Course: Programming Fundamental – ENSF 337
Lab #: Lab 9
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Lab Section: B01
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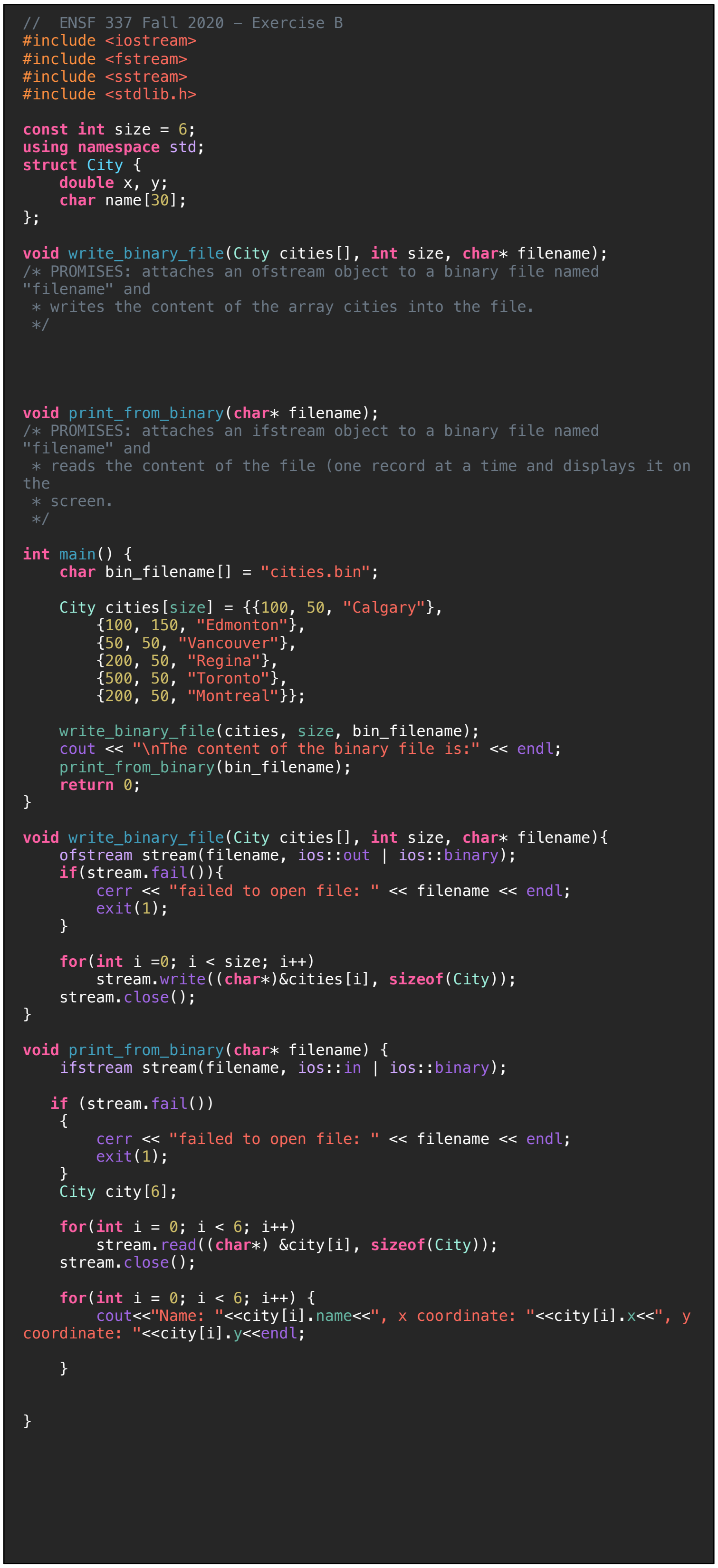
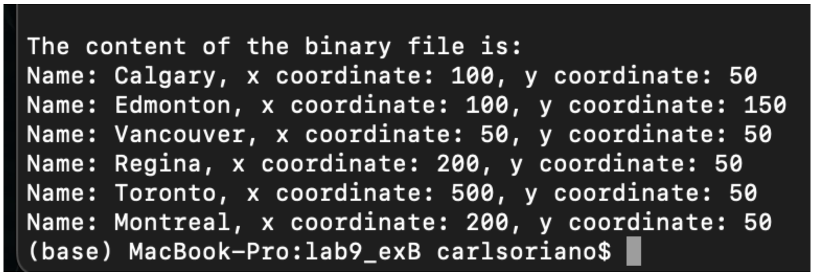
Exercise A

Unmarked

Exercise B

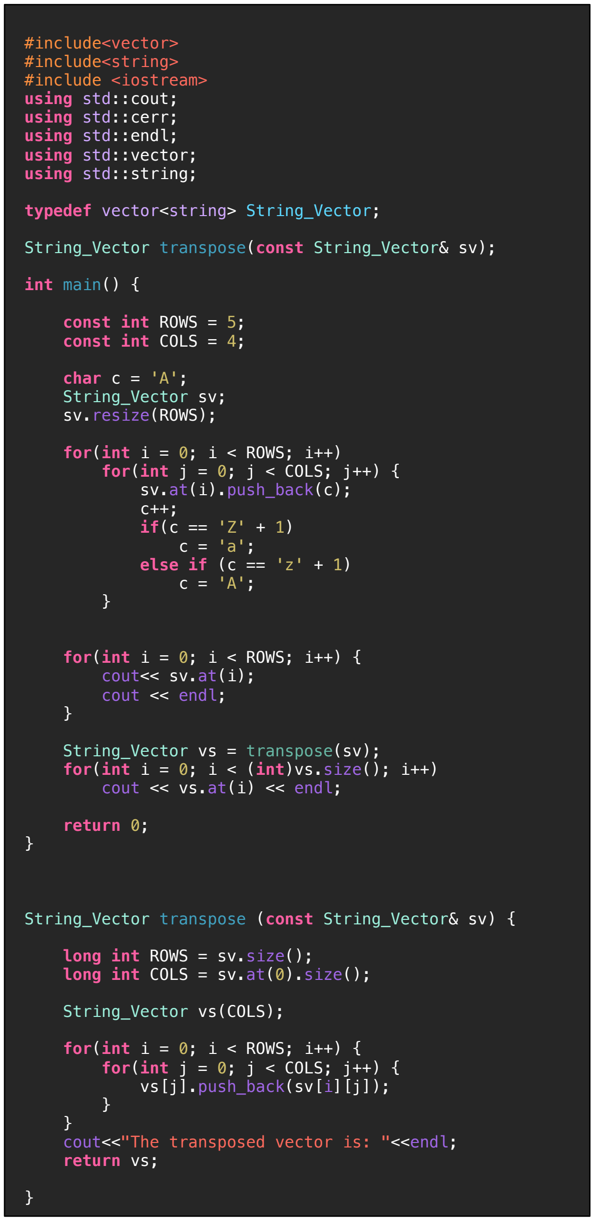


```
//  ENSF 337 Fall 2020 - Exercise B
#include <iostream>
#include <fstream>
#include <sstream>
#include <stdlib.h>

const int size = 6;
using namespace std;
struct City {
    double x, y;
    char name[30];
};

void write_binary_file(City cities[], int size, char* filename);
/* PROMISES: attaches an ofstream object to a binary file named
"filename" and
 * writes the content of the array cities into the file.
 */



void print_from_binary(char* filename);
/* PROMISES: attaches an ifstream object to a binary file named
"filename" and
 * reads the content of the file (one record at a time and displays it on
the
 * screen.
 */

int main() {
    char bin_filename[] = "cities.bin";

    City cities[size] = {{100, 50, "Calgary"},
        {100, 150, "Edmonton"},
        {50, 50, "Vancouver"},
        {200, 50, "Regina"},
        {500, 50, "Toronto"},
        {200, 50, "Montreal"}};

    write_binary_file(cities, size, bin_filename);
    cout << "\nThe content of the binary file is:" << endl;
    print_from_binary(bin_filename);
    return 0;
}

void write_binary_file(City cities[], int size, char* filename){
    ofstream stream(filename, ios::out | ios::binary);
    if(stream.fail()){
        cerr << "failed to open file: " << filename << endl;
        exit(1);
    }

    for(int i =0; i < size; i++)
        stream.write((char*)&cities[i], sizeof(City));
    stream.close();
}

void print_from_binary(char* filename) {
    ifstream stream(filename, ios::in | ios::binary);

   if (stream.fail())
    {
        cerr << "failed to open file: " << filename << endl;
        exit(1);
    }
    City city[6];

    for(int i = 0; i < 6; i++)
        stream.read((char*) &city[i], sizeof(City));
    stream.close();

    for(int i = 0; i < 6; i++) {
        cout<<"Name: "<<city[i].name<<", x coordinate: "<<city[i].x<<", y
coordinate: "<<city[i].y<<endl;

    }


}
```

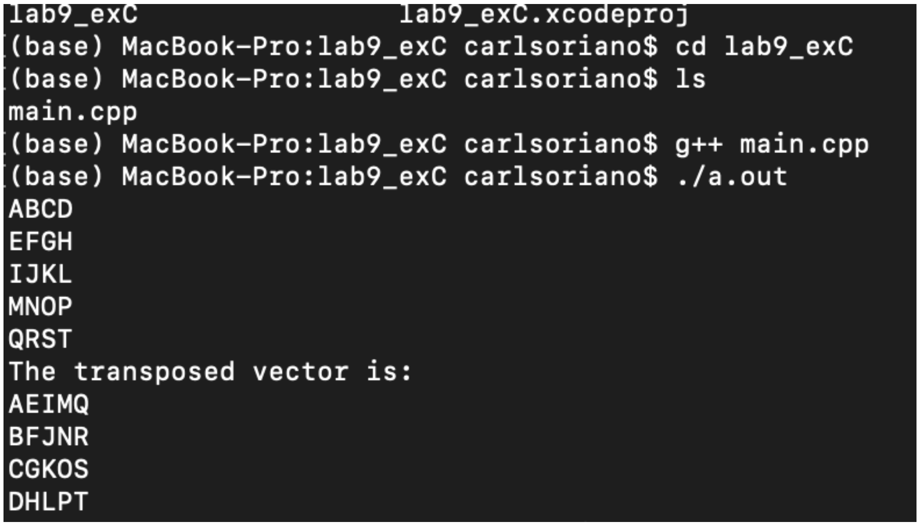


```
The content of the binary file is:
Name: Calgary, x coordinate: 100, y coordinate: 50
Name: Edmonton, x coordinate: 100, y coordinate: 150
Name: Vancouver, x coordinate: 50, y coordinate: 50
Name: Regina, x coordinate: 200, y coordinate: 50
Name: Toronto, x coordinate: 500, y coordinate: 50
Name: Montreal, x coordinate: 200, y coordinate: 50
(base) MacBook-Pro:lab9_exB carlsoriano$
```

Exercise C

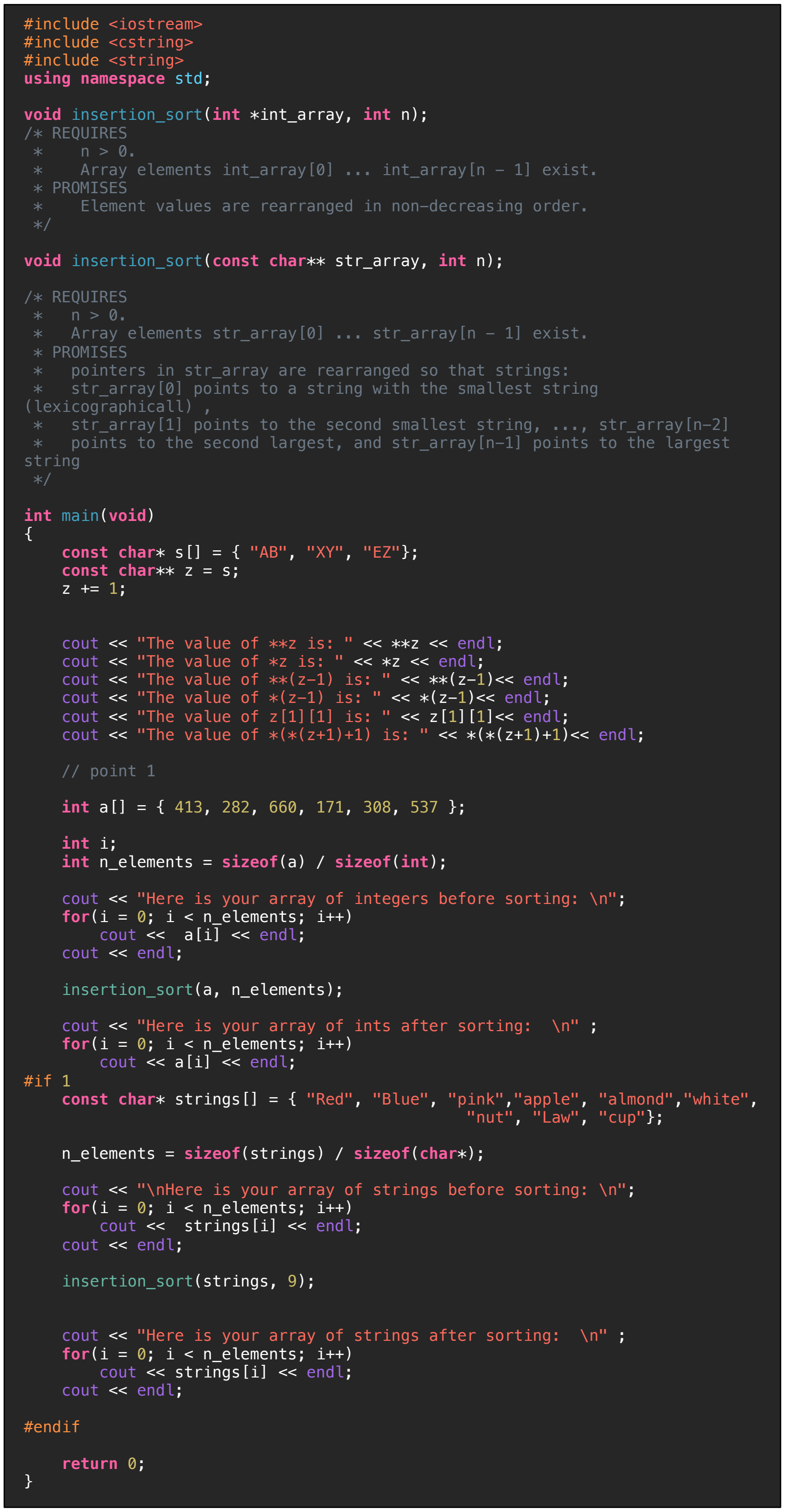


```cpp
#include<vector>
#include<string>
#include <iostream>
using std::cout;
using std::cerr;
using std::endl;
using std::vector;
using std::string;

typedef vector<string> String_Vector;

String_Vector transpose(const String_Vector& sv);

int main() {

    const int ROWS = 5;
    const int COLS = 4;

    char c = 'A';
    String_Vector sv;
    sv.resize(ROWS);

    for(int i = 0; i < ROWS; i++)
        for(int j = 0; j < COLS; j++) {
            sv.at(i).push_back(c);
            c++;
            if(c == 'Z' + 1)
                c = 'a';
            else if (c == 'z' + 1)
                c = 'A';
        }


    for(int i = 0; i < ROWS; i++) {
        cout<< sv.at(i);
        cout << endl;
    }

    String_Vector vs = transpose(sv);
    for(int i = 0; i < (int)vs.size(); i++)
        cout << vs.at(i) << endl;

    return 0;
}



String_Vector transpose (const String_Vector& sv) {

    long int ROWS = sv.size();
    long int COLS = sv.at(0).size();

    String_Vector vs(COLS);

    for(int i = 0; i < ROWS; i++) {
        for(int j = 0; j < COLS; j++) {
            vs[j].push_back(sv[i][j]);
        }
    }
    cout<<"The transposed vector is: "<<endl;
    return vs;

}
```

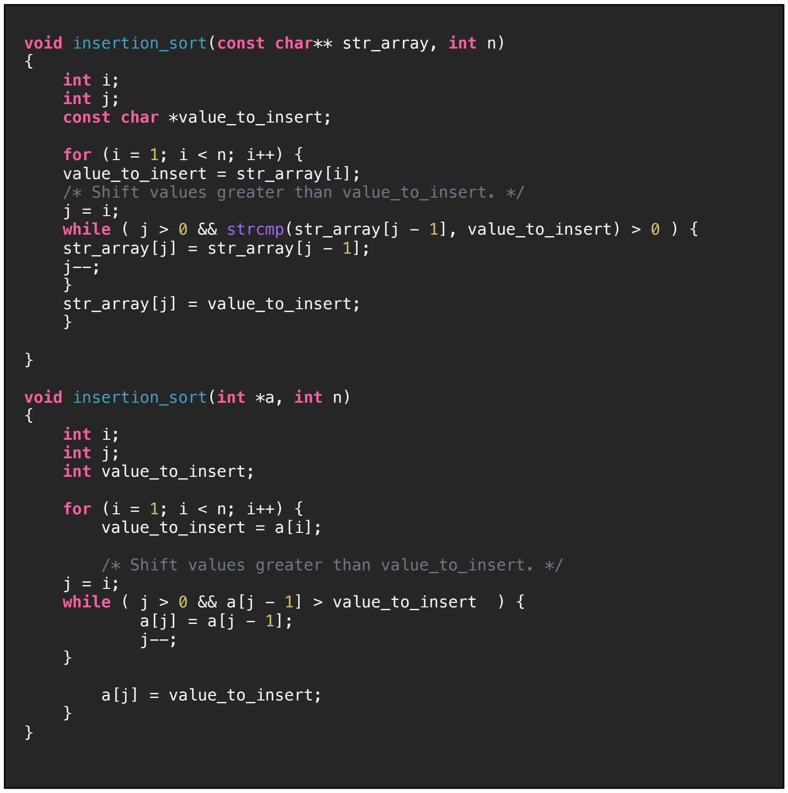


```
lab9_exC                    lab9_exC.xcodeproj
(base) MacBook-Pro:lab9_exC carlsoriano$ cd lab9_exC
(base) MacBook-Pro:lab9_exC carlsoriano$ ls
main.cpp
(base) MacBook-Pro:lab9_exC carlsoriano$ g++ main.cpp
(base) MacBook-Pro:lab9_exC carlsoriano$ ./a.out
ABCD
EFGH
IJKL
MNOP
QRST
The transposed vector is:
AEIMQ
BFJNR
CGKOS
DHLPT
```

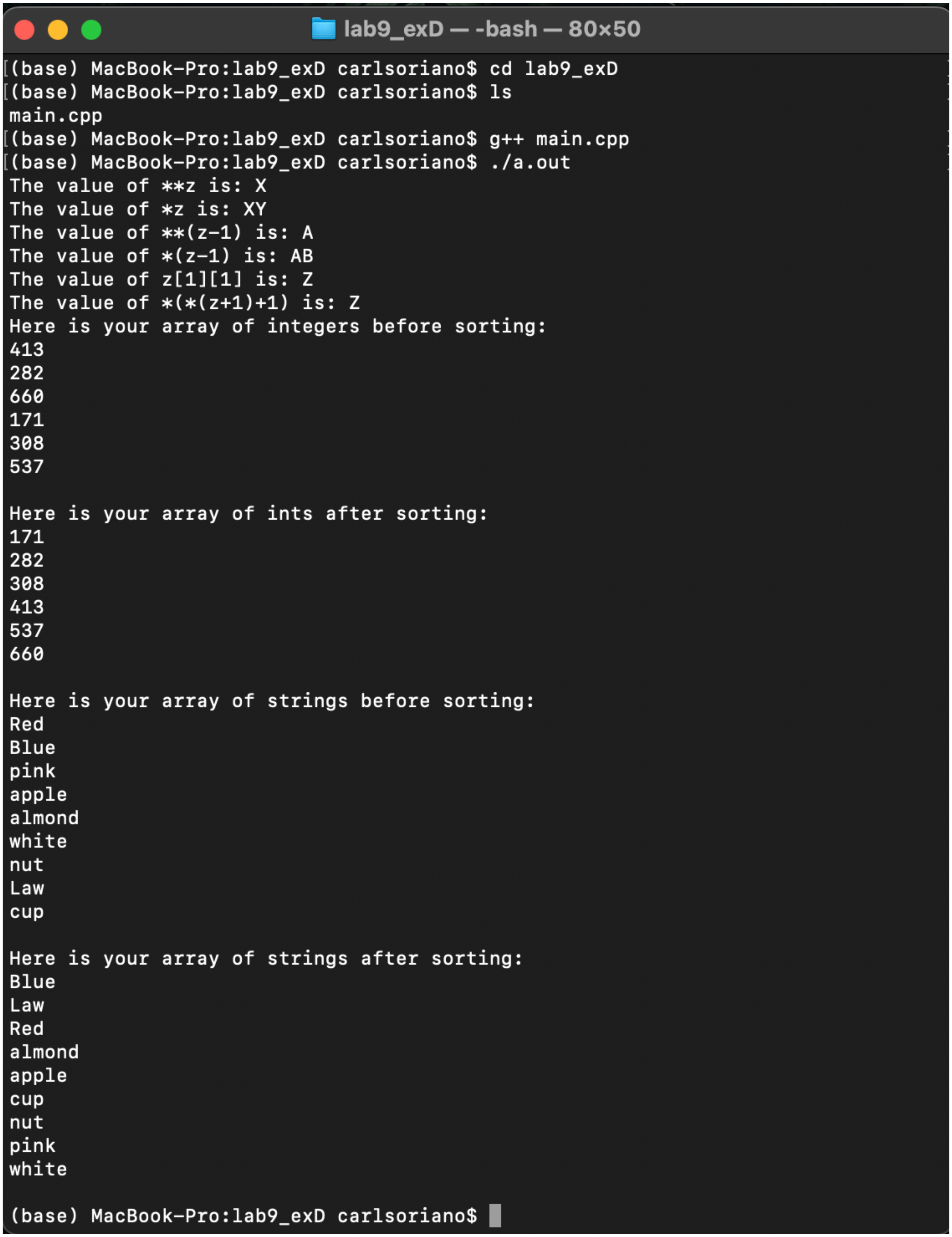
Exercise D



```
#include <iostream>
#include <cstring>
#include <string>
using namespace std;

void insertion_sort(int *int_array, int n);
/* REQUIRES
 *    n > 0.
 *    Array elements int_array[0] ... int_array[n - 1] exist.
 * PROMISES
 *    Element values are rearranged in non-decreasing order.
 */

void insertion_sort(const char** str_array, int n);

/* REQUIRES
 *   n > 0.
 *   Array elements str_array[0] ... str_array[n - 1] exist.
 * PROMISES
 *   pointers in str_array are rearranged so that strings:
 *   str_array[0] points to a string with the smallest string
(lexicographicall) ,
 *   str_array[1] points to the second smallest string, ..., str_array[n-2]
 *   points to the second largest, and str_array[n-1] points to the largest
string
 */

int main(void)
{
    const char* s[] = { "AB", "XY", "EZ"};
    const char** z = s;
    z += 1;


    cout << "The value of **z is: " << **z << endl;
    cout << "The value of *z is: " << *z << endl;
    cout << "The value of **(z-1) is: " << **(z-1)<< endl;
    cout << "The value of *(z-1) is: " << *(z-1)<< endl;
    cout << "The value of z[1][1] is: " << z[1][1]<< endl;
    cout << "The value of *(*(z+1)+1) is: " << *(*(z+1)+1)<< endl;

    // point 1

    int a[] = { 413, 282, 660, 171, 308, 537 };

    int i;
    int n_elements = sizeof(a) / sizeof(int);

    cout << "Here is your array of integers before sorting: \n";
    for(i = 0; i < n_elements; i++)
        cout <<  a[i] << endl;
    cout << endl;

    insertion_sort(a, n_elements);

    cout << "Here is your array of ints after sorting:  \n" ;
    for(i = 0; i < n_elements; i++)
        cout << a[i] << endl;
#if 1
    const char* strings[] = { "Red", "Blue", "pink","apple", "almond","white",
                                               "nut", "Law", "cup"};

    n_elements = sizeof(strings) / sizeof(char*);

    cout << "\nHere is your array of strings before sorting: \n";
    for(i = 0; i < n_elements; i++)
        cout <<  strings[i] << endl;
    cout << endl;

    insertion_sort(strings, 9);


    cout << "Here is your array of strings after sorting:  \n" ;
    for(i = 0; i < n_elements; i++)
        cout << strings[i] << endl;
    cout << endl;

#endif

    return 0;
}
```

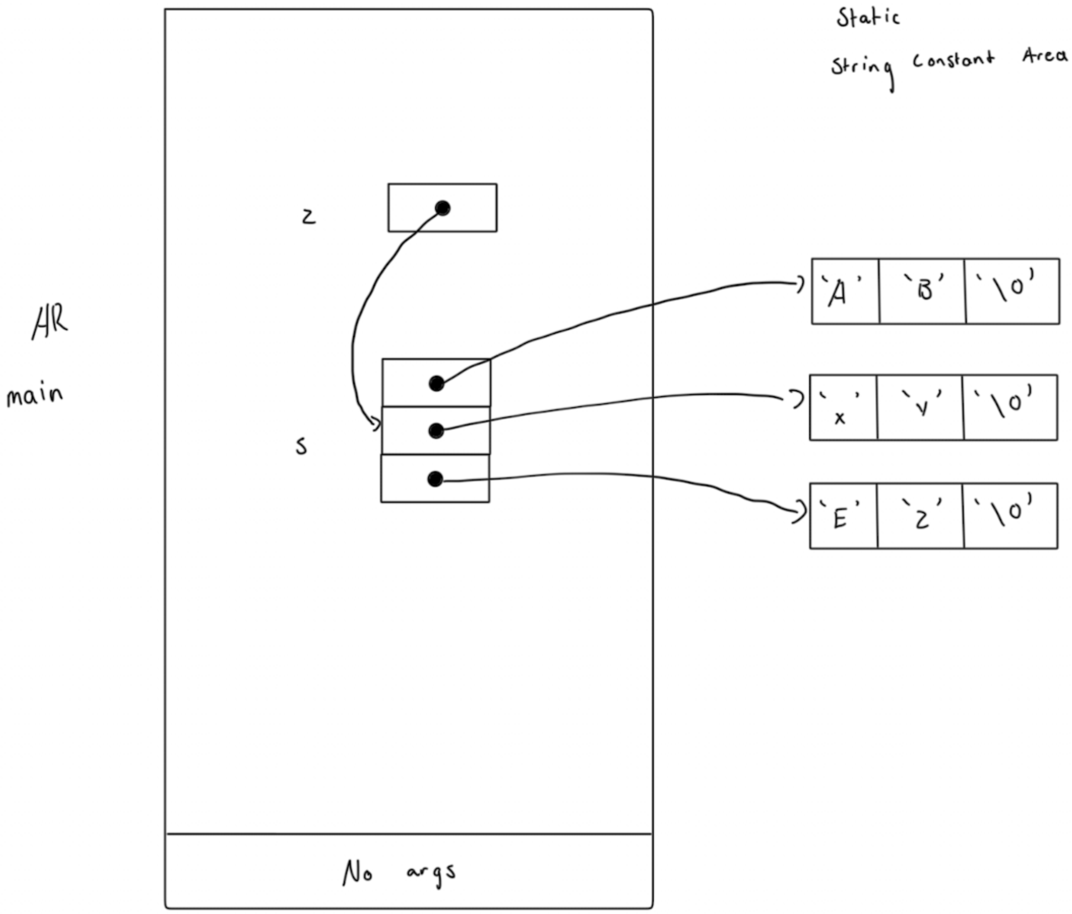


```
void insertion_sort(const char** str_array, int n)
{
    int i;
    int j;
    const char *value_to_insert;

    for (i = 1; i < n; i++) {
    value_to_insert = str_array[i];
    /* Shift values greater than value_to_insert. */
    j = i;
    while ( j > 0 && strcmp(str_array[j - 1], value_to_insert) > 0 ) {
    str_array[j] = str_array[j - 1];
    j--;
    }
    str_array[j] = value_to_insert;
    }

}

void insertion_sort(int *a, int n)
{
    int i;
    int j;
    int value_to_insert;

    for (i = 1; i < n; i++) {
        value_to_insert = a[i];

        /* Shift values greater than value_to_insert. */
    j = i;
    while ( j > 0 && a[j - 1] > value_to_insert  ) {
            a[j] = a[j - 1];
            j--;
    }

        a[j] = value_to_insert;
    }
}
```

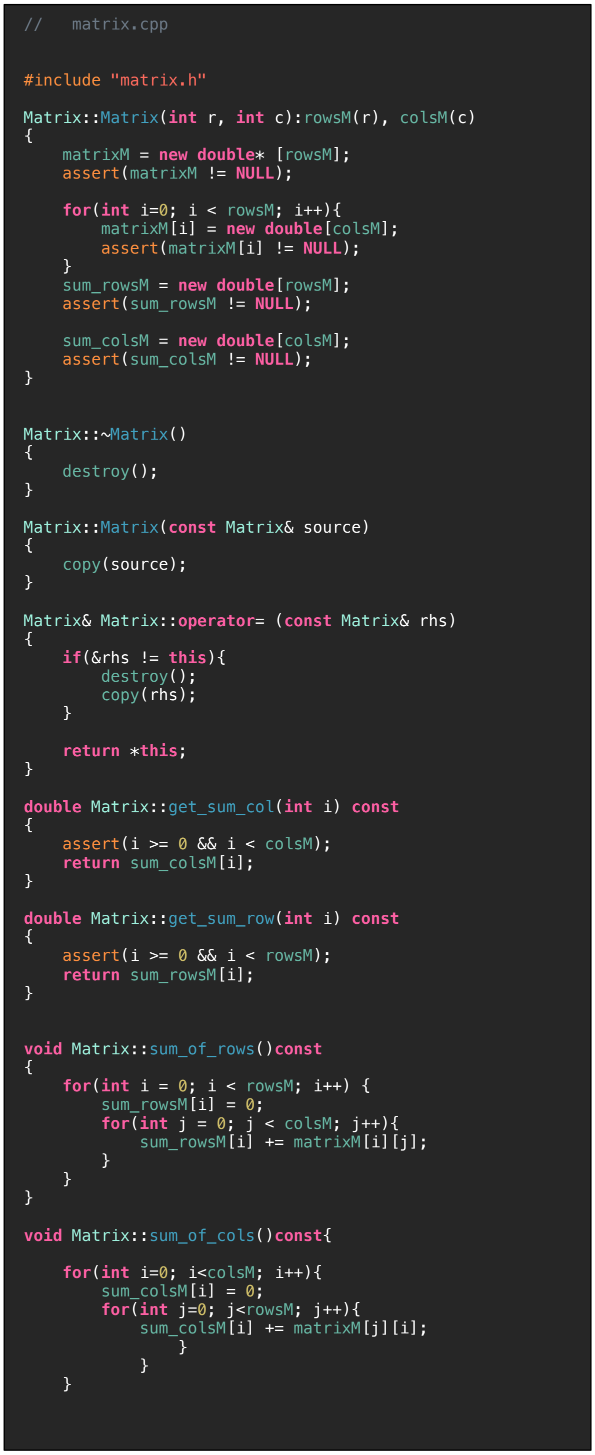


```
[(base) MacBook-Pro:lab9_exD carlsoriano$ cd lab9_exD
[(base) MacBook-Pro:lab9_exD carlsoriano$ ls
main.cpp
[(base) MacBook-Pro:lab9_exD carlsoriano$ g++ main.cpp
[(base) MacBook-Pro:lab9_exD carlsoriano$ ./a.out
The value of **z is: X
The value of *z is: XY
The value of **(z-1) is: A
The value of *(z-1) is: AB
The value of z[1][1] is: Z
The value of *(*(z+1)+1) is: Z
Here is your array of integers before sorting:
413
282
660
171
308
537

Here is your array of ints after sorting:
171
282
308
413
537
660

Here is your array of strings before sorting:
Red
Blue
pink
apple
almond
white
nut
Law
cup

Here is your array of strings after sorting:
Blue
Law
Red
almond
apple
cup
nut
pink
white

(base) MacBook-Pro:lab9_exD carlsoriano$ 
```

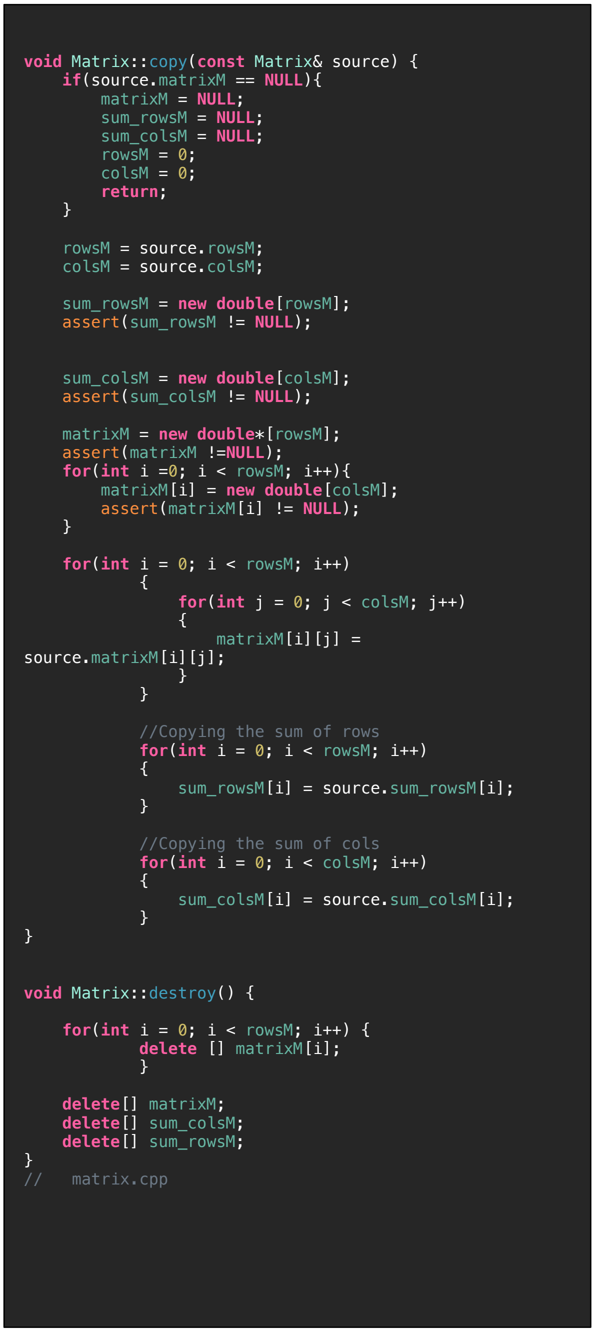
Exercise D



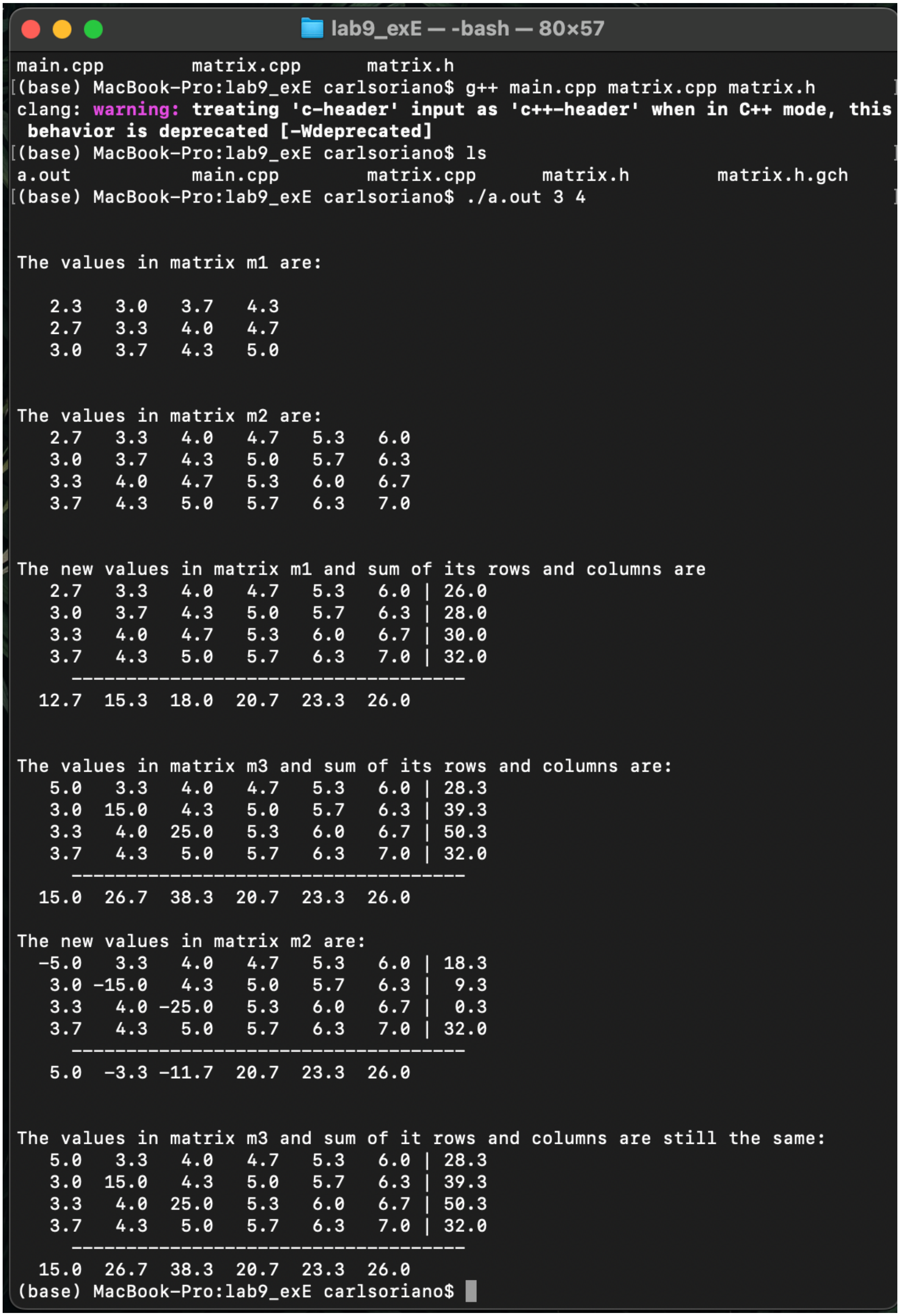
Exercise E



```
//   matrix.cpp


#include "matrix.h"

Matrix::Matrix(int r, int c):rowsM(r), colsM(c)
{
    matrixM = new double* [rowsM];
    assert(matrixM != NULL);

    for(int i=0; i < rowsM; i++){
        matrixM[i] = new double[colsM];
        assert(matrixM[i] != NULL);
    }
    sum_rowsM = new double[rowsM];
    assert(sum_rowsM != NULL);

    sum_colsM = new double[colsM];
    assert(sum_colsM != NULL);
}


Matrix::~Matrix()
{
    destroy();
}

Matrix::Matrix(const Matrix& source)
{
    copy(source);
}

Matrix& Matrix::operator= (const Matrix& rhs)
{
    if(&rhs != this){
        destroy();
        copy(rhs);
    }

    return *this;
}

double Matrix::get_sum_col(int i) const
{
    assert(i >= 0 && i < colsM);
    return sum_colsM[i];
}

double Matrix::get_sum_row(int i) const
{
    assert(i >= 0 && i < rowsM);
    return sum_rowsM[i];
}


void Matrix::sum_of_rows()const
{
    for(int i = 0; i < rowsM; i++) {
        sum_rowsM[i] = 0;
        for(int j = 0; j < colsM; j++){
            sum_rowsM[i] += matrixM[i][j];
        }
    }
}

void Matrix::sum_of_cols()const{

    for(int i=0; i<colsM; i++){
        sum_colsM[i] = 0;
        for(int j=0; j<rowsM; j++){
            sum_colsM[i] += matrixM[j][i];
                }
            }
    }
```



```
void Matrix::copy(const Matrix& source) {
    if(source.matrixM == NULL){
        matrixM = NULL;
        sum_rowsM = NULL;
        sum_colsM = NULL;
        rowsM = 0;
        colsM = 0;
        return;
    }

    rowsM = source.rowsM;
    colsM = source.colsM;

    sum_rowsM = new double[rowsM];
    assert(sum_rowsM != NULL);


    sum_colsM = new double[colsM];
    assert(sum_colsM != NULL);

    matrixM = new double*[rowsM];
    assert(matrixM !=NULL);
    for(int i =0; i < rowsM; i++){
        matrixM[i] = new double[colsM];
        assert(matrixM[i] != NULL);
    }

    for(int i = 0; i < rowsM; i++)
            {
                for(int j = 0; j < colsM; j++)
                {
                    matrixM[i][j] =
source.matrixM[i][j];
                }
            }

            //Copying the sum of rows
            for(int i = 0; i < rowsM; i++)
            {
                sum_rowsM[i] = source.sum_rowsM[i];
            }

            //Copying the sum of cols
            for(int i = 0; i < colsM; i++)
            {
                sum_colsM[i] = source.sum_colsM[i];
            }
}


void Matrix::destroy() {

    for(int i = 0; i < rowsM; i++) {
            delete [] matrixM[i];
            }

    delete[] matrixM;
    delete[] sum_colsM;
    delete[] sum_rowsM;
}
//   matrix.cpp
```



```
main.cpp        matrix.cpp      matrix.h
[(base) MacBook-Pro:lab9_exE carlsoriano$ g++ main.cpp matrix.cpp matrix.h
clang: warning: treating 'c-header' input as 'c++-header' when in C++ mode, this
 behavior is deprecated [-Wdeprecated]
[(base) MacBook-Pro:lab9_exE carlsoriano$ ls
a.out           main.cpp        matrix.cpp      matrix.h        matrix.h.gch
[(base) MacBook-Pro:lab9_exE carlsoriano$ ./a.out 3 4


The values in matrix m1 are:

   2.3   3.0   3.7   4.3
   2.7   3.3   4.0   4.7
   3.0   3.7   4.3   5.0


The values in matrix m2 are:
   2.7   3.3   4.0   4.7   5.3   6.0
   3.0   3.7   4.3   5.0   5.7   6.3
   3.3   4.0   4.7   5.3   6.0   6.7
   3.7   4.3   5.0   5.7   6.3   7.0


The new values in matrix m1 and sum of its rows and columns are
   2.7   3.3   4.0   4.7   5.3   6.0 | 26.0
   3.0   3.7   4.3   5.0   5.7   6.3 | 28.0
   3.3   4.0   4.7   5.3   6.0   6.7 | 30.0
   3.7   4.3   5.0   5.7   6.3   7.0 | 32.0
     ------------------------------------
  12.7  15.3  18.0  20.7  23.3  26.0


The values in matrix m3 and sum of its rows and columns are:
   5.0   3.3   4.0   4.7   5.3   6.0 | 28.3
   3.0  15.0   4.3   5.0   5.7   6.3 | 39.3
   3.3   4.0  25.0   5.3   6.0   6.7 | 50.3
   3.7   4.3   5.0   5.7   6.3   7.0 | 32.0
     ------------------------------------
  15.0  26.7  38.3  20.7  23.3  26.0

The new values in matrix m2 are:
  -5.0   3.3   4.0   4.7   5.3   6.0 | 18.3
   3.0 -15.0   4.3   5.0   5.7   6.3 |  9.3
   3.3   4.0 -25.0   5.3   6.0   6.7 |  0.3
   3.7   4.3   5.0   5.7   6.3   7.0 | 32.0
     ------------------------------------
   5.0  -3.3 -11.7  20.7  23.3  26.0


The values in matrix m3 and sum of it rows and columns are still the same:
   5.0   3.3   4.0   4.7   5.3   6.0 | 28.3
   3.0  15.0   4.3   5.0   5.7   6.3 | 39.3
   3.3   4.0  25.0   5.3   6.0   6.7 | 50.3
   3.7   4.3   5.0   5.7   6.3   7.0 | 32.0
     ------------------------------------
  15.0  26.7  38.3  20.7  23.3  26.0
(base) MacBook-Pro:lab9_exE carlsoriano$ 
```