TAL->MAL:

R format- Register -> Register Comparison:

6 Bit Opcode	5 Bit Source Register #1	5 Bit Source Register #2	5 Bit Destn. register	6 Bit Shamt	6 Bit Func

I format-> LW/SW/Branch/Immediate values:

- Branch Case

6 Bit Opcode	5 Bit Source Register #1	5 Bit Source Register #2	16 Bit Offset

- Immediate Case

6 Bit Opcode	5 Bit Source Register #1	5 Bit Destn. Register	16 Bit Immediate

J format- Jump:

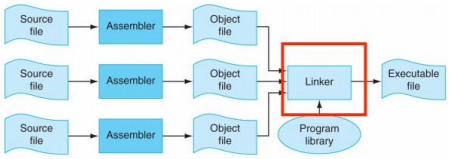
6 Bit Opcode	26 Bit EXACT address

- NOTE: First 4 and Last 2 bits are set to zero

Assembler (4): Create Object Files

- object file header: size and position of the other pieces of the object file
- text segment: the machine code
- data segment: binary representation of the data in the source file
- relocation information: identifies lines of code that need to be "handled"
- symbol table: list of this file's labels and data that can be referenced
- debugging information

The purpose of a linker



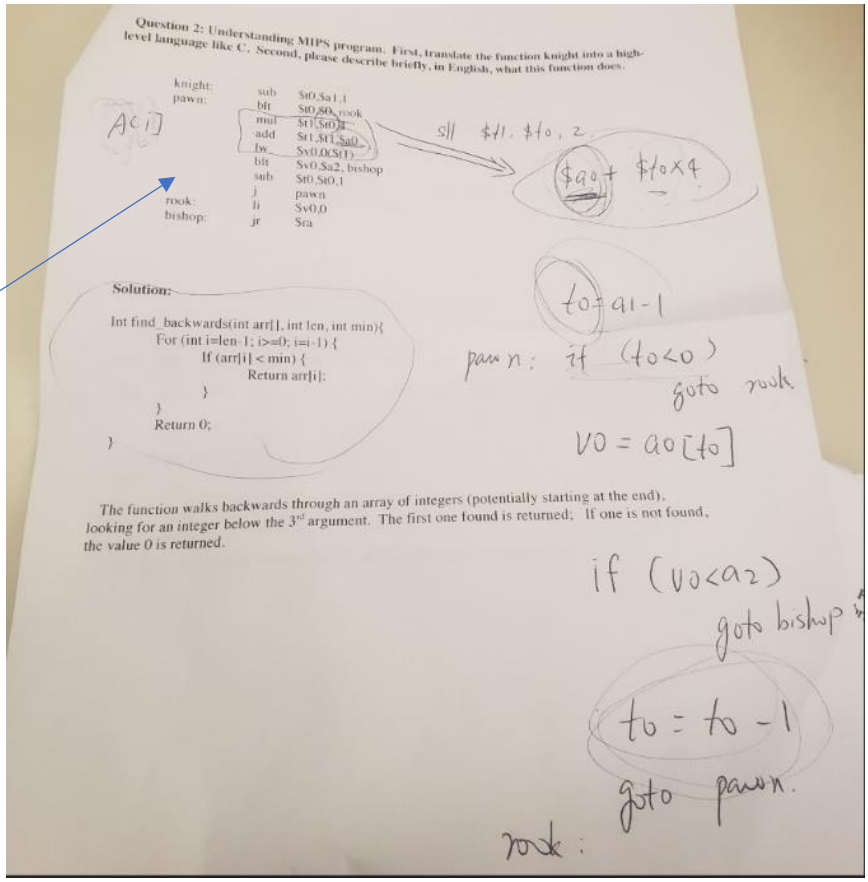
- The linker is a program that takes one or more object files and assembles them into a single executable program.
- The linker resolves references to undefined symbols by finding out which other object defines the symbol in question, and replaces placeholders with the symbol's address.

Concepts:

- **Steps to starting a program:**
  - Write Code->Compiler->Assembler->Object File Code (Binary)->Linker->Exe->Loader->Memory
  - Compiler translates high level code to Assembly
  - Assembler reads and uses directives, replaces pseudo-code, creates MAL, and creates Object File
  - Linker combines several object (.o) files into a single executable, it stiches files together and resolves references
  - Loader's job is to load exe files into memory
- **Chronological Order for making->Executing C Code**
  - Student writes code in C
  - C code is translated into MIPS
  - MAL translated into TAL
  - Link tables produced
  - Code and data stitched together
  - Links are edited
  - Space in memory is reserved
  - Execution begins at main

MIPS->C:

- Translate line by line with pseudo code
- Translate that to C code
- In this example, lines 3,4,5=A[0+i]
  - T0=i
  - T1=A[0]
-



Compiler vs. Interpreter Advantages

Compilation:

- Faster Execution
- Single file to execute
- Compiler can do better diagnosis of syntax and semantic errors, since it has more info than an interpreter (Interpreter only sees one line at a time)
- Can find syntax errors *before* run program
- Compiler can optimize code

Interpreter:

- Easier to debug program
- Faster development time

Compiler vs. Interpreter Disadvantages

Compilation:

- Harder to debug program
- Takes longer to change source code, recompile, and relink

Interpreter:

- Slower execution times
- No optimization
- Need all of source code available
- Source code larger than executable for large systems
- Interpreter must remain installed while the program is interpreted