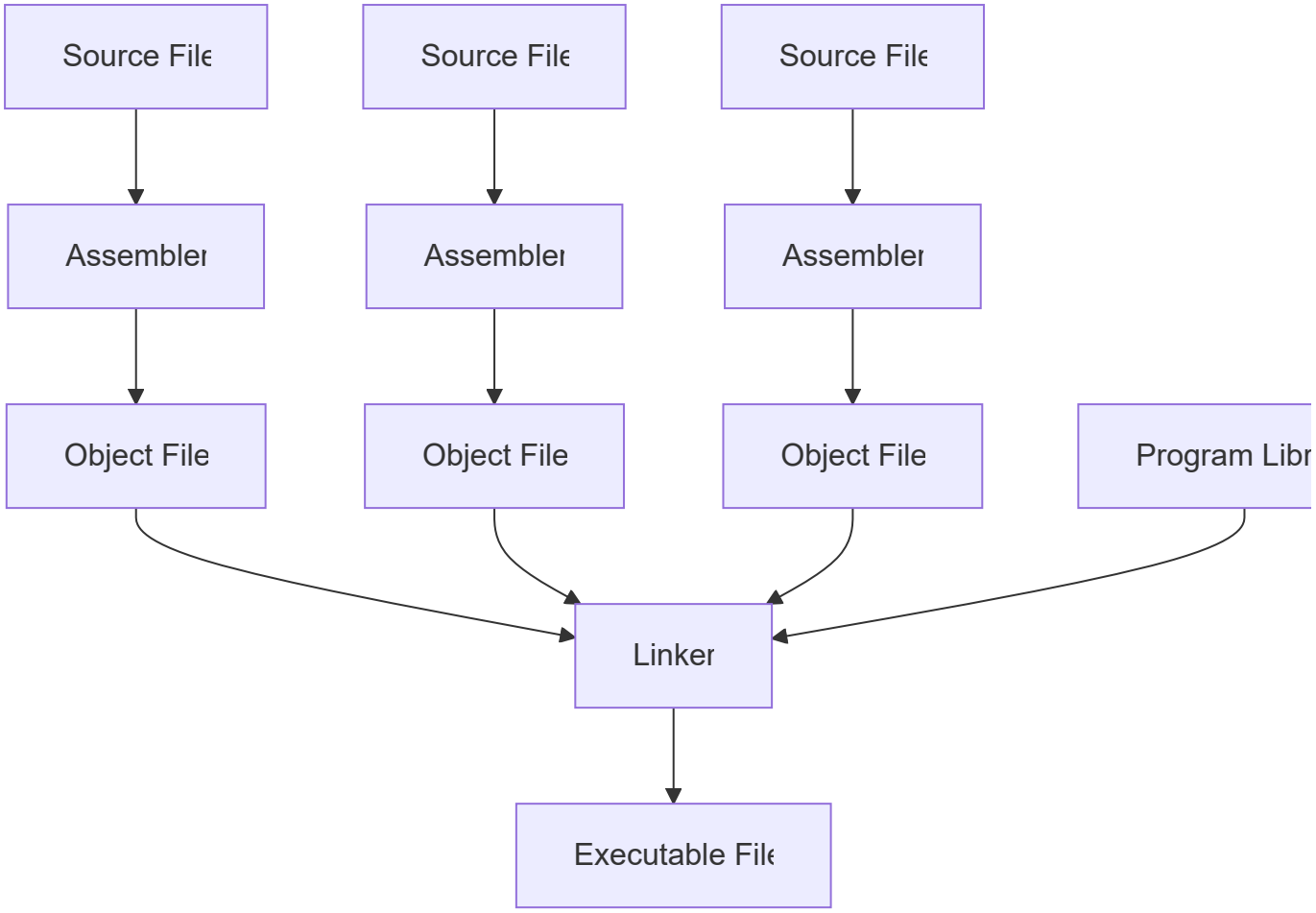
Assembler, Linker, Loader



Assembler

Passes

First Pass

- Relative addressing
- Symbol table

Second Pass

- Creates hexadecimal instructions
- Compiles these instructions to an object file

Labels

- Used for things like jump instructions and loops

Forward Reference

- Referencing a symbol/label that is after the current one

Relative Addressing

- The (relative) instruction number
- First pass

Global Labels

- `.glob LABELNAME
- Only available to other programs if specified as global
    - Otherwise the label is local

Lexemes

- Breaking down each line of the MIPS code

One Pass Assembler

- RISC vs CISC
- How instructions are loaded into memory
- How data is stored in HDD vs instructions loaded in memory
- Forward references - needs to be patched later

Object File

- List of machine instructions in hexadecimal

Linker

- Some symbol table entries are passed to the linker
- The output of the linker is an exe file
    - Similar format as the object file, but it does not contain any unresolved references or relocation information

Loader

- Loads executable into memory and starts the program to execute on the system
    - Determines size of text and data segment
    - Creates new address space for the program
    - Copies instruction and data from executable file to memory
    - Copies arguments to be paused to the program onto the stack
    - Initialize machine registers - stack pointer to point to free stack location
    - Jumps to the main startup routine

Additional Facilities

Data Layout Directives

- Provides easier way to describe data
- You have constants and predefined global variables stored in specific locations

String Layout

- Assembler support `.asciiz` / `.ascii` directives to define string in a natural way
- String is stored in the memory as ascii code (usually byte long)
- Assembler converts the defined string into into equivalent multi-byte storage

Macros

```
.macro macro_name ($arg)
    macro_body
.end_macro
```

- User written
- Provides way to shorten code writing for repetitive codes
- String pattern matching matches a 'name' and replaces it with a sequence of code
- Not a function because it does string replacement directly

Pseudo Instructions

- Combines two or more fundamental instructions into one instruction
- Not user defined like a macro