

# CS 150 Lab 3

## Arithmetic and the Debugger

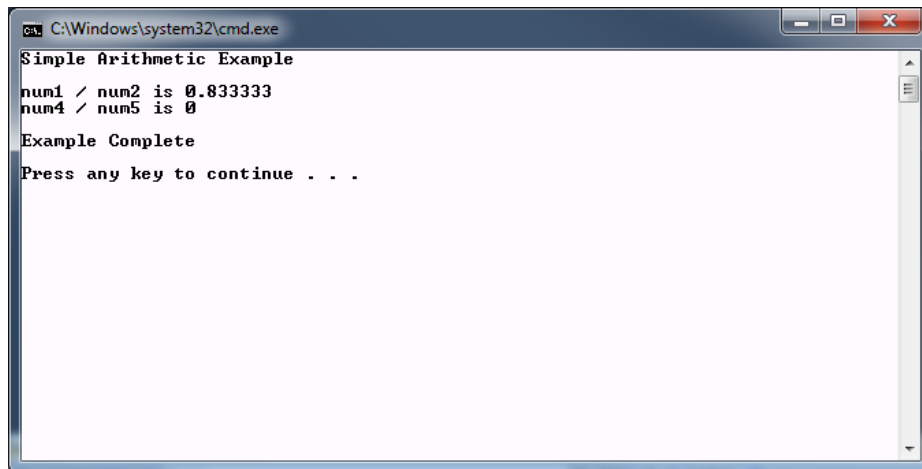
The main objective of today's lab is to use some basic mathematics to solve a few real world problems. In doing so, you are to begin getting accustomed to using the Visual Studio debugger.

- Be sure your output looks exactly like the specified output.
- Be sure to submit the completed project to **CS150-01 Lab** when you are done.
- Be sure to use the program skeleton and add comments to your code!
- Show the instructor or TA your solution to each problem before submitting.
- You do not need to submit the challenge question!

### Lab 3.0

We are going to begin using the Visual Studio 2017 debugger to aid with debugging programs.

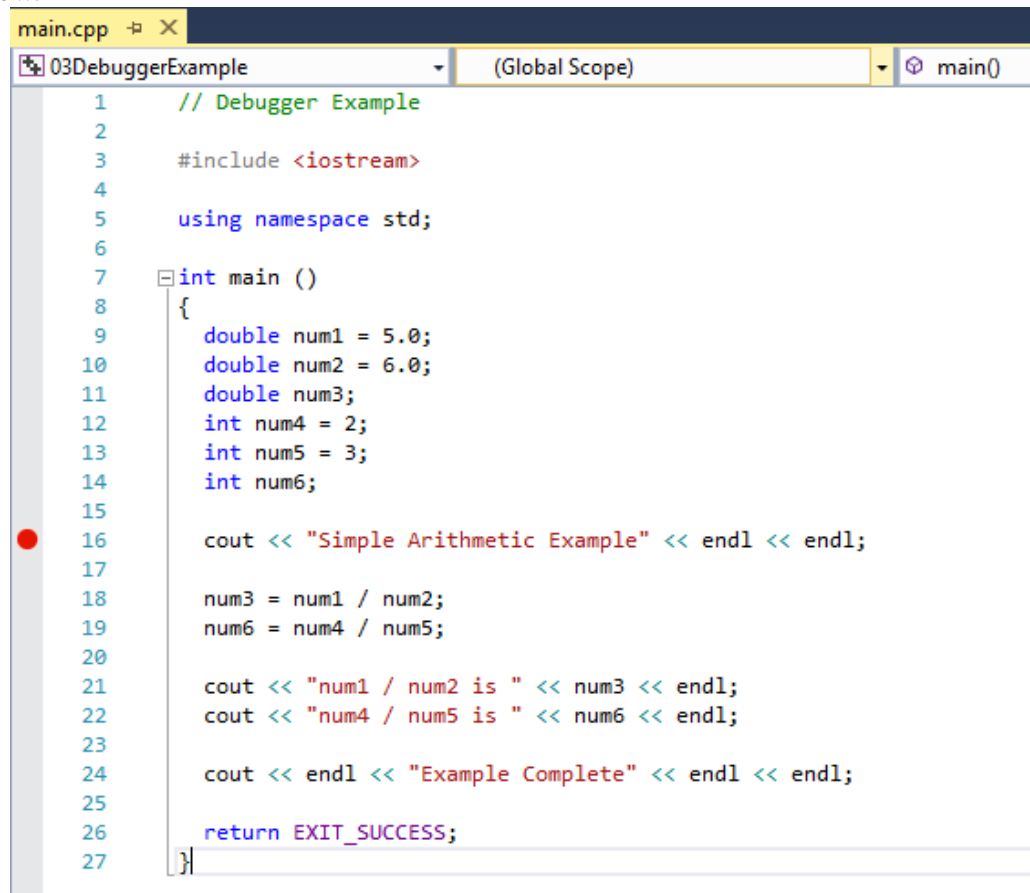
1. Go to **CS150Public** folder on Grace and drag a copy of the solution **03DebuggerExample** to your desktop.
2. Open up the solution by clicking on the 03DebuggerExample Visual Studio file within this folder, and from within Visual Studio open the main.cpp source file and read the code. Make sure you understand it.
3. Build your solution and then execute the program using the command "Start Without Debugging." You will see the following.



```
C:\Windows\system32\cmd.exe
Simple Arithmetic Example
num1 / num2 is 0.833333
num4 / num5 is 0
Example Complete
Press any key to continue . . .
```

4. In looking at your output you wonder why num4 / num5 is 0 since both numbers are nonzero. What is going on? Let's debug!

5. Close the output window and go back to the code.
6. Set a breakpoint by clicking in the dark gray column to the left of the executable statement on line 16. This will place a large red circle in that spot. Your screen should look like the one below.



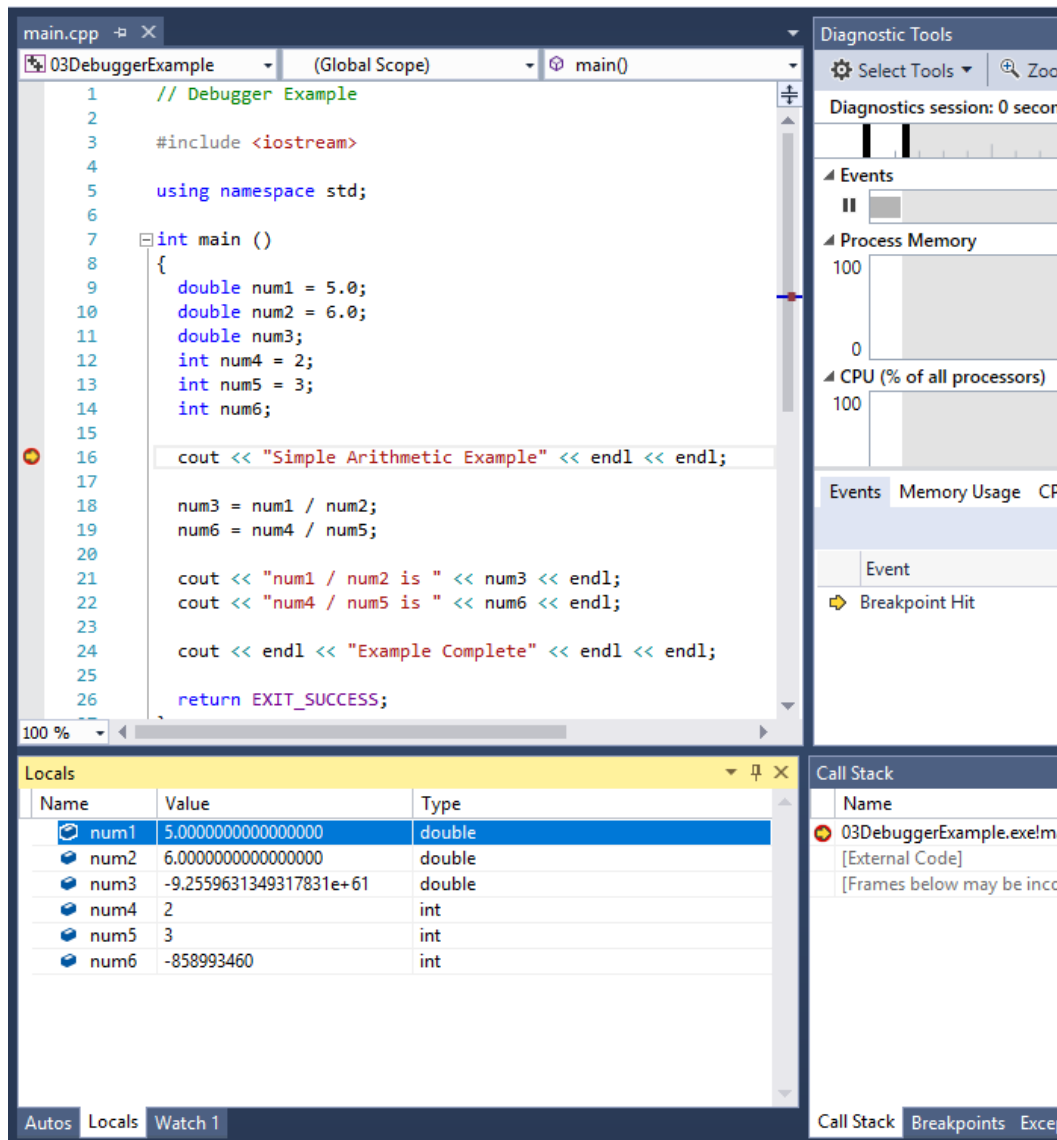
The screenshot shows a code editor window titled 'main.cpp'. The code is as follows:

```
1 // Debugger Example
2
3 #include <iostream>
4
5 using namespace std;
6
7 int main ()
8 {
9     double num1 = 5.0;
10    double num2 = 6.0;
11    double num3;
12    int num4 = 2;
13    int num5 = 3;
14    int num6;
15
16    cout << "Simple Arithmetic Example" << endl << endl;
17
18    num3 = num1 / num2;
19    num6 = num4 / num5;
20
21    cout << "num1 / num2 is " << num3 << endl;
22    cout << "num4 / num5 is " << num6 << endl;
23
24    cout << endl << "Example Complete" << endl << endl;
25
26    return EXIT_SUCCESS;
27 }
```

A red circle breakpoint is visible in the left margin next to line 16. The editor interface includes a toolbar at the top with '03DebuggerExample', '(Global Scope)', and 'main()'.

7. Debugging starts running the program, but will stop at your breakpoint. This allows you to step through the program one statement at a time, and see the contents of the variables.

Let's start the debugger and step through our program one executable statement at a time. Start the debugger by going to Debug → Start Debugging. The debugger will stop at the first executable statement that has a breakpoint. The yellow arrow indicates the spot that the program will execute next. Your screen should look something like the following. At the bottom of the screen, make sure the **Locals tab** is selected and not the Autos tab.



8. Study the screen and answer the following questions:

1. What is stored in the variable **num1**: \_\_\_\_\_
2. What is stored in the variable **num4**: \_\_\_\_\_
3. Why are they different? \_\_\_\_\_
4. What is stored in the variable **num6**: \_\_\_\_\_
5. Why does **num6** contain that value? \_\_\_\_\_
6. Did the console (output) window open? If so, where is it? What does it contain?  
\_\_\_\_\_


9. While the debugger is running, look for the following toolbar at the top of the screen. Don't press any of the buttons yet.



The buttons that most concern us are:

**Continue:** will continue running the program until the next breakpoint or the end of the program 

**Stop Debugging:** will stop running the program 

**Step Over:** will step over the program, one executable statement at a time 

10. What happens when you click on **Step Over** once?

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11. What happens when you click on **Step Over** once again?

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12. Hover the mouse over **num4** on line 19. What happens? What is stored in **num4**?

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13. Hover the mouse over **num5** on line 19. What happens? What is stored in **num5**?

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14. What do you expect to be stored in **num6** after executing line 19?

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15. Click Step Over. What is stored in **num6** now?

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16. Modify the program so that it displays 0.666667 for **num4** / **num5** instead of 0

17. **► STOP – Show the instructor or TA. You will not turn in this portion of the lab.**

## Lab 3.1: Fahrenheit to Celsius

Open up your PUNetIDLabs solution that contains the lab projects from the last two weeks.

Add a project called **03\_1\_TemperatureConversion** to your **PUNetIDLabs** solution. This project is to convert a Fahrenheit temperature to both Celsius and Kelvin. The conversion formulas are:

$$C = \frac{5}{9}(F - 32)$$

$$K = \frac{5}{9}(F - 32) + 273$$

Sample Input/Output where the Fahrenheit temperature is the only input shown in bold below.

```
*****
Temperature Converter
*****

Enter a non-negative Fahrenheit temperature: 212

212 Fahrenheit is 100 Celsius

212 Fahrenheit is 373 Kelvin
```

1) Briefly describe the data that your program will need to use.

---

---

2) List the variable declarations necessary to store the data listed in 1.

---

---

3) Open up Visual Studio and write a complete program for the above problem.

4) Build, run and test your program.

5) Once it's working, show the instructor/TA that you can step through your solution with the debugger.

**► STOP – Show the instructor or TA**

## Lab 3.2: Time Converter

Add a project called **03\_2\_TimeConverter** to your **PUNetIDLabs** solution. This project is to convert a number of seconds into hours, minutes, and seconds in a format like **HH:MM:SS**.

Sample Input / Output where the total number of seconds is the only input shown in bold below.

```
*****  
Time Converter  
*****  
  
Enter seconds since day began: 100  
  
The time is 0:1:40
```

1) Briefly describe the data that your program will need to use.

---

---

---

2) List the variable declarations necessary to store the data listed in 1.

---

---

---

3) Open Visual Studio and write a complete program for the above problem.

4) Build, run and test your program.

**► STOP – Show the instructor or TA**

### Optional Challenge:

Always print your time as **HH:MM:SS** so the above time would show **00:01:40**

Once both projects are completed, place your solution **PUNetIDLabs** into the **CS150-01 Drop** folder on Grace. Your solution is to have all six (2 from lab 1, 2 from lab 2, 2 from lab 3) projects completely working and correct.