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 C:\Users\zidian\Desktop\DebugConsoleApp\DebugConsoleApp....
Enter first integer: 3
Enter second integer: 5
They are Equal!
Please enter a character to exit

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

Debugging Example #1 (a console app.)

😎 DebugConsoleApp - Microsoft Visual Studio (Adminis	strator)
File Edit View Project Build Debug Team D	ata Tools VisualSVN Architecture Test Analyze Window Help
:∎· ⊡·⊒ ⊴∎;≉чаа;••(•••	
🏷 Solution Explorer 🔹 🕂 🗙	DebugConsoleApp.cpp ×
o B B Solution 'Debug Concole() np' (1 project)	(Global Scope)
 DebugConsoleApp External Dependencies Header Files std_lib_facilities.h Resource Files Source Files DebugConsoleApp.cpp 	<pre>2 E#include "std_lib_facilities.h" 3 4 5 Eint 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 return 0; 27 } </pre>
🖏 Solution Explorer 📑 Team Explorer	100 % • <
🔲 Output 🔉 Find Symbol Results 🧮 Code Metr Ready	ics Results 📸 Error List

HY150 Programming, University of Crete

Lecture: Visual Studio Debugger, Slide 7

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.

e Edit	View Project Build Debug Tools Test Window Community Help	
- 🛅 -	🚰 🛃 🎒 👗 🖺 🖄 🕫 - 🔍 - 📮 - 🖳 🕨 Debug 🛛 - Win32 🔹 🖡	*
1 🖻 🕯) 15 15 15 15 15 17 17 17	Ð
Objec	Browser Start Page DebugWin32App.cpp	×
(Global Sc	ope) 🔍 = WinMain(HINSTANCE hInstance, HINSTANCE hPrevInstan	~
þ	//	
	// Main Loop	
-	//	
	<pre>while(msg.message != WM_QUIT)</pre>	
	{	
	<pre>if(PeekMessage(&msg, NULL, 0, 0, PM_REMOVE))</pre>	
	Iranslatemessage(&msg); DierstebMessage(&msg);	r
	Dispatchnessage(&msg);	Ξ
		-
	l l	
	<pre>// Process input, update the scene and render it here</pre>	
T	,,	
-	// Give up some CPU time	
	Sleep(1);	
	}	
	}	
	return (int) msg.wParam;	
}		
		~

Debugging Example #1 (continued)



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

View Project Build	Debu	g Team	Data	Tools	VisualSVN	Architecture
i • 💕 🛃 🗿 🐰 🛍		Windows				•
⊾ 🔺 📬 🛊 🚝 💆		Start Debu	gging		F5	
on Explorer	≡Þ	Start With	out Deb	ugging	Ctrl+	-F5
🗟 😰 🗉 🖧		Start Perfo	rmance	Analysis	s Alt+	F2
Solution 'DebugConsoleA _l ③ DebugConsoleApp		Exceptions	S		Ctrl+	-D, E
External Dependent	S	Step Into			F11	
 Image: Header Files Image: std_lib_facilities 	Ç⊒	Step Over			F10	
Resource Files		Toggle Bre	eakpoin	t	F9	
Carrier Films		Nam Presh	in ount			

Debugging Example #1 - Running in the debugger

<u>File Edit View Project</u>	<u>B</u> uild <u>D</u> ebug	Tea <u>m</u>	D <u>a</u> ta	<u>T</u> ools	Visu	ual <u>S</u> VN	Ar <u>c</u> hitecture Te	e <u>s</u> t A <u>n</u> alyze <u>W</u>	<u>V</u> indow <u>I</u>	<u>H</u> elp			
	* • •	- (2)	• (월 •		De	ebug	- Click	:		<u>-</u> 🖓 🖞	st 🎲 🔜 🔆	9 📑 🗄	•
! □, ч. ೬. ሎ 作 拝	1 1 2 -) (j) (j	4 💭	📮 🛃 i	} 4	- √ ₽5	₩ û <mark>-</mark>						
Solution Explorer	•	Ψ×	Debu	gConsole	App.o	.срр 🗙							•
🌯 🖶 📴			(G	lobal Sco	ope)			+ [≡] ∳ r	main()				-
Solution DebugConsoleAp	oleApp' (1 project) p idencies ilities.h soleApp.cpp		•	9 10 11 12 13 14 15 16 17 18 19 20 21 22	cc c: c: i: e: c:	<pre>cout << cout << cin >> cin >> cout else if cou else cou cout<<</pre>	"Enter first "Enter second y; t << "They are (x>y) t << "The firs t << "The seco endl;	<pre>integer: "; integer: "; Equal!" << e t one is bigg nd ont is big</pre>	endl; ger!" <<	endl; < endl;			∓ ▲
🎼 IntelliTrace 🛛 🔩 Solutio	on Explorer		100 %	• • [F.
Autos				▼ ₽	×	Call Sta	:k					*	Ψ×
Name Value				Туре	^	Nan	ne					Langua	ige 🔶
				int	- 1	Deb	ugConsoleApp.exe	main() Line 15		FFF 0.40		C++	-
y J				m		Deb kern [Fra ntdl ntdl	ugConsoleApp.exe ugConsoleApp.exe el32.dll!7526339a() mes below may be .dll!776d9ef2() .dll!776d9ec5()	incorrect and/or	r missing,	no symbol:	s loaded for kerr	C C nel3.	
	n 👼 Lo 🚎	Au	震 W	. 🛃 T	h								Ŧ
🙀 Err 🔳 Ou 🎄 Fi													

Debugging Example #1 Stepping, examine variables

IntelliTrace	 ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓	<pre>Pebug - P Click - P P P P P P P P P P P P P P P P P P</pre>
IntelliTrace	✓ DebugConsoleA (Global Scop) 9 10 11 12 13 14 14 15 15 16 17 18 19 20 21 22 21 22 100 % ▼ < _	<pre>eApp.cpp × eApp.cpp × exppe)</pre>
 A X Colution Explorer A X Solution 'DebugConsoleApp' (1 project) DebugConsoleApp External Dependencies Header Files std_lib_facilities.h Resource Files Source Files Source Files DebugConsoleApp.cpp 	✓ DebugConsoleA (Global Scop) 9 10 11 12 13 14 15 ⇒ 16 17 18 19 20 21 22 23 100 % ▼ ≮	<pre>eApp.cpp × ppe)</pre>
 Solution 'DebugConsoleApp' (1 project) Solution 'DebugConsoleApp External Dependencies Header Files std_lib_facilities.h Resource Files Source Files DebugConsoleApp.cpp 	(Global Scope 9 10 11 12 13 14 ● 15 ● 16 17 18 19 20 21 22 33 100 % ▼ ≮	<pre>ppe)</pre>
Solution 'DebugConsoleApp' (1 project) Solution 'DebugConsoleApp Header Files Header Files Solution Files DebugConsoleApp.cpp IntelliTrace Solution Explorer Autos	9 10 11 12 13 14 15 ➡ 16 17 18 19 20 21 22 23 100 % ➡ ◀	<pre>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; else cout << endl; cout << endl;</pre>
IntelliTrace 💫 Solution Explorer	100 % 👻 🖌 🔛	III
Autos		
NI N	- ₽ 3	· × Call Stack
Name Value	Type /	DebugConcoleAnn evelmain() Line 16 C++
✓ x 5	int	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!//6d9et2()
		Intuituiti://daseCity

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.

Autos						- T	×
Name		Value			T	Гуре	*
🧼 🛠		5			i	nt	
🥥 y		5			i	nt	
							-
📸 Err	🔳 Ou	🔉 Fin	👼 Lo	武 Au	👼 Wa	🛃 Tł	.

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.

Locals				Х
Name	Value		Туре	*
🖉 x	5		int	
🧼 y	5		int	
-			_	Ŧ
🛛 🔂 Err 🛛 🧮 Ou	🔉 🐺 Fin 🐺 🌆 Lo	🗮 Au 💻 Wa	🛃 Th	r

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

Watch 1					×		
Name	Value		Туре		^		
📮 player	{x=25.000000 y=	50.000000 state=24 }	Player				
- x	25.000000		float				
— у	50.000000		float				
state	24		int				
IsAlive	true		bool				
Health	100		int				
							-
		Watch 1					
		Name	Value	ð		Туре	
		🥥 x	5			int	
		🥥 y	634	ſ		int	
							V
] Throade 🔜 Modu	laa 🔜 Wakab 1			
		Aucos 100 Locais 10	Inceas Modu	watch I			

HY150 Programming, University of Crete

Lecture: Visual Studio Debugger, Slide 16

Debugging Example #1 – Found error

<u>File Edit View</u>	<u>P</u> roject <u>B</u> uild <u>D</u>	ebug Tea <u>m</u>	D <u>a</u> ta <u>T</u>	ools V	/isual <u>S</u> VN	Ar <u>c</u> hitecture Te <u>s</u> t	A <u>n</u> alyze <u>W</u> indow	<u>H</u> elp	
i 🖥 + 🔛 + 💕	🗐 🥔 X 🖬 🛱	9-0	- JE - E		Debug	- 🏄 Click		- 🛛 🕾 🖬	à 📯 🛃 🛄 🍹 🕨
📑 🗞 📐 🗛	帽建建门团的	≗∣₽0	a 💷 🛤	42 🗈	Q =	↓ ↓			
Solution Explorer		τIX	DebugCo	ncole A n	n cnn				
			Clab	полемр	, hichh				
Solution 'Del Solution 'Del DebugCa Extern Head Source Source Di	ougConsoleApp' (1 p onsoleApp nal Dependencies er Files d_lib_facilities.h urce Files e Files ebugConsoleApp.cp	p	9 10 11 12 13 14 5 16 17 18 19 20 20 21 22 23	[<pre>cout < cin >> cout < cin >> if(x=y co else i co else co cout <</pre>	<pre>< "Enter first int x; < "Enter second in y;) of < "They are Eq f(x>y) ut << "The first o ut << "The second of < endl;</pre>	eger: ": teger: ", ual!" << endl; ne is bigger!" ont is bigger!'	< <pre><< endl; ' << endl;</pre>	-y)
Intelli I race	Solution Explorer		100 %						- 8.1
Autor			Tra	• 4 ×	Call St	ack			, ∓ ∓ Language
Name	Value		1.11	<i>ie</i> –		me			Language
Name	Value		int			hugConsoleApp evelma	in () Line 15		C++
Name X X X X	Value 3 5		int int	_	De De	bugConsoleApp.exe!ma bugConsoleApp.exe! tr	in() Line 15 nainCRTStartup()	.ine 555 + 0x19 bytes	C++ C
Name X X X X V X	Value 3 5		int int		De De	bugConsoleApp.exe!ma bugConsoleApp.exe!_tr bugConsoleApp.exe!ma	in() Line 15 nainCRTStartup() I inCRTStartup() Lin	ine 555 + 0x19 bytes e 371	C++ C C
Name	Value 3 5		int int		De De De kei	bugConsoleApp.exe!ma bugConsoleApp.exe!_tr bugConsoleApp.exe!ma nel32.dll!7526339a()	in() Line 15 nainCRTStartup() I inCRTStartup() Lin	.ine 555 + 0x19 bytes e 371	C++ C C
Name	Value 3 5		int int		De De De kei	bugConsoleApp.exelma bugConsoleApp.exel_tr bugConsoleApp.exelma nel32.dll!7526339a() ames below may be inco	in() Line 15 nainCRTStartup() I inCRTStartup() Lin prrect and/or missir	.ine 555 + 0x19 bytes e 371 ng, no symbols loaded fi	C++ C C or kernel3
Name v x v y	Value 3 5		int int		De De De ke [Fr	bugConsoleApp.exe!ma bugConsoleApp.exe!_tr bugConsoleApp.exe!ma nel32.dll!7526339a() ames below may be inco ill.dll!776d9ef2()	in() Line 15 nainCRTStartup() I inCRTStartup() Lin prrect and/or missin	ine 555 + 0x19 bytes e 371 ng, no symbols loaded f	C++ C C or kernel3.
Name	Value 3 5		int int		De De De kei [Fr ntd	bugConsoleApp.exelma bugConsoleApp.exel_tr bugConsoleApp.exelma nel32.dll!7526339a() ames below may be inco all.dll!776d9ef2() lll.dll!776d9ec5()	in() Line 15 nainCRTStartup() Lin inCRTStartup() Lin prrect and/or missi	ine 555 + 0x19 bytes e 371 ng, no symbols loaded f	C++ C C or kernel3,
Name X X Y	Value 3 5		int int		De De kei [Fr nto	bugConsoleApp.exelma bugConsoleApp.exel_tr bugConsoleApp.exelma nel32.dll!7526339a() ames below may be inco III.dll!776d9ef2() III.dll!776d9ec5()	in() Line 15 nainCRTStartup() Lin inCRTStartup() Lin prrect and/or missin	ine 555 + 0x19 bytes e 371 ng, no symbols loaded f	C++ C C or kernel3
Name x y Karr 🗐 Ou.	Value 3 5 5 ∰ Fin ₩ Lo.	<u>E</u> Au	int int		De De kei [Fr nta nta	bugConsoleApp.exelma bugConsoleApp.exel_tr bugConsoleApp.exelma nel32.dll!7526339a() ames below may be inco III.dll!776d9ef2() III.dll!776d9ec5()	in() Line 15 nainCRTStartup() Lin inCRTStartup() Lin prrect and/or missi	ine 555 + 0x19 bytes e 371 ng, no symbols loaded f	C++ C C or kernel3
Name × y V K V V V V V V V V V V V V V	Value 3 5 5 K Fin Lo.	🛒 Au	int int		De De ke [Fr ntr	bugConsoleApp.exelma bugConsoleApp.exel_tr bugConsoleApp.exelma nel32.dll!7526339a() ames below may be inco III.dll!776d9ef2() III.dll!776d9ec5()	in() Line 15 nainCRTStartup() Lin inCRTStartup() Lin prrect and/or missin	ine 555 + 0x19 bytes e 371 ng, no symbols loaded f	C++ C C or kernel3

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

	n D <u>a</u> ta <u>T</u> ools Visual <u>S</u> VN Ar <u>c</u> hitecture Te <u>s</u> t A <u>n</u> alyze <u>W</u> indow <u>H</u> elp - - - - - - - - - - - - -	4 🗖
: III: 18: 18: 18: 18: 18: 18: 19: 19: 19: 19: 19: 19: 19: 19: 19: 19	G \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	
	DebugConsoleApp.cpp X	
 Solution 'DebugConsoleApp' (1 project) DebugConsoleApp External Dependencies Header Files std_lib_facilities.h Resource Files Source Files DebugConsoleApp.cpp 	<pre>10</pre>	
Intelli I race Solution Explorer		
Autos	Tune A Name	Langu
	int DebugConsoleApp.evelmain() Line 17	C++
✓ y 5	int 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()	C

Slide 18

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

👓 DebugConsoleApp (Debugging) - Micro	osoft Visual Studio (Administrator)	
 DebugConsoleApp (Debugging) - Micro File Edit View Project Build Debug File Edit View Project Build Debug Solution Explorer Solution Explorer Solution 'DebugConsoleApp' (1 projections) BebugConsoleApp External Dependencies Header Files std_lib_facilities.h Resource Files Source Files Source Files DebugConsoleApp.cpp 	ug Team Dgta Tools Visual§VN Architecture Test Analyze Window Help Image: Im	
	22 cout << endl;	
🍕 IntelliTrace 🛛 💐 Solution Explorer	22 cout << endl; 23 24 keep_window_open(); 100 % • 4 III	
屁 IntelliTrace 획 Solution Explorer Autos	22 cout << endl; 23 24 keep_window_open(); 100 % ▼ 4 III ▼ ₽ × Call Stack]
IntelliTrace Real Solution Explorer Autos Name Value	22 cout << endl; 23 24 keep_window_open(); 100 % ▼ 4 III ▼ ↓ × Call Stack Type ▲ Name	Langua
IntelliTrace IntelliTrace Autos Name	22 cout << endl;	Langua C++
IntelliTrace IntelliTrace Autos Name	22 cout << endl;	Langua C++ C
IntelliTrace IntelliTrace Autos Name Value	22 cout << endl;	Langua C++ C C
IntelliTrace IntelliTrace Autos Name Value	22 cout << endl;	Langua C++ C C
IntelliTrace Solution Explorer Autos Name	22 cout << endl;	Langua C++ C C
IntelliTrace Solution Explorer Autos Name	22 cout << endl;	Langua C++ C
IntelliTrace Image: Solution Explorer Autos Value Name Value	22 cout << endl;	Langua C++ C C
IntelliTrace Autos Name Value	22 cout << endl;	Langua C++ C C

Slide 19