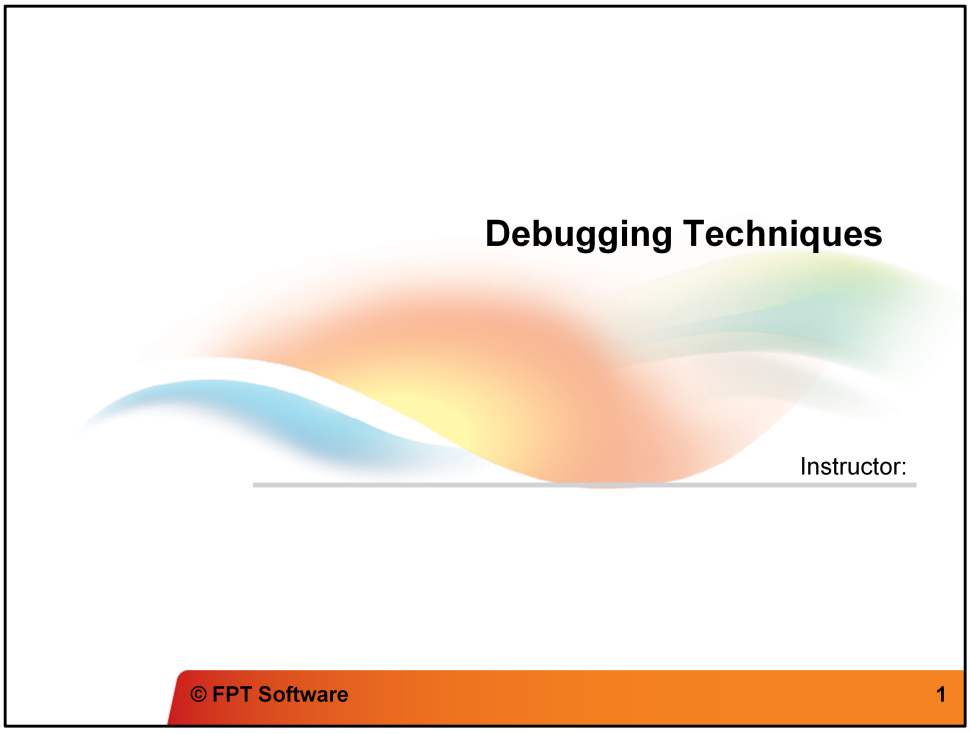


Latest updated by: HanhTT1

Agenda

- Basic Debugging Technique
- Breakpoints
- Watches
- Stepping
- Stopping the Debugger
- Conditions and Hit Counts
- Break on Exception
- Step Into
- Trace and Assert

Basic Debugging Technique

- The debugger is a tool to help correct runtime and semantic errors
- note that no debugging tools are useful in solving *compiler errors.*
- Compiler errors are those that show at the bottom of the screen when compiling

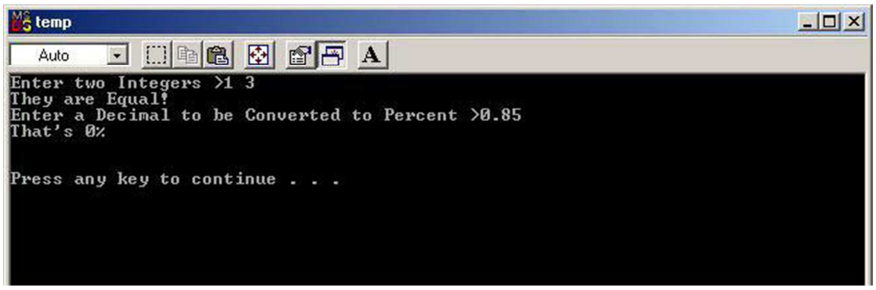
Basic Debugging Technique

- If the program isn't working correctly, one of two things could be going wrong:
  - *Data is corrupt somewhere*
  - The code isn't correct
- Example

```
int a = 0;
int b = 1;
printf("%d", (b/a));
```

A Buggy Program

- Trying to debug a program that's working perfectly is rather pointless



The Buggy Code

```
#include <stdio.h>
int toPercent (float decimal);

int main() {
        int a, b;
        float c;
        int cAsPercent;

        printf("Enter A >");
        scanf("%d", &a);
        printf("Enter B >");
        scanf("%d", &b);

        if (a = b) printf("They are Equal!\n");
        else if (a > b) printf("The first one is bigger!\n");
        else printf("The second one is bigger!\n");
        printf("Enter a Decimal to be Converted to Percent >");
        scanf("%f", &c);
        cAsPercent = toPercent(c);
        printf("That's %d %\n", cAsPercent);
        printf("\n\n");
        getchar();
        return 0;
}
```

The Buggy Code

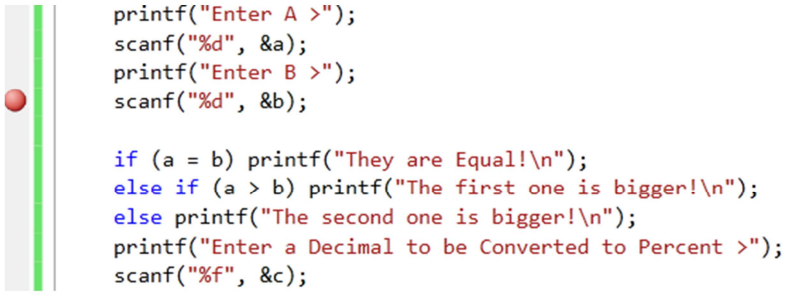
```
/* ToPercent():
Converts a given float (eg 0.9) to a percentage (90).
*/
int toPercent (float decimal) {
        int result;
        result = int(decimal) * 100;
        return result;
}
```

Debug Mode or Not?

- Ctrl+F5 to run your program
- The F5 key alone will also run in debug mode.
- Build for Debug
- Build for Release

Breakpoints

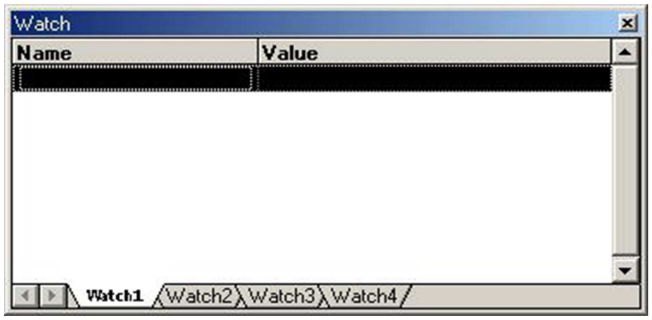
- Breakpoints are the lifeblood of debugging.
- Right-click and select "Insert/Remove Breakpoint" or press the F9 key



```
printf("Enter A >");
scanf("%d", &a);
printf("Enter B >");
scanf("%d", &b);

if (a = b) printf("They are Equal!\n");
else if (a > b) printf("The first one is bigger!\n");
else printf("The second one is bigger!\n");
printf("Enter a Decimal to be Converted to Percent >");
scanf("%f", &c);
```

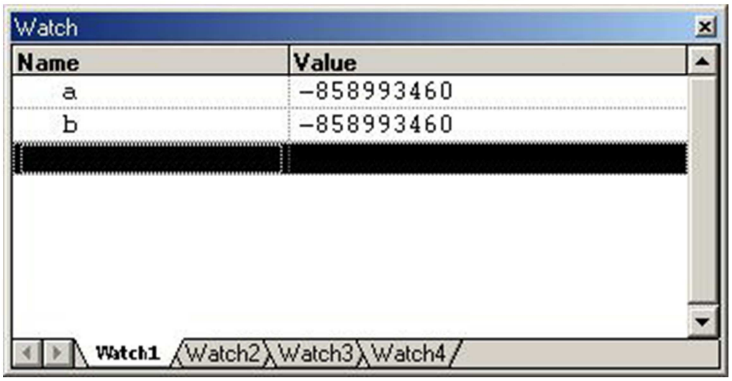
Watches

- The "Watch" window lets you *watch the contents of any variables you select as your program* executes.
- Open it from the View menu (Debug Windows > Watch), or by clicking the "Watch" icon in the toolbar, or by pressing Alt+3



Watches

- Enter to add *variables to your Watch* list:



Watches

- Watch a range of values inside array:
  Syntax: array + <offset>, <range>

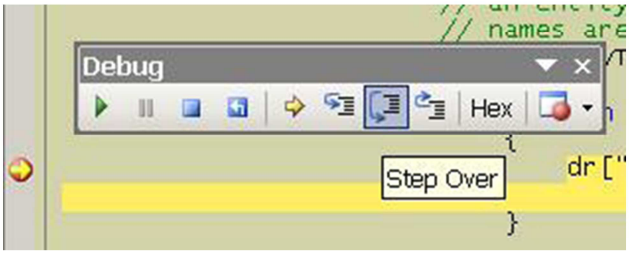
```
1  #include <iostream>
2  #include <stdexcept>
3
4  using namespace std;
5
6  void main()
7  {
8      int* arr = new int[1000];
9
10     for(int i = 0; i < 1000; i++)
11     {
12         arr[i] = i;
13     }
14 }
```

Watch 1

Name	Value
arr, 3	0x00801290
[0]	0
[1]	1
[2]	2
arr + 3, 3	0x0080129c
[0]	3
[1]	4
[2]	5

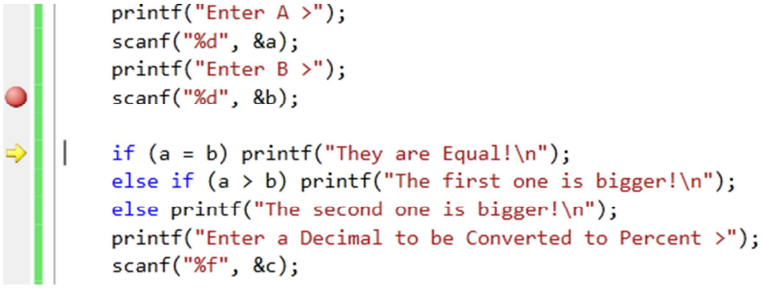
Stepping

- Step Over F10
- Step Into F11 (Some code inside a function may *or may not need to be examined*)
- Step Out Shift + F11



Stepping

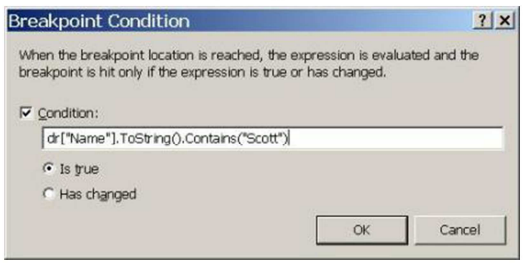
- When you are tired of stepping through the code, F5 resumes execution.



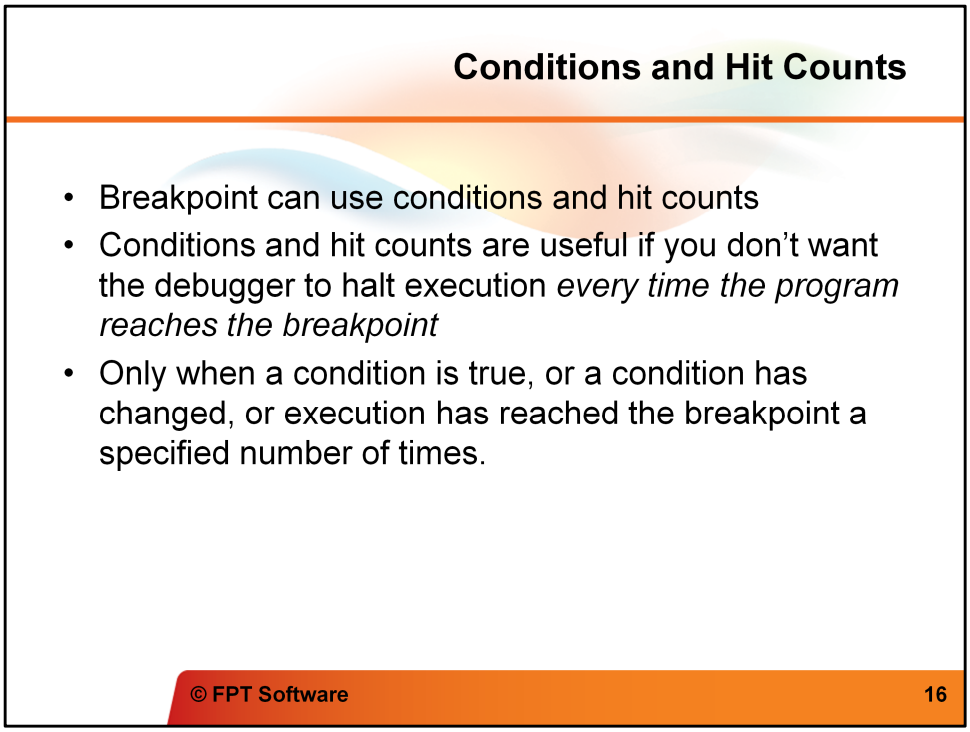
```
printf("Enter A >");
scanf("%d", &a);
printf("Enter B >");
scanf("%d", &b);

if (a = b) printf("They are Equal!\n");
else if (a > b) printf("The first one is bigger!\n");
else printf("The second one is bigger!\n");
printf("Enter a Decimal to be Converted to Percent >");
scanf("%f", &c);
```

Stopping the Debugger

When you've found a problem to correct, it may be tempting to press Ctrl+C in your program window to end the program



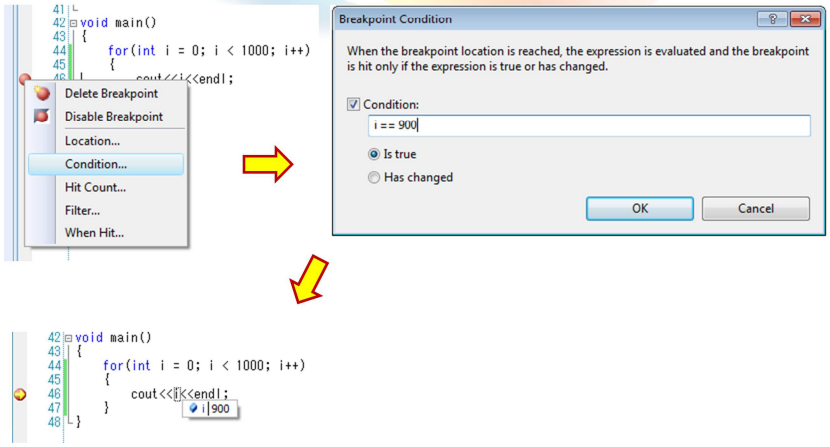
Select "Stop Debugging" from the Debug menu or on the toolbar or press Shift+F5.



Conditions and hit counts are useful when setting breakpoints inside of a loop. For example, if
your code iterates through a collection of Customer objects ith a for each loop, and you want to
break on the 10th iteration of the loop, you can specify a hit count of 10. If something bad only
happens when the Customer object's Name property is equal to "Scott", you can right click the
breakpoint red glyph, select Condition from the context menu, and enter the expression
customer.Name == "Scott" into the breakpoint condition textbox. Intellisense is available in this
textbox to ensure you are using the correct syntax.

Conditions and Hit Counts

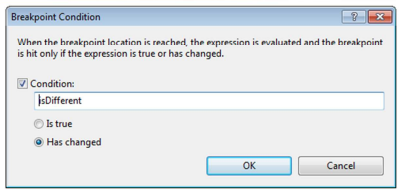
- Condition: Is true



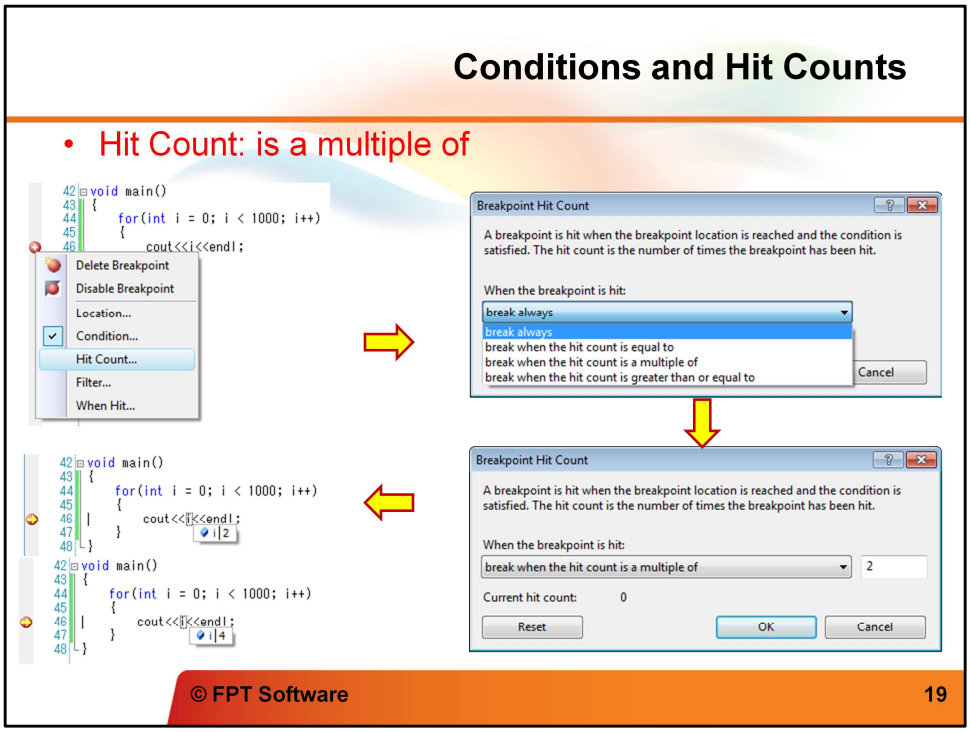
Conditions and Hit Counts

- Condition: Has changed

```
#include <iostream>

using namespace std;

void main()
{
    bool isDifferent = false;

    int arr1[10] = {0, 0, 0, 0, 0, 0, 0, 0, 0, 0};
    int arr2[10] = {0, 0, 0, 0, 0, 0, 0, 0, 0, 1};

    for(int i = 0; i < 10; i++)
    {
        if(arr1[i] != arr2[i])
        {
            isDifferent = true;
        }

        cout<<"arr1 = "<<arr1[i]<<" and arr2 = "<<arr2[i]<<endl;
    }
}
```

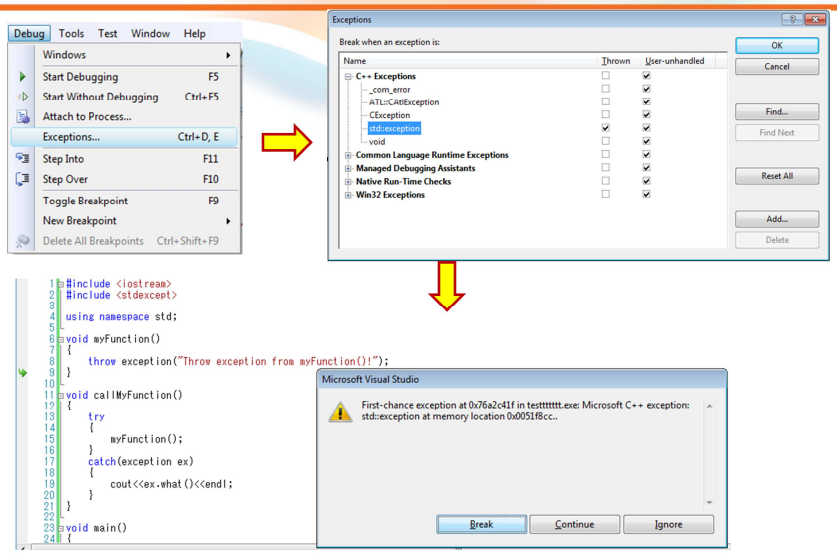


```
#include <iostream>

using namespace std;

void main()
{
    bool isDifferent = false;

    int arr1[10] = {0, 0, 0, 0, 0, 0, 0, 0, 0, 0};
    int arr2[10] = {0, 0, 0, 0, 0, 0, 0, 0, 0, 1};

    for(int i = 0; i < 10; i++)
    {
        if(arr1[i] != arr2[i])
        {
            isDifferent = true;
        }

        cout<<"arr1 = "<<arr1[i]<<" and arr2 = "<<arr2[i]<<endl;
    }
}
```



The Hit Count is used along with Condition (use same condition as previous slide: i – Has changed)
Take an example of Hit Count: break when the hit count is a multiple of 2
So, when we press F5, instead of press F5 4 times (if we choose break always) we just press F5 2 times (the number of multiple of 2: 2, 4, 6, 8…)
In this example that is 2, 4

Break on Exception



Stepping Into Assembly

- Be careful when you "Step Into" lines involving printf, scanf, or other system functions!

```
int __cdecl scanf (
        const char *format,
        ...
        )
{
        va_list arglist;
        va_start(arglist, format);
        return vscanf(_input_l, format, NULL, arglist);
}
```

Debug commands

Command	Meaning
Ctrl+F5	Run program
F5	Run in debug mode
F9	Create breakpoint
F10	Step over
F11	Step into
Shift + F11	Step out
Shift + F5	Stop debugging
Ctrl + Tab	Change window

Trace and Assert

- Trace: Allows the programmer to put a log message onto the main output window
- Assert: To check program assumptions

Trace and Assert

```
#include "stdafx.h"

using namespace System::Diagnostics;

void main()
{
    double result = 0.0;

    Trace::WriteLine("START OPERATION");
    for(int i = 0; i < 10; i++)
    {
        int numToDevide     = i - 10;
        int numToBeDevided  = i;

        Trace::WriteLine(result);

        result = numToBeDevided / numToDevide;
    }
    Trace::WriteLine("END OPERATION");
}
```

Press F5

```
Output
Show output from: Debug
'AssertTrace.exe': Loaded 'C:¥Windows¥assembly¥NativeImages_v2.0.50
'AssertTrace.exe' (Managed): Loaded 'C:¥Windows¥assembly¥GAC_MSIL¥S
START OPERATION
0
0
0
0
0
0
-1
-1
-2
-4
END OPERATION
The thread 'Win32 Thread' (0x424) has exited with code 0 (0x0).
```

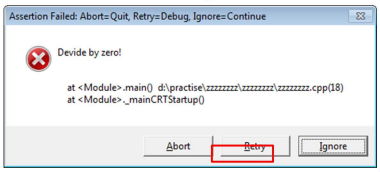
- Keep tracing code processing by output value during debugging

Trace and Assert

```
#include "stdafx.h"

using namespace System::Diagnostics;

void main()
{
    double result = 0.0;

    Trace::WriteLine("START OPERATION");
    for(int i = 0; i < 11; i++)
    {
        int numToDevide     = i - 10;
        int numToBeDevided  = i;

        Trace::Assert(numToBeDevided != 0, "Devide by zero!");
        Trace::WriteLine(result);

        result = numToBeDevided / numToDevide;
    }
    Trace::WriteLine("END OPERATION");
}
```

This code contain potential bug, if another developer change 10 to other values (such as 11)

We use Assert to validate that the value is valid or not



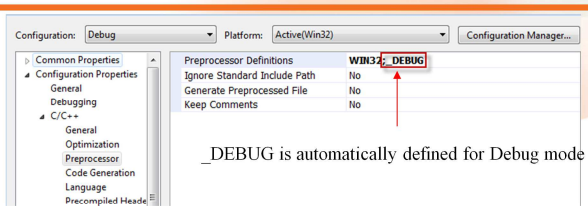
Press Retry allow us to debug after Assert

```
#include "stdafx.h"

using namespace System::Diagnostics;

void main()
{
    double result = 0.0;

    Trace::WriteLine("START OPERATION");
    for(int i = 0; i < 11; i++)
    {
        int numToDevide     = i - 10;
        int numToBeDevided  = i;

        Trace::Assert(numToBeDevided != 0, "Devide by zero!");
        Trace::WriteLine(result);

        result = numToBeDevided / numToDevide;
    }
    Trace::WriteLine("END OPERATION");
}
```

Trace and Assert

- The behavior for Trace will not change between a debug and a release build
- This mean that we must #ifdef any Trace-related code to prevent debug behavior in a release build

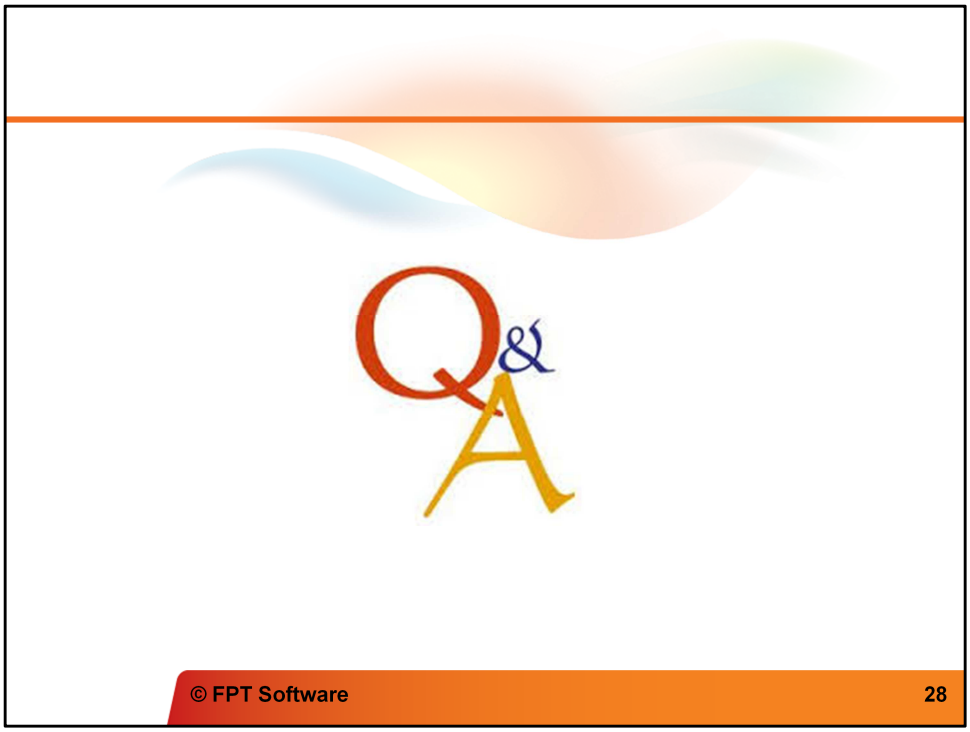
Trace and Assert



_DEBUG is automatically defined for Debug mode

```
#include "stdafx.h"

using namespace System::Diagnostics;

void main()
{
    double result = 0.0;

#ifdef _DEBUG
    Trace::WriteLine("START OPERATION");
#endif

    for(int i = 0; i < 10; i++)
    {
        int numToDevide     = i - 10;
        int numToBeDevided  = i;

#ifdef _DEBUG
        Trace::WriteLine(result);
#endif

        result = numToBeDevided / numToDevide;
    }
#ifdef _DEBUG
    Trace::WriteLine("END OPERATION");
#endif
}
```

We can use #ifdef _DEBUG to prevent debug behavior in release mode


Q&A
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