Source File: `~/1337/23/lab23.(C|CPP|cpp|c++|cc|cxx|cp)`
Input: Under control of `main` function
Output: Under control of `main` function
Value: 1

Write a function whose prototype is given by

```
unsigned int bitsOn(int word);
```

The function returns the number of bits that are on (i.e., equal to 1) in `word`.

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 `lab23` to `targets2srcfiles`.

```
1  #include <iostream>
2  #include <cstdlib>
3  #include <iomanip>
4  #include <bitset>
5  #include <climits>
6
7  using namespace std;
8
9  // Returns the number of bits that are on (i.e., equal to 1) in word
10 unsigned int bitsOn(int word);
11
12 extern const int N = sizeof(int) * CHAR_BIT; // # of bits in an int
13
14 int main()
15 {
16   int num, numBitsOn;
17
18   while (cin >> num)
19   {
20     cout << right << setw(11) << num << " base 10 = ";
21     cout << bitset<N>(num) << " base 2 has ";
22     numBitsOn = bitsOn(num);
23     cout << setw(2) << numBitsOn
24          << left << setw(5) << (numBitsOn == 1 ? " bit" : " bits")
25          << right << " on" << endl;
26   }
27
28   return EXIT_SUCCESS;
29 }
```

Figure 1. `/usr/local/1337/src/lab23main.C`

```
newuser@csunix ~> cd 1337
newuser@csunix ~/1337> mkdir 23
newuser@csunix ~/1337> cd 23
newuser@csunix ~/1337/23> cp /usr/local/1337/data/23/* .
newuser@csunix ~/1337/23> cp /usr/local/1337/src/lab23main.C .
newuser@csunix ~/1337/23> cp /usr/local/1337/src/Makefile .
newuser@csunix ~/1337/23> touch lab23.cpp
newuser@csunix ~/1337/23> # Edit Makefile and lab23.cpp
newuser@csunix ~/1337/23> make lab23
g++ -g -Wall -std=c++11 -c lab23main.C -I/usr/local/1337/include -I.
g++ -g -Wall -std=c++11 -c lab23.cpp -I/usr/local/1337/include -I.
g++ -o lab23 lab23main.o lab23.o -L/usr/local/1337/lib -lm -lbits
newuser@csunix ~/1337/23> cat 01.dat
0 1 -1 2 -2 1362 -1362 2147483647 -2147483647 -2147483648
newuser@csunix ~/1337/23> cat 01.dat | ./lab23
          0 base 10 = 00000000000000000000000000000000 base 2 has  0 bits on
          1 base 10 = 00000000000000000000000000000001 base 2 has  1 bit  on
         -1 base 10 = 11111111111111111111111111111111 base 2 has 32 bits on
          2 base 10 = 00000000000000000000000000000010 base 2 has  1 bit  on
         -2 base 10 = 11111111111111111111111111111110 base 2 has 31 bits on
       1362 base 10 = 00000000000000000000010101010010 base 2 has  5 bits on
      -1362 base 10 = 11111111111111111111101010101110 base 2 has 27 bits on
 2147483647 base 10 = 01111111111111111111111111111111 base 2 has 31 bits on
-2147483647 base 10 = 10000000000000000000000000000001 base 2 has  2 bits on
-2147483648 base 10 = 10000000000000000000000000000000 base 2 has  1 bit  on
newuser@csunix ~/1337/23> cat 01.dat | ./lab23 > my.out
newuser@csunix ~/1337/23> diff 01.out my.out
newuser@csunix ~/1337/23> cat 02.dat | ./lab23 > my.out
newuser@csunix ~/1337/23> diff 02.out my.out
newuser@csunix ~/1337/23>
```

Figure 2. Commands to Compile, Link, & Run Lab 23