CS 6015: Software Engineering

Spring 2024

Lecture 12: Include files - Libraries

One way to organize source files

- Split header files from cpp files
- Can we compile?

- What happens to .cpp files?
  - One way to update all cpp files with the new header location
  - Could be time consuming for large project

- Solution?

One way to organize source files

- Split header files from cpp files
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- Solution: include the new path while compiling (using `-I` flag)
  - Update only the `Makefile`

Libraries

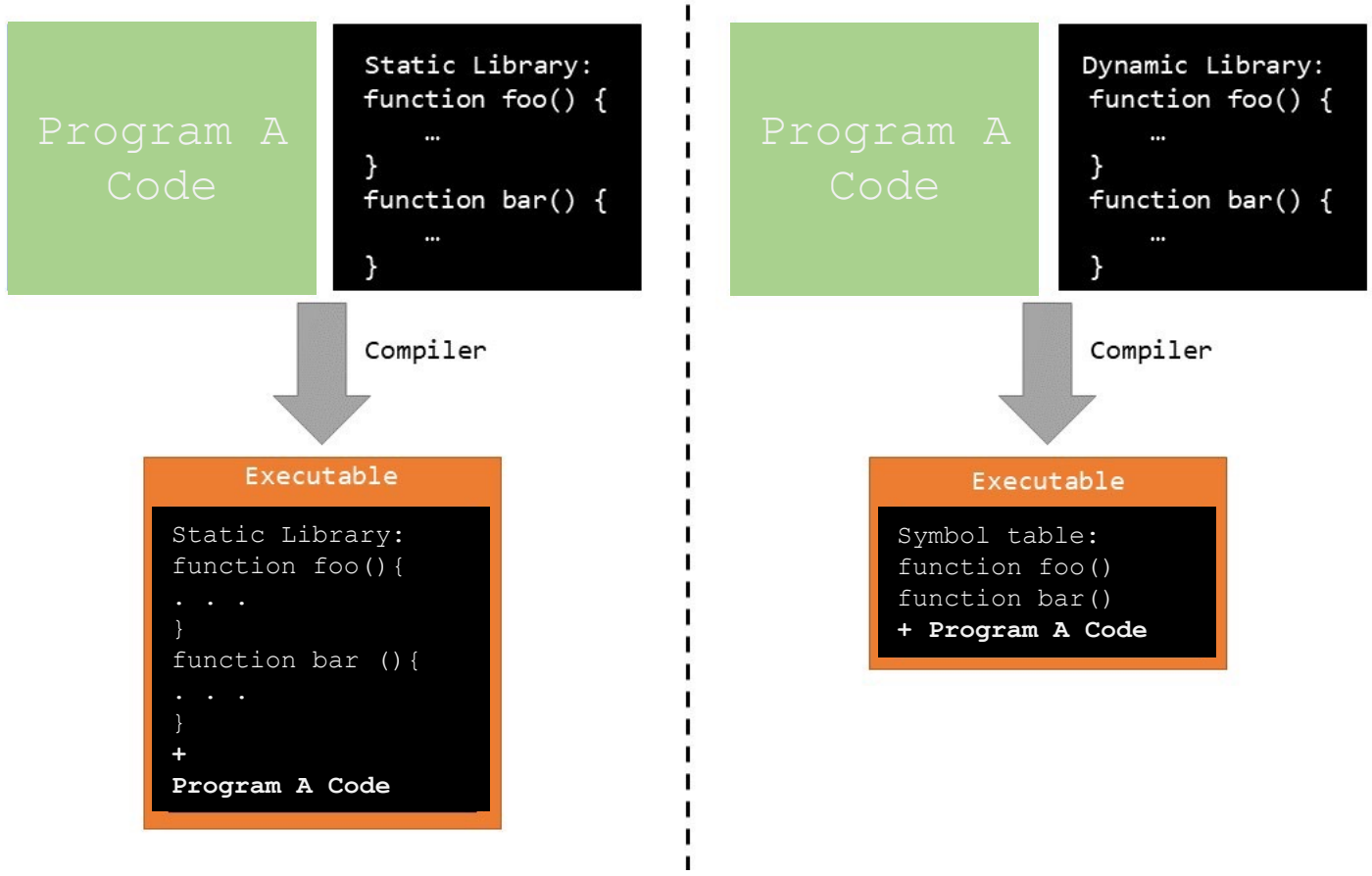
- Code that can be reused by programs
- Two types:
  - Static library (or **archive**)
  - Dynamic library (or **shared library**)
- Libraries vs. namespaces

Static library vs Dynamic library

- Static library: code linked **at compile time**. The executable file generated keeps its own copy of the library code.

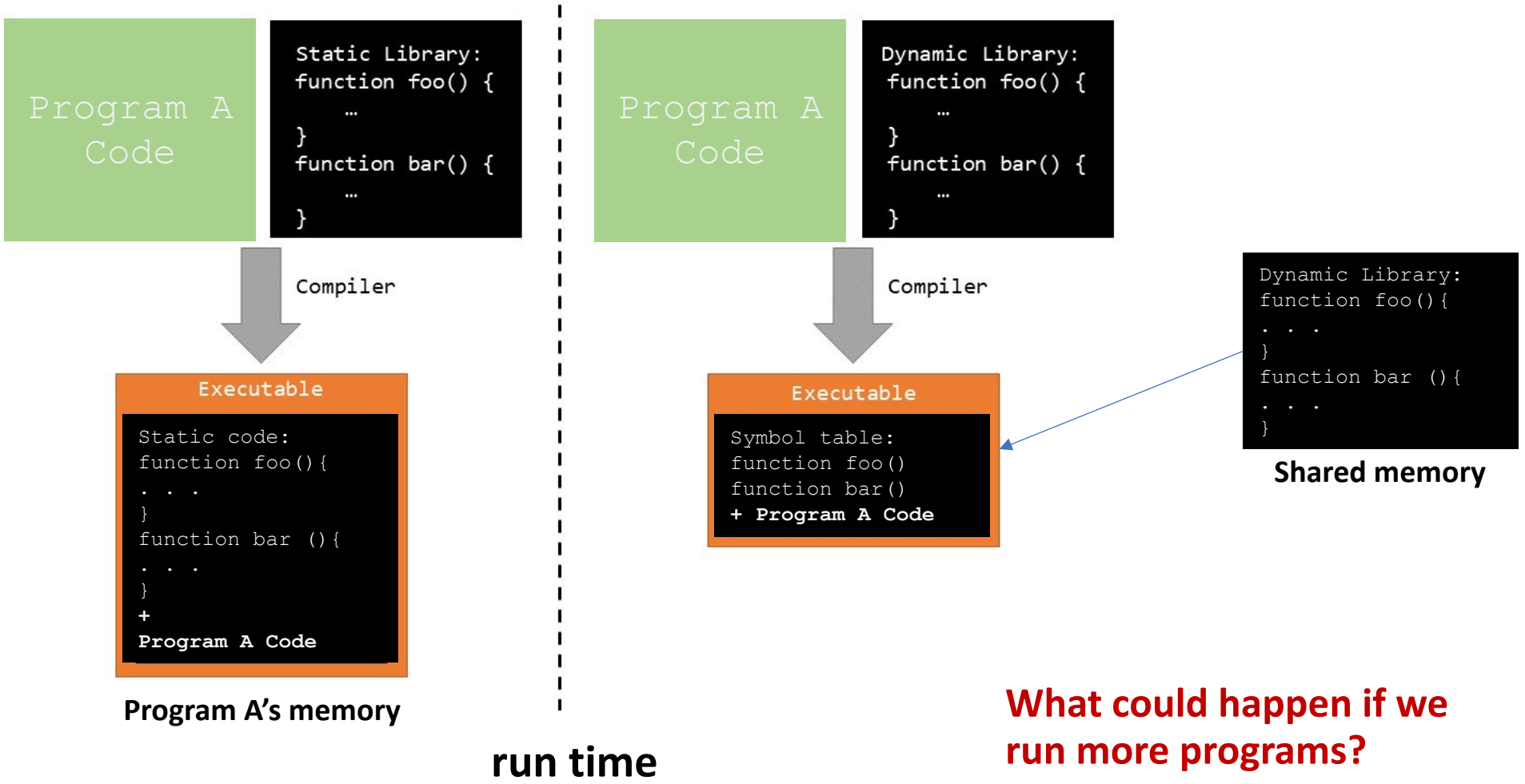
- Dynamic library: code shared by multiple programs and loaded to memory **at runtime.**

Static library vs Dynamic library: Illustration

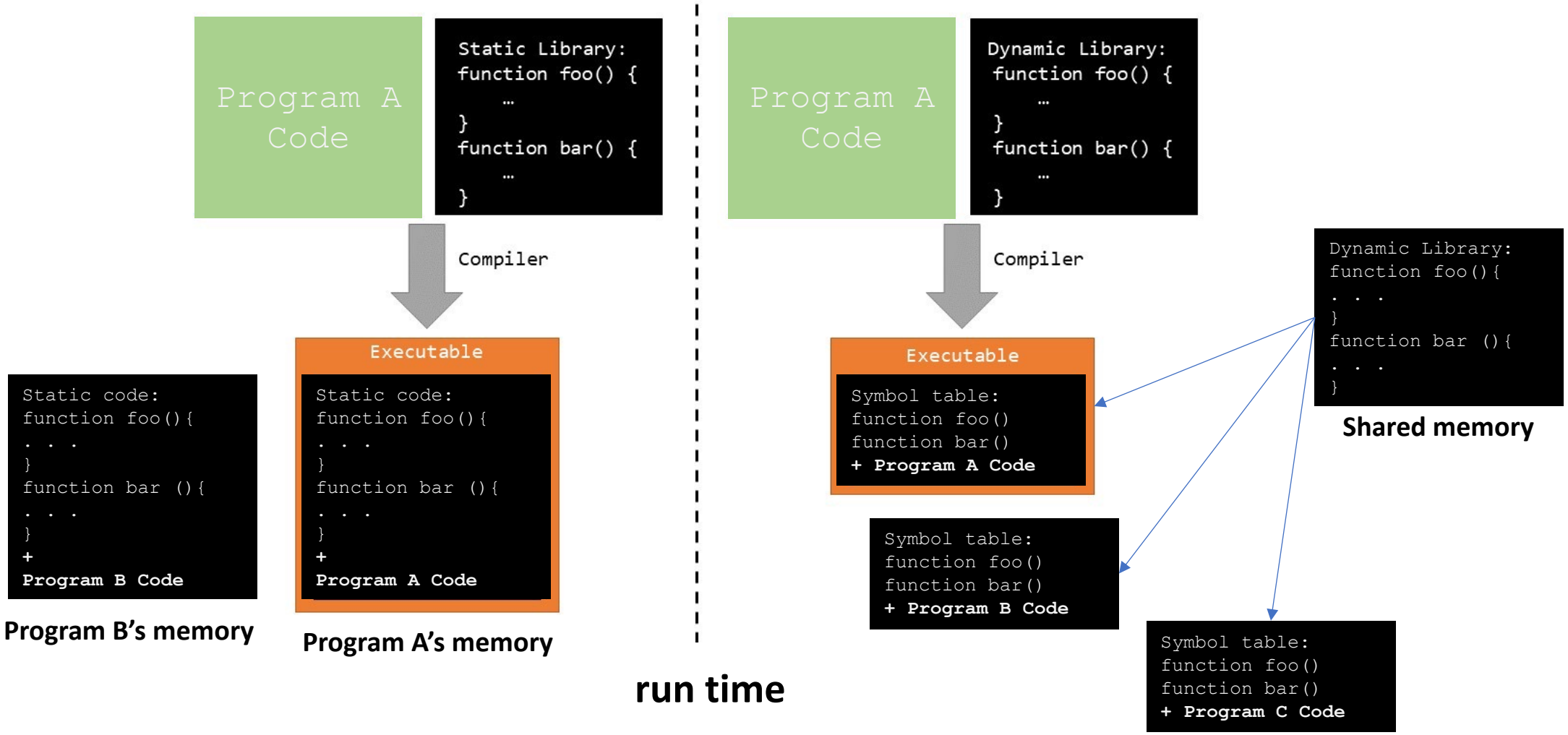


Compile time

Static library vs Dynamic library: Illustration



Static library vs Dynamic library: Illustration



Drawbacks

- Static library
  - Increases the size of the program
  - Modifying the library requires recompiling and reloading into the program.
- Dynamic library
  - Extra concern on installing

Extensions

- Static library
  - .a on Unix/Linux/Mac machines
  - .lib on windows machines

- Dynamic library
  - .so on Unix/Linux/Mac machines
  - .dll on windows machines

Static library: Adding and Linking

- Create the library
  - Generate the object files
  - Use ar (a Linux ***ar***chive utility tool) to create the library file
- Linking the library
  - Specify library path using: `-L flag`
  - `-lname` is equivalent to `libname.a`
- With Cmake:
  - `add_library(LibraryName STATIC simple_lib.cpp)`

Dynamic library: Adding and Linking

- Linux
  - Create the library
    - Generate the object files
    - Use -shared flag with clang++: *clang++ -shared -o libmy_library.so my_library.o*
  - Linking the library
    - Specify library path using: `-L flag` with `-lname` as in static library
    - Use `-rpath` flag to specify the shared library path when building the executable.

- With Cmake:
  - `add_library(LibraryName SHARED simple_lib.cpp)`