Course: ENSF 337 – Fall 2020

Lab #: Lab 9

Instructor: M. Moussavi

Student Name: Quentin Jennings

Lab Section: B03

Submission Date: 2020-12-01

Exercise B print_from_binary Function Definition:

```
53  void print_from_binary(char* filename) {
54      ifstream inStream(filename, ios::in | ios::binary);
55      if(inStream.fail()){
56          cerr << "failed to open file: " << filename << endl;
57          exit(1);
58      }
59
60      City temp[size];
61      for(int i = 0; i < size; i++)
62      {
63          inStream.read((char*)&temp[i], sizeof(City));
64          cout << "Name: " << temp[i].name << ", x coordinate: "
65              << temp[i].x << ", y coordinate: " << temp[i].y << endl;
66      }
67      inStream.close();
68  }
```

Exercise B Output:

```
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
```

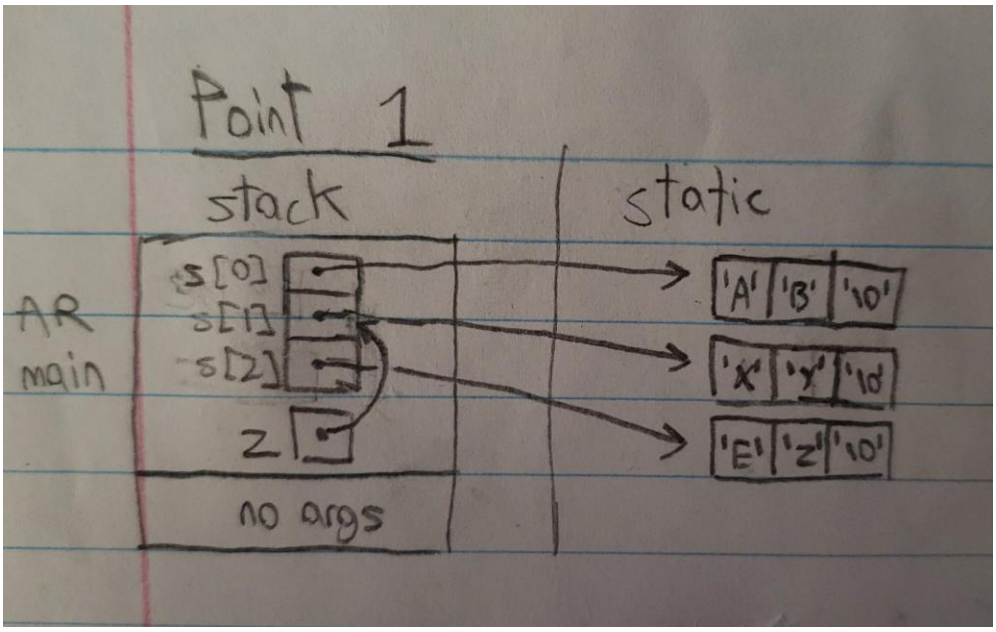
Exercise C transpose Function Definition:

```
57  String_Vector transpose (const String_Vector& sv) {
58      String_Vector vs;
59      for(int i = 0; i < sv[0].size(); i++)
60      {
61          string temp;
62          for(int j = 0; j < sv.size(); j++)
63          {
64              temp.append(1, sv[j][i]);
65          }
66          vs.push_back(temp);
67      }
68      return vs;
69  }
```

Exercise C Output:

```
ABCD
EFGH
IJKL
MNOP
QRST
AEIMQ
BFJNR
CGKOS
DHLPT
```

Exercise D Point One Memory Diagram:



Exercise_D_labyExD.cpp:

```cpp
#include <iostream>
#include <string.h>
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;
}
```

```
81
82  void insertion_sort(int *a, int n)
83  {
84      int i;
85      int j;
86      int value_to_insert;
87
88      for (i = 1; i < n; i++) {
89          value_to_insert = a[i];
90
91          /* Shift values greater than value_to_insert. */
92          j = i;
93          while ( j > 0 && a[j - 1] > value_to_insert  ) {
94              a[j] = a[j - 1];
95              j--;
96          }
97
98          a[j] = value_to_insert;
99      }
100 }
101
102 void insertion_sort(const char** str_array, int n)
103 {
104     const char* temp;
105
106     for(int i = 1; i < n; i++) {
107         for(int j = 0; j < n; j++) {
108             if(strcmp(str_array[i], str_array[j]) < 0) { //#include <string.h> added to header of file
109                 temp = str_array[i];
110                 str_array[i] = str_array[j];
111                 str_array[j] = temp;
112             }
113         }
114     }
115 }
116
```

Exercise D Output:

```
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
```

Exercise E matrix.cpp:

```cpp
//   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 j = 0; j < colsM; j++)
        sum_colsM[j] = 0;

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

```

```cpp
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);

    //added content past this point
    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];
    }
    sum_of_rows();
    sum_of_cols();
}

```

```cpp
void Matrix::destroy()
{
    for(int i = 0; i < rowsM; i++)
        free(matrixM[i]);
    free(matrixM);

    free(sum_rowsM);
    free(sum_colsM);
}
```

Exercise E Output:

```
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
```