

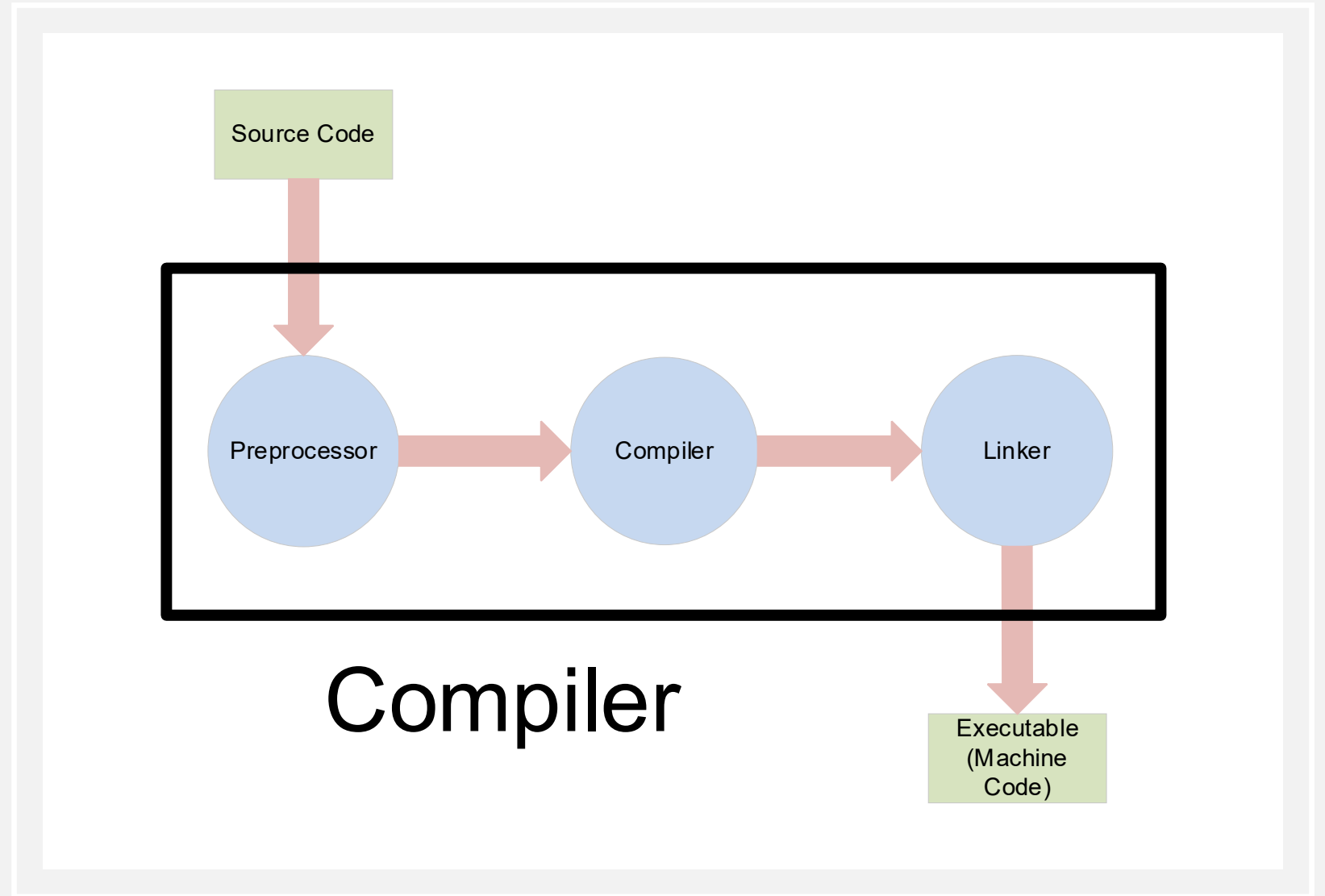


# BUGS AND DEBUGGING

If debugging is the process of taking bugs out of a program,  
then programming must be the process of putting bugs into a program



# THE COMPILER SYSTEM





# KINDS OF BUGS

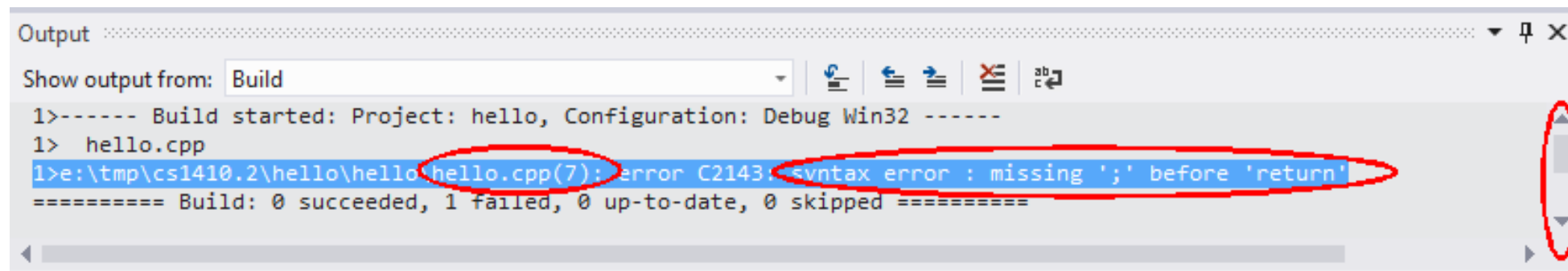
- Syntax                      incorrect sequence of keywords, punctuation, etc.



## SYNTAX ERRORS: “RULES” FOR DEBUGGING

1. Work from the first error to the last (top to bottom)
2. Use the IDE's features to navigate
3. The compiler indicates the line where the error is located, the bug is never below that line but may be above it – work from the indicated line backwards
4. Modern compilers perform “error recovery” which can mask some errors
5. Don't waste time searching for error numbers

# SYNTAX ERROR DIAGNOSTIC



The screenshot shows the Output window in Visual Studio. The 'Show output from:' dropdown is set to 'Build'. The output text is as follows:

```
1>----- Build started: Project: hello, Configuration: Debug Win32 -----  
1> hello.cpp  
1>e:\tmp\cs1410.2\hello\hello\hello.cpp(7): error C2143: syntax error : missing ';' before 'return'  
===== Build: 0 succeeded, 1 failed, 0 up-to-date, 0 skipped =====
```

The error message line is highlighted in blue. Two red ovals are drawn on the image: one around the file path and line number 'e:\tmp\cs1410.2\hello\hello\hello.cpp(7):' and another around the error description 'syntax error : missing ';' before 'return''. A vertical scrollbar on the right side of the window is also circled in red.



## KINDS OF BUGS

- Syntax                      incorrect sequence of keywords, punctuation, etc.
- Link                         linker/loader unable to create a final executable

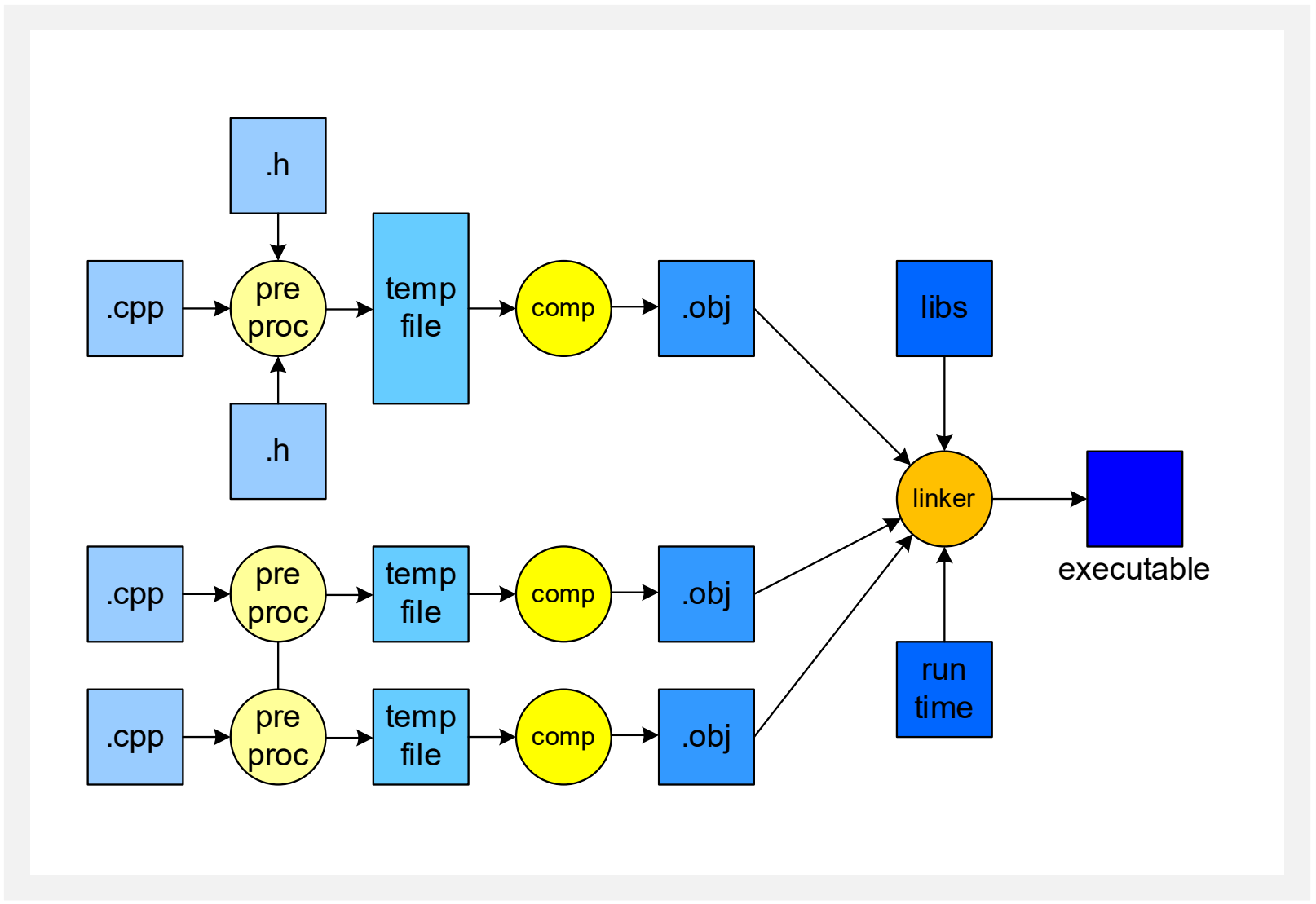


## LINK ERROR DIAGNOSTIC

```
I>----- Rebuild All started: Project: Error3, Configuration: Debug Win32 -----
I>C:\Program Files (x86)\MSBuild\Microsoft.Cpp\v4.0\VL10\Microsoft.CppClean.targets(75,5):
    warning :Access to the path 'E:\TMP\CS1410 PAST\ERROR3\DEBUG\ERROR3.EXE' is denied.
I>C:\Program Files (x86)\MSBuild\Microsoft.Cpp\v4.0\VL10\Microsoft.CppClean.targets(75,5):
    warning :Access to the path 'E:\tmp\cs1410 past\Error3\Debug\Error3.exe' is denied.
I> Error3.cpp
I>LINK : fatal error LNK1104: cannot open file '*****.exe'
===== Rebuild All: 0 succeeded, 1 failed, 0 skipped =====
```



# THE LINKER ASSEMBLES FILES







# KINDS OF BUGS

- Syntax                      incorrect sequence of keywords, punctuation, etc.
- Link                         linker/loader unable to create a final executable
- Logical                     programmer didn't correctly solve the problem



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- Runtime program fails by crashing or never completing
- Task synchronization multiple tasks do not coordinate correctly



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- Syntax incorrect sequence of keywords, punctuation, etc.
- Link linker/loader unable to create a final executable
- Logical programmer didn't correctly solve the problem
- Runtime program fails by crashing or never completing
- Task synchronization multiple tasks do not coordinate correctly
- Heisenbug program behaves differently while being debugged