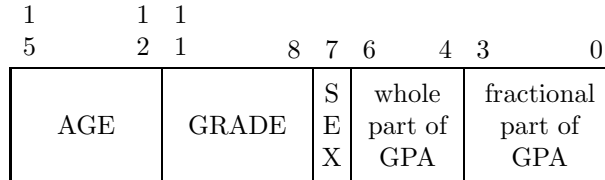**Source File:**   `~/1337/29/lab29.(C|CPP|cpp|c++|cc|cxx|cp)`
Input: Under control of `main` function
Output: Under control of `main` function
Value: 2

Write a decompress function to complement the compress function of Lab 25. The prototype is given by

```
void decompress(unsigned int info, unsigned int& age,
                unsigned int& grade, char& sex, double& GPA);
```

The function receives as input `info`, an `unsigned int` with the low-order 16 bits compressed as shown below.

1 5	1 2	1 1	8	7	6 4	3 0
AGE		GRADE		S E X	whole part of GPA	fractional part of GPA

The function returns the child's age (from 3 through 18), grade in school (from 0 through 12), sex (either 'M' or 'F'), and grade point average (a number from 0.0 [all F's] through 4.0 [all A's]). Recall that a sex of 'M' was stored as one (1), and a sex of 'F' was stored as zero (0).

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 `lab29` to `targets2srcfiles`.

```
1   #include <iostream>
2   #include <cstdlib>
3   #include <iomanip>
4   #include <bitset>
5   #include <climits>
6
7   using namespace std;
8
9   // printLine: prints a horizontal line of length hyphens to output
10  // stream os
11  void printLine(int length, ostream& os);
12
13  // decompress: decompresses the low-order 16 bits of info and
14  // returns age, grade, sex, and GPA
15  void decompress(unsigned int info, unsigned int& age,
16                  unsigned int& grade, char& sex, double& GPA);
17
18  extern const int N = sizeof(int) * CHAR_BIT; // # of bits in an int
19
20  int main()
21  {
22      unsigned int age, grade, info;
23      char sex;
24      double GPA;
25
26      // Prepare for floating-point output format; show one digit after
27      // the decimal point
28      cout << fixed << showpoint << setprecision(1);
29
```

Figure 1. `/usr/local/1337/src/lab29main.C` (Part 1 of 2)

```
30    printLine(78, cout);
31    cout << setw(76) << "33222222222221111111111110000000000" << endl;
32    cout << "  Age     Grade    Sex     GPA     Compress       "
33          << "10987654321098765432109876543210" << endl;
34    printLine(78, cout);
35
36    while (cin >> info)
37    {
38      decompress(info, age, grade, sex, GPA);
39      cout << setw(5) << age << setw(8) << grade << setw(7) << sex
40            << setw(8) << GPA << setw(11) << info << setw(5) << " "
41            << bitset<N>(info) << endl;
42    }
43
44    printLine(78, cout);
45
46    return EXIT_SUCCESS;
47  }
48
49  void printLine(int length, ostream& os)
50  {
51    char ch = os.fill();
52    os << setfill('-') << setw(length) << "-" << setfill(ch) << endl;
53  }
```

Figure 1. `/usr/local/1337/src/lab29main.C` (Part 2 of 2)

```
 1   newuser@csunix ~> cd 1337
 2   newuser@csunix ~/1337> mkdir 29
 3   newuser@csunix ~/1337> cd 29
 4   newuser@csunix ~/1337/29> cp /usr/local/1337/data/29/* .
 5   newuser@csunix ~/1337/29> cp /usr/local/1337/src/lab29main.C .
 6   newuser@csunix ~/1337/29> cp /usr/local/1337/src/Makefile .
 7   newuser@csunix ~/1337/29> touch lab29.cpp
 8   newuser@csunix ~/1337/29> # Edit Makefile and lab29.cpp
 9   newuser@csunix ~/1337/29> make lab29
10   g++ -g -Wall -std=c++11 -c lab29main.C -I/usr/local/1337/include -I.
11   g++ -g -Wall -std=c++11 -c lab29.cpp -I/usr/local/1337/include -I.
12   g++ -o lab29 lab29main.o lab29.o -L/usr/local/1337/lib -lm -lbits
13   newuser@csunix ~/1337/29> cat 01.dat
14   12736     9 64696 60199 55958
15   newuser@csunix ~/1337/29> cat 01.dat | ./lab29
16   --------------------------------------------------------------------------------
17                                             33222222222221111111111110000000000
18     Age    Grade    Sex    GPA    Compress  10987654321098765432109876543210
19   --------------------------------------------------------------------------------
20       6       1      M     4.0      12736   00000000000000000011000111000000
21       3       0      F     0.9          9   00000000000000000000000000001001
22      18      12      M     3.8      64696   00000000000000001111110010111000
23      17      11      F     2.7      60199   00000000000000001110101100100111
24      16      10      M     1.6      55958   00000000000000001101101010010110
25   --------------------------------------------------------------------------------
26   newuser@csunix ~/1337/29> cat 01.dat | ./lab29 > my.out
27   newuser@csunix ~/1337/29> diff 01.out my.out
28   newuser@csunix ~/1337/29>
```

Figure 2. Commands to Compile, Link, & Run Lab 29