The linker

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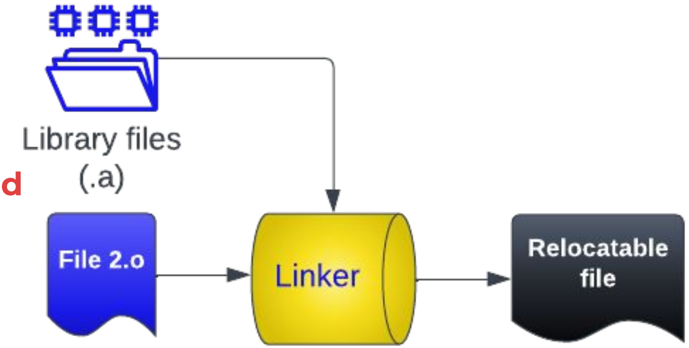
Outlines

- Introduction
- Relocation
- Symbol resolution
- Types of linking

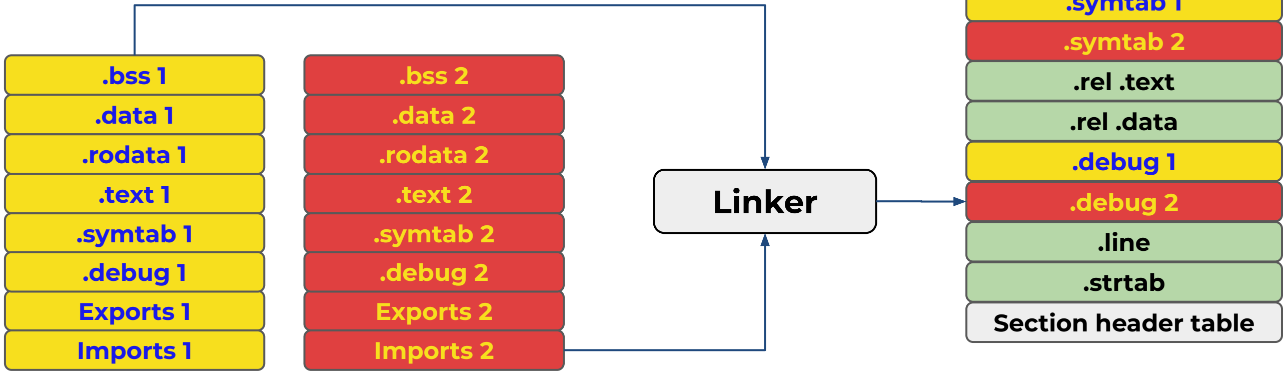
Introduction

- Linking is the process of **collecting** and **combining** various pieces of code and data **into a single file** that can be loaded into memory and executed.
- **Understanding linkers will help you**:
  - **Build large programs**
  - **Avoid dangerous programming errors**
  - **Understand how language scoping rules are implemented**
- **linker performs the following operations**:
  - **Relocation**
  - **Symbol resolution**



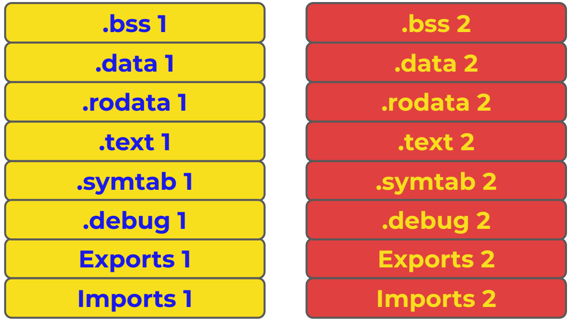
Relocation

- It is **changing of the addresses assigned to variables**.
- Relocation is done for **two reasons**:
  - Section merging
  - Section placement



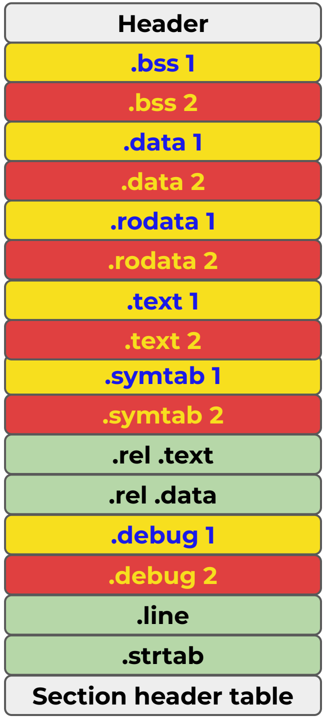
Symbol resolution

- In **multi-file program**, if there are any **references to** labels defined in **another file**, the **compiler marks** these references as “**unresolved**”.
- **The linker determines the values of these references from other object files**
- **Linker errors**:
  - **Unresolved reference to variable**
  - **Redefinition error**



.bss 1
.data 1
.rodata 1
.text 1
.symtab 1
.debug 1
Exports 1
Imports 1

.bss 2
.data 2
.rodata 2
.text 2
.symtab 2
.debug 2
Exports 2
Imports 2



Header
.bss 1
.bss 2
.data 1
.data 2
.rodata 1
.rodata 2
.text 1
.text 2
.symtab 1
.symtab 2
.rel .text
.rel .data
.debug 1
.debug 2
.line
.strtab
Section header table

Types of linking

- **Static linking**:
  - It is the process of **copying all library** modules used in the program into the final **executable image**.
  - Takes place **during build process**.
  - **Constant load time** and **larger code size**.
  - **No Compatibility issues**.
- **Dynamic linking**:
  - It is the process of **loading the external shared libraries** into the program and then **binds** those shared **libraries dynamically** to the **program**.
  - Takes place **during run-time**.
  - **Small load time** and **less code size**.
  - **Compatibility issues existed**.

Summary

- Now you have good understanding about the linker and linking process.
- You have learned how linker resolve symbols and relocate them to create a relocatable object files.
- Remember that linker errors will occur when there is a missing reference to a symbol or if there was multiple references to the same symbol.
- Remember that there are two types of linking, static and dynamic.