

Course Wrap-up & Future Courses

Introduction to Computer Systems, Fall 2024

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Claire Lu

Juan Lopez

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❖ How are you?

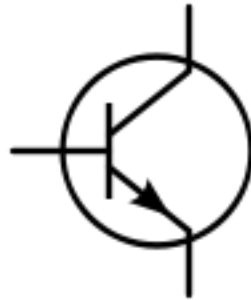
Administrivia

- ❖ End of Semester Survey Posted
 - Due before next lecture (Tuesday)

- ❖ All Homework Assignments are out right now and due Monday December 9th @ 11:59pm

- ❖ Exam Review Session:
 - Saturday December 14th from 3pm to 5pm
 - Levine 101 (Or maybe Towne 100? We will announce on ed)

Course Overview

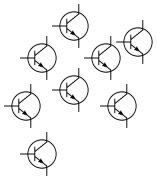




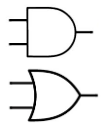
Course Overview



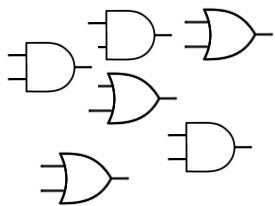
Course Overview



Course Overview



Course Overview



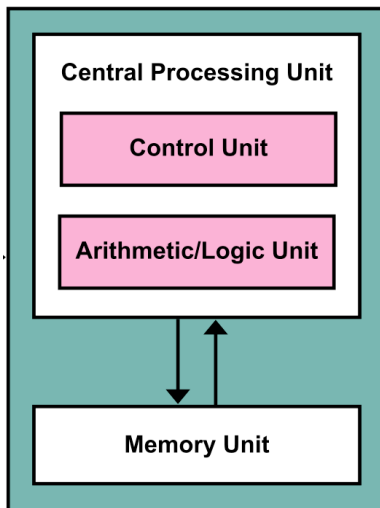
Course Overview

Adder

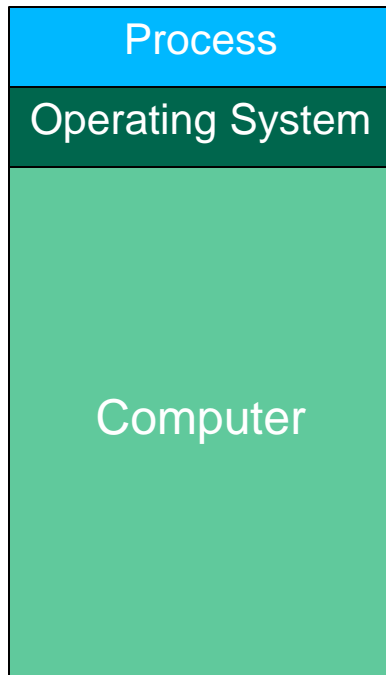
Mux/Demux

Latch/Flip-Flop

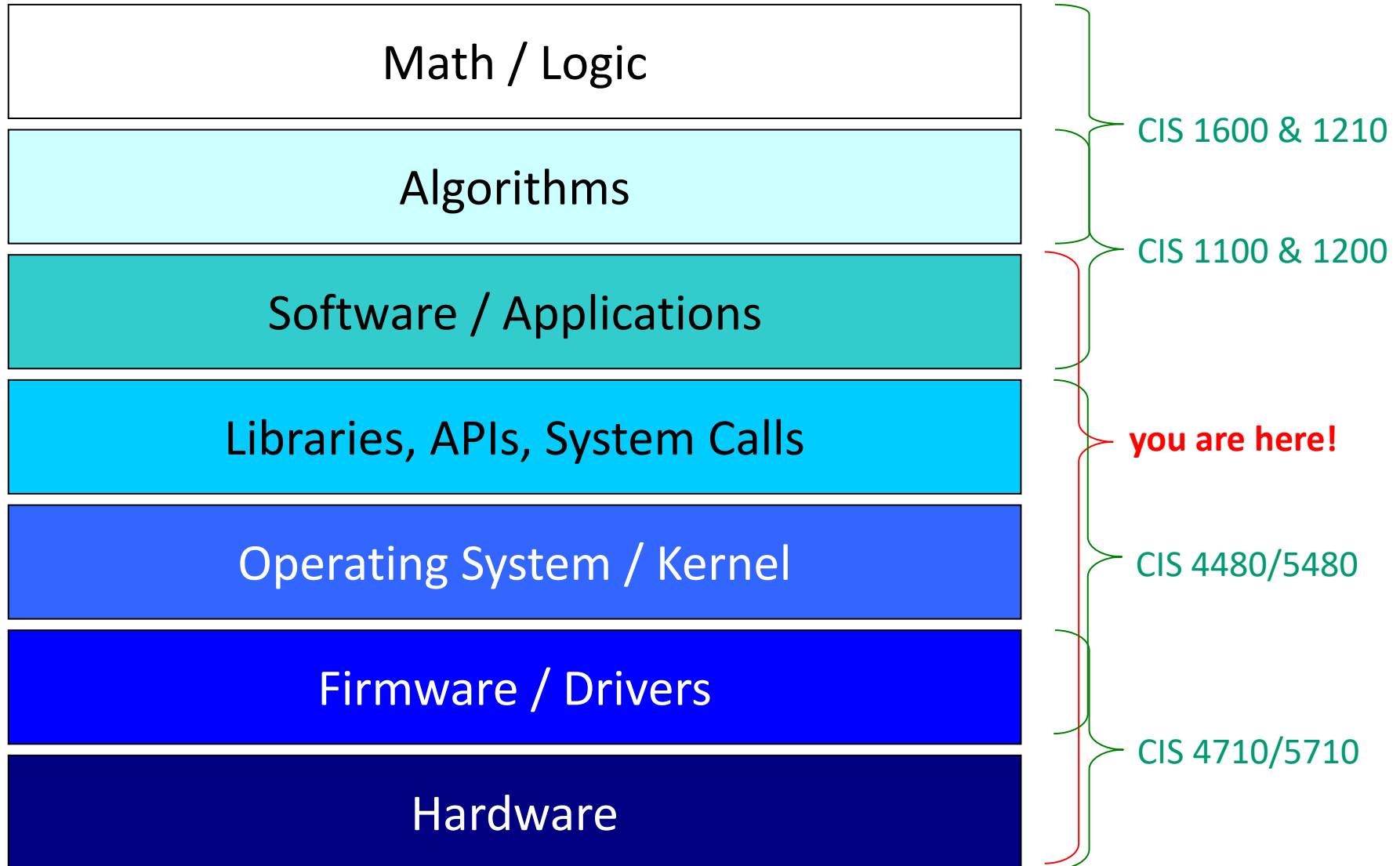
Course Overview



Course Overview



Course Overview



How Software Relates to Hardware

```
int main(int argc, char* argv[]) {
    printf("Hello World!\n");
    return EXIT_SUCCESS;
}
```

❖ C Programming 😊

```
8 main:
9     addi    sp, sp, -32
10    sw     ra, 28(sp)
11    sw     s0, 24(sp)
12    addi    s0, sp, 32
13    li     a2, 0
14    sw     a2, -12(s0)
15    sw     a0, -16(s0)
16    sw     a1, -20(s0)
17    lui    a0, %hi(.L.str)
18    addi    a0, a0, %lo(.L.str)
19    call   printf
20    li     a0, 0
```

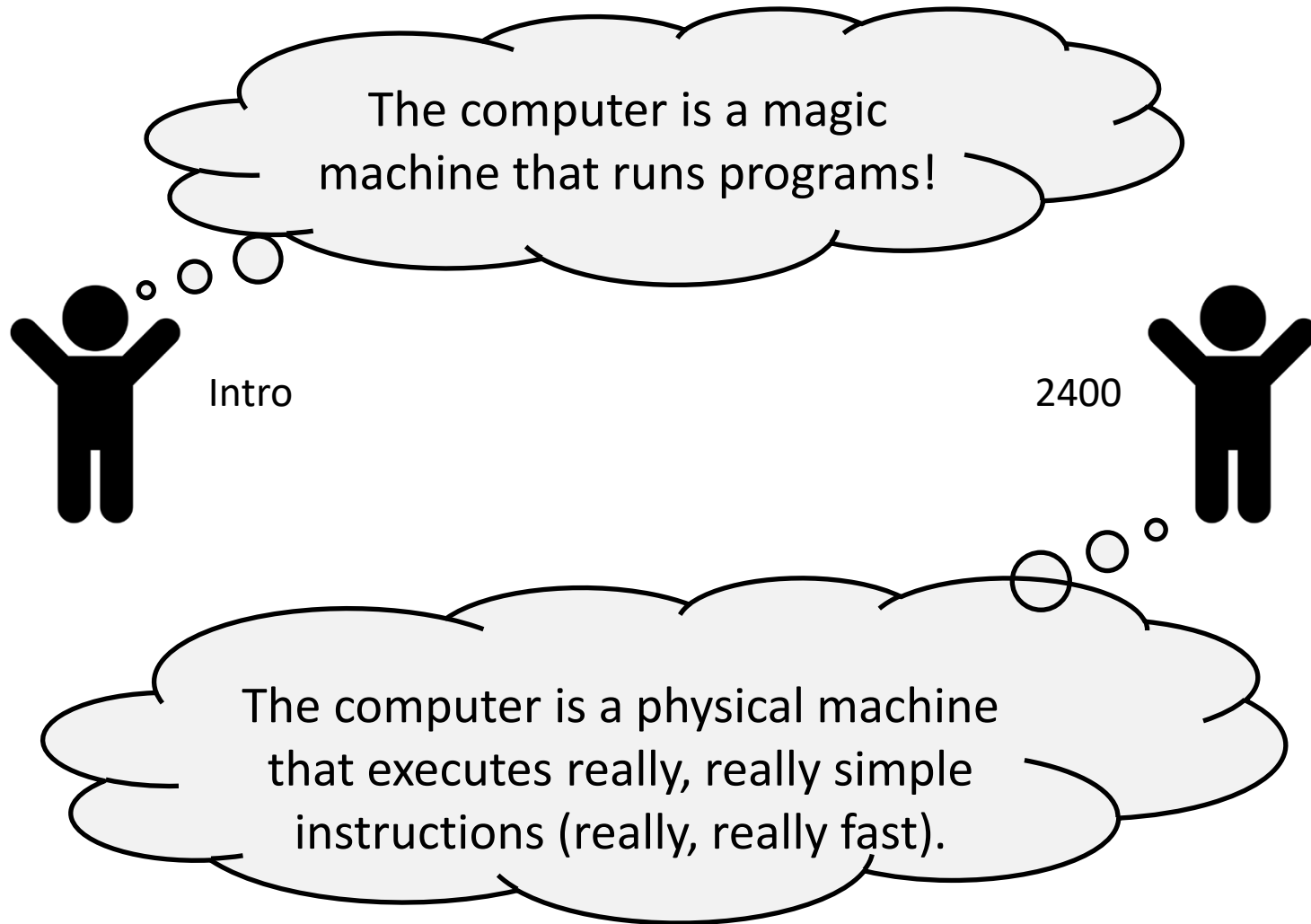
❖ Assembly Translation

```
00000000: 7f45 4c46 0201 0100 0000 0000 0000 0000  .ELF.....
00000010: 0300 3e00 0100 0000 5010 0000 0000 0000  ..>....P.....
00000020: 4000 0000 0000 0000 d036 0000 0000 0000  @.....6.....
00000030: 0000 0000 4000 3800 0d00 4000 1f00 1e00  ....@.8...@....
00000040: 0600 0000 0400 0000 4000 0000 0000 0000  .....@.....
00000050: 4000 0000 0000 0000 4000 0000 0000 0000  @.....@.....
00000060: d802 0000 0000 0000 d802 0000 0000 0000  .....
00000070: 0800 0000 0000 0000 0300 0000 0100 0000  .....
```

❖ Machine Code

Course Goals

❖ Go from



Course Goal: Binary Representation

- ❖ All digital computer represent EVERYTHING with a combination of 0s and 1s.

- ❖ "Everything" includes:
 - Integers
 - Floating point numbers
 - Characters
 - Code (instructions)
 - Pointers
 - File contents, Images, Audio, Videos, etc.

Course Goal: Memory

- ❖ Data must be stored somewhere on a computer, and that place is usually in memory

- ❖ How does a computer organize different types of data?
 - Dynamic data (Heap)
 - Local Data (Stack)
 - Globals (Global segment of memory)

Why do these themes matter?

- ❖ Helps Programmers & Engineers develop a better mental model of how a computer works
- ❖ Understanding how your code translates & runs on hardware may allow you to write better code
- ❖ Many of the logic/themes/approaches to solving problems in this course apply to many other concepts

Course Goals: Survey of Computer Systems

- ❖ There is a lot more detail to all of the course topics than what we could cover.
- ❖ There are many topics that we did not really touch on at all
- ❖ This course is designed to be a survey, an introduction.
- ❖ There are many other courses that build on top of what we introduced in this course.

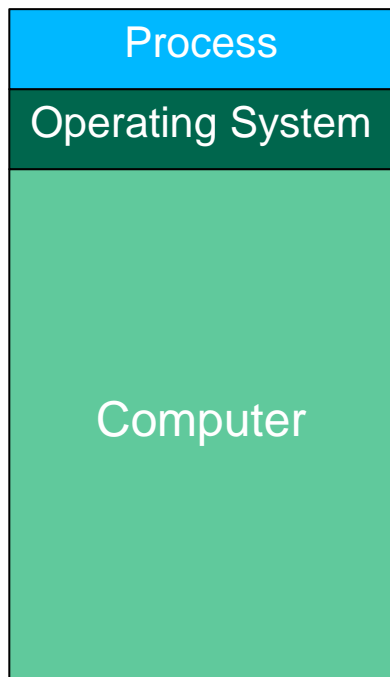
Implicit Course Goal: Writing Code

- ❖ We wrote a lot of code!
- ❖ How do you get better at most things?
 - By practicing it
- ❖ Hopefully you feel better at programming
- ❖ Hopefully you got some good experience writing code without much of a skeleton

Things Left Out

- ❖ Is this model for a computer true?
- ❖ Is it a useful model? **Yes**

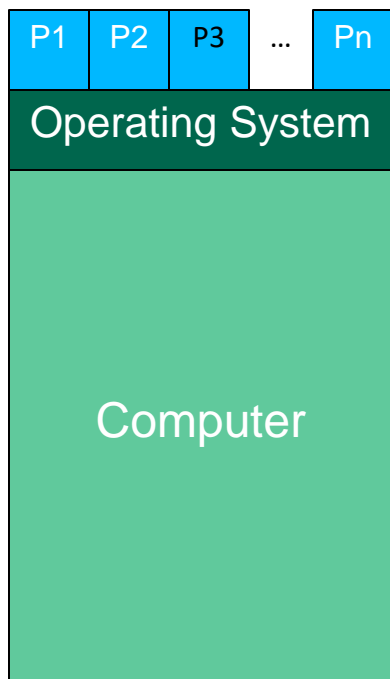
Eh..... no



Things Left Out: Memory

- ❖ Is memory one giant array of bytes? **Eh..... no**
- ❖ Is this a useful model? **Yes**

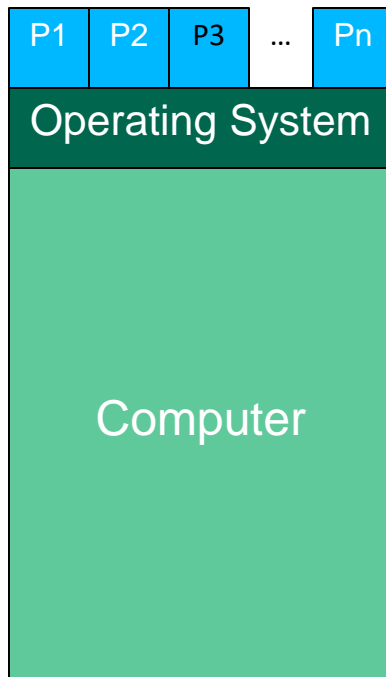
Things Left Out: Multiple Programs



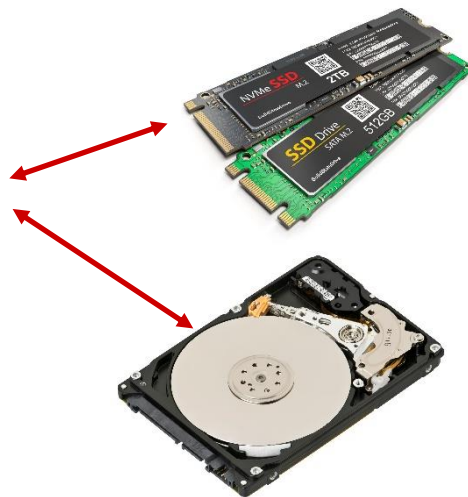
THERE IS A LOT
GOING ON TO
SUPPORT THIS



Things Left Out: File System



Everything in memory is lost when you lose power, so computers have a file system to store larger things that we want to keep longer term



Things Left Out: Networking



MISSING Topic Theme: Society

- ❖ One flaw (among others) of this course is how we don't talk about how this relates to the rest of the world
 - These systems we build do not have to necessarily be “evil”, but can often be used in those ways
 - We need to work and communicate with other people, even in CS.

- ❖ Actions:
 - Take Algorithmic Justice (CIS 7000) with Danaë Metaxa
 - Join a community of people working on things that matter to you, (Unions or other organizations)
 - Join us as a TA or student in the future! We will try to integrate ethics into CIS 5480 next semester (still working out details).

Congratulations!

- ❖ Look how much we learned!
- ❖ Lots of effort and work, but lots of useful takeaways:
 - Debugging practice
 - Reading documentation
 - Tools (`gdb`, `valgrind`)
 - C familiarity
 - Assembly & Low Level Understanding
 - Hardware & Muxes & Logic Gates
- ❖ Go forth and build cool systems!

Future Courses

❖ Systems Courses

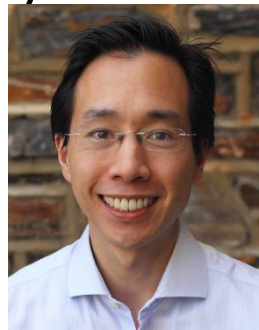
- CIS 4480/5480: Operating Systems Design and Implementation
- CIS 4710/5710: Computer Organization and Design
- CIS 3034/3999: Intermediate Systems (Starting in fall)
- CIS 5050: Software Systems
- CIS 4521/5521 Compilers
- CIS 5530: Networked Systems
- CIS 5550 Internet and Web Systems
- CIS 5500: Database and Information Systems
- CIS 5470: Software Analysis

❖ Otherwise related courses

- CIS 5600 Interactive Computer Graphics
- CIS 5650 GPU Programming and Architecture

Thanks for a great semester!

- ❖ Special thanks to all the instructors before us (at Upenn, UW and Stanford) who have influenced me to make the course what it is



- ❖ Huge thanks to the course TA's for helping with the



Thanks for a great semester!

- ❖ Thanks to you!
 - It has been another tough semester. Still not completely out of the pandemic, Zoom fatigue, faltering motivation, etc
 - Relatively “new” version of the course. Many of the assignments and infrastructure are recently developed.
 - You’ve made it through so far, be proud that you’ve made it and what you’ve accomplished!

- ❖ **Please take care of yourselves, your friends, and your community**

Ask Us Anything

