Source File: ~/1337/22/lab22.(C|CPP|cpp|c++|cc|cxx|cp)
Input: Under control of `main` function
Output: Under control of `main` function
Value: 2

You are to write four similar functions for this assignment. Each of the functions must use bit operations (the use of the `sizeof` operator is not allowed). One of the functions determines the number of bits in the internal representation of a `short`. The other functions determine the number of bits in the internal representation of an `int`, a `long`, and a `long long`. The prototype of each of the functions is shown in Figure 1.

A sample `main` function for testing your function is shown in Figure 1 and a sample execution sequence is shown in Figure 2. To use the `Makefile` as distributed in class, add a target of `lab22` to `targets2srcfiles`.

```
1    #include <iostream>
2    #include <iomanip>
3    #include <cstdlib>
4
5    using namespace std;
6
7    // sizeOfShort determines the number of bits in the internal
8    // representation of a short
9    unsigned int sizeOfShort(void);
10
11   // sizeOfInt determines the number of bits in the internal
12   // representation of an int
13   unsigned int sizeOfInt(void);
14
15   // sizeOfLong determines the number of bits in the internal
16   // representation of a long
17   unsigned int sizeOfLong(void);
18
19   // sizeOfLongLong determines the number of bits in the internal
20   // representation of a long long
21   unsigned int sizeOfLongLong(void);
22
23   // Function printLine writes n hyphens to output stream out
24   void printLine(ostream& out, int n);
25
26   int main()
27   {
28     // output table title and heading
29     cout << "    Number of Bits in the" << endl
30          << "  Internal Representation of" << endl
31          << "Fundamental Integral Data Types" << endl;
32     printLine(cout, 31);
33     cout << "    Data Type      # Bits" << endl;
34     printLine(cout, 31);
35
```

Figure 1. /usr/local/1337/src/lab22main.C (Part 1 of 2)

```
36    cout << "      short" << setw(14) << sizeOfShort() << endl;
37    cout << "      int" << setw(16) << sizeOfInt() << endl;
38    cout << "      long" << setw(15) << sizeOfLong() << endl;
39    cout << "      long long" << setw(10) << sizeOfLongLong() << endl;
40
41    printLine(cout, 31);
42
43    return EXIT_SUCCESS;
44 }
45
46 void printLine(ostream& out, int n)
47 {
48    char ch = out.fill();
49    out << setfill('-') << setw(n) << "-" << setfill(ch) << endl;
50    return;
51 }
```

Figure 1. `/usr/local/1337/src/lab22main.C` (Part 2 of 2)

```
1  newuser@csunix ~> cd 1337
2  newuser@csunix ~/1337> mkdir 22
3  newuser@csunix ~/1337> cd 22
4  newuser@csunix ~/1337/22> cp /usr/local/1337/data/22/* .
5  newuser@csunix ~/1337/22> cp /usr/local/1337/src/lab22main.C .
6  newuser@csunix ~/1337/22> cp /usr/local/1337/src/Makefile .
7  newuser@csunix ~/1337/22> touch lab22.cpp
8  newuser@csunix ~/1337/22> # Edit Makefile and lab22.cpp
9  newuser@csunix ~/1337/22> make lab22
10 g++ -g -Wall -std=c++11 -c lab22main.C -I/usr/local/1337/include -I.
11 g++ -g -Wall -std=c++11 -c lab22.cpp -I/usr/local/1337/include -I.
12 g++ -o lab22 lab22main.o lab22.o -L/usr/local/1337/lib -lm -lbits
13 newuser@csunix ~/1337/22> ./lab22
14       Number of Bits in the
15    Internal Representation of
16 Fundamental Integral Data Types
17 -------------------------------
18       Data Type      # Bits
19 -------------------------------
20       short           16
21       int             32
22       long            64
23       long long       64
24 -------------------------------
25 newuser@csunix ~/1337/22> ./lab22 > my.out
26 newuser@csunix ~/1337/22> diff 01.out my.out
27 newuser@csunix ~/1337/22>
```

Figure 2. Commands to Compile, Link, & Run Lab 22