

Patents and Copyright Compilation Pipeline



Welcome

CS 2130: Computer Systems and Organization 1
October 22, 2025

Announcements

- Homework 6 **due Monday at 11:59pm**

Patents and Copyright

Remember our Toy ISA. Can we patent our ISA? Should we?

icode	b	meaning
0		$rA = rB$
1		$rA \&= rB$
2		$rA += rB$
3	0	$rA = \sim rA$
	1	$rA = !rA$
	2	$rA = -rA$
	3	$rA = pc$
4		$rA = \text{read from memory at address } rB$
5		write rA to memory at address rB
6	0	$rA = \text{read from memory at } pc + 1$
	1	$rA \&= \text{read from memory at } pc + 1$
	2	$rA += \text{read from memory at } pc + 1$
	3	$rA = \text{read from memory at the address stored at } pc + 1$
		For icode 6, increase pc by 2 at end of instruction
7		Compare rA as 8-bit 2's-complement to 0 if $rA \leq 0$ set $pc = rB$ else increment pc as normal

Patents and Copyright

Copyright

- “Everyone is a copyright owner. Once you create an original work and fix it, like taking a photograph, writing a poem or blog, or recording a new song, you are the author and the owner.”
from <https://www.copyright.gov/what-is-copyright/>

Patents and Copyright

Patent

- “Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.”
from 35 U.S.C. 101

Patents

In software and hardware, patents become messy

- Code is a description of a process we want the computer to do
- Do not have to implement the process to patent it

Question: Should we patent something like our ISA?

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Question: Should we patent something like our ISA?

What is the current state of the art?

Common Approaches to Software

How can we get value from what we create?

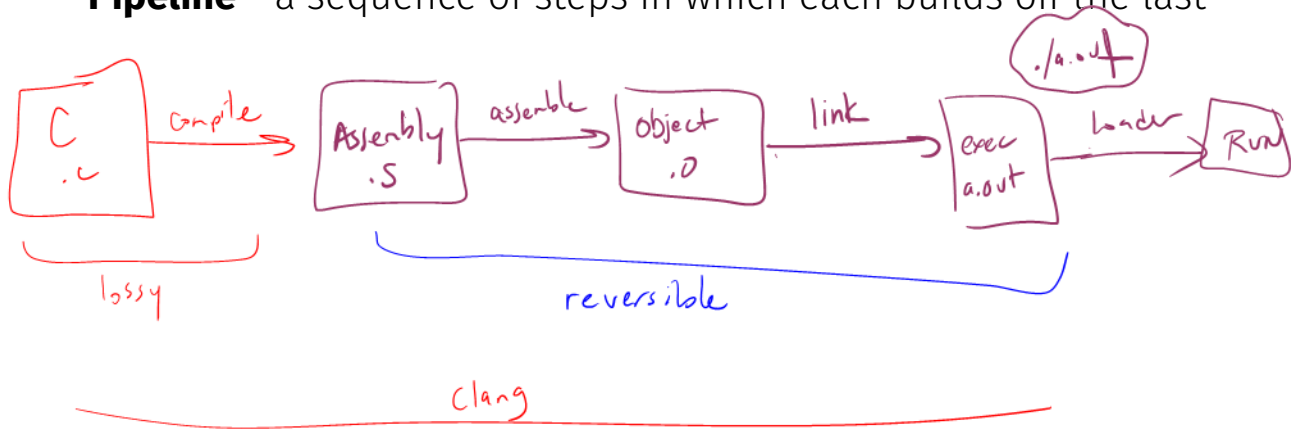
- Copyright - distribute closed source software
- License Agreements (in contract law)
- Always innovate

Back to x86-64 and assembly

Compilation Pipeline

Turning our code into something that runs

- **Pipeline** - a sequence of steps in which each builds off the last



Why did we discuss assembly?

C

C is a thin wrapper around assembly

- This is by design!
- Invented to write an operating system
 - Can write inline assembly in C
- Many other languages decided to look like C

Simple C Example

```
int main() {  
    int y = 5;  
    return 0;  
}
```

Compilation Pipeline

Earlier, we saw:

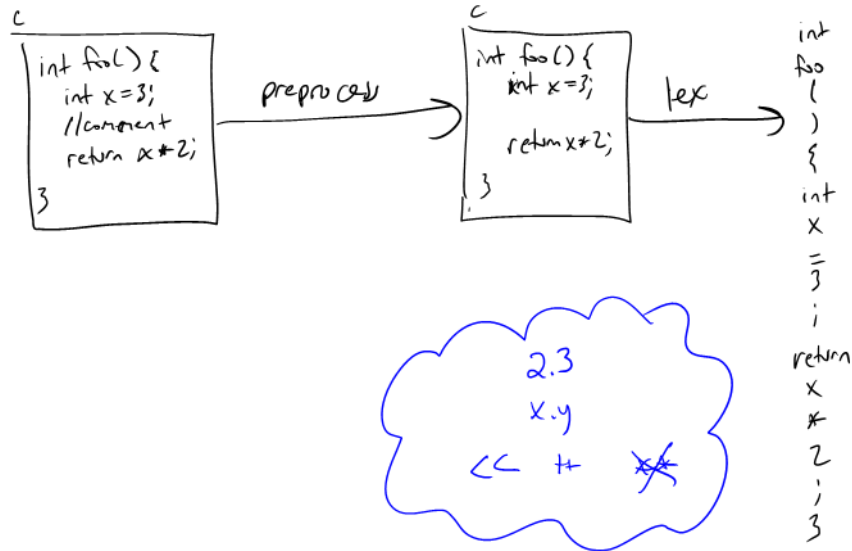
- C files (.c) compiled to assembly (.s)
- Assembly (.s) assembled into object files (.o)
- Object files (.o) linked into a program / executable

Compiling C to Assembly

Multiple stages to compile C to assembly

- Preprocess - produces C
 - C is actually implemented as 2 languages:
C preprocessor language, C language
 - Removes comments, handles preprocessor directives (#)
 - ~~#include~~, #define, #if, #else, ...
- Lex - breaks input into individual tokens
- Parse - assembles tokens into intended meaning (parse tree)
- Type check - ensures types match, adds casting as needed
- Code generation - creates assembly from parse tree

Compiling C to Assembly



Compiling C to Assembly

Errors

Compile-time errors

- Errors we can catch during compilation (this process)
- **Before** running our program

Runtime errors

- Errors that occur when running our programs

Simple C Example

```
int main() {  
    return 0;  
}
```

The `main` function

- Start running the `main()` function
- `main` must return an integer - **exit code**
 - 0 = everything went okay
 - Anything else = something went wrong
- There *should* be arguments to `main`