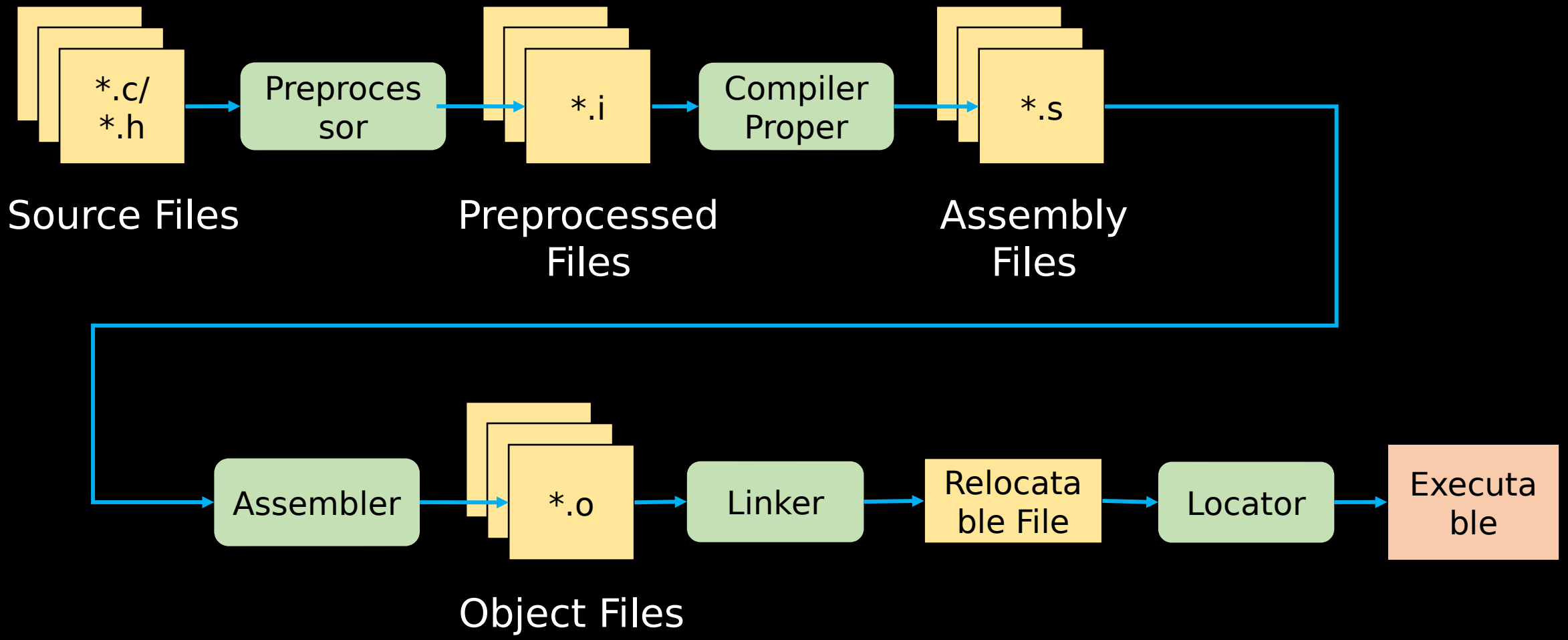
Embedded Software Essentials

Compiling and Invoking GCC

C1 M2 V2

Copyright

Build Process (linear)



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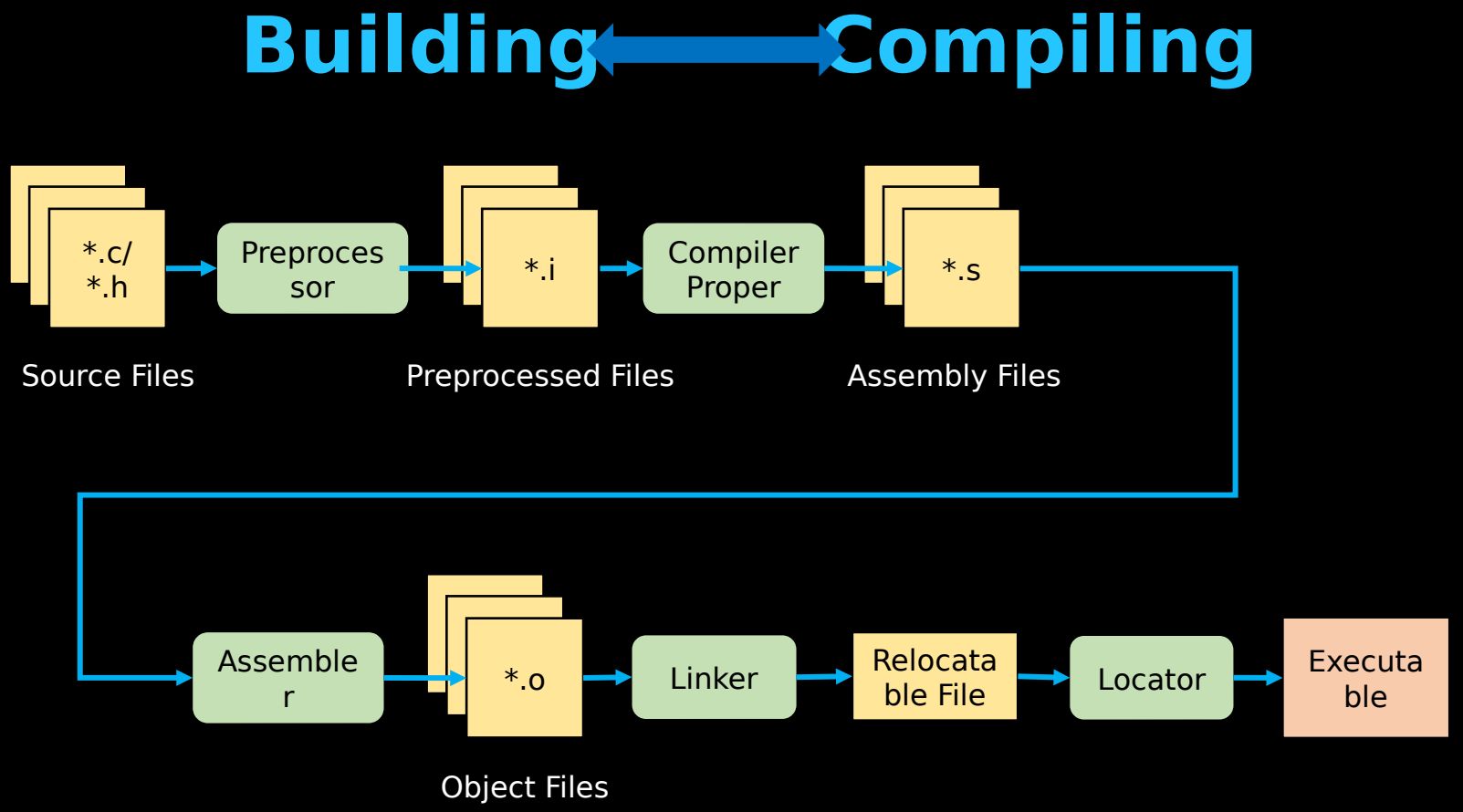
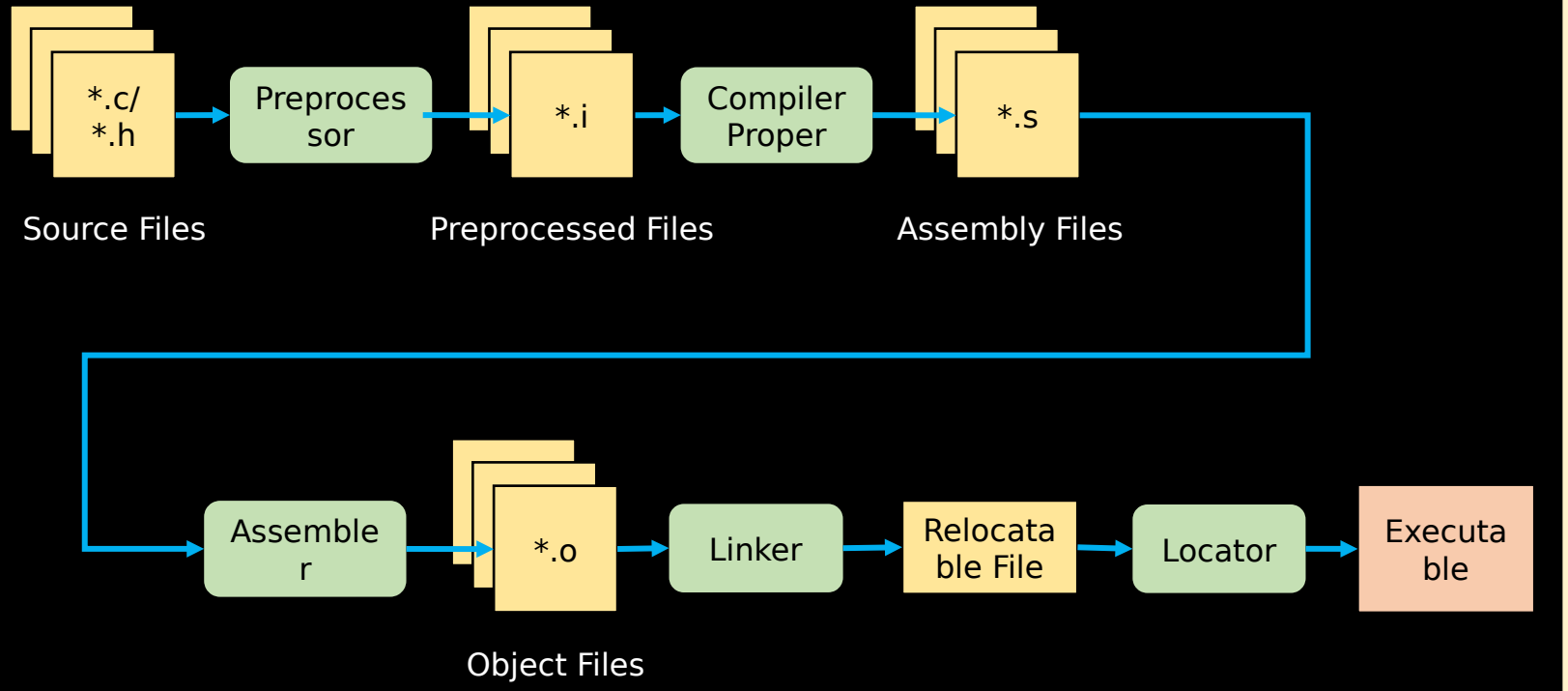
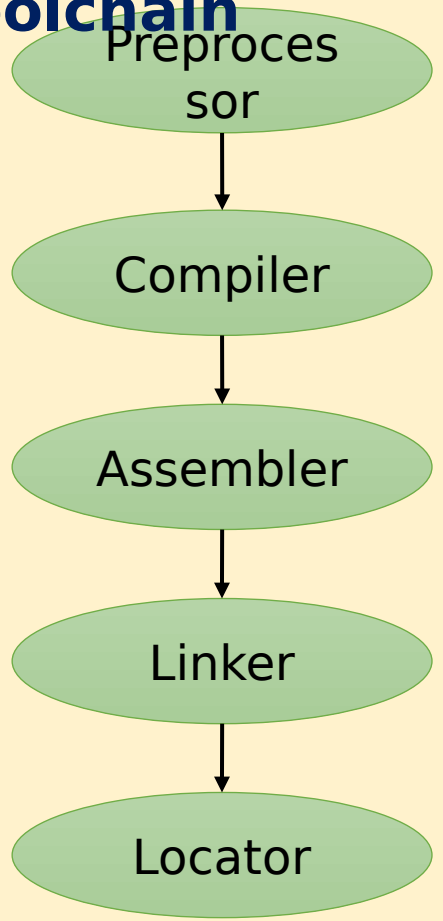


Build Process (linear)

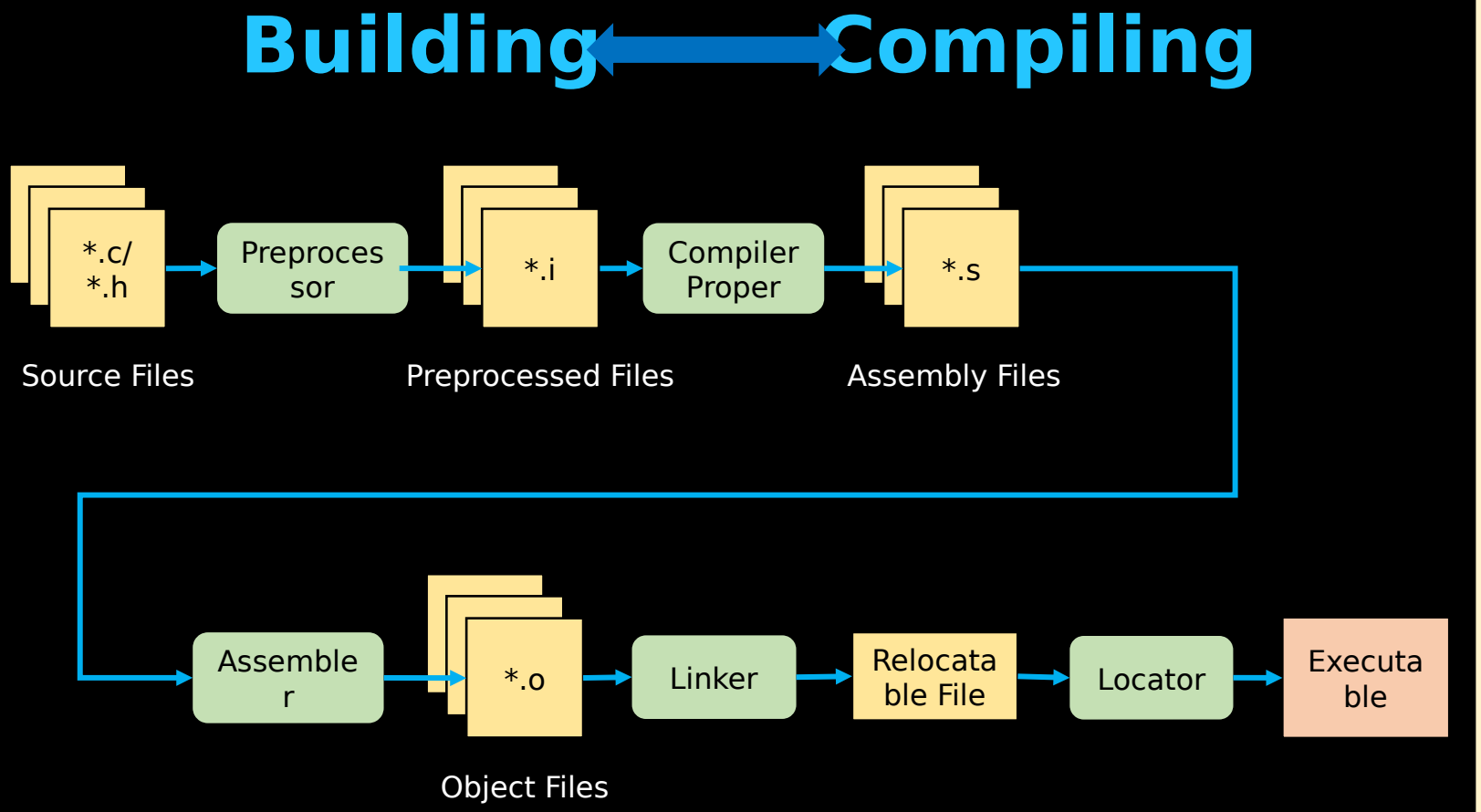
Building ⟷ **Compiling**

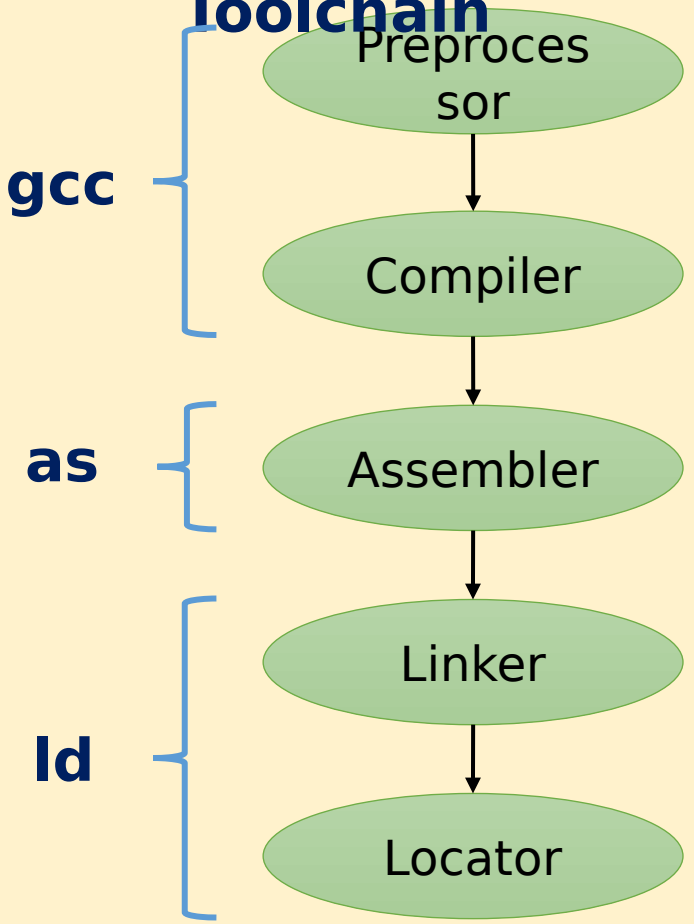


GNU's Compiler Collection (GCC) Toolchain



Build Process (linear)

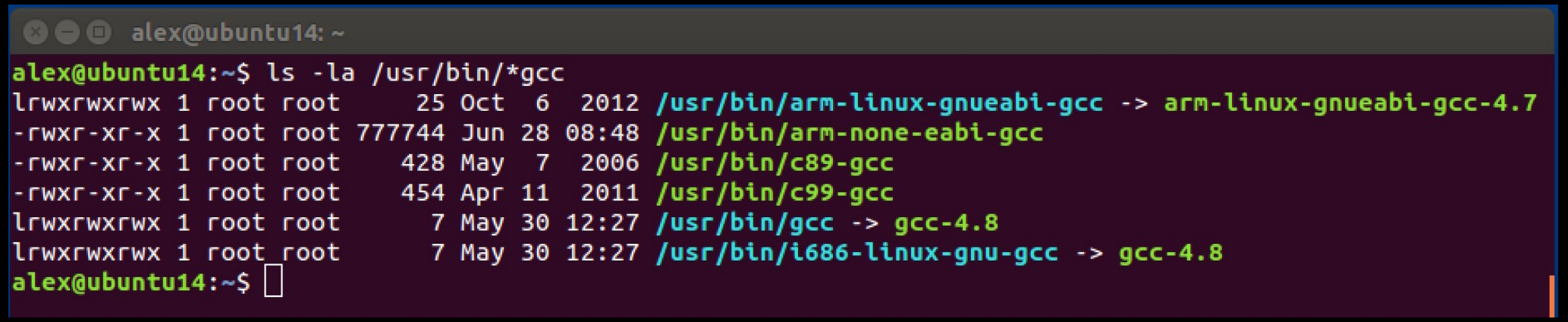




GCC Tool Check

Many compilers toolchains can be installed

```
$ ls –la /usr/bin/*gcc
```



<ARCH>-<VENDOR>-<OS>-<ABI>

arm-none-eabi-gcc	arm-linux-gnueabi-gcc
-Arch = ARM	-Arch = ARM
-Vendor = N/A	-Vendor = N/A
-OS = None (Bare-Metal)	-OS = Linux OS
-ABI = EABI	-ABI = GNUEABI

Compilers

Native Compiler:

- **gcc -> gcc-4.8**

For code run on the host machine

Cross Compiler:

- **arm-none-eabi-gcc**

For code run on the target processor

Compilers

Cross Compiler:

- **arm-none-eabi-gcc**

For code run on the target processor

Showd all tools in the Cross-Compiler Toolchain

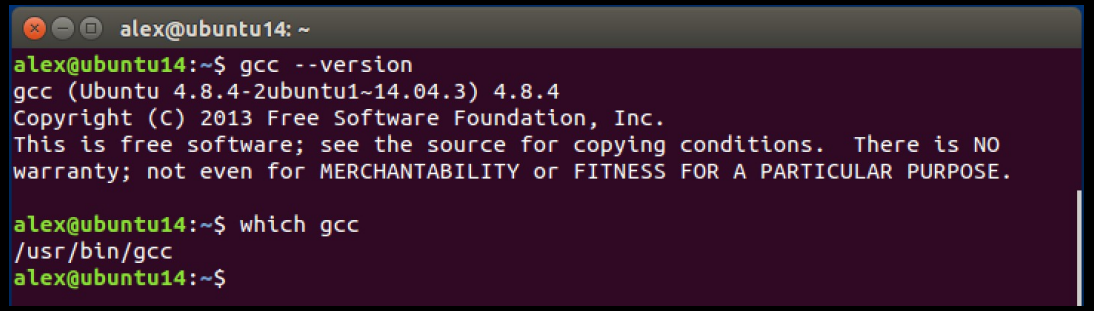
```
$ ls –la /usr/bin/arm-none-eabi*
```

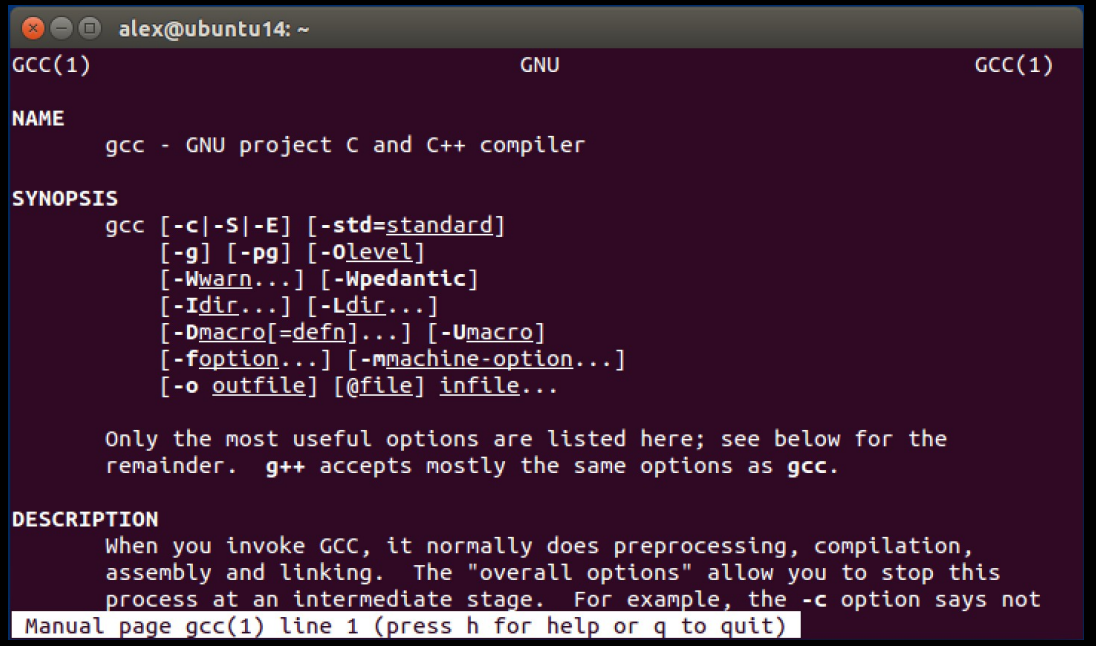
GCC Tool Check

```
$ gcc --version
```

```
$ which gcc
```

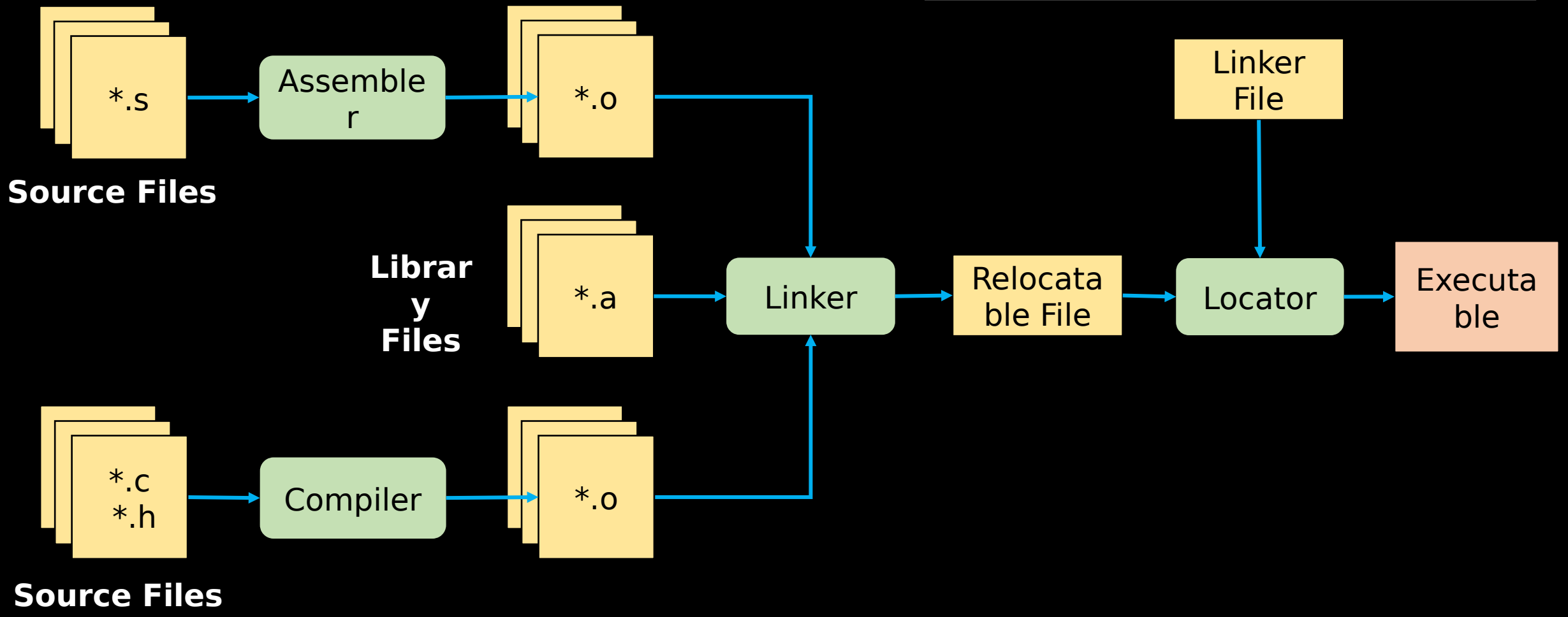
```
$ man gcc
```





Typical Build Process

Assembly Files	.s Extension
✉	.o Extension
Object Files ✉	.a Extension
Library Files ✉	(with .h)
Executable File	Extension Varies
✉	



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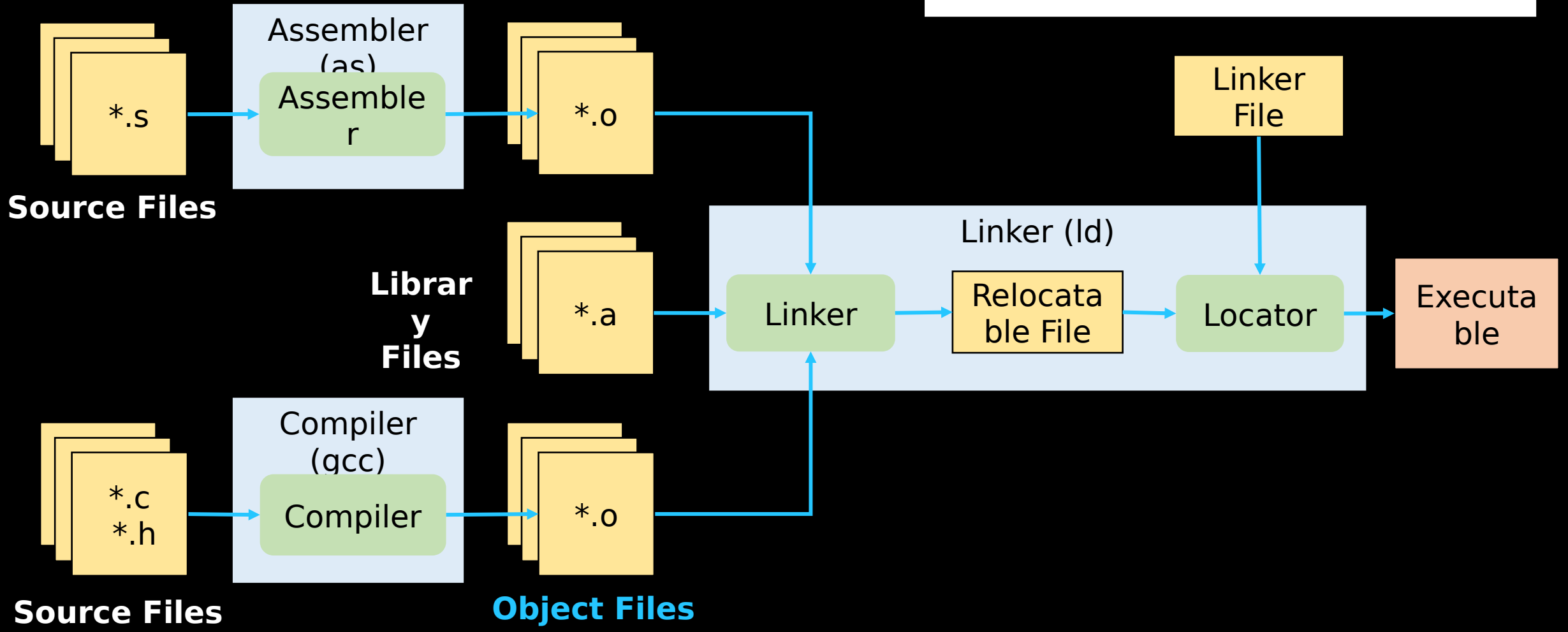

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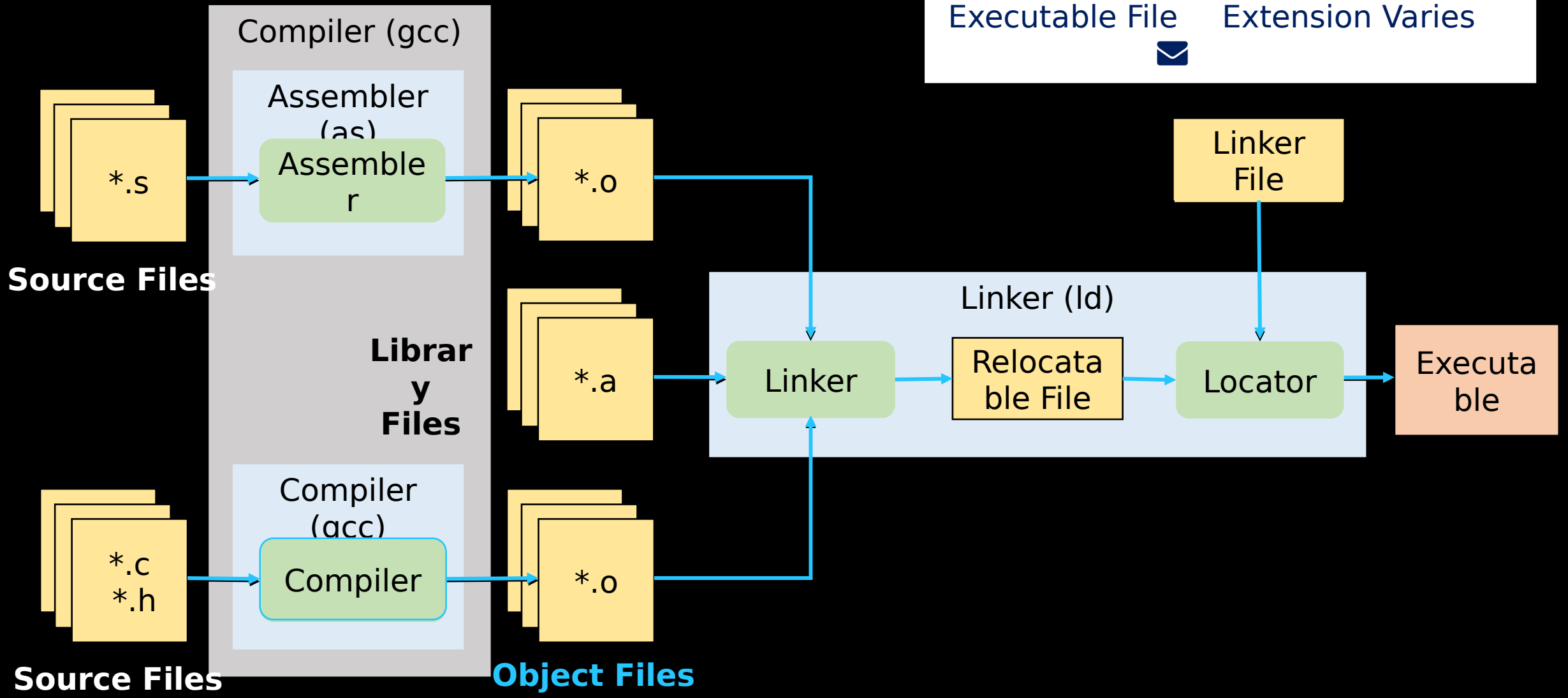

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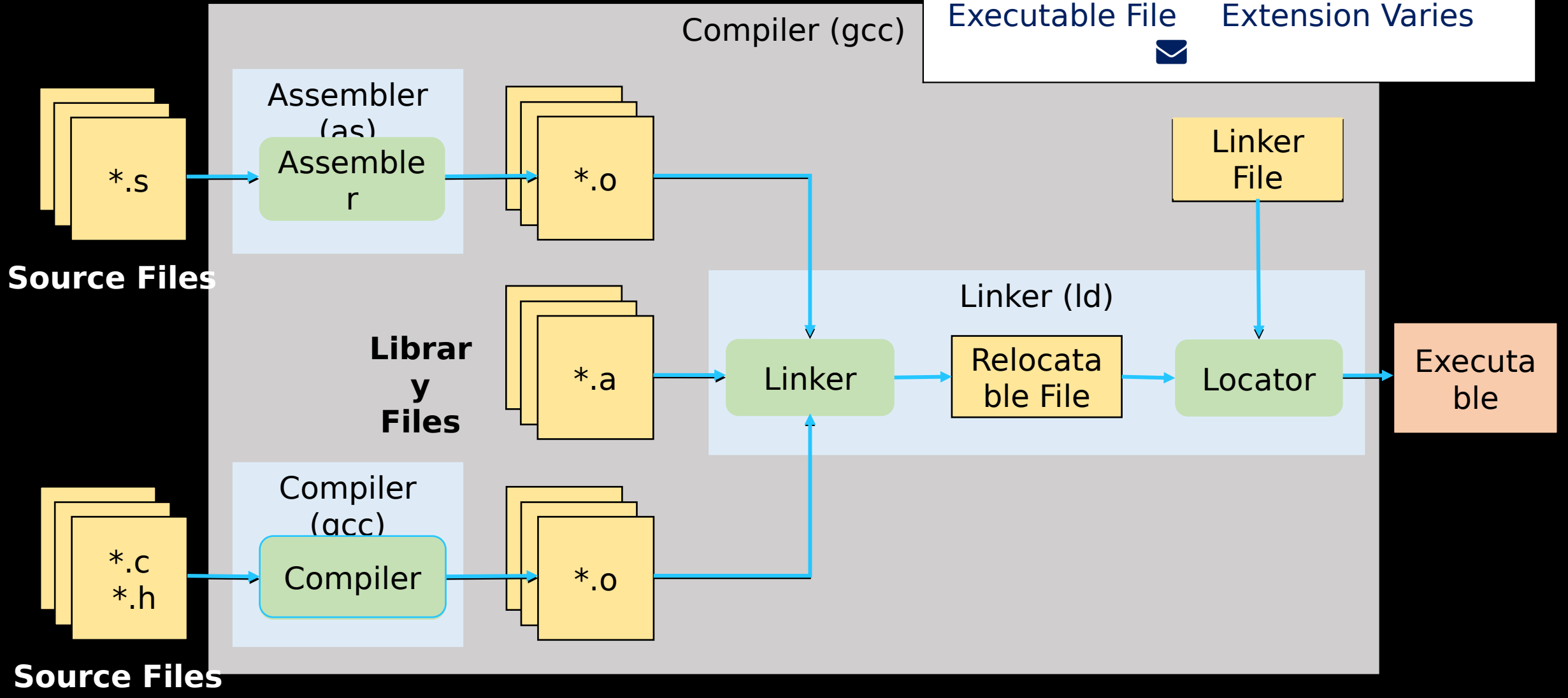
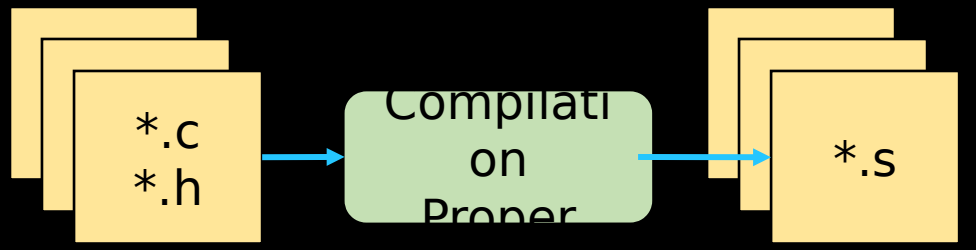


Compilation Proper

C-Programming (High Level Language)

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



Source Files

Assembly Files

Compilation Proper

C-Programming (High Level Language)

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while (y >= z) {
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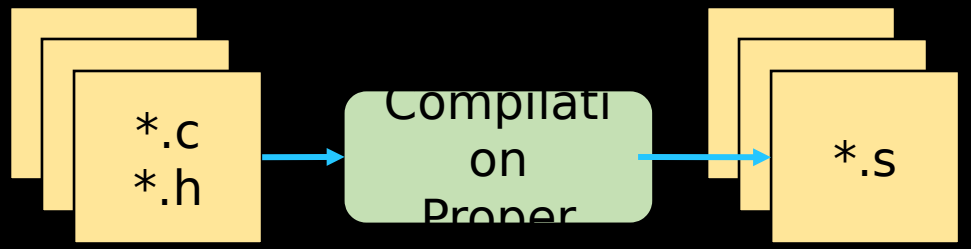
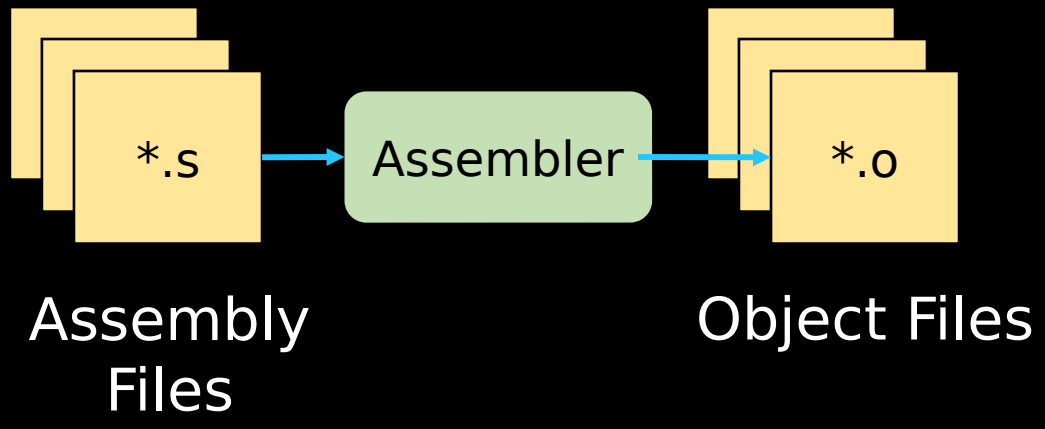


High level language translated to low level language via compiler

ARM Assembly Language

```
    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
```

Assembly to Machine Code




```
movs    r3, #0
```

Operation **Operand**

Assembly Language	Machine Code
`movs r3, #0`	0x2300
`strb r3, [r7, #7]`	0x71fb
`adds r3, r7, #7`	0x1dfb
`str r3, [r7, #8]`	0x60bb
`adds r1, r7, #7`	0x1df9
`adds r3, r7, #6`	0x1dbb

General Compiler Flags

Option & Format	Purpose
`-c`	Compile and Assemble File, Do Not Link
`-o <FILE>`	Compile, Assemble, and Link to OUTPUT_FILE
`-g`	Generate Debugging Information in Executable
`-Wall`	Enable All Warning Messages
`-Werror`	Treat All Warnings as Errors
`-I<DIR>`	Include this <DIR> to Look for Header Files
`-ansi` `-std=STANDARD`	Specify Which Standard Version to Use (ex: c89,c99)
`-v`	Verbose Output from GCC

Architecture Specific Compiler Flags

Option & Format	Purpose
`-mcpu=[NAME]`	Specifies Target ARM Processor and Architecture (ex: cortex-m0plus)
`-march=[NAME]`	Target ARM Architecture (ex: armv7-m, thumb)
`-mtune=[NAME]`	Target ARM Processor (ex: cortex-m0plus)
`-mthumb`	Generate code in Thumb States (ISA)
`-marm`	Generate code in ARM State (ISA)
`-mthumb-interwork`	Generate code that supports calling between ARM and Thumb (ISA)
`-mlittle-endian`	Generate code for Little Endian Mode
`-mbig-endian`	Generate code for Big Endian Mode