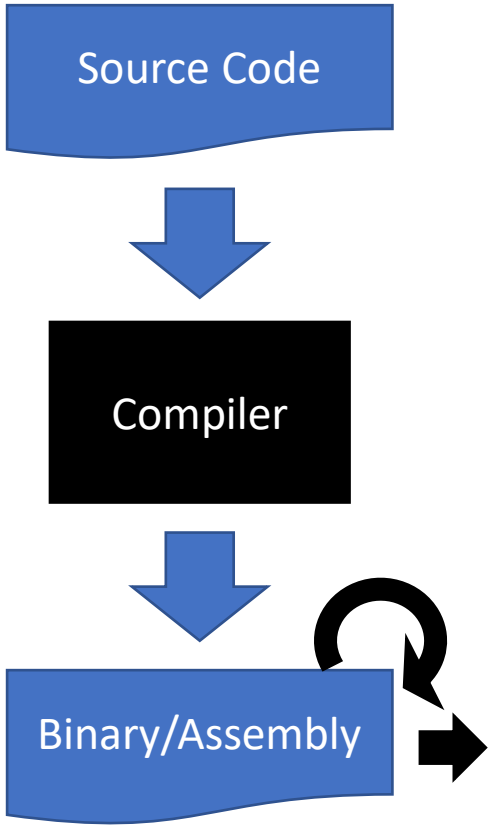
CS440: Programming Languages and Translators

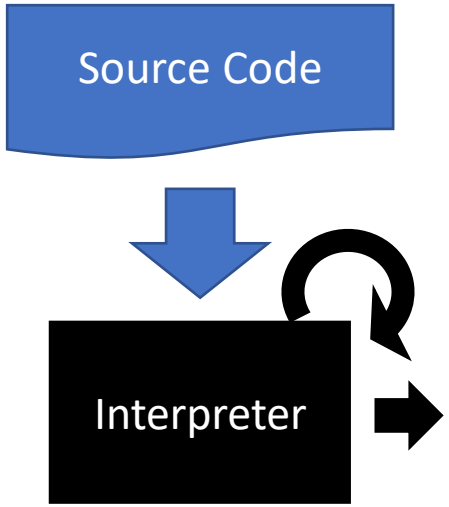
Lecture 1

Spring 2023

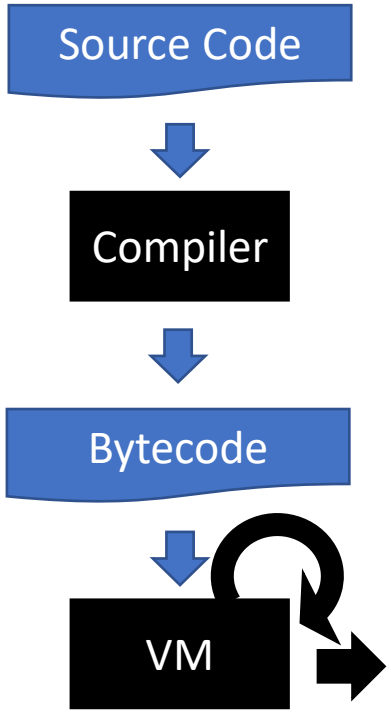
There are different ways of translating a programming language



Ex.: C, C++



Ex.: Python



Ex.: Java

“Go straight on to the roundabout; mind the lorries”

“OK, so keep going that way”;
“Here, you’re going to go straight ahead”

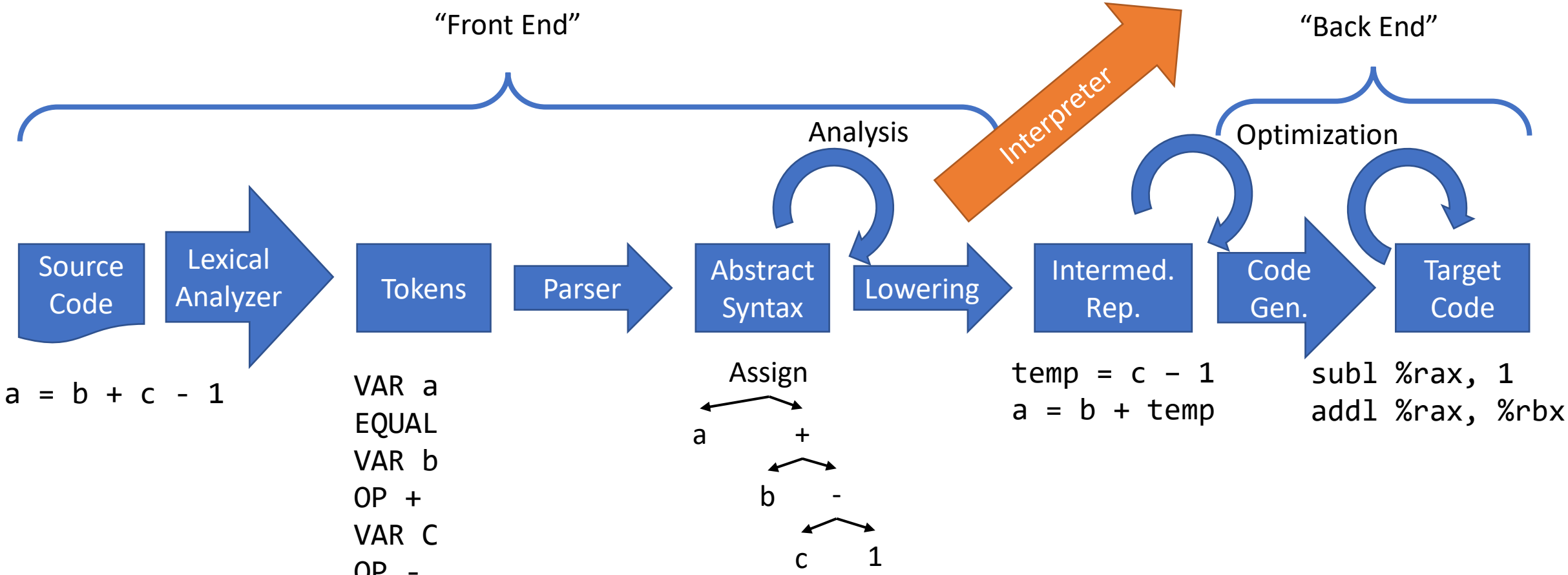
“It means ‘keep going until you get to this circular intersection; watch out for trucks.’”

Compilers vs. interpreters

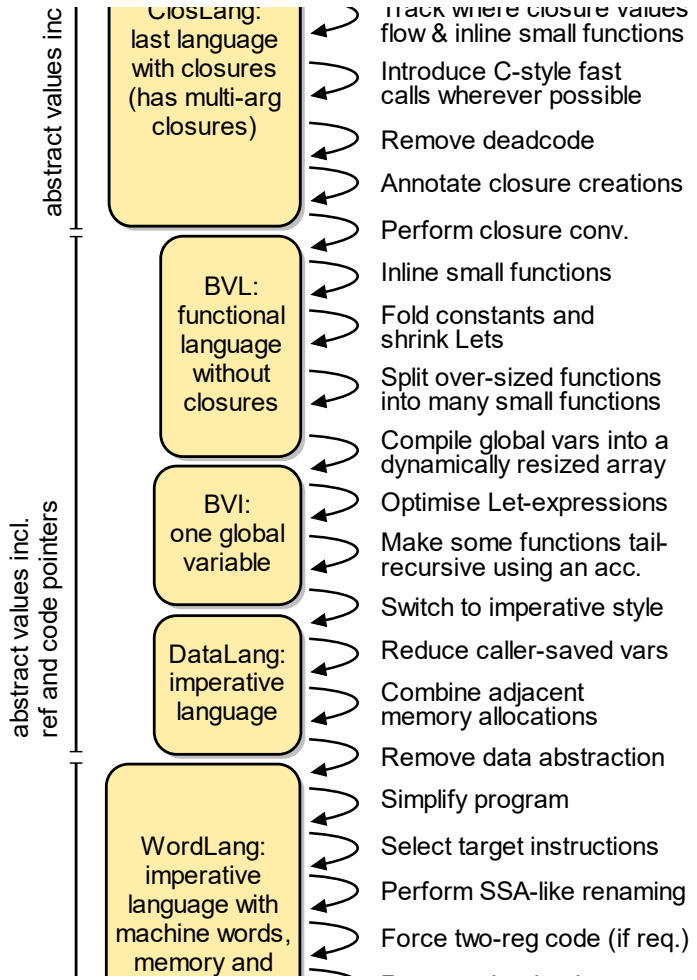
- Compiler
  - Translates the program to a form executable by the machine (or assembly)
  - Compile, then can run the executable: compiler no longer involved

- Interpreter
  - Doesn’t translate to machine-readable format
    - Might compile to bytecode or intermediate representation
  - Runs (“interprets”) program directly
  - Can’t run without the interpreter

Compilers translate code in phases

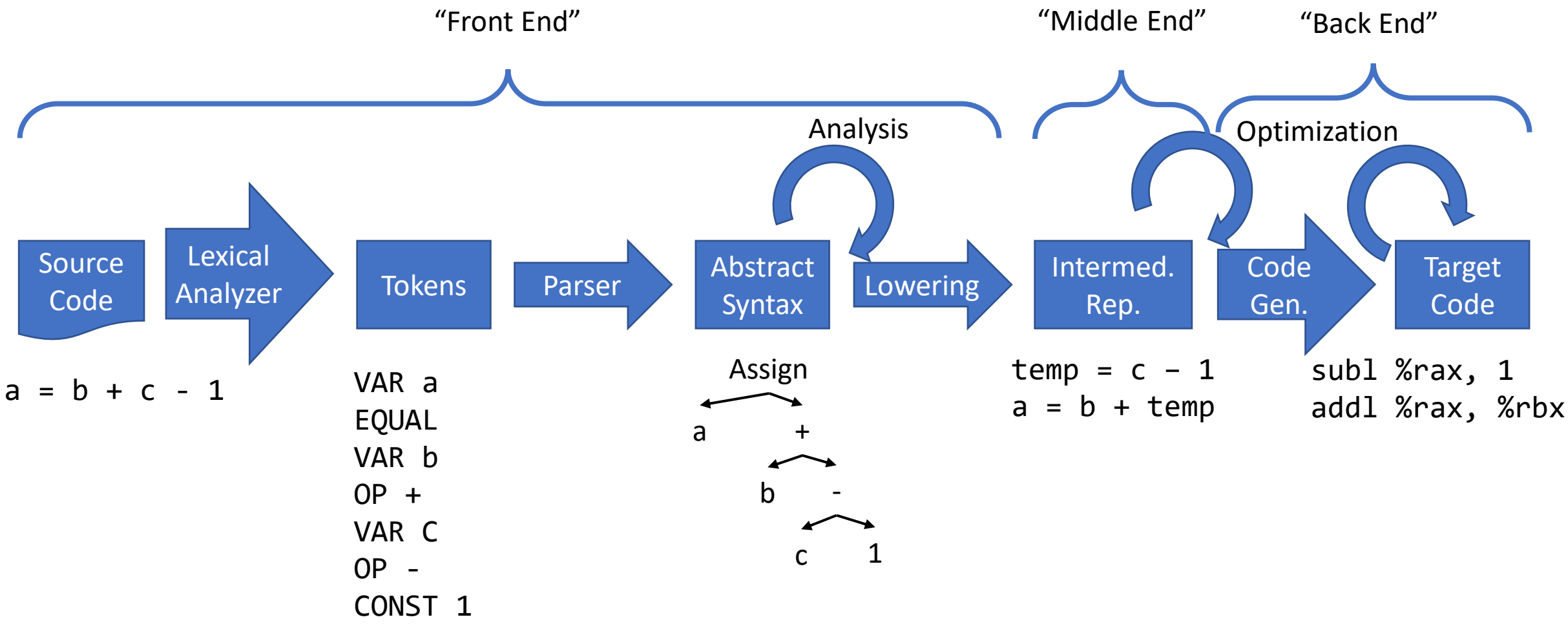


May have many more phases, several intermediate representations

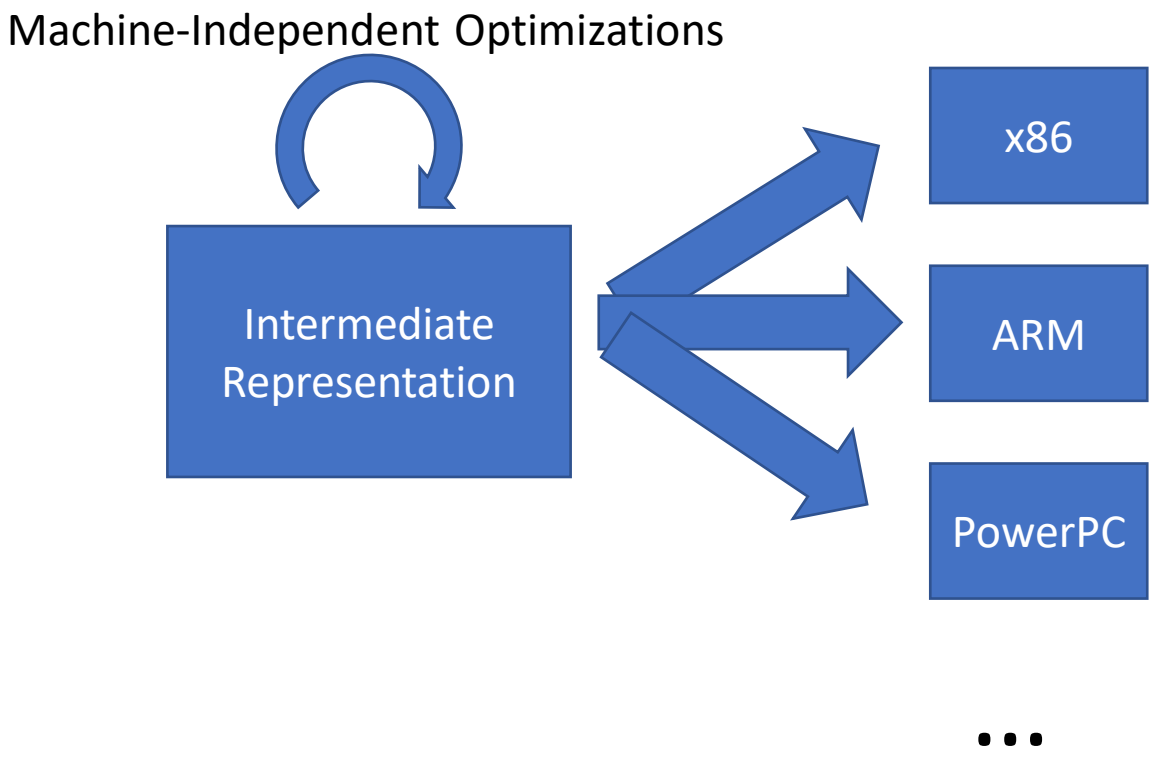


CAKEML
A Verified Implementation of ML

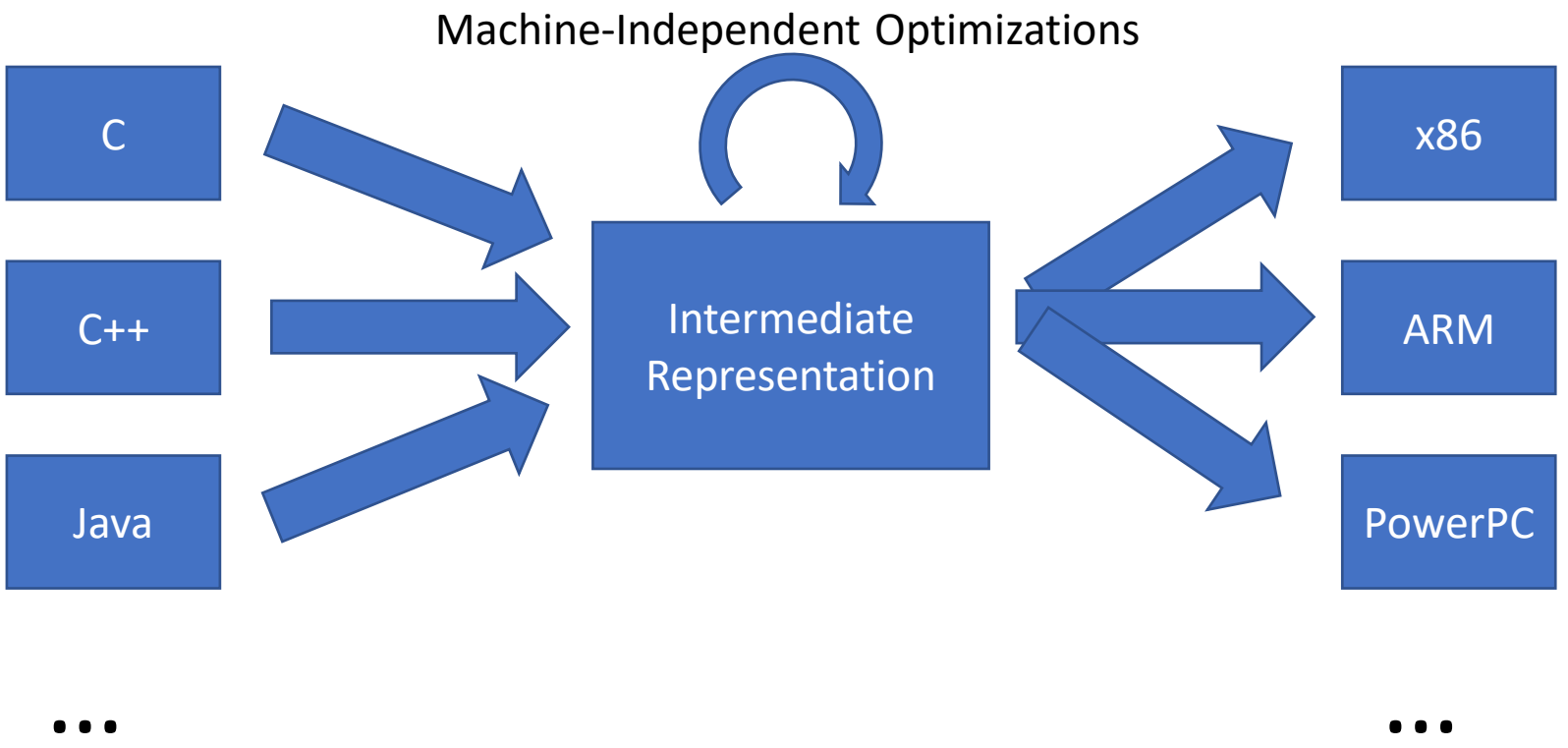
Front End is language specific
Back End is machine specific



Can (and usually do) swap out back ends to target different machines



Compiler collections also swap out front ends for different languages



- More about compilers: CS443
- This class: more about interpreters

Functional Programming

- Strong mathematical foundations
- Very high-level
- Really elegant for expressing many algorithms

xkcd.com/1270

(Alt text: Functional programming combines the flexibility and power of abstract mathematics with the intuitive clarity of abstract mathematics)

- Statically typed, functional
  - (also has imperative and object-oriented features)

- Strong, expressive type system
  - (makes implementing many data structures very easy)
- Type inference
  - `int x = 5;`
  - `x = 5`

- Probably the most used functional language
- First appeared 1996
  - “ML family” of languages (Standard ML, F#) goes back to the 1970s
- Version 5.0.0 released Dec. 16, 2022

- Industrial-strength compiler
  - Actively maintained
  - Lots of libraries (standard and 3rd-party)