Source File: `~/2336/27/lab27.cpp`
Input: under control of `main` function
Output: under control of `main` function
Value: 2

The purpose of this assignment is to perform some vector processing. Three different versions of the same function template are to be written, one using indexing, one using iterators, and one using pointers. The prototypes can be found in the `main` function shown below. The function templates receive as input a `vector`. Each function returns the ***mode*** of the elements and the number of occurrences of the mode. The mode is defined as the value which occurs most frequently in a set of data. Each function should utilize the solution strategy of sorting the incoming vector in ascending order (use the built-in `sort` algorithm to accomplish this) and then using a single linear loop to determine the mode. The running time of each of your functions must be $O(N \log N)$, where N represents the size of the incoming vector.

A sample `main` function for testing your functions is shown in Figure 1. Commands to compile, link, and run this assignment are shown in Figure 2. To use the `Makefile` as distributed in class, add a target of `lab27main` to `targets1srcfile`.

```
1  #include <iostream>
2  #include <cstdlib>
3  #include <vector>
4  #include <utility>
5  #include <string>
6
7  using namespace std;
8
9  template<typename T>
10 pair<T, int> modeUsingIndexing(const vector<T>& v);
11
12 template<typename T>
13 pair<T, int> modeUsingIterators(const vector<T>& v);
14
15 template<typename T>
16 pair<T, int> modeUsingPointers(const vector<T>& v);
17
18 #include "lab27.cpp"
19
20 template<typename T>
21 void callModeFunctions(const vector<T>& v, string nameOfVector)
22 {
23   if (v.size() == 0)
24     cout << "No data\n";
25   else
26   {
27     cout << "For vector " << nameOfVector << ":" << endl;
28     pair<T, int> result = modeUsingIndexing(v);
29     cout << " Using Indexing Mode = " << result.first
30          << " # of occurrences = " << result.second << endl;
31
```

Figure 1. `/usr/local/2336/src/lab27main.C` (Part 1 of 2)

```
32      result = modeUsingIterators(v);
33      cout << "Using Iterators Mode = " << result.first
34           << " # of occurrences = " << result.second << endl;
35
36      result = modeUsingPointers(v);
37      cout << " Using Pointers Mode = " << result.first
38           << " # of occurrences = " << result.second << endl;
39      cout << endl;
40    }
41  }
42
43  int main()
44  {
45    const int aCount = 5, bCount = 1, cCount = 14, dCount = 12;
46    int a[aCount] = {5, 5, 5, 5, 5};
47    double b[bCount] = {7.7};
48    char c[cCount] = {'r', 'a', 'c', 'e', 'c', 'a', 'r',
49                      ' ', 'd', 'r', 'i', 'v', 'e', 'r'};
50    string d[dCount] = {"Cadillac", "GMC", "GMC",
51                        "Lexus", "Lexus", "Dodge", "GMC", "BMW",
52                        "BMW", "GMC", "Dodge", "Lexus"};
53
54    vector<int> aVector(a, a + sizeof(a) / sizeof(a[0]));
55    callModeFunctions(aVector, "aVector");
56
57    vector<double> bVector(b, b + sizeof(b) / sizeof(b[0]));
58    callModeFunctions(bVector, "bVector");
59
60    vector<char> cVector(c, c + sizeof(c) / sizeof(c[0]));
61    callModeFunctions(cVector, "cVector");
62
63    vector<string> dVector(d, d + sizeof(d) / sizeof(d[0]));
64    callModeFunctions(dVector, "dVector");
65
66    int num;
67    vector<int> v;
68
69    while (cin >> num)
70      v.push_back(num);
71
72    callModeFunctions(v, "v");
73
74    return EXIT_SUCCESS;
75  }
```

Figure 1. `/usr/local/2336/src/lab27main.C` (Part 2 of 2)

```
newuser@csunix ~> cd 2336
newuser@csunix ~/2336> ./getlab.ksh 27
  * Checking to see if a folder exists for Lab 27. . .No
  * Creating a folder for Lab 27
  * Checking to see if Lab 27 has sample input and output files. . .Yes
  * Copying input and output files for Lab 27
    from folder /usr/local/2336/data/27 to folder ./27
  * Checking to see if /usr/local/2336/src/lab27main.C exists. . .Yes
  * Copying file /usr/local/2336/src/lab27main.C to folder ./27
  * Checking to see if /usr/local/2336/include/lab27.h exists. . .No
  * Copying file /usr/local/2336/src/Makefile to folder ./27
  * Adding a target of lab27main to targets1srcfile
  * Touching file ./27/lab27.cpp
  * Edit file ./27/lab27.cpp in Notepad++
newuser@csunix ~/2336> cd 27
newuser@csunix ~/2336/27> ls
01.dat        02.out        10.dat        lab27.cpp
01.out        03.dat        10.out        lab27main.C
02.dat        03.out        Makefile
newuser@csunix ~/2336/27> make lab27main
g++ -g -Wall -std=c++11 -c lab27main.C -I/usr/local/2336/include -I.
g++ -o lab27main lab27main.o -L/usr/local/2336/lib -lm -lbits
newuser@csunix ~/2336/27> cat 01.dat
6 2 6
newuser@csunix ~/2336/27> cat 01.dat | ./lab27main
For vector aVector:
 Using Indexing Mode = 5 # of occurrences = 5
Using Iterators Mode = 5 # of occurrences = 5
 Using Pointers Mode = 5 # of occurrences = 5

For vector bVector:
 Using Indexing Mode = 7.7 # of occurrences = 1
Using Iterators Mode = 7.7 # of occurrences = 1
 Using Pointers Mode = 7.7 # of occurrences = 1

For vector cVector:
 Using Indexing Mode = r # of occurrences = 4
Using Iterators Mode = r # of occurrences = 4
 Using Pointers Mode = r # of occurrences = 4

For vector dVector:
 Using Indexing Mode = GMC # of occurrences = 4
Using Iterators Mode = GMC # of occurrences = 4
 Using Pointers Mode = GMC # of occurrences = 4

For vector v:
 Using Indexing Mode = 6 # of occurrences = 2
Using Iterators Mode = 6 # of occurrences = 2
 Using Pointers Mode = 6 # of occurrences = 2
```

Figure 2. Commands to Compile, Link, & Run Lab 27 (Part 1 of 2)

```
50
51 newuser@csunix ~/2336/27> cat 01.dat | ./lab27main > my.out
52 newuser@csunix ~/2336/27> diff 01.out my.out
53 newuser@csunix ~/2336/27> cat 02.dat | ./lab27main > my.out
54 newuser@csunix ~/2336/27> diff 02.out my.out
55 newuser@csunix ~/2336/27> cat 03.dat | ./lab27main > my.out
56 newuser@csunix ~/2336/27> diff 03.out my.out
57 newuser@csunix ~/2336/27> cat 10.dat | ./lab27main > my.out
58 newuser@csunix ~/2336/27> diff 10.out my.out
59 newuser@csunix ~/2336/27>
```

Figure 2. Commands to Compile, Link, & Run Lab 27 (Part 2 of 2)