BME 121: Digital Computation
Assignment 0: Hands-On Exposure to C++ Programming

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Submission Deadline: Sept 16, 2022 at 10pm Waterloo Time

I. Overall Scope

This coding exercise is intended to get you started on C++ programming and apply the syntax rules you have learned in class to instruct the computer to perform tasks. By the end of this assignment, you are expected to have achieved these learning outcomes:

1. Use the syntax rules covered in class to take inputs from user and command-line arguments
2. Provide feedback to users based on their input
3. Read the error messages returned by the compiler to debug syntax errors in your code

Through working on this exercise, you will learn how to use Visual Studio Code and the g++ compiler to create executable computer programs to achieve the expected design goals. More information about syntax rules and technical details on computer programming can be found in the course notes.

II. Details of Exercise

You will be given two C++ skeleton code files: `HelloWorld.cpp` and `Welcome.cpp`. You are expected to develop compilable C++ source codes based on these skeletons and execute them to test different operations. You are also requested to develop your first C++ program from scratch, namely `Area.cpp`. Specific instructions will be provided below.

You will need to submit your completed C++ source codes and a response file via LEARN. Please see Section III for details. This assignment is worth 2% of your final grade in BME 121.

Part 1 – Debugging HelloWorld.cpp [4 marks]

The provided `HelloWorld.cpp` intentionally contains errors. You are required to debug, document, and fix the errors. As demonstrated in Class 1, the expected output of the `HelloWorld` program in the terminal is:

```
Hello World.
```

To-Do Tasks:

1) Fix the syntax errors in the provided source code file. Please compile it and make sure that the console output matches the expected one stated above.
2) Document what are the syntax errors and what you have done to fix the problems. You should provide such documentation by leaving comments in the file near where you found them.

Part 2 – Command-Line Arguments [6 marks]

The provided `Welcome.cpp` takes in two command-line arguments: 1) name, and 2) WatIAM. For example, if you run the program by typing:

```
./Welcome Justin jtrudeau
```

The corresponding console output should be:

```
Welcome to UW Biomedical Engineering, Justin.
Your University of Waterloo E-mail address is jtrudeau@uwaterloo.ca
```

Note that the output is case-sensitive. There should not be any leading or trailing spaces or additional characters.

To-Do Tasks:

1) Modify `Welcome.cpp` such that it will take in exactly three command-line arguments in the following orders: 1) first name, 2) last name, and 3) WatIAM. When you run the program again with the following command-line arguments:

```
./Welcome Justin Trudeau jtrudeau
```

The corresponding output should be:

```
The value stored in argc is 4.
Student full name: Justin Trudeau
Student's E-mail address: jtrudeau@uwaterloo.ca
```

2) Run the completed program with the following combinations of command-line arguments and answer these questions:

(a) What is shown as the student's full name if the program is run with the following command-line arguments?

```
./Welcome Trudeau Justin jtrudeau
```

(b) What is shown as the student's email address if the program is run with the following command-line arguments?

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```
./Welcome Justin jtrudeau Trudeau
```

(c) What is the value of argc, student's full name, and email address if the program is run with the following command-line arguments?

```
./Welcome Justin Pierre James Trudeau jtrudeau
```

<u>Part 3 – Basic User Input and Math Operations [10 marks]</u>

Starting from scratch, write a C++ program named `Area.cpp` that calculates the area of a trapezoid. This program does not involve command-line arguments. Instead, it would take in 3 integers from the user:

- *a* (length of the trapezoid's first parallel side)
- *b* (length of the second parallel side)
- *h* (height)

With the inputted values, the program would calculate the trapezoid's area *A*. As a reminder, a trapezoid's area is given by the formula:

$$A = \frac{a+b}{2}h$$

To-Do Tasks:

1) Please code your C++ program such that it yields the following console output if a user enters the numbers 4, 8, and 6:

```
Please enter the length of the first parallel side (a) [in cm]: 4
Please enter the length of the second parallel side (b) [in cm]: 8
Please enter the height (h) [in cm]: 6
The area of the trapezoid is 36 squared centimeters.
```

<u>Note</u>: In the above console window, the numbers in **`bold purple`** *refer to user input from the keyboard during program's online execution. In each of these instances, the user would input the number and then press the Enter key.*

2.

(A)

```
The value stored in argc is 4.
Student full name: Trudeau Justin.
Student's E-mail address: jtrudeau@uwaterloo.ca
```

(B)

```
The value stored in argc is 4.
Student full name: Justin jtrudeau.
Student's E-mail address: Trudeau@uwaterloo.ca
```

(C)

```
The value stored in argc is 6.
Student full name: Justin Pierre.
Student's E-mail address: James@uwaterloo.ca
```

2) Use your completed program to test the output for the following sets of input values and complete the three right columns of the table:

a	*b*	*h*	*A* computed by your C++ program	*A* computed by calculator	C++ program output correct?
1	4	2	5	5	Yes
6	0	3	9	9	Yes
0	5	6	15	15	Yes
0	0	0	0	0	Yes
2	2	2500000000	-2	5.0e9	No
1000000000	1200000000	3	-994967296	3.3e9	No
5	2	3.5	10	12.25	No

III. Submission Requirements

Submit your completed `HelloWorld.cpp`, `Welcome.cpp`, `Area.cpp`, and a response file (containing results for Part 2, Task 2 and Part 3, Task 2) through LEARN. There is a Dropbox folder for this assignment, under ***Submit → Dropbox → Assignment 0***. You may submit as many times as you want, as long as it is before the deadline. The submission deadline is Friday 16, Sept 2022 at 10pm.

You will be assigned a mark out of 20 for this assignment, which will account towards 2% of your final course grade.