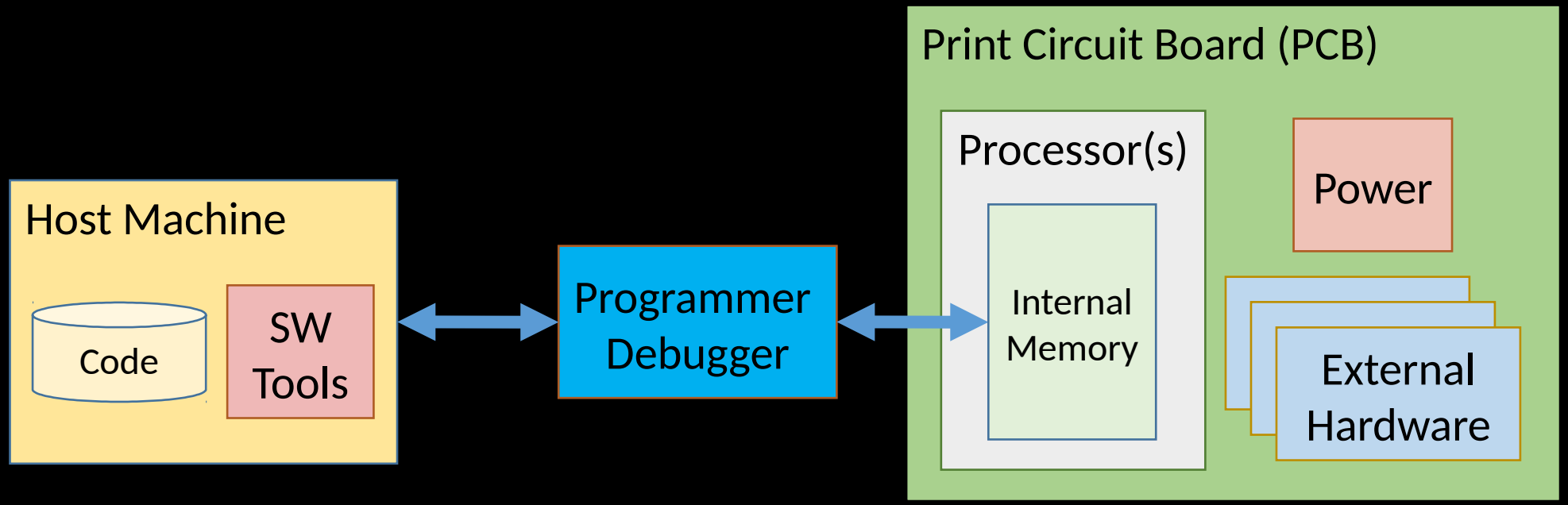
Embedded Software Essentials

Introduction to Build Systems using GNU Toolsets

C1 M2 V1

Copyright

Embedded System Development Platform



The host machine contains our [Build Environment]

Build Environment

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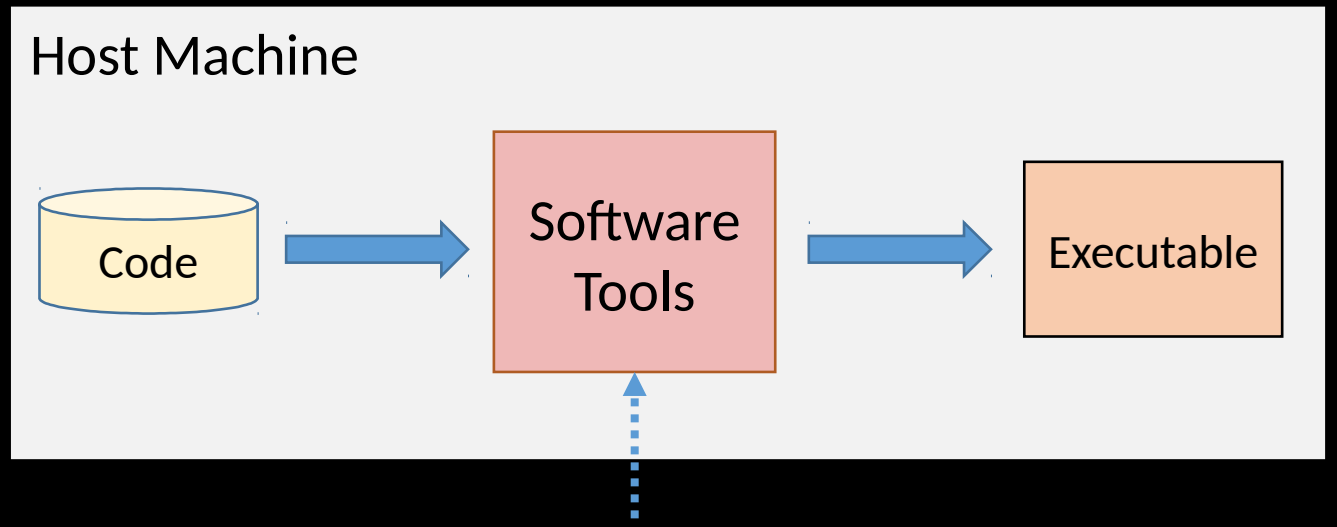
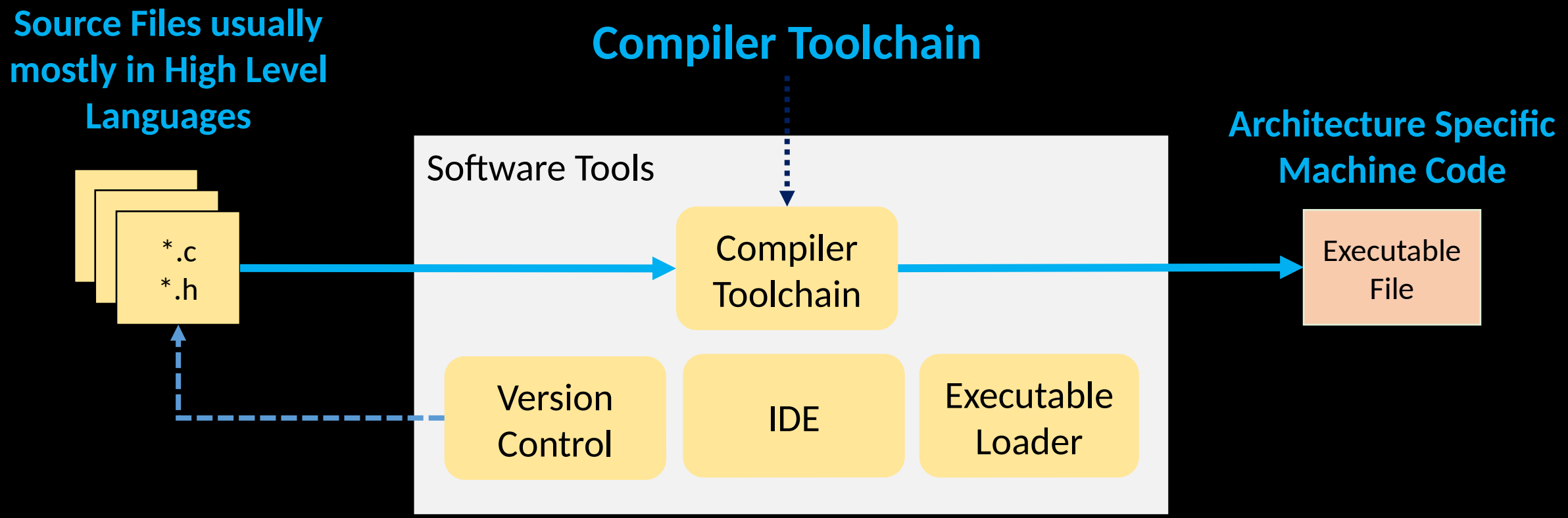


Software Engineer's Tools include Compiler Toolchain

- GCC – GNU's Compiler Collection
- Make

Software Tools



Building a Software Project

C-Programming (High Level Language)

```
int x = 0;
int y = 20;
int z = 5;
    …
while (y >= z) {
  y = y – z;
  x++;
}
```

ARM Assembly Language (Low Level Language)[1]

```
    ldr   r2, (y)
    ldr   r3, (z)
    ldr   r4, (x)
LOOP:
    sub   r2, r3
    inc   r4
    cmp   r2, r3
    bgt   LOOP
    str   r2, (y)
    str   r4, (x)
```

[1] (x),(y),(z) = Pseudocode

Machine Code (Binary encoded Assembly Instructions) [2]

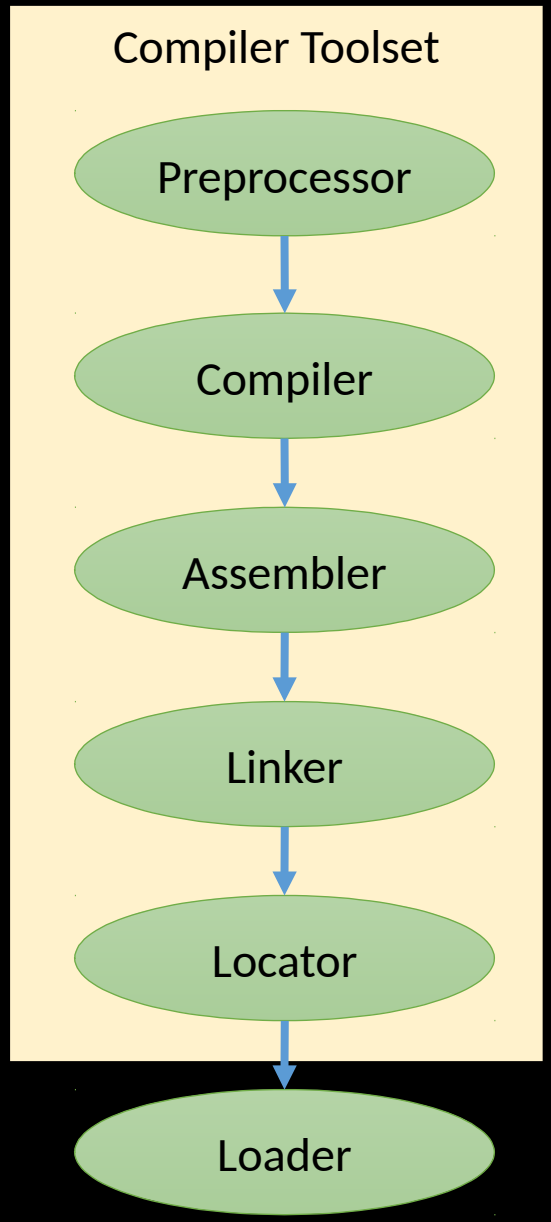
```
0x0c1b
0x7023
0x2302
0x71bb
0x2300
0xf7ff ef24
0xc407
0x8023
0x3402
```

[2] Machine code just an example

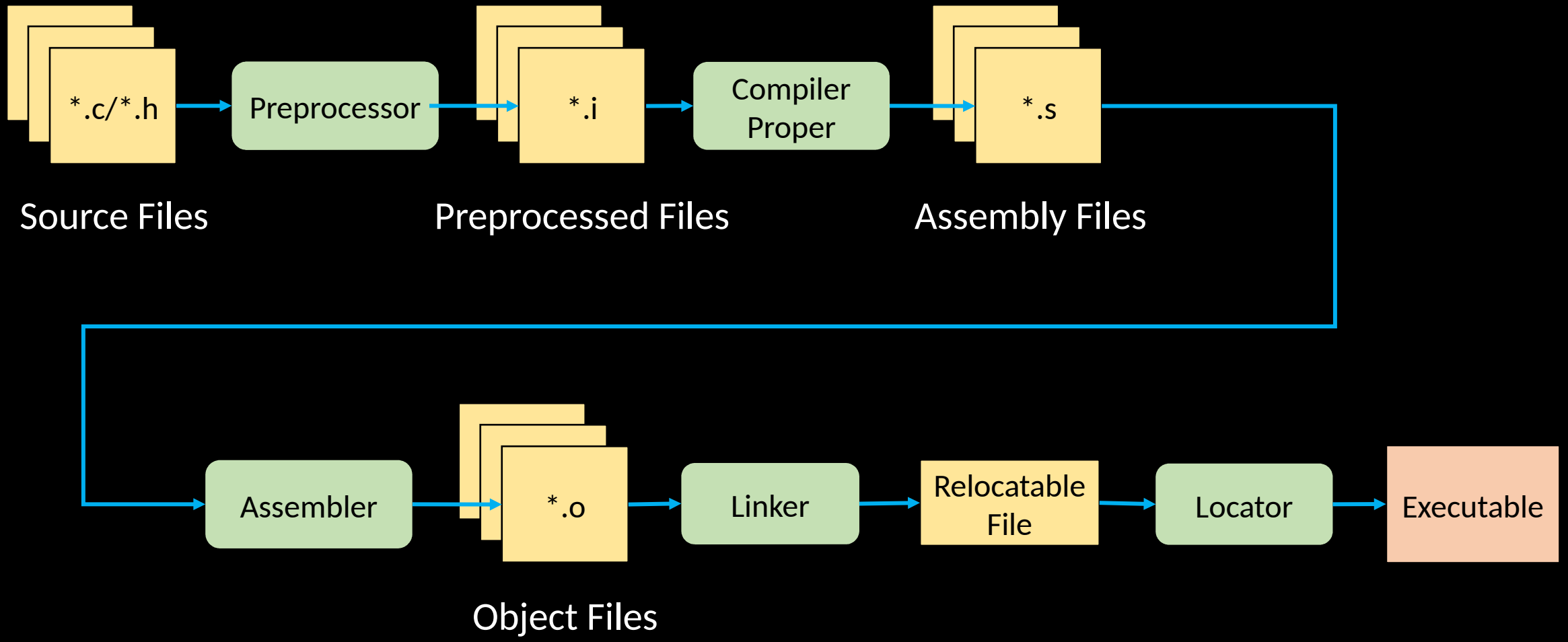
Building a Software Project

- Build and Install Process:
  - Preprocessing
  - Assembling
  - Compiling
  - Linking
  - Locating
  - Installing

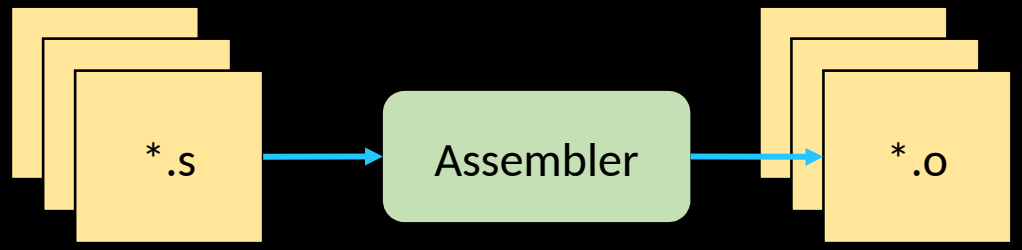
- Installation will require other tools



Build Process (linear)

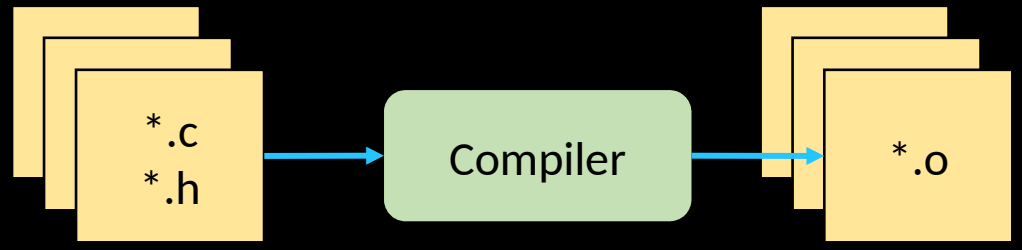


Compilation (No Linking)



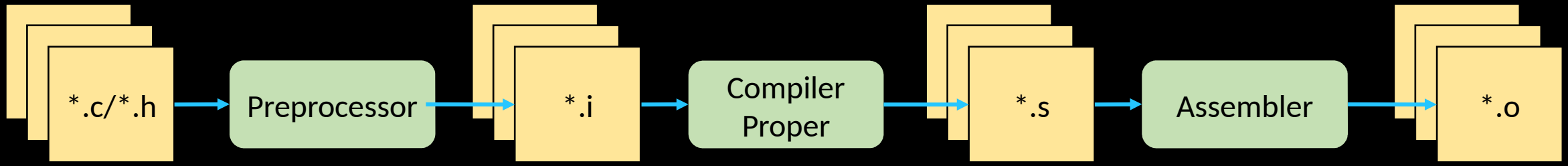
Assembly Files

Object Files



Source Files

Object Files



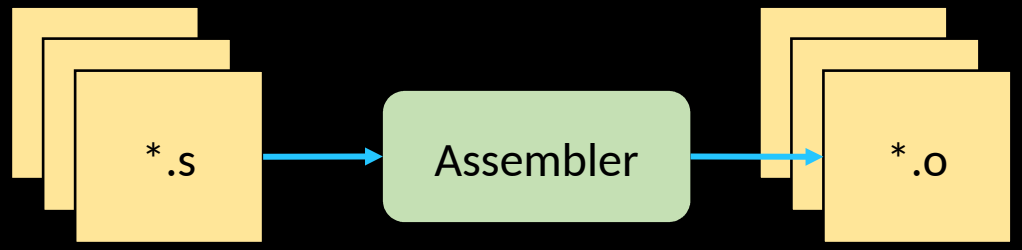
Source Files

Preprocessed Files

Assembly Files

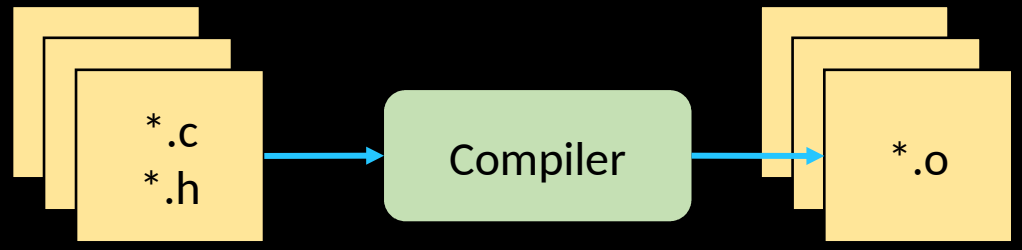
Object Files

Compilation (No Linking)



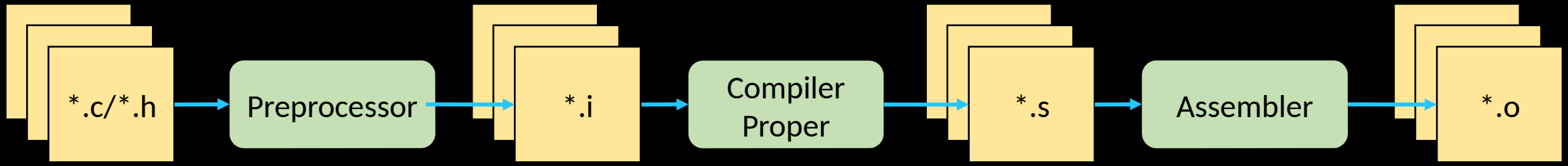
Assembly Files

Object Files



Source Files

Object Files



Source Files

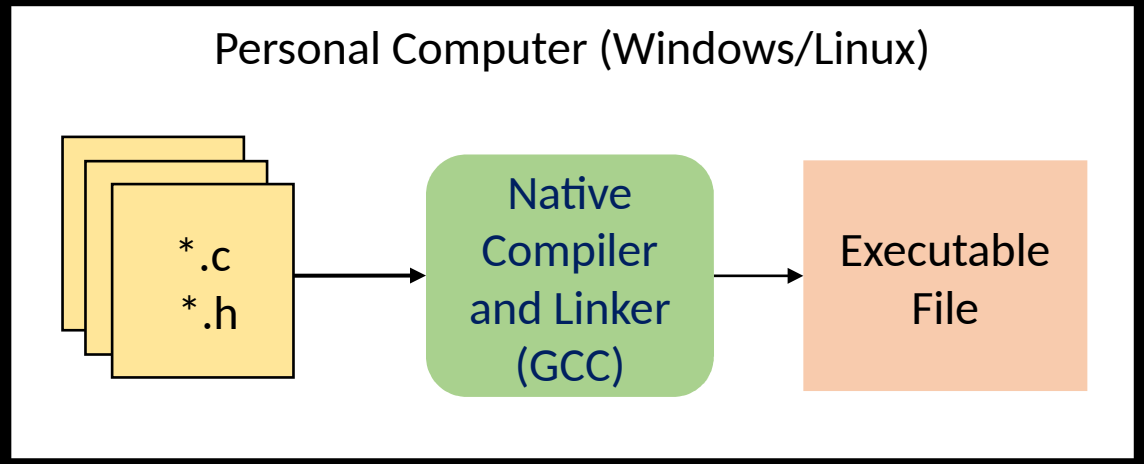
Preprocessed Files

Assembly Files

Object Files

Native Compilation

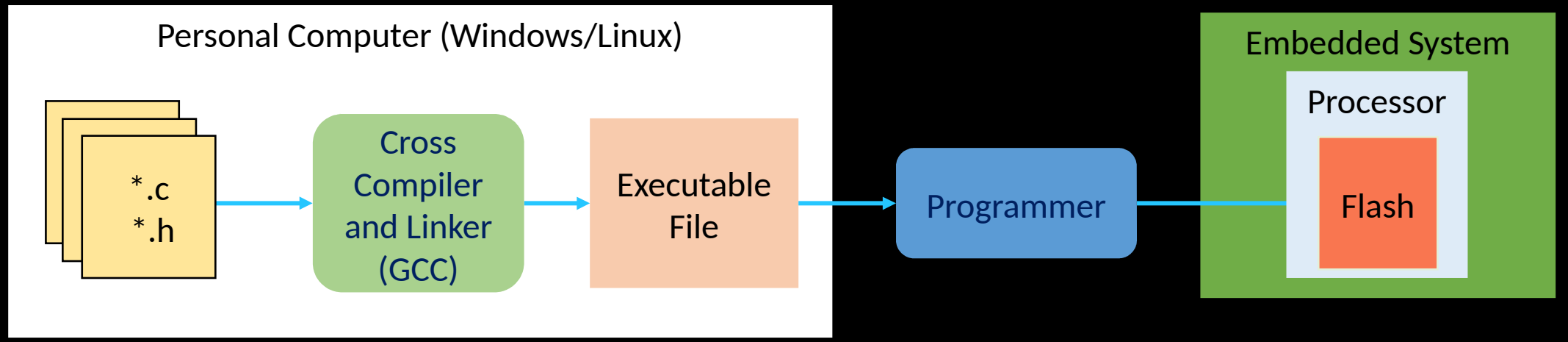
- Compile an executable on one system and it is intended to run on same system



No hardware needed

Cross Compilation

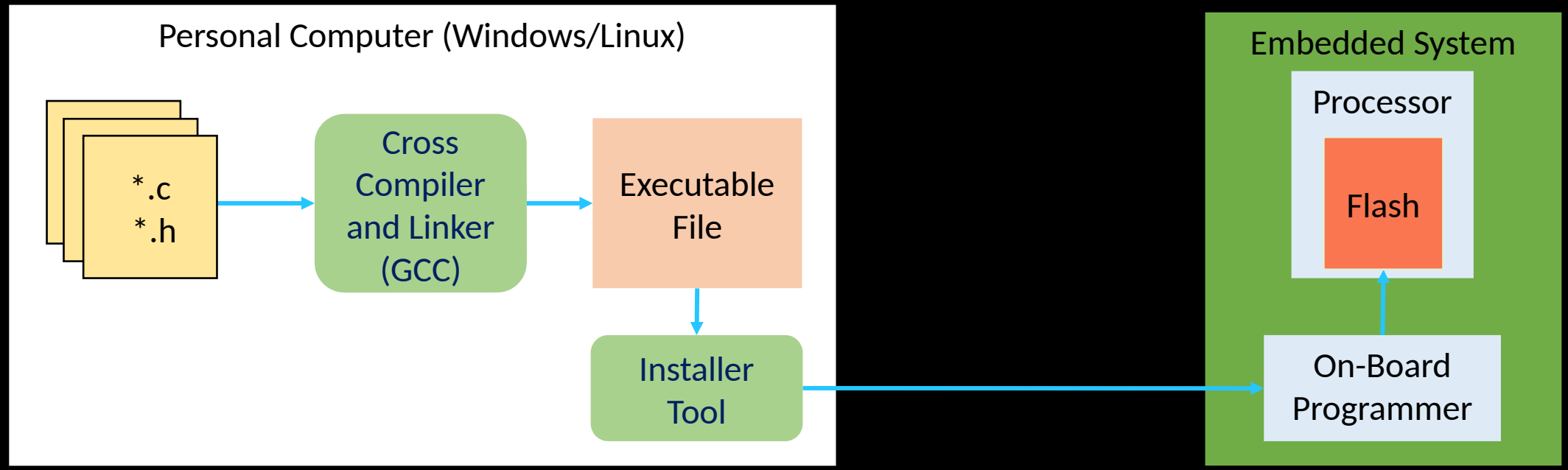
- Compile an executable on one system and it is intended to run on another



Programmer HW needed for Install

Cross Compilation

- Installer tool sends executable to on board programmer
  - No external hardware needed



Compiler Toolchain

- **GCC = GNU's Compiler Collection**
  - Contains many tools (compiler, assembler, linker, etc)
- **GNU Make**
  - "Tool that controls the generation of executables and other non-source files of a program from the program's source files"[2]