Lab01: C++ Expressions
ES036a: Programming Fundamentals – Fall 2007

A. Rationale and Background

Welcome to ES036b Lab01. In Lab00 we learned how to create a solution and then a project within this solution in Visual Studio 2005. You are encouraged to revise Lab00. In this lab we will open our existing solution *ES036Labs* and create our second project *Lab01*. Please read section G to learn how to do this before doing section E.

In this lab you will write your own simple programs by declaring variable and writing simple expressions. Once you complete the lab you will be able to

- Write and execute a simple C++ program
- Use `cin` and `cout`.
- Do you own calculation in C++.

B. How to Get Full Credit for this Lab

You will get credit for your lab when you demonstrate it and get your TA's approval. Submitting your lab online is required.

B.1. Submission Instructions

Number of files   :   2
Files to be submitted   :   cpp file in E.1 and cpp file in E.2
Rename these files as   :   your_uwo_user_name_lab01_q1.cpp,
                                      your_uwo_user_name_lab01_q2.cpp

C. Pre-lab Questions

It is important that you read and understand the lab beforehand. Answering the following questions will help. You do not have to submit the pre-lab but be ready for a simple lab quiz.

1. What is the purpose of the function `main()` in the following code?

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

int main()
{
    cout<<"Welcome to ES036 lab."<<endl;
    return 0;
}
```

2. Explain the purpose of each line in the above code segment.
3. When do you use `cout` and `cin`?
4. How do you declare variables in C++?
5. How do you include comment in C++?
6. What are the variables declared in the following code?

```
#include <iostream>
#include <string>
```

```
using namespace std;

int main()
{
      int age;                     //a variable named age of type int
      string name;                 //a variable named name of type string

      cout<<"Tell me your name please: ";         //prints on screen
      cin>>name;                                  //waits for keyboard input
      cout<<"Tell me your age please: ";          //prints on screen
      cin>>age;                                   //waits for keyboard input

      cout<<"Hello "<< name <<" you are "<<age<<" years old."<<endl;

      return 0;
}
```

7. What is the purpose of the above code?
8. What does the line before the `return 0` do?
9. What is the major difference between the data-types `int` and `double`?
10. What is the limitation of integer division?

D. Good Programming Practice
- Include comments in your program.
- Initialize your variables appropriately.

E. Lab Questions
This is the part that you need to complete to obtain full credit. You will need to submit the cpp files for questions E.1 and E.2. Your TA will ask you questions and request you to do simple modifications. Now we will open our existing solution *ES036Labs* and create our second project *Lab01*. Please refer to section G on how to do this.

E.1. Question 1: Area of a Circle
Requirement:
Write a program that calculates and prints the area of a circle, given the radius.
Specifications:
1. The program will print a greeting message that describes its mission.
2. It will prompt the user for the radius.
3. It calculates the area and displays the result. See sample output.
Hints:
- You need to add a new project called Lab01 and then add a new item (a cpp file). See instructions in section G to see how to add a new project to an existing solution.
- The area of a circle is given by $A = \pi \times r^2$ where $\pi \approx 3.1416$ and *r* is the radius of the circle.
Sample output:

```
****************************************************
*                                                  *
*           ES036a-2007 Lab01 Q1                    *
*           Your Name                               *
*                                                  *
****************************************************
```

```
This program calculates the area of circle when the radius is given.
Please enter the radius (cm): 7
The area of a circle with radius 7cm is 153.938 cm^2.
Bye bye.
Press any key to continue . . ..
```

E.2. Question 2: Intersection of Two Lines

Requirement:

Assume that you are given the equations of two lines. $y = m_1 x + c_1$ and $y = m_2 x + c_2$. Write a C++ program to obtain the constants m_1, c_1, m_2 and c_2 from the user and calculate the point at which the two lines intersect.

Specifications:

1. Program will print a greeting message that describes its mission.
2. It will prompt the user for the constants m_1, c_1, m_2 and c_2.
3. It calculates the area and displays the point at which the two lines intersect.

Hints:

- You need to remove username_lab01_q1.cpp and add a new cpp file: username_lab01_q2.cpp.

- The point at which the two lines intersect is given by (x, y) where $x = \dfrac{c_2 - c_1}{m_1 - m_2}$ and $y = \dfrac{c_2 m_1 - c_1 m_2}{m_1 - m_2}$.

Sample Output:

```
******************************************************
*                                                    *
*            ES036a-2007 Lab01   Q1                  *
*            Your Name                               *
*                                                    *
******************************************************

This program finds the intersection of two lines given the slopes and
intercepts.
Please enter m1: 2
Please enter c1: 1
Please enter m2: 3
Please enter c2: 5
Line y = 2x + 1 intersects with y = 3x + 5 at: (-4, -7).
Bye bye.
Press any key to continue . . .
```

Run the program and enter 2 for m_1, 1 for c_1, 3 for m_2 and 5 for c_2. Compare your output with the sample output. What will happen if you enter 2 for m_2 instead of 3?

F. Additional Questions

These problems are for you to practice at home. You do not need to demonstrate or submit them online.

a. Write a simple C++ program that would display 'Hello!' on the screen.
b. Write a program to print a block F using letter 'F', where F is 7 characters high and 5 characters wide, as shown below. Can you display your first name in this form?

```
FFFFF
F
F
FFF
F
F
F
Press any key to continue
```

c. Write a program that prompts the user to enter the speed of a vehicle in miles per hour and display the speed in kilometers per hour where, v miles/h = v kilometers/h x 0.6213712.
d. Write a program that prompts the user to input the height and width of a rectangle and then print its area (height x width) and perimeter (2 x height x width) on the screen.
e. How can you truncate the result in E.2 to two decimal places (see class notes and/or book)?
f. Write a program that would ask the use to input an integer and display the square of the input integer.
g. Write a program that would calculate the period of oscillation (in seconds) of a simple pendulum given by the equation $T = 2\pi\sqrt{l/g}$ with user input length l (in meters). Assume acceleration due to gravity, g = 9.81 ms^2 and π = 3.1416. Hint: We have to use the `sqrt` function to calculate the square root. To make this function available, add the following statement:

```
#include <cmath>
```

See page 457 of the textbook for the complete list of math functions that are available.

## G. Adding a New Project to a Solutions

Please read this section before doing section E.

We created a solution called ES036Labs in our last lab. This solution contained a project called Lab00. In this assignment, we need to add another project to this existing solution. To do that, we need to reopen the solution. We can do this by opening ES036Labs.sln file. This should be located in H:/ES036Labs if you properly followed the instruction during the last lab.

Once you have the solution open, right click on the item at the left panel, as shown in the following figure, and select **Add → New Project.** Please refer Lab00 for the steps to follow. What you need to do is to create and empty Win32Console application as we did in Lab00.
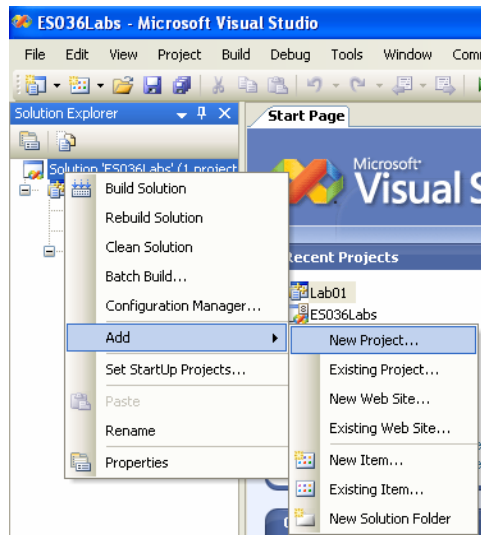
Now we need to add a new cpp file. Right click the Lab01 item on the left panel and **select Add → New Item**.
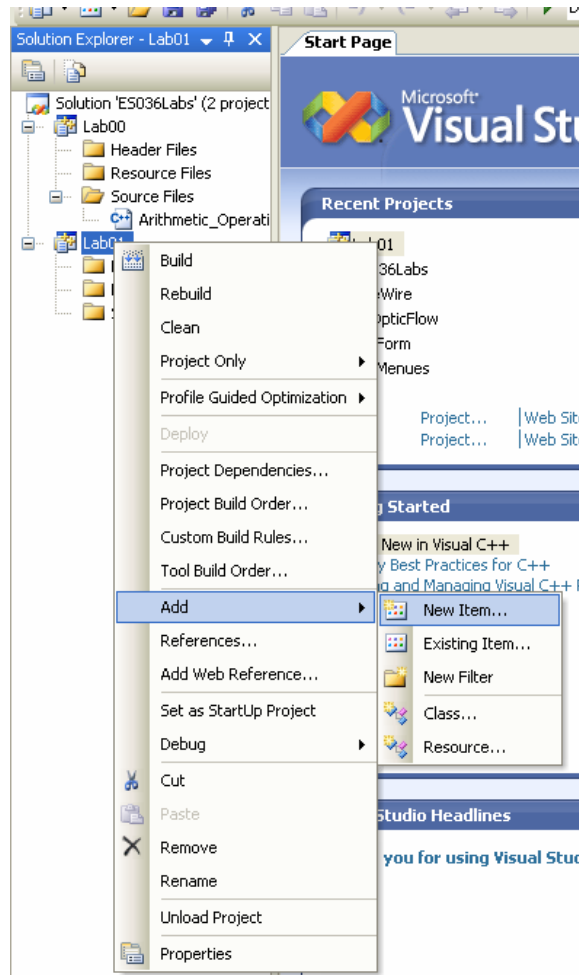
Form the dialog that appears (see below), select C++ File (.cpp). Here you will need to type a name for the new cpp file that you will be creating. Please use the following file naming convention for ES036 labs.
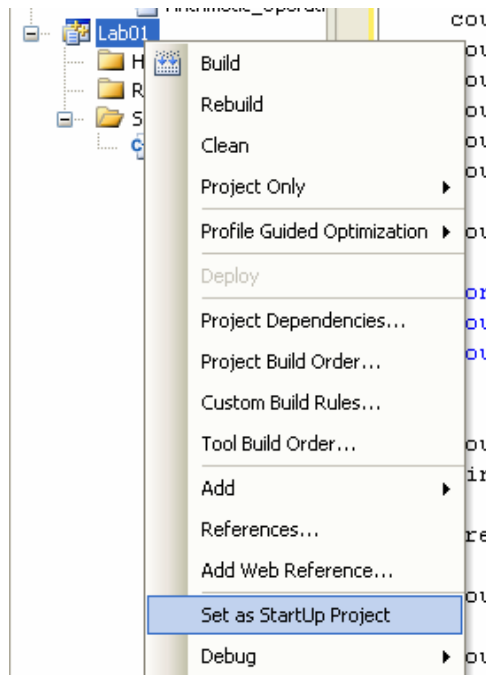
     username_labxx_qx

for example for Lab01, question 1 if your username is wtern, you would use the file name

     wtern_lab01_q1.

Notice that the new file will be located in H:\ES036Labs\Lab01 folder.
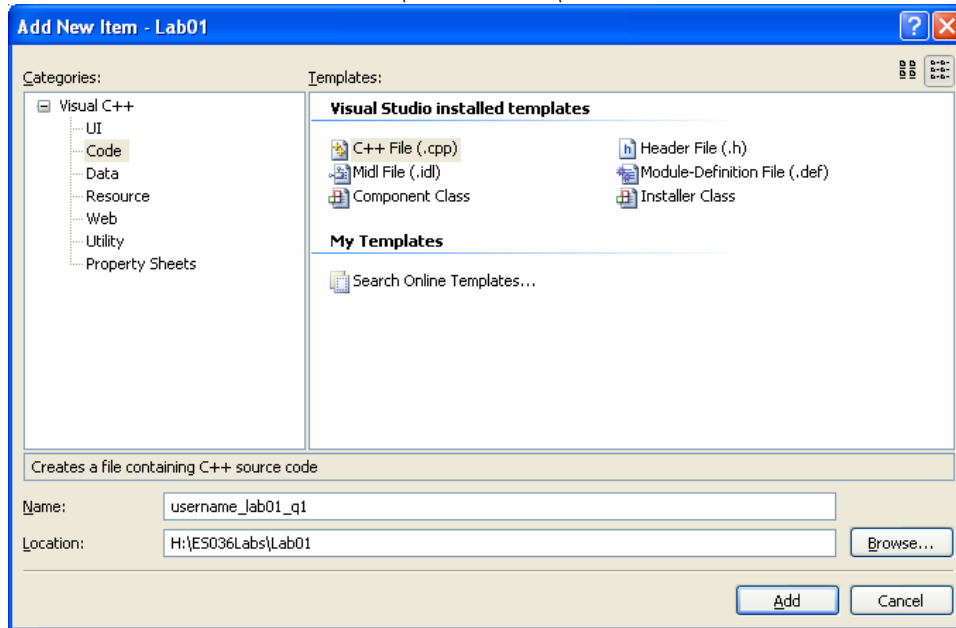
Before your can run your Lab01, you should set it as the startup project as shown below by right clicking Lab01.

Now you know how to add a project to an existing solution. Please return to section E now.