WORKED EXAMPLE 6.2 A World Population Table

Consider the following population data.

Population Per Continent (in millions)							
Year	1750	1800	1850	1900	1950	2000	2050
Africa	106	107	111	133	221	767	1766
Asia	502	635	809	947	1402	3634	5268
Australia	2	2	2	6	13	30	46
Europe	163	203	276	408	547	729	628
North America	2	7	26	82	172	307	392
South America	16	24	38	74	167	511	809

You are to print the data in tabular format and add column totals that show the total world populations in the given years.

Step 1 First, we break down the task into steps:

- Initialize the table data.
- Print the table.
- Compute and print the column totals.

Step 2 Initialize the table as a sequence of rows:

```
int data[ROWS][COLUMNS] =
   {
      { 106, 107, 111, 133, 221, 767, 1766 },
      { 502, 635, 809, 947, 1402, 3634, 5268 },
      { 2, 2, 2, 6, 13, 30, 46 },
      { 163, 203, 276, 408, 547, 729, 628 },
      { 2, 7, 26, 82, 172, 307, 392 },
      { 16, 24, 38, 74, 167, 511, 809 }
   };
```

Step 3 To print the row headers, we also need a one-dimensional array of the continent names. Note that it has the same number of rows as our table.

```
string continents[ROWS] =
   {
      "Africa",
      "Asia",
      "Australia",
      "Europe",
      "North America",
      "South America"
   };
```

To print a row, we first print the continent name, then all columns. This is achieved with two nested loops. The outer loop prints each row:

```
// Print data
for (int i = 0; i < ROWS; i++)
{
   // Print the ith row
   . . .
   cout << endl; // Start a new line at the end of the row
}
```

To print a row, we first print the row header, then all columns:

```
cout << setw(20) << continents[i];
for (int j = 0; j < COLUMNS; j++)
{
   cout << setw(5) << data[i][j];
}
```

Step 4 To print the column sums, we use a helper function, as described in Section 6.6.4. We carry out that computation once for each column.

```
for (int j = 0; j < COLUMNS; j++)
{
   cout << setw(5) << column_total(data, ROWS, j);
}
```

Here is the complete program, `ch06/worldpop.cpp`.

```
#include <iostream>
#include <iomanip>
#include <string>

using namespace std;

const int ROWS = 6;
const int COLUMNS = 7;

/**
   Computes the total of a column in a table.
   @param table a table with 7 columns
   @param rows the number of rows of the table
   @param column the column that needs to be totaled
   @return the sum of all elements in the given column
*/
int column_total(int table[][COLUMNS], int rows, int column)
{
   int total = 0;
   for (int i = 0; i < rows; i++)
   {
      total = total + table[i][column];
   }
   return total;
}

int main()
{
   int data[ROWS][COLUMNS] =
   {
      { 106, 107, 111, 133, 221, 767, 1766 },
      { 502, 635, 809, 947, 1402, 3634, 5268 },
      { 2, 2, 2, 6, 13, 30, 46 },
      { 163, 203, 276, 408, 547, 729, 628 },
```

```
      { 2, 7, 26, 82, 172, 307, 392 },
      { 16, 24, 38, 74, 167, 511, 809 }
   };

   string continents[ROWS] =
      {
         "Africa",
         "Asia",
         "Australia",
         "Europe",
         "North America",
         "South America"
      };

   cout << "                Year 1750 1800 1850 1900 1950 2000 2050"
      << endl;

   // Print data
   for (int i = 0; i < ROWS; i++)
   {
      // Print the ith row
      cout << setw(20) << continents[i];
      for (int j = 0; j < COLUMNS; j++)
      {
         cout << setw(5) << data[i][j];
      }
      cout << endl; // Start a new line at the end of the row
   }

   // Print column totals
   cout << "               World";
   for (int j = 0; j < COLUMNS; j++)
   {
      cout << setw(5) << column_total(data, ROWS, j);
   }
   cout << endl;

   return 0;
}
```

Program Run

```
                Year 1750 1800 1850 1900 1950 2000 2050
              Africa  106  107  111  133  221  767 1766
                Asia  502  635  809  947 1402 3634 5268
           Australia    2    2    2    6   13   30   46
              Europe  163  203  276  408  547  729  628
       North America    2    7   26   82  172  307  392
       South America   16   24   38   74  167  511  809
               World  791  978 1262 1650 2522 5978  890
```