

CSCI 104



Lab 3: Makefiles



What is a Makefile?

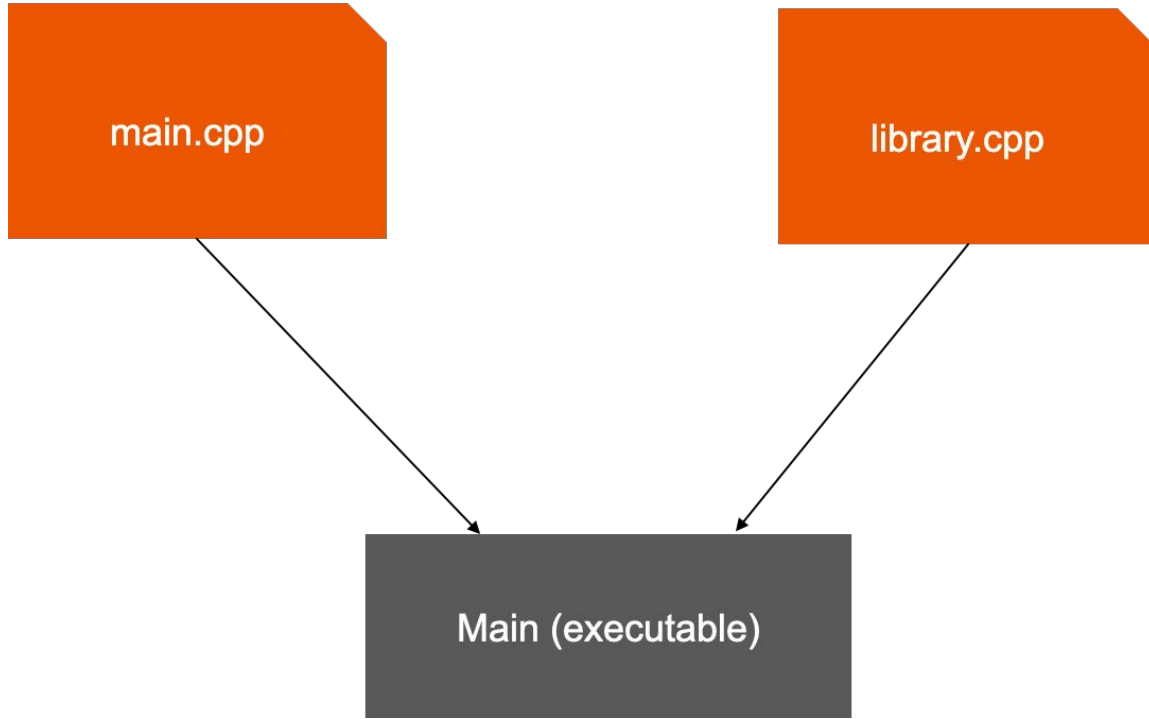
- From <https://www.gnu.org/software/make/>::
 - GNU Make is a tool which controls the generation of executables and other non-source files of a program from the program's source files.
- In other words, it's a way to specify and automate your build process.

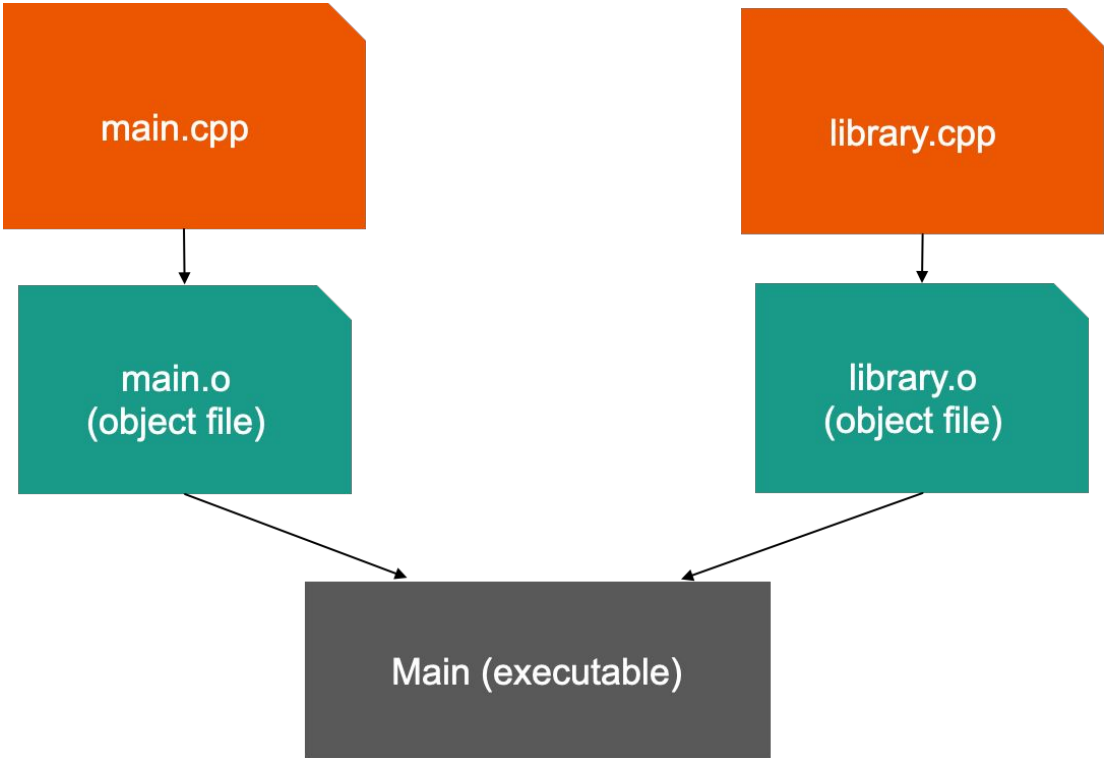


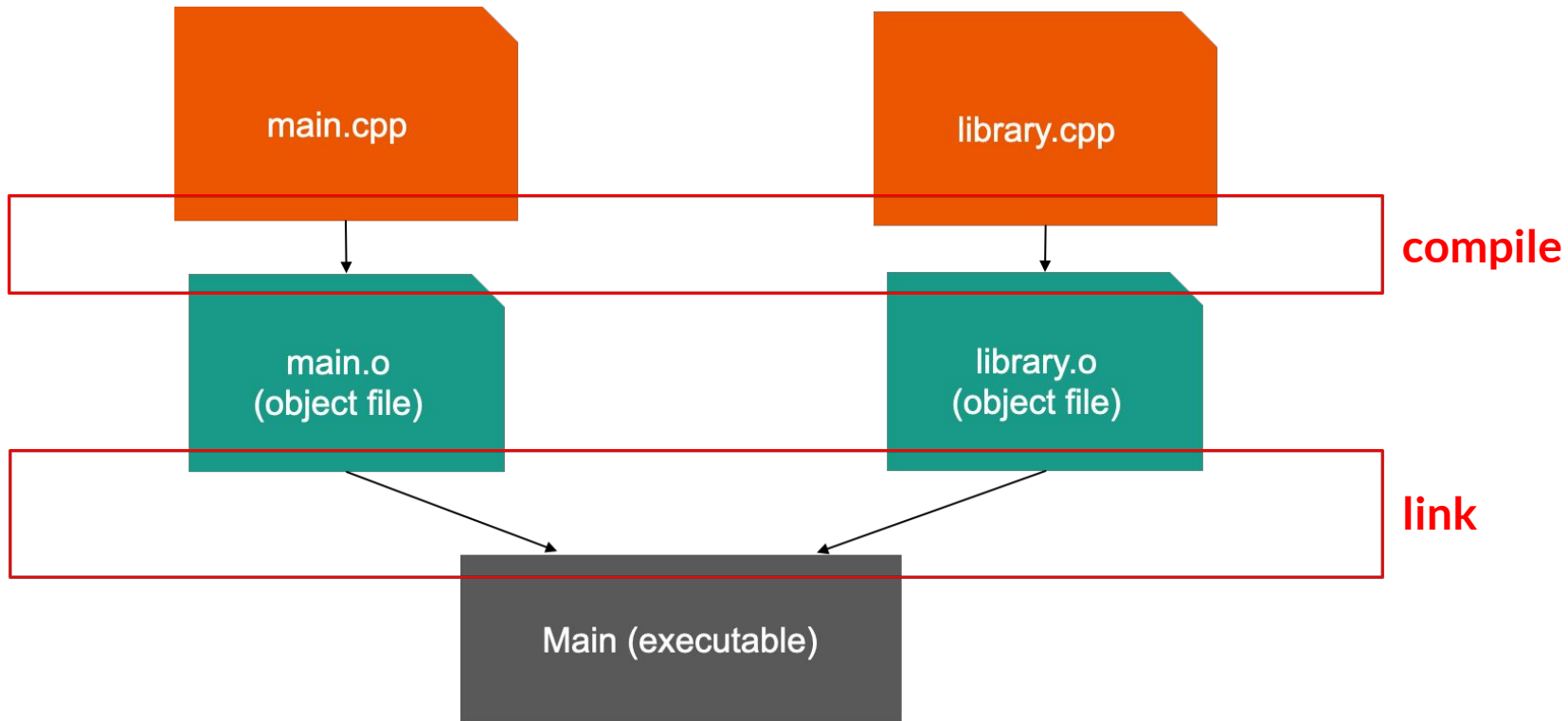
How is a C++ program compiled?

- When you type:
 - `g++ library.cpp main.cpp -o main`

... what exactly is the compiler doing?









The “-c” flag

- Turns out we can ask the compiler to only do the “compile” step:
 - `g++ main.cpp -c -o main.o`
 - `g++ library.cpp -c -o library.o`
- “-c” stands for compile only.
- The above commands creates “main.o” and “library.o”.
- It does not link them together.



Linking them together

- Pass the object files to g++, as if they were cpp files:
 - `g++ library.cpp main.cpp -o main`
 - `g++ library.o main.o -o main`

Why would you do that?

- Simple: if you changed “library.cpp”, you do not have to recompile “main.cpp”!



Now we can explain Makefiles!

- Think of makefiles as recipes:
 - The ingredients for “main.o” is “main.cpp”.
 - The ingredients for “library.o” is “library.cpp”.
 - The ingredients for “main” is “main.o” and “library.o”.

- To make “main.o”, do “g++ main.cpp -c -o main.o”
- To make “library.o”, do “g++ library.cpp -c -o library.o”
- To make “main”, do “g++ main.o library.o -o main”



In Makefile language:

```
main.o: main.cpp
```

```
  g++ main.cpp -c -o main.o
```

```
library.o: library.cpp
```

```
  g++ library.cpp -c -o library.o
```

```
main: main.o library.o
```

```
  g++ main.o library.o -o main
```



Now with make with more flags

main.o: main.cpp

```
g++ -Wall -g main.cpp -c -o main.o
```

library.o: library.cpp

```
g++ -Wall -g library.cpp -c -o library.o
```

main: main.o library.o

```
g++ -Wall -g main.o library.o -o main
```



Variables!

```
cxx = g++ -Wall -g
```

```
main.o: main.cpp
```

```
$(cxx) main.cpp -c -o main.o
```

```
library.o: library.cpp
```

```
$(cxx) library.cpp -c -o library.o
```

```
main: main.o library.o
```

```
$(cxx) main.o library.o -o main
```



Lab Assignment & Reminders

- To do the lab:
 - Go to the Bytes site, read the writeup
 - Git pull the resources folder to get lab3; work within your Docker environment!

 - Part 1 is guided, very easy Makefile
 - Part 2 is semi-guided, implementing linking and variables
 - Show a tutor/TA the final Pokemon battle using your make command to compile/link and get checked off!