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

Compiler

Source Code

Preprocessor ➔ Compiler ➔ Linker

Executable (Machine Code)
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
KINDS OF BUGS

• Syntax  incorrect sequence of keywords, punctuation, etc.
• Link  linker/loader unable to create a final executable
C:\Program Files (x86)\MSBuild\Microsoft.Cpp\v4.0\V110\Microsoft.CppClean.targets(75,5):
    warning : Access to the path 'E:\TMP\CS1410 PAST\ERROR3\DEBUG\ERROR3.EXE' is denied.
C:\Program Files (x86)\MSBuild\Microsoft.Cpp\v4.0\V110\Microsoft.CppClean.targets(75,5):
    warning : Access to the path 'E:\tmp\cs1410 past\Error3\Debug\Error3.exe' is denied.
 Error3.cpp
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
KINDS OF BUGS

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- Link: linker/loader unable to create a final executable
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- Runtime: program fails: crashes or never completes
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- Task synchronization: multiple tasks do not coordinate correctly
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
- Runtime: program fails: crashes or never completes
- Task synchronization: multiple tasks do not coordinate correctly
- Heisenbug: program behaves differently while being debugged