

**Source File:** ~/1337/59/lab59. (C|CPP|cpp|c++|cc|cxx|cp)  
**Input:** Under control of main function  
**Output:** Under control of main function  
**Value:** 2

The purpose of this lab assignment is to extend the `Rational` abstract data type from Labs 57 and 58. In this assignment you will add functions for performing comparisons with rational numbers. The header file for this assignment is shown in Figure 1.

```
1 #ifndef LAB59_H
2 #define LAB59_H
3
4 #include <lab58.h>
5
6 using namespace std;
7
8 // Function rationalEqual returns true if rational first is equal to
9 // rational second and false otherwise.
10 bool rationalEqual(const Rational& first, const Rational& second);
11
12 // Function rationalNotEqual returns true if rational first is not
13 // equal to rational second and false otherwise.
14 bool rationalNotEqual(const Rational& first, const Rational& second);
15
16 // Function rationalLessThan returns true if rational first is less
17 // than rational second and false otherwise.
18 bool rationalLessThan(const Rational& first, const Rational& second);
19
20 // Function rationalLessThanOrEqual returns true if rational first
21 // is less than or equal to rational second and false otherwise.
22 bool rationalLessThanOrEqual(const Rational& first, const Rational& second);
23
24 // Function rationalGreaterThan returns true if rational first is greater
25 // than rational second and false otherwise.
26 bool rationalGreaterThan(const Rational& first, const Rational& second);
27
28 // Function rationalGreaterThanOrEqual returns true if rational first
29 // is greater than or equal to rational second and false otherwise.
30 bool rationalGreaterThanOrEqual(const Rational& first, const Rational& second);
31
32 #endif
```

Figure 1. /usr/local/1337/include/lab59.h

A sample main function for testing these functions is shown in Figure 2. A sample execution sequence is shown in Figure 3. To use the Makefile as distributed in class, add a target of `lab59` to `targets2srcfileswithlibrary`.

```
1 #include <lab59.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 (rationalInput(rationalInput(cin, first), second))
16     {
17         if (rationalValid(first) && rationalValid(second))
18         {
19             for (i = 0; i < 6; ++i)
20             {
21                 rationalOutput(cout, first);
22                 cout << ' ' << operators[i] << ' ';
23                 rationalOutput(cout, second);
24                 cout << " = ";
25                 switch (i)
26                 {
27                     case 0: cout << rationalEqual(first, second); break;
28                     case 1: cout << rationalNotEqual(first, second); break;
29                     case 2: cout << rationalLessThan(first, second); break;
30                     case 3: cout << rationalLessThanOrEqual(first, second); break;
31                     case 4: cout << rationalGreaterThan(first, second); break;
32                     case 5: cout << rationalGreaterThanOrEqual(first, second); break;
33                     default: cerr << "Error. Unknown operator. Exiting." << endl;
34                             exit(EXIT_FAILURE);
35                 }
36                 cout << endl;
37             }
38         }
39     }
40
41     return EXIT_SUCCESS;
42 }
```

Figure 2. /usr/local/1337/src/lab59main.C

```
1 newuser@csunix ~> cd 1337
2 newuser@csunix ~/1337> mkdir 59
3 newuser@csunix ~/1337> cd 59
4 newuser@csunix ~/1337/59> cp /usr/local/1337/data/59/* .
5 newuser@csunix ~/1337/59> cp /usr/local/1337/include/lab59.h .
6 newuser@csunix ~/1337/59> cp /usr/local/1337/src/lab59main.C .
7 newuser@csunix ~/1337/59> cp /usr/local/1337/src/Makefile .
8 newuser@csunix ~/1337/59> touch lab59.cpp
9 newuser@csunix ~/1337/59> # Edit Makefile and lab59.cpp
10 newuser@csunix ~/1337/59> make lab59
11 g++ -g -Wall -std=c++11 -c lab59main.C -I/usr/local/1337/include -I.
12 g++ -g -Wall -std=c++11 -c lab59.cpp -I/usr/local/1337/include -I.
13 g++ -o lab59 lab59main.o lab59.o -L/usr/local/1337/lib -lm -lbits \
14 -Wl,-whole-archive -llab59 -Wl,-no-whole-archive
15 newuser@csunix ~/1337/59> 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 ~/1337/59> cat 01.dat | ./lab59
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
```

Figure 3. Commands to Compile, Link, & Run Lab 59 (Part 1 of 2)

```
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 ~/1337/59> cat 01.dat | ./lab59 > my.out
81 newuser@csunix ~/1337/59> diff 01.out my.out
82 newuser@csunix ~/1337/59> cat 04.dat | ./lab59 > my.out
83 newuser@csunix ~/1337/59> diff 04.out my.out
84 newuser@csunix ~/1337/59>
```

Figure 3. Commands to Compile, Link, & Run Lab 59 (Part 2 of 2)