This sheet is to be returned at the conclusion of the lab session.

Student Name: Student Number:

ENG 1D04, Lab 10, Marked Assignment 5, Objects and Classes, Wednesday

This assignment has to be submitted via ELM before 2:10 pm. **Assignments will not be accepted after this time.** Please remember to submit your work early and resubmit often. **You should not wait until the end of the lab to start submitting.** You must do the assignment on your own. Conversations between students will not be permitted. You cannot bring reference material into the lab or access information through the Internet. You may use the Visual C# help, Notepad, and the Calculator program.

Background

A *vector* is a mathematical entity that has direction and magnitude. A two-dimensional vector can be represented by a pair $V = (a, b)$ of real numbers where a and b are the x- and y-coordinates of V. Given a real number r and two vectors $V_1 = (a_1, b_1)$ and $V_2 = (a_2, b_2)$, the *magnitude* of V_1 is the real number $|V_1| = \sqrt{(a_1)^2 + (b_1)^2}$, the *scalar multiple* of r and V_1 is the vector $r*V_1 = (r*a_1, r*b_1)$ and the *sum* of V_1 and V_2 is the vector $V_1 + V_2 = (a_1 + a_2, b_1 + b_2)$. The *maximum* of V_1 and V_2 is the vector $\mathsf{max}(V_1, V_2) = V_1$ if $|V_1| > |V_2|$ and $\mathsf{max}(V_1, V_2) = V_2$ otherwise.

Overview

Your program will input two vectors and then apply a method to these two vectors. Design, implement, and test the application described in the requirements below. A definition of a class `Vector` of objects representing 2-dimensional vectors is in a file named `Vector.cs` attached to this assignment on ELM. Name the application

>   *MacID_StudentNumber_LabSection_*`Lab10`

where *MacID*, *StudentNumber*, and *LabSection* are your MacID, student number, and lab section (written as L*xy*), respectively. When done, compress the project and similarly name the zip file

>   *MacID_StudentNumber_LabSection_*`Lab10.zip`

Details of what you must submit are specified below.

Requirements

1. Your project's `Form1.cs` file contains a copy of the `Vector` class after the `Form1` class. The `Vector` class is in a file named `Vector.cs` attached to this assignment on ELM. (You are free to copy and paste Vector.cs directly into your code.)

2. The `Vector` class contains an additional method with the heading

   ```
   public Vector maximum(Vector v)
   ```

   such that, when `v1.maximum(v2)` is called, the maximum of the vectors `v1` and `v2` is returned.

3. A graphical user interface (GUI) consisting of a form with the controls described below. The text `Vector Manipulation` is at the top of the form. (The placement of the controls is your decision.)

4. Two input text boxes in a row followed by a `Build Vector 1` button. When the `Build Vector 1` button is clicked, an object of type `Vector` is constructed whose x-coordinate is given by the contents of the first input text box and whose y-coordinate is given by the contents of the second input text box. A variable named `vector1` is given this object as its value. When the application starts, these two input text boxes are empty.

5. Two more input text boxes in a row followed by a `Build Vector 2` button. When the `Build Vector 2` button is clicked, an object of type `Vector` is constructed whose x-coordinate is given by the contents of the first input text box and whose y-coordinate is given by the contents of the second input text box. A variable named `vector2` is given this object as its value. When the application starts, these two input text boxes are empty.

6. An output label box with label `Result` to show the result of applying the method `maximum` to `vector1` and `vector2`.

7. A `Calculate` button that when clicked replaces the label `Result` by `The Maximum of Vector 1 and Vector 2 = X` where `X` is the pair of the `x` and `y` values of

    `vector1.maximum(vector2)`.

8. A `Clear` button that when clicked causes all four input text boxes to be cleared of their values and restores the output label box back to the original value of `Result`.

Design

In your project folder include a separate text document (using Notepad) with the file name *Name_LabNumber*_`Lab10.txt` where *Name* is your name and *LabNumber* is your lab section. The report will answer two questions, one related to design and the other related to testing. The testing question is given below. The design question is:

> In the class `Vector`, what is the advantage of defining `sum` using the public methods `getXCoordinate` and `getYCoordinate` instead of the private fields `x` and `y`?

Implementation in Visual C#

Implement the requirements listed above. The method `maximum` should not create a new vector. That is, when applied to `vector1` and `vector2`, it should return either `vector1` or `vector2`.

Testing

In the *Name_LabNumber*_`Lab10.txt` file, answer the following testing question:

> Explain how calling `maximum` via the `Calculate` button could be used to test whether `vector1` and `vector2` are built correctly.

Bonus

You will receive two bonus points if the method `maximum` is defined using only public methods (i.e., it does not reference any variables or private methods).