Using the Visual Studio Debugger

Introduction

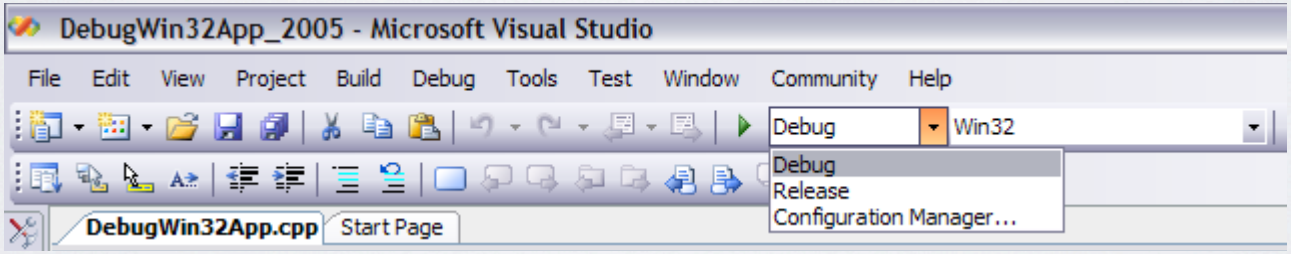
- There are two types of errors
  - Compilation errors
  - Logic errors (also called bugs)
- Eliminate compilation errors from your code
- Most C++ compiler vendors provide software called a debugger
  - Allows you to monitor the execution of your programs to locate and remove logic errors

Why Should I Use Visual Studio to Debug my Program?

- Even most experienced coder creates errors or "bugs"
- Visual Studio debugger will provide two powerful runtime facilities:
  - Trace the program Execution
  - Watch variables during program execution
- These allow you to stop at procedure locations, inspect memory and register values, change variables, observe message traffic, and get a close look at what your code does.

Project Configuration Settings

- Debug vs. Release Configurations
  - The **Debug** configuration of your program is compiled with full symbolic debug information and no optimization.
  - The **Release** configuration of your program is fully optimized and contains no symbolic debug information.
  - Must be in Debug configuration to debug your program!.

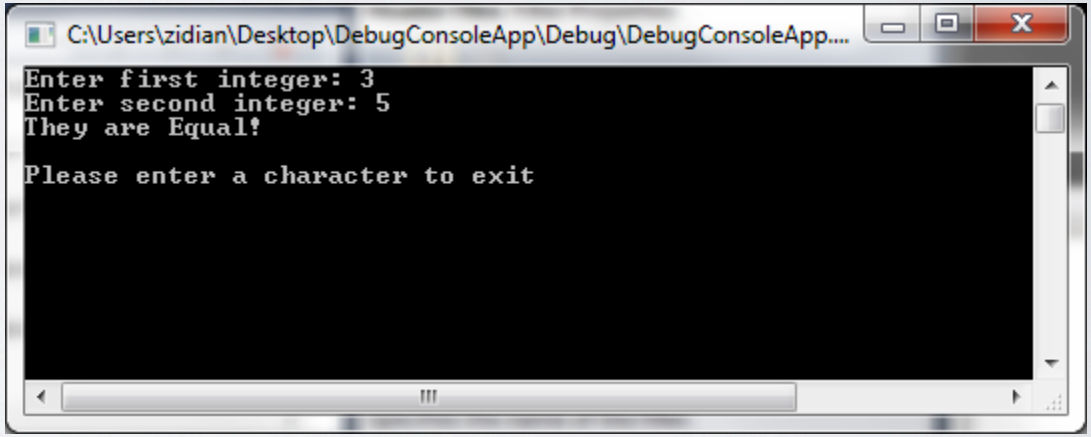


Getting Acquainted with Visual Studio Debugger

- Debugger Windows
  - Autos
  - Locals
  - Watch
  - Call Stack
  - etc.
- Execution Control
  - Starting or Continuing Execution
  - Stopping
  - Breaking Execution
  - Stepping Into and Out of code
  - etc.

Debugging Example #1
Console app

This simple console program should determine whether two integers are equal.



Code compiled just fine,

0 warnings, 0 errors

… BUT the code obviously has a logical error! 3 does not equal 5!

Debugging Example #1 (a console app.)

DebugConsoleApp - Microsoft Visual Studio (Administrator)

File Edit View Project Build Debug Team Data Tools VisualSVN Architecture Test Analyze Window Help

Debug | Click

Solution Explorer

- Solution 'DebugConsoleApp' (1 project)
  - DebugConsoleApp
    - External Dependencies
    - Header Files
      - std_lib_facilities.h
    - Resource Files
    - Source Files
      - DebugConsoleApp.cpp

DebugConsoleApp.cpp

(Global Scope) | main()

```
#include "std_lib_facilities.h"


int main()
{
    int x, y;

    cout << "Enter first integer: ";
    cin >> x;

    cout << "Enter second integer: ";
    cin >> y;

    if(x=y)
        cout << "They are Equal!" << endl;
    else if(x>y)
        cout << "The first one is bigger!" << endl;
    else
        cout << "The second ont is bigger!" << endl;

    cout << endl;

    keep_window_open();

    return 0;
}
```

Solution Explorer | Team Explorer

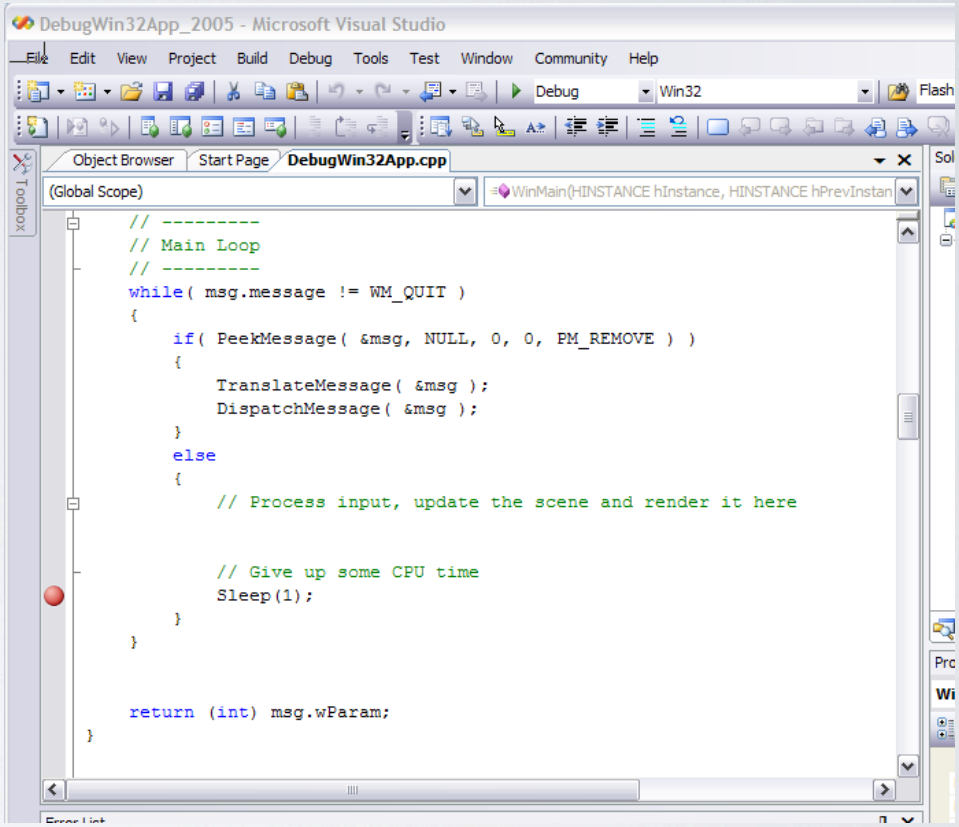
100 %

Output | Find Symbol Results | Code Metrics Results | Error List

Ready

What is a Breakpoint?

- Breakpoints are user-defined code locations that pause execution
- You know them by the little, red "dot" in the left margin of the editor window
- F9 to add or remove (toggle)
- Or left-mouse click in margin
- Unlimited number of them to use.



Debugging Example #1 (continued)

DebugConsoleApp - Microsoft Visual Studio (Administrator)

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Solution Explorer

- Solution 'DebugConsoleApp' (1 project)
  - DebugConsoleApp
    - External Dependencies
    - Header Files
      - std_lib_facilities.h
    - Resource Files
    - Source Files
      - DebugConsoleApp.cpp

DebugConsoleApp.cpp

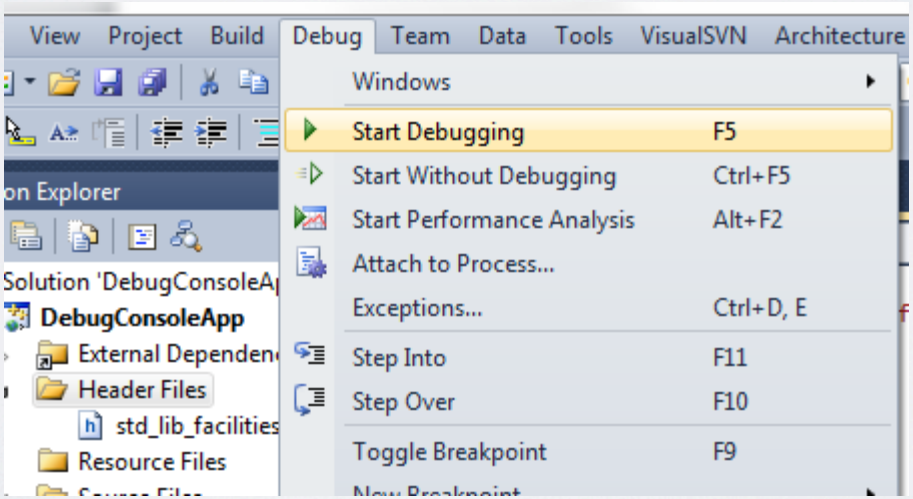
```
1
2  #include "std_lib_facilities.h"
3
4
5  int main()
6  {
7      int x, y;
8
9      cout << "Enter first integer: ";
10     cin >> x;
11
12     cout << "Enter second integer: ";
13     cin >> y;
14
15     if(x=y)
16         cout << "They are Equal!" << endl;
17     else if(x>y)
18         cout << "The first one is bigger!" << endl;
19     else
20         cout << "The second ont is bigger!" << endl;
21
22     cout << endl;
23
24     keep_window_open();
25
26     return 0;
27 }
```

Add a breakpoint here

We arbitrarily picked this line because it seemed like a reasonable place

Starting the Debugging Session

- Make sure you are in a Debug configuration
- Press F5
- Or click on Debug icon
- Or select menu Debug – Start Debugging



Debugging Example #1 - Running in the debugger

DebugConsoleApp (Debugging) - Microsoft Visual Studio (Administrator)

File Edit View Project Build Debug Team Data Tools VisualSVN Architecture Test Analyze Window Help

Debug | Click

Solution Explorer

- Solution 'DebugConsoleApp' (1 project)
  - **DebugConsoleApp**
    - External Dependencies
    - Header Files
      - std_lib_facilities.h
    - Resource Files
    - Source Files
      - DebugConsoleApp.cpp

IntelliTrace | Solution Explorer

DebugConsoleApp.cpp — (Global Scope) — main()

```
9     cout << "Enter first integer: ";
10    cin >> x;
11
12    cout << "Enter second integer: ";
13    cin >> y;
14
15    if(x=y)
16        cout << "They are Equal!" << endl;
17    else if(x>y)
18        cout << "The first one is bigger!" << endl;
19    else
20        cout << "The second ont is bigger!" << endl;
21
22    cout << endl;
```

100 %

Autos

Name	Value	Type
x	3	int
y	5	int

Err... | Ou... | Fin... | Lo... | Au... | W... | Th...

Call Stack

Name	Language
DebugConsoleApp.exe!main() Line 15	C++
DebugConsoleApp.exe!__tmainCRTStartup() Line 555 + 0x19 bytes	C
DebugConsoleApp.exe!mainCRTStartup() Line 371	C
kernel32.dll!7526339a()	
[Frames below may be incorrect and/or missing, no symbols loaded for kernel3	
ntdll.dll!776d9ef2()	
ntdll.dll!776d9ec5()	

Immediate Window

Ready

Debugging Example #1 Stepping, examine variables

DebugConsoleApp (Debugging) - Microsoft Visual Studio (Administrator)

File Edit View Project Build Debug Team Data Tools VisualSVN Architecture Test Analyze Window Help

Debug | Click

Solution Explorer

- Solution 'DebugConsoleApp' (1 project)
  - DebugConsoleApp
    - External Dependencies
    - Header Files
      - std_lib_facilities.h
    - Resource Files
    - Source Files
      - DebugConsoleApp.cpp

IntelliTrace | Solution Explorer

DebugConsoleApp.cpp

(Global Scope) | main()

```
9   cout << "Enter first integer: ";
10  cin >> x;
11
12  cout << "Enter second integer: ";
13  cin >> y;
14
15  if(x=y)
16      cout << "They are Equal!" << endl;
17  else if(x>y)
18      cout << "The first one is bigger!" << endl;
19  else
20      cout << "The second ont is bigger!" << endl;
21
22  cout << endl;
```

100 %

Autos

Name	Value	Type
x	5	int
y	5	int

Call Stack

Name	Language
DebugConsoleApp.exe!main() Line 16	C++
DebugConsoleApp.exe!__tmainCRTStartup() Line 555 + 0x19 bytes	C
DebugConsoleApp.exe!mainCRTStartup() Line 371	C
kernel32.dll!7526339a()	
[Frames below may be incorrect and/or missing, no symbols loaded for kernel3	
ntdll.dll!776d9ef2()	
ntdll.dll!776d9ec5()	

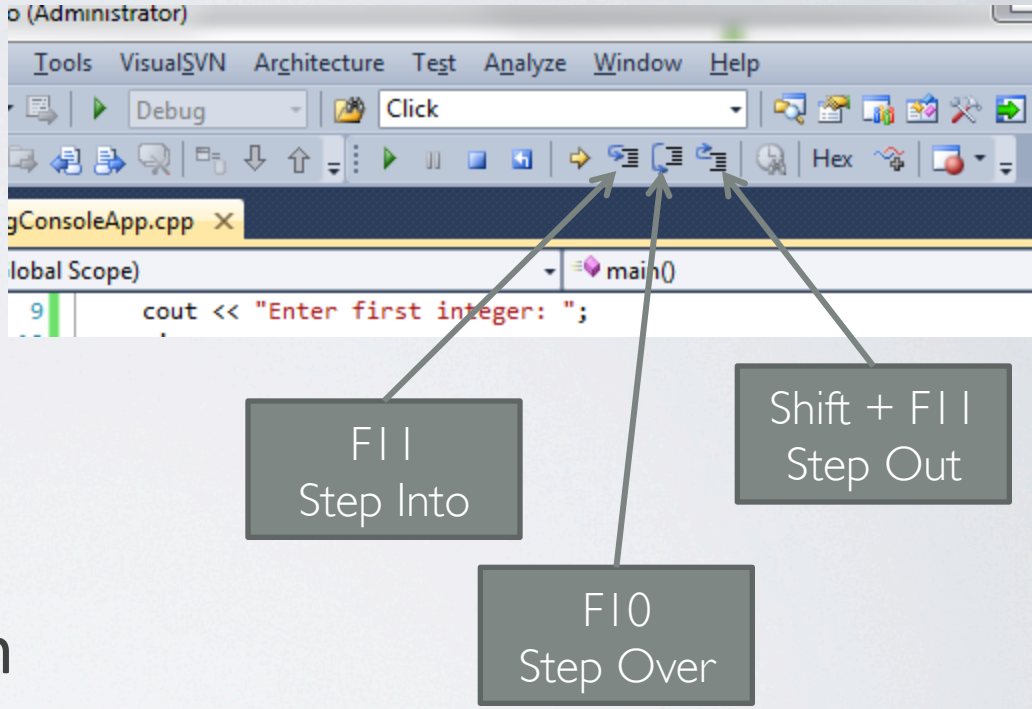
Err... Ou... Fin... Lo... Au... W... Th...

Immediate Window

Ready Ln 16 Col 1 Ch 1 INS

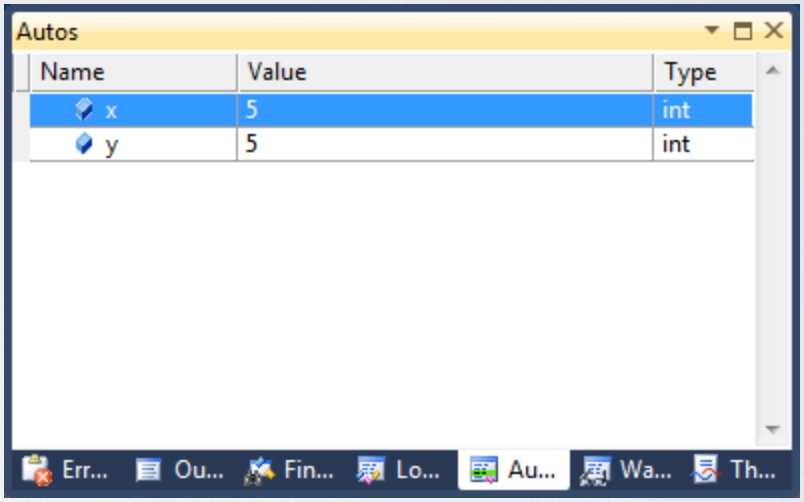
Execution Control
Stepping through your code

- Starting / Stopping
- Breaking
- Stepping through your application
- – (F10, F11 or Toolbar buttons)
- Run to a specific location
- **Run To Cursor** (right-click menu)



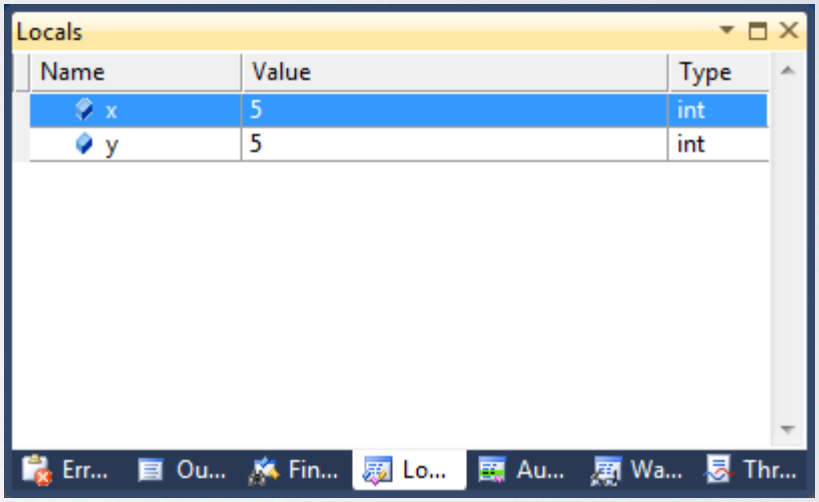
Autos Window

- **Name**
  - The names of all variables in the current statement and the previous statement. The current statement is the statement at the current execution location, which is the statement that will be executed next if execution continues.
- **Value**
  - The value contained by each variable. By default, integer variables are represented in decimal form.
- **Type**
  - The data type of each variable listed in the Name column.



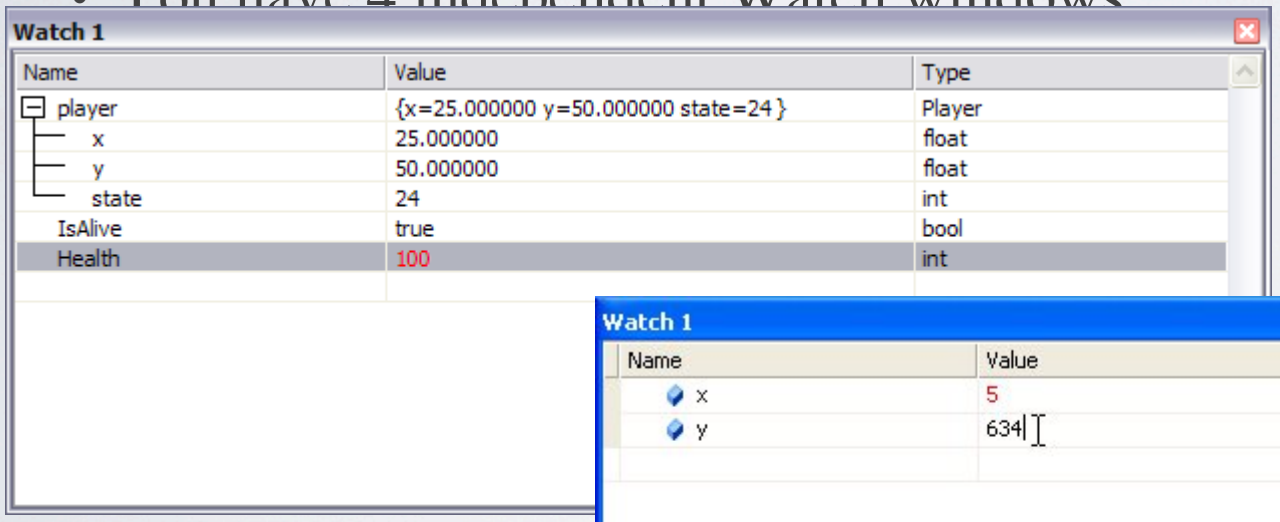
Locals Window

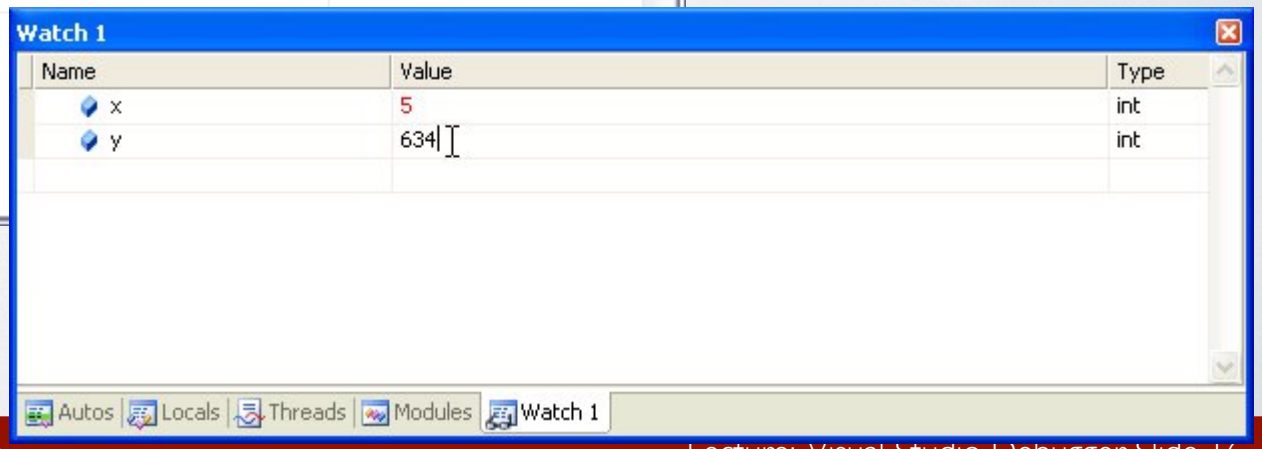
- **Name**
  - This column contains the names of all local variables in the current scope.
- **Value**
  - The value contained by each variable. By default, integer variables are represented in decimal form.
- **Type**
  - The data type of each variable listed in the **Name** column.



Watch window(s)

- Watch window displays Name, Value, and Type of variables
- Type in or click-drag variables into window
- Change values live while at break
- You have 4 independent Watch windows





Debugging Example #1 – Found error

DebugConsoleApp (Debugging) - Microsoft Visual Studio (Administrator)

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Debug | Click

Solution Explorer

- Solution 'DebugConsoleApp' (1 project)
  - DebugConsoleApp
    - External Dependencies
    - Header Files
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DebugConsoleApp.cpp

(Global Scope)

```
9   cout << "Enter first integer: "
10  cin >> x;
11
12  cout << "Enter second integer: "
13  cin >> y;
14
15  if(x=y)
16      cout << "They are Equal!" << endl;
17  else if(x>y)
18      cout << "The first one is bigger!" << endl;
19  else
20      cout << "The second ont is bigger!" << endl;
21
22  cout << endl;
```

100 %

if (x==y)

IntelliTrace | Solution Explorer

Autos

Name	Value	Type
x	3	int
y	5	int

Call Stack

Name	Language
DebugConsoleApp.exe!main() Line 15	C++
DebugConsoleApp.exe!__tmainCRTStartup() Line 555 + 0x19 bytes	C
DebugConsoleApp.exe!mainCRTStartup() Line 371	C
kernel32.dll!7526339a()	
[Frames below may be incorrect and/or missing, no symbols loaded for kernel3	
ntdll.dll!776d9ef2()	
ntdll.dll!776d9ec5()	

Err... Ou... Fin... Lo... Au... W... Th...

Immediate Window

Ready

Debugging Example #1 - Fixed error, recompiled, run, step

DebugConsoleApp (Debugging) - Microsoft Visual Studio (Administrator)

File Edit View Project Build Debug Team Data Tools VisualSVN Architecture Test Analyze Window Help

Solution Explorer

- Solution 'DebugConsoleApp' (1 project)
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    - Header Files
      - std_lib_facilities.h
    - Resource Files
    - Source Files
      - DebugConsoleApp.cpp

DebugConsoleApp.cpp

(Global Scope) main()

```
10      cin >> x;
11
12      cout << "Enter second integer: ";
13      cin >> y;
14
15      if(x==y)
16          cout << "They are Equal!" << endl;
17      else if(x>y)
18          cout << "The first one is bigger!" << endl;
19      else
20          cout << "The second ont is bigger!" << endl;
21
22      cout << endl;
23
24      keep_window_open();
```

Autos

Name	Value	Type
x	3	int
y	5	int

Call Stack

Name	Language
DebugConsoleApp.exe!main() Line 17	C++
DebugConsoleApp.exe!__tmainCRTStartup() Line 555 + 0x19 bytes	C
DebugConsoleApp.exe!mainCRTStartup() Line 371	C
kernel32.dll!7526339a()	
[Frames below may be incorrect and/or missing, no symbols loaded for kernel32.dll	
ntdll.dll!776d9ef2()	
ntdll.dll!776d9ec5()	

Ready

Debugging Example #1 - Step. Hey the code worked!

DebugConsoleApp (Debugging) - Microsoft Visual Studio (Administrator)

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Solution Explorer

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    - Source Files
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DebugConsoleApp.cpp

(Global Scope) main()

```
10      cin >> x;
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12      cout << "Enter second integer: ";
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15      if(x==y)
16          cout << "They are Equal!" << endl;
17      else if(x>y)
18          cout << "The first one is bigger!" << endl;
19      else
20          cout << "The second ont is bigger!" << endl;
21
22      cout << endl;
23
24      keep_window_open();
```

Autos

Name	Value	Type

Call Stack

Name	Language
DebugConsoleApp.exe!main() Line 20	C++
DebugConsoleApp.exe!__tmainCRTStartup() Line 555 + 0x19 bytes	C
DebugConsoleApp.exe!mainCRTStartup() Line 371	C
kernel32.dll!7526339a()	
[Frames below may be incorrect and/or missing, no symbols loaded for kernel32.dll	
ntdll.dll!776d9ef2()	
ntdll.dll!776d9ec5()	

Ready Ln 20 Col 1 Ch 1 INS