Department of Electrical & Software Engineering
University of Calgary

ENSF 614
Lab 4
Winter 2024

Notes:
- This is an individual lab assignment -- NOT a group assignment.
- This is another important lab assignment, and it is aimed to help you understand essential topics such as dynamic allocation of memory in C++ and concepts such as copying objects in C++.

Due Date: Wednesday, Feb 15, before 11:59 PM

Marking scheme

- Exercise A   16 marks
- Exercise B   4 marks
- Exercise C   4 marks

Exercise A: Design a Dynamic Array Class

Read This First:
This exercise is designed to provide insight into a resizable array class. It also shows other features of C++, including the proper way of copying objects of this class.

What to do:
Download files in the files `MyArray.h` and `lab4ExA.cpp`. Then read the file `MyArray.h`, which tells you what the `MyArray` class interface is and what the member variables are. Pay close attention to the comment that describes the memory management strategy for the `MyArray` class.
Read the file `lab4ExA.cpp`, demonstrating how a `MyArray` object could be used. The file `MyArray.cpp` is missing. It's your job to write this file.

What to Submit:
Submit your file `MyArray.cpp` and your program output as part of your lab report.

Exercise B: Using C++ library classes, `vector` and `string`.

The objective of this exercise is to gain some experience in understanding the C++ library classes, `vector,` and `string`.

What to Do:
Download the files `lab4ExB.cpp` from D2L. In this file, there is a declaration of `vector <string>`. If you compile and run this program, it creates the following output:
```
ABCD
EFGH
IJKL
MNOP
QRST
```

Let's visualize this output as a matrix of letters (5 rows and 4 columns):

A	B	C	D
E	F	G	H
I	J	K	L
M	N	O	P
Q	R	S	T

Your job is to complete the definition of the function called `transpose` that creates a new object of `vector<string>` where its strings are the transpose of the original vector:

A	E	I	M	Q
B	F	J	N	R
C	G	K	O	S
D	H	L	P	T

To test your program, you can change the values of the constants `ROWS` and `COLS`, in the `main` function to make sure your function works with other sizes of the `String_Vector`.

What to Submit:

Submit the definition of your function transpose and the program's output.

Exercise C: C++ File I/O

The objective of this exercise is to help you understand the basics of file I/O in C++.

What to Do:

Download the files `lab4ExC.cpp` from D2L. If you read this file carefully, you will realize that this simple C++ program creates a binary file (for example, `cities.bin`), that contains several records of type `struct City`. Each record has two double types representing x and y coordinates of a city on the Cartesian Plan, followed by the name of the city, which is stored as a C-string in an array of characters with 30 elements. The program has several functions, but the implementation of one of them, called `print_from_binary`, is missing. Your task will be to write the definition of the missing function. This function is supposed to read the content of the binary file created by the program and display its content (records both on the screen and into a text file, using the following format:
```
Name: Calgary, x coordinate: 100, y coordinate: 50
```

Here is the functions prototype and interface comment:
```
void print_from_binary(char* filename);
/* PROMISES: uses ifstream library object to open the binary file named
* "filename" reads the content of the file, which are objects of struct City
* (one record at a time), and displays them on the screen. It also saves the records
* into a text file that its name must be a filename argument, but with the extension of .txt
 */
```

What to Submit:

Submit the definition of your function `print_from_binary` and the content or the generated text file as part of your lab report in PDF format.