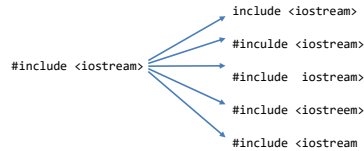




Line 1

- Let's make some changes to the first line:



- These authors have made each of these mistakes from time-to-time...



Line 1: include <iostream>

In `example.cpp`, on line 1 starting at column 1: look for the ^

- The error message:

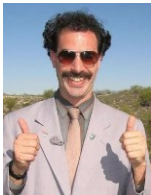

```

example.cpp:1:1: error: 'include' does not name a type
include <iostream>
^
example.cpp: In function 'int main()':
example.cpp:7:5: error: 'cout' is not a member of 'std'
std::cout << "Hello world!" << std::endl;
^
example.cpp:7:36: error: 'endl' is not a member of 'std'
std::cout << "Hello world!" << std::endl;
^
example.cpp:8:5: error: 'cout' is not a member of 'std'
std::cout << "sin(0.5) = " << my_sin(0.5) << "! " << std::endl;
^
example.cpp:8:57: error: 'endl' is not a member of 'std'
std::cout << "sin(0.5) = " << my_sin(0.5) << "! " << std::endl;
^
      
```
- Always look at the first error message first
 - The compiler is trying to interpret `include` as a type like `int` or `double`

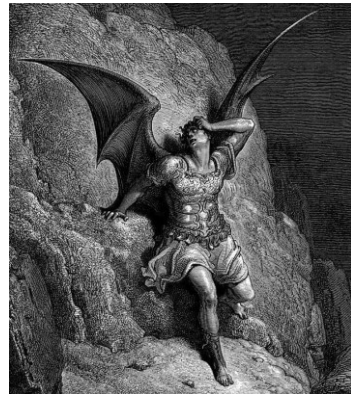


Line 1: include <iostream>

- With so many error messages, you may think you just committed a cardinal sin...
- Don't despair: Often fixing the first error will eliminate many of the others



Baron Cohen as Borat



Gustave Doré, *Lucifer*



Line 1: inculde <iostream>

- The error message:


```

example.cpp:1:2: error: invalid preprocessing directive #inculde
#inculde <iostream>
^
example.cpp: In function 'int main()':
example.cpp:7:5: error: 'cout' is not a member of 'std'
std::cout << "Hello world!" << std::endl;
^
example.cpp:7:36: error: 'endl' is not a member of 'std'
std::cout << "Hello world!" << std::endl;
^
example.cpp:8:5: error: 'cout' is not a member of 'std'
std::cout << "sin(0.5) = " << my_sin(0.5) << "! " << std::endl;
^
example.cpp:8:57: error: 'endl' is not a member of 'std'
std::cout << "sin(0.5) = " << my_sin(0.5) << "! " << std::endl;
^
      
```
- Again, look at the first error message first
 - The compiler does not recognize `#inculde` as a preprocessing directive



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Compile-time errors 9

Line 1: #include iostream>

- The error message:

```
example.cpp:1:11: error: #include expects "FILENAME" or <FILENAME>
#include iostream>
      ^
example.cpp: In function 'int main()':
example.cpp:7:5: error: 'cout' is not a member of 'std'
std::cout << "Hello world!" << std::endl;
      ^
example.cpp:7:36: error: 'endl' is not a member of 'std'
std::cout << "Hello world!" << std::endl;
                        ^
example.cpp:8:5: error: 'cout' is not a member of 'std'
std::cout << "sin(0.5) = " << my_sin(0.5) << "!" << std::endl;
      ^
example.cpp:8:57: error: 'endl' is not a member of 'std'
std::cout << "sin(0.5) = " << my_sin(0.5) << "!" << std::endl;
                        ^
```

- The included file must be started with either a " or a <



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Compile-time errors 10

Line 1: #include <iostream>

- The error message:

```
example.cpp:1:20: fatal error: iostream: No such file or directory
#include <iostream>
      ^
```

- If the file cannot be found, chances are it is misspelled



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Compile-time errors 11

Line 1: #include <iostream

- The error message:

```
example.cpp:1:19: error: missing terminating > character
#include <iostream
      ^
```

- The error message here is very clear



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Compile-time errors 12

Line 4: integer main();

- Suppose you forget that the type is int, and instead use integer

```
// Function declarations
integer main();
double my_sin( double x );
```

In example.cpp, on line 4
starting at column 1...

- The error message is clear, too:

```
example.cpp:4:1: error: 'integer' does not name a type
integer main();
^
```



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Compile-time errors 13

Line 4: int Main();

- Some programming languages use Main: suppose you forgot you were using C++:

```
// Function declarations
int Main();
double my_sin( double x );
```

```
// Function definitions
int Main() {
...
}
```

- The error message is initially unclear, but the point is made:
/usr/lib/gcc/x86_64-redhat-linux/4.8.5/../../../../lib64/crt1.o: In function '_start':
(.text+0x20): undefined reference to 'main'
collect2: error: ld returned 1 exit status
- Our function `int Main()` is a perfectly good function
 - It's just not the one that C++ executes when launching a program



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Compile-time errors 14

Line 5: double my_sin(...)

- Suppose you forgot the semicolon after the function declaration:

```
// Function declarations
int main();
double my_sin( double x )
```

```
// Function definitions
int main() {
...
}
```

- The error message is less clear:
example.cpp:8:1: error: expected initializer before 'int'
int main() {
^
- It's trying to understand:
double my_sin(double x) int main() { ...



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Compile-time errors 15

Line 9 & 10: cout << ...

- Suppose you forget the namespace `std::`:
cout << "Hello world!" << endl;
cout << "sin(0.5) = " << mysin(0.5) << "!" << endl;

- The compiler makes suggestions:

```
example.cpp: In function 'int main()':
example.cpp:9:5: error: 'cout' was not declared in this scope
  cout << "Hello world!" << endl;
  ^
```

Like we include `iostream`,
`iostream` includes `ostream`

```
example.cpp:9:5: note: suggested alternative:
In file included from example.cpp:1:0:
/usr/include/c++/4.8.2/iostream:61:18: note: 'std::cout'
extern ostream cout; /// Linked to standard output
^
```

```
example.cpp:9:31: error: 'endl' was not declared in this scope
  cout << "Hello world!" << endl;
                        ^
```

```
example.cpp:9:31: note: suggested alternative:
In file included from /usr/include/c++/4.8.2/iostream:39:0,
from example.cpp:1:
/usr/include/c++/4.8.2/ostream:564:5: note: 'std::endl'
  endl(basic_ostream&, _Traits&, _os)
  ^
```



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Compile-time errors 16

Line 9: no opening quote

- Suppose you forgot an opening quote:
std::cout << Hello world!" << std::endl;

- The error message is somewhat complicated:

```
example.cpp:9:30: warning: missing terminating " character [enabled by default]
  std::cout << Hello world!" << std::endl;
                        ^
```

```
example.cpp:9:5: error: missing terminating " character
  std::cout << Hello world!" << std::endl;
  ^
```

```
example.cpp: In function 'int main()':
example.cpp:9:18: error: 'Hello' was not declared in this scope
  std::cout << Hello world!" << std::endl;
                  ^
```

```
example.cpp:9:24: error: expected ';' before 'world'
  std::cout << Hello world!" << std::endl;
                        ^
```



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Compile-time errors 17

Line 9: no closing quote

- Suppose you forgot a closing quote:


```
std::cout << "Hello world! << std::endl;
```
- The error message is straight-forward:


```
example.cpp:9:18: warning: missing terminating " character [enabled by default]
std::cout << "Hello world! << std::endl;
                   ^
example.cpp:9:5: error: missing terminating " character
std::cout << "Hello world! << std::endl;
                   ^
```



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Compile-time errors 18

Line 10: no closing quote

- Suppose you forgot a different closing quote:


```
std::cout << "sin(0.5) = << my_sin(0.5) << !" << std::endl;
```
- The error message is somewhat confusing:


```
example.cpp:10:51: warning: missing terminating " character [enabled by default]
std::cout << "sin(0.5) = << my_sin(0.5) << !" << std::endl;
                                                           ^
example.cpp:10:5: error: missing terminating " character
std::cout << "sin(0.5) = << my_sin(0.5) << !" << std::endl;
                   ^
example.cpp: In function 'int main()':
example.cpp:10:50: error: expected ';' before '!' token
std::cout << "sin(0.5) = << my_sin(0.5) << !" << std::endl;
```
- The last message recognizes ! as a unary operator
 - For this line to make any sense, the previous statement must end before the ! operator


```
std::cout << "sin(0.5) = << my_sin(0.5) << ";
! " << std::endl;
```



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Compile-time errors 19

Line 10: misspelled identifiers

- Suppose you misspelled the function identifier `my_sin`:


```
std::cout << "sin(0.5) = " << mysin(0.5) << !" << std::endl;
```
- The error message is less clear:


```
example.cpp: In function 'int main()':
example.cpp:10:44: error: 'mysin' was not declared in this scope
std::cout << "sin(0.5) = " << mysin(0.5) << !" << std::endl;
                                   ^
```
- The issue is clear: the compiler does not know what `mysin` is.



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Compile-time errors 20

Line 15: unmatched definition

- Suppose the function declaration and definition don't match in the return type:


```
int my_sin( double x ) {
```
- The error message points out the ambiguity:


```
example.cpp: In function 'int my_sin(double)':
example.cpp:15:22: error: new declaration 'int my_sin(double)'
int my_sin( double x ) {
                   ^
example.cpp:5:8: error: ambiguates old declaration 'double my_sin(double)'
double my_sin( double x );
                   ^
```
- The return types of the function declaration and definition must match



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Compile-time errors 21

Line 15: unmatched definition

- Suppose function declaration and definition don't match in the parameter types:

```
double my_sin( int x ) {
```

- The error message points out the ambiguity:

```
/tmp/cc46i29P.o: In function 'main':
example.cpp:(.text+0x39): undefined reference to 'my_sin(double)'
collect2: error: ld returned 1 exit status
```

- It was fine with you defining a `my_sin` taking an `int`, but it's looking for a `my_sin` taking a `double`



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Compile-time errors 23

Line 17: unmatched opening parenthesis

- Suppose you forget a closing parenthesis:

```
return ((-0.00019841269841269841*x*x
+ 0.00833333333333333333 *x*x
- 0.16666666666666667)*x*x + 1.0;
```

- Its suggesting you add a closing parenthesis, but in the wrong location:

```
example.cpp: In function 'double my_sin(double)':
example.cpp:19:45: error: expected ')' before ';' token
- 0.16666666666666667)*x*x + 1.0;
^
```



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Compile-time errors 22

Line 16: invalid comments

- Suppose you accidentally used `/` for a comment:
`/ This uses a Taylor series approximation of sin(x)`

- The error message is less clear:

```
example.cpp: In function 'double my_sin(double)':
example.cpp:16:5: error: expected primary-expression before '/' token
/ This uses a Taylor series approximation of sin(x)
^
example.cpp:16:7: error: 'This' was not declared in this scope
/ This uses a Taylor series approximation of sin(x)
^
example.cpp:16:12: error: expected ';' before 'uses'
/ This uses a Taylor series approximation of sin(x)
^
```

- The compiler is interpreting the `/` as a division sign
 - As division is a binary operator, it needs a left operand



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Compile-time errors 24

Line 17: unmatched closing parenthesis

- Suppose you forgot an opening parenthesis:

```
return (-0.00019841269841269841*x*x
+ 0.00833333333333333333 *x*x
- 0.16666666666666667)*x*x + 1.0;
```

- The error message suggests the statement ends after the 7:

```
example.cpp: In function 'double my_sin(double)':
example.cpp:19:34: error: expected ';' before ')' token
- 0.16666666666666667)*x*x + 1.0;
^
example.cpp:19:34: error: expected primary-expression before ')' token
example.cpp:19:34: error: expected ';' before ')' token
```

- The suggestion is wrong, but the compiler doesn't know your intentions



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Compile-time errors 25

Line 17: unknown identifiers

- Suppose you forgot the * with juxtaposition:

```
return ((-0.00019841269841269841*xx
+ 0.00833333333333333333)*x*x
- 0.16666666666666667)*x*x + 1.0;
```
- The error message says nothing about the missing *; instead:

```
example.cpp: In function 'double my_sin(double)':
example.cpp:17:38: error: 'xx' was not declared in this scope
return ((-0.00019841269841269841*xx
      ^
```
- Its just saying: "I have no clue what 'xx' is..."



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Compile-time errors 26

Line 17: space for multiplication

- Suppose you forgot the * and used a space:

```
return ((-0.00019841269841269841*x x
+ 0.00833333333333333333)*x*x
- 0.16666666666666667)*x*x + 1.0;
```
- The error message is a little unhelpful:

```
example.cpp: In function 'double my_sin(double)':
example.cpp:17:40: error: expected ')' before 'x'
return ((-0.00019841269841*x x
      ^
example.cpp:19:45: error: expected ')' before ';' token
- 0.16666666666666667)*x*x + 1.0;
      ^
```
- It suggests there should be a closing parenthesis after the first 'x'
 - After this, the second error message is confusing



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Compile-time errors 27

Line 17: unmatched braces

- Students often forget to close braces at the end of functions:
- The error message is very clear:

```
example.cpp: In function 'double my_sin(double)':
example.cpp:19:45: error: expected ')' at end of input
- 0.16666666666666667)*x*x + 1.0;
      ^
```
- It's suggesting you put the closing brace at the end of the line
 - The start of the next line is fine

```
double my_sin( double x ) {
// This uses a Taylor series approximation of sin(x)
return ((-0.00019841269841269841*x*x
+ 0.00833333333333333333)*x*x
- 0.16666666666666667)*x*x + 1.0; }
```



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Compile-time errors 28

Summary

- Following this lesson, you now:
 - Understand that some mistakes lead to code that cannot be compiled
 - Understand the compiler makes attempts to point out where the issue is
 - It may be wrong...
 - Know to always try to fix the first compile-time error first
 - That may fix subsequent errors





References

- [1] Wikipedia
https://en.wikipedia.org/wiki/Compilation_error
- [2] cplusplus.com: list of preprocessing directives
<http://www.cplusplus.com/doc/tutorial/preprocessor/>



Colophon

These slides were prepared using the Georgia typeface. Mathematical equations use Times New Roman, and source code is presented using Consolas.

The photographs of lilacs in bloom appearing on the title slide and accenting the top of each other slide were taken at the Royal Botanical Gardens on May 27, 2018 by Douglas Wilhelm Harder. Please see

<https://www.rbg.ca/>

for more information.



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