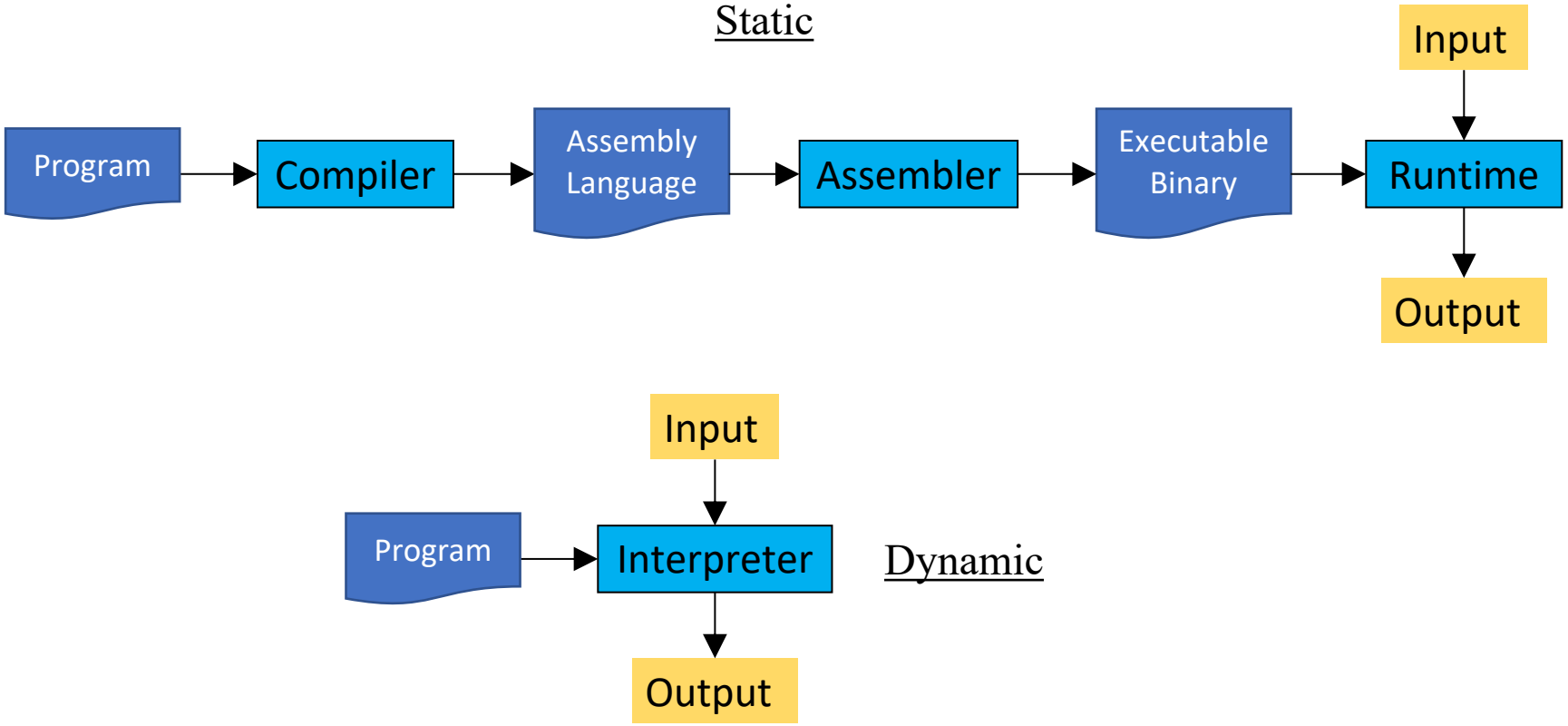
IN3: What is a Compiler

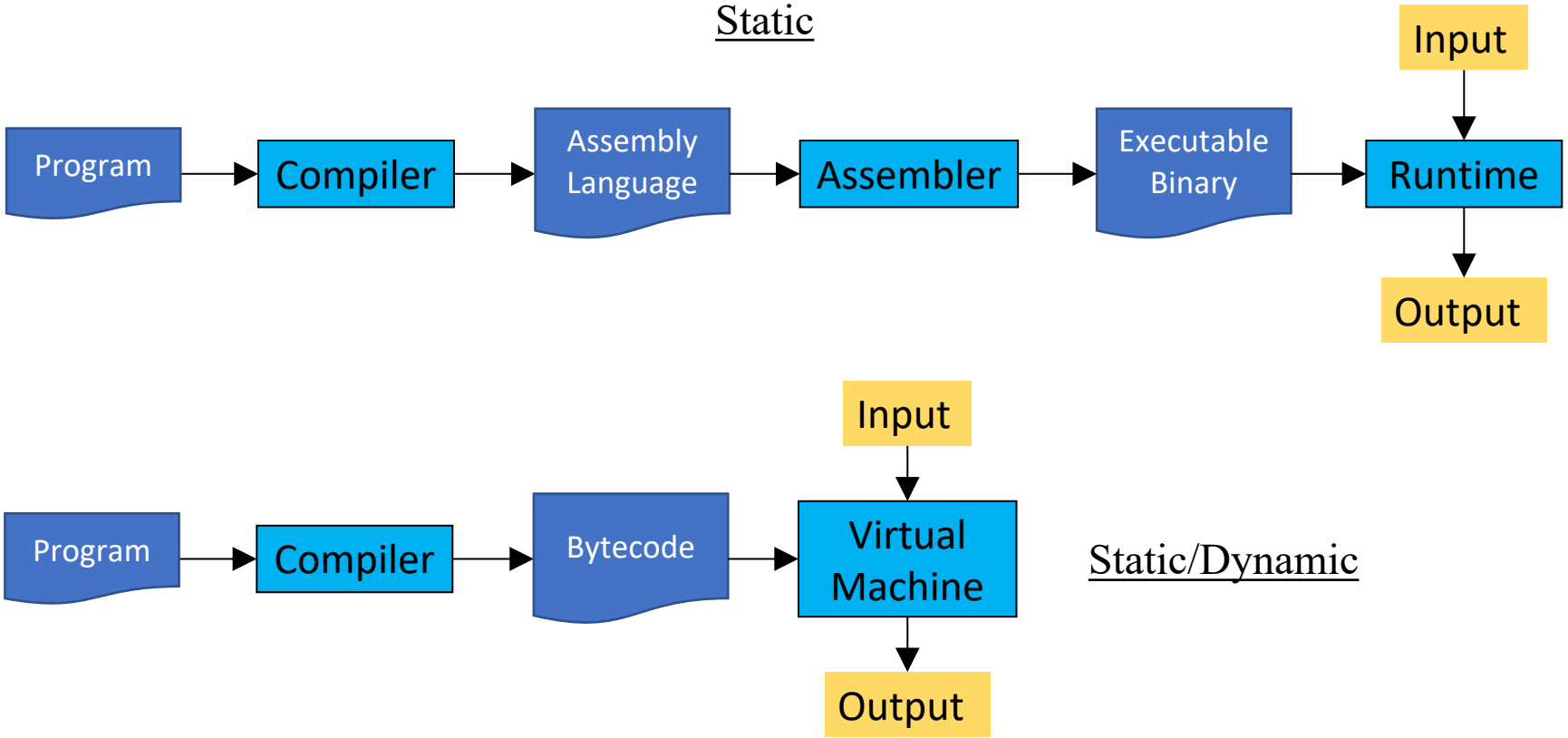
Introduction to Compilers

CMPT 379: Compilers

Instructor: Anoop Sarkar

anoopsarkar.github.io/compilers-class

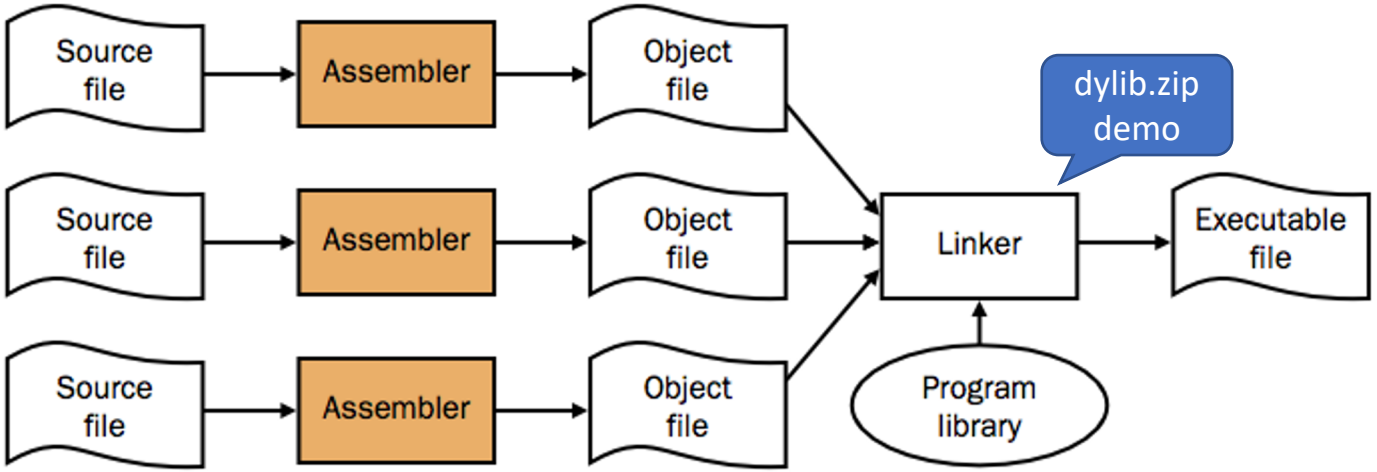

Static
Input
Program
Compiler
Assembly Language
Assembler
Executable Binary
Runtime
Output
Input
Program
Interpreter
Dynamic
Output


Static
Program
Compiler
Assembly Language
Assembler
Executable Binary
Input
Runtime
Output
Program
Compiler
Bytecode
Input
Virtual Machine
Output
Static/Dynamic

Compilers

- Analysis of the source (front-end)
- Synthesis of the target (back-end)
- The *translation* from source code to executable
- Requirements from a Compiler are:
  - Support high-level programming languages
  - Good error messages
  - Speed of compilation
  - Produce fast executables with small footprint

The UNIX toolchain



Bootstrapping a Compiler

- Machine code at the beginning
- Make a simple subset of the language, write a compiler for it
- Use that subset for the rest of the language definition
- Bootstrap from a simpler language
- Interpreters: write it in a lower level language,
  - e.g. Python interpreter is written in C
- Cross compilation
  - generate ARM executables with compiler running on x86

Modern challenges

- Instruction Parallelism
  - Out of order execution; branch prediction
- Parallel algorithms:
  - New programming languages for grid computing, multi-core computers
- Memory hierarchy: register, cache, memory
- New architectures: GPUs, quantum computers, DNA computers
- Hardware synthesis (extreme inner loop optimization)