### WELCOME TO COMP 411!





#### 1. Course Mechanics

- a. What do I have to do to get an A in this course?
- b. Where are the course materials posted online, because I'm pretty sure that I am gonna sleep through a lot of these lectures?
- c. Fridays, is he serious?
- 2. Course Objectives
  - a. How do computers work?
  - b. Show me the binary?
  - c. Some assembly required.
- 3. Course Changes

WHOS



#### Lectures:



Leonard McMillan (SN 316) Office Hours: M 2-4pm

#### TAS:



Bhavya Vyas & Yubo Luo Office Hours: TBA

#### 017

### WHAT5

- Book: None Required, but I recommend
  - Will he follow the book?Definitely not
  - Are the problem set answers in the book?
    - Perhaps
  - Why do I need it then?
    - In case you find yourself
       lost, need additional examples,
       or need a doorstop





### COURSE MECHANICS



Grading:

Best 5 of 6 problem sets Best 9 of 10 laboratories 2 in-class midterms Final exam

25% 18% 32% 25%

You will have at least two weeks to complete each problem set. Problem sets will be online. Late problem sets will not be accepted, but the lowest problem-set score will be dropped.

Friday Labs, starting next week (9/1), are mandatory, and will meet on most Fridays. Grade is based on completing a "lab checklist".

I will attempt to make Lecture Notes, Problem Sets, and other course materials available on the web before class on the day they are given.



### COURSE WEBSITE



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Home	Research	Courses	Publications	Setup
Announcei				
• August 2 • August 2 Course Des Comp 411, Co and hardware. universe of con and arrive to th	<b>23, 2017:</b> The first class <b>scription</b> <i>mputer Organization</i> , ex It covers a wide range of mputation. We also disc ne conclusion that, to a conclusion that, to a conclusion that, to a conclusion that that the second se	meeting in SN014 ( <sup>(2)</sup> plores the topic of how of topics including wha uss how information is computer, everything is	summer is over). <i>c</i> computers work, in terms of t a <i>bit</i> is, and why bits are the represented and processed is data, including the instruction	both software atoms in the n hardware, ns that underly

08/23/2017

### GOALS OF COMPYII

To answer fundamental questions:

- What does a computer do with my program?
- How is data represented in a computer?
  - Numbers
  - Strings
  - Arrays
  - Photographs
  - Music

- DEEP PHILOSOPHICAL QUESTIONS
- How is a program represented in a computer?
- Are there limits to what a computer can do?

# GOAL 1: TO DEMYSTIFY COMPUTERS



Strangely, most people seem to be afraid of computers.

People only fear things they do not understand!

"I do not fear computers, I fear the lack of them." - Isaac Asimov (1920 - 1992)



"Fear is the main source of superstition, and one of the main Sources of cruelty. To conquer fear is the beginning of wisdom." - Bertrand Russell (1872 - 1970)

"Nobody knows exactly what's going on because of computers!" - Donald Trump



Define a function, develop a roust implementation, and then put a box around it.



Abstraction enables us to create unfathomable systems, including computer hardware and software.

Why do we need ABSTRACTION? Imagine a billion ...



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## WHAT'S IN A COMPUTER?

#### Structure

- Hierarchical design
- · Limited complexity at each level
- · Reusable building blocks

#### Interfaces

- Key element of system engineering typically outlives its implementation
- Isolate design from technology, allows evolution
- Major abstraction mechanism
- What makes a good system?
  - "Bang for the buck." Minimal mechanism, maximal function
  - Reliable, resilient, reusable
  - Accommodating future improvements



that does

on stack

overflow?

### COMPUTATIONAL STRUCTURES



What are the fundamental elements of computation?

Can we define computation independent of implementation or the technology that it is implemented with?





Edward Hardebeck helps to assemble the Tinkertoy computer

Comp 411 - Fall 2017



### WHAT DO PROGRAMS REALLY DO?

By now you should be able to look at a program specification and figure out what it does.

```
int f(int x) {
    int r;
    int odd = 1;
    for (r = 0; x >= odd; r++) {
        x -= odd;
        odd += 2;
    }
    return r;
}
```

What does this do?

How would you figure it out? Try f(36), f(64), f(100)



### HOW DOES A COMPUTER DO IT?

What does a computer do with this program specification?

int	<pre>f(int x) { int r; int odd = 1:</pre>		mov mov b	odd, #1 r, #0 test
	<pre>for (r = 0; x &gt;= odd; r++) {     x -= odd;     odd += 2;</pre>	loop:	sub add add	x, x, odd odd, odd, #2 r, r, #1
}	} return r;	test: done:	cmp bge b	x, odd loop done

It translates it to a series of simple instructions...



# ARE THERE LIMITS TO COMPUTATION?

- Will some new instruction be invented that fundamentally change how fast computers solve problems?
- Can computers solve any well specified problem?
- Can we predict how long it will take for a computer to solve a given problem?
- Does there exist a new model of computation?





### A PROGRAM EMULATING A COMPUTER

```
int memory[16384]; // for instructions and data
int register[32]; // for variables
int pc; // next instruction to execute
int flags; // persistent state
```

```
void main(void) {
    pc = 0;
    while (1) {
        instruction = memory[pc];
        pc = pc + 1;
        flags = execute(instruction);
    }
}
```

A computer is just an interpreter that executes simple program loop

### WHERE ARE WE GOING?

- How is data represented, stored, and manipulated in a computer?
- What basic operations does a computer use?
- What does mean to "compute"?
- Are there limits to what can be computed?
- Why are computers so fast?
- What am I asking a computer to do when I give it a program to execute?
- How are programs translated into computer instructions?
- Why are some programs faster than others that perform the same function?





### SUMMARY



- 411 answers the following questions:
  - How is information represented, stored, and manipulated by a computer?
  - What does a computer really do with my program?
  - How do you design, build, and manage large systems?

### 411 logistics

- M, W lectures and discussions
- F~2 hr labs starting 9/1