1337/67> cat 01.dat
16 -3 4 -3 4
17 -3 4 3 4
18 0 5 0 7
19 1 1 5 4
20 25 45 8 99
21 3 4 -3 4
22 1 4 3 2
23 1 4 3 -2
24 -1 -4 -3 -2
25 newuser@csunix ~/1337/67> cat 01.dat | ./lab67
26 -3/4 == -3/4 = true
27 -3/4 != -3/4 = false
28 -3/4 < -3/4 = false
29 -3/4 <= -3/4 = true
30 -3/4 > -3/4 = false
31 -3/4 >= -3/4 = true
32 -3/4 == 3/4 = false
33 -3/4 != 3/4 = true
34 -3/4 < 3/4 = true
35 -3/4 <= 3/4 = true
36 -3/4 > 3/4 = false
37 -3/4 >= 3/4 = false
38 0/5 == 0/7 = true
39 0/5 != 0/7 = false
40 0/5 < 0/7 = false
41 0/5 <= 0/7 = true
42 0/5 > 0/7 = false
43 0/5 >= 0/7 = true
44 1/1 == 5/4 = false
45 1/1 != 5/4 = true
46 1/1 < 5/4 = true
47 1/1 <= 5/4 = true

48 1/1 > 5/4 = false
49 1/1 >= 5/4 = false
50 25/45 == 8/99 = false
51 25/45 != 8/99 = true
52 25/45 < 8/99 = false
53 25/45 <= 8/99 = false
54 25/45 > 8/99 = true
55 25/45 >= 8/99 = true
56 3/4 == -3/4 = false
57 3/4 != -3/4 = true
58 3/4 < -3/4 = false
59 3/4 <= -3/4 = false
60 3/4 > -3/4 = true
61 3/4 >= -3/4 = true
62 1/4 == 3/2 = false
63 1/4 != 3/2 = true
64 1/4 < 3/2 = true
65 1/4 <= 3/2 = true
66 1/4 > 3/2 = false
67 1/4 >= 3/2 = false
68 1/4 == 3/-2 = false
69 1/4 != 3/-2 = true
70 1/4 < 3/-2 = false
71 1/4 <= 3/-2 = false
72 1/4 > 3/-2 = true
73 1/4 >= 3/-2 = true
74 -1/-4 == -3/-2 = false
75 -1/-4 != -3/-2 = true
76 -1/-4 < -3/-2 = true
77 -1/-4 <= -3/-2 = true
78 -1/-4 > -3/-2 = false
79 -1/-4 >= -3/-2 = false

80 newuser@csunix ~/1337/67> cat 01.dat | ./lab67 > my.out
81 newuser@csunix ~/1337/67> diff 01.out my.out
82 newuser@csunix ~/1337/67> cat 04.dat | ./lab67 > my.out
83 newuser@csunix ~/1337/67> diff 04.out my.out
84 newuser@csunix ~/1337/67>

```

Figure 3. Commands to Compile, Link, & Run Lab 67