

CS107e

Computer Systems from

the Ground Up

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<https://cs107e.github.io/>

Pat



Julie



Ashwin



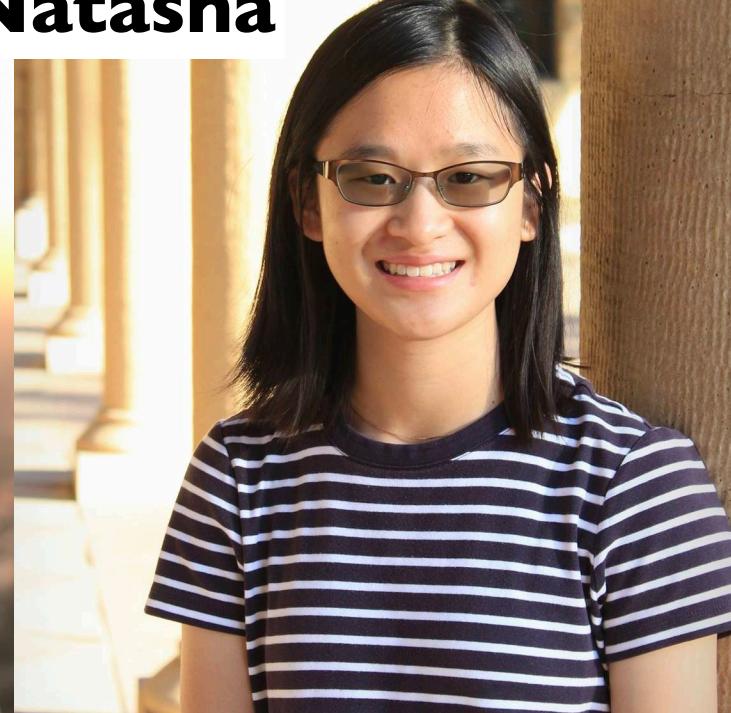
Jennifer



Eric



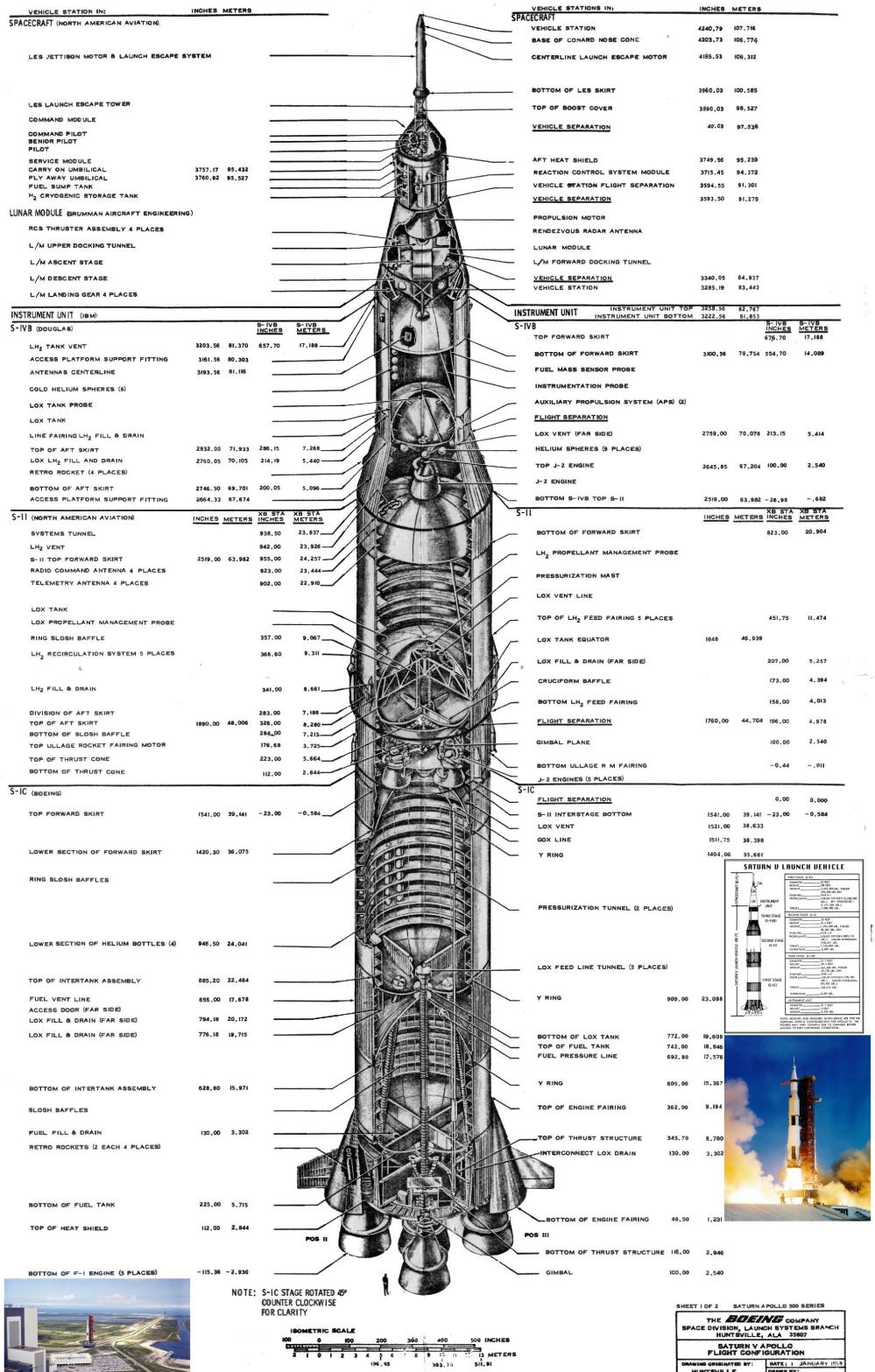
Natasha



Learning Goal 1

**Understand how computers
represent data,
execute programs,
and control peripherals**





Command Module 64,000 lbs

Saturn V 6,200,000 lbs

Payload 1.5% of total weight

Falcon 9



Elon Musk

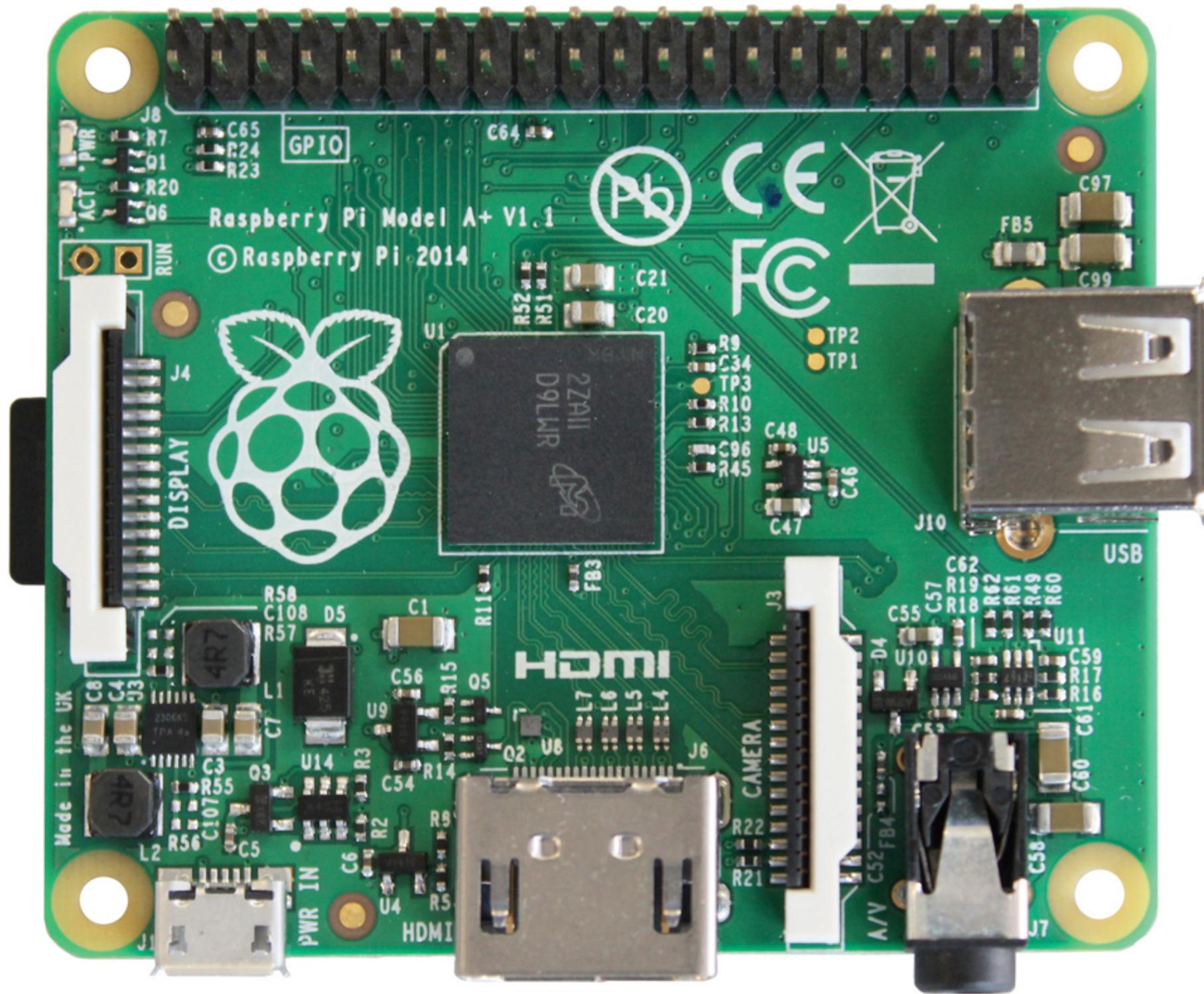


Understanding is Empowering

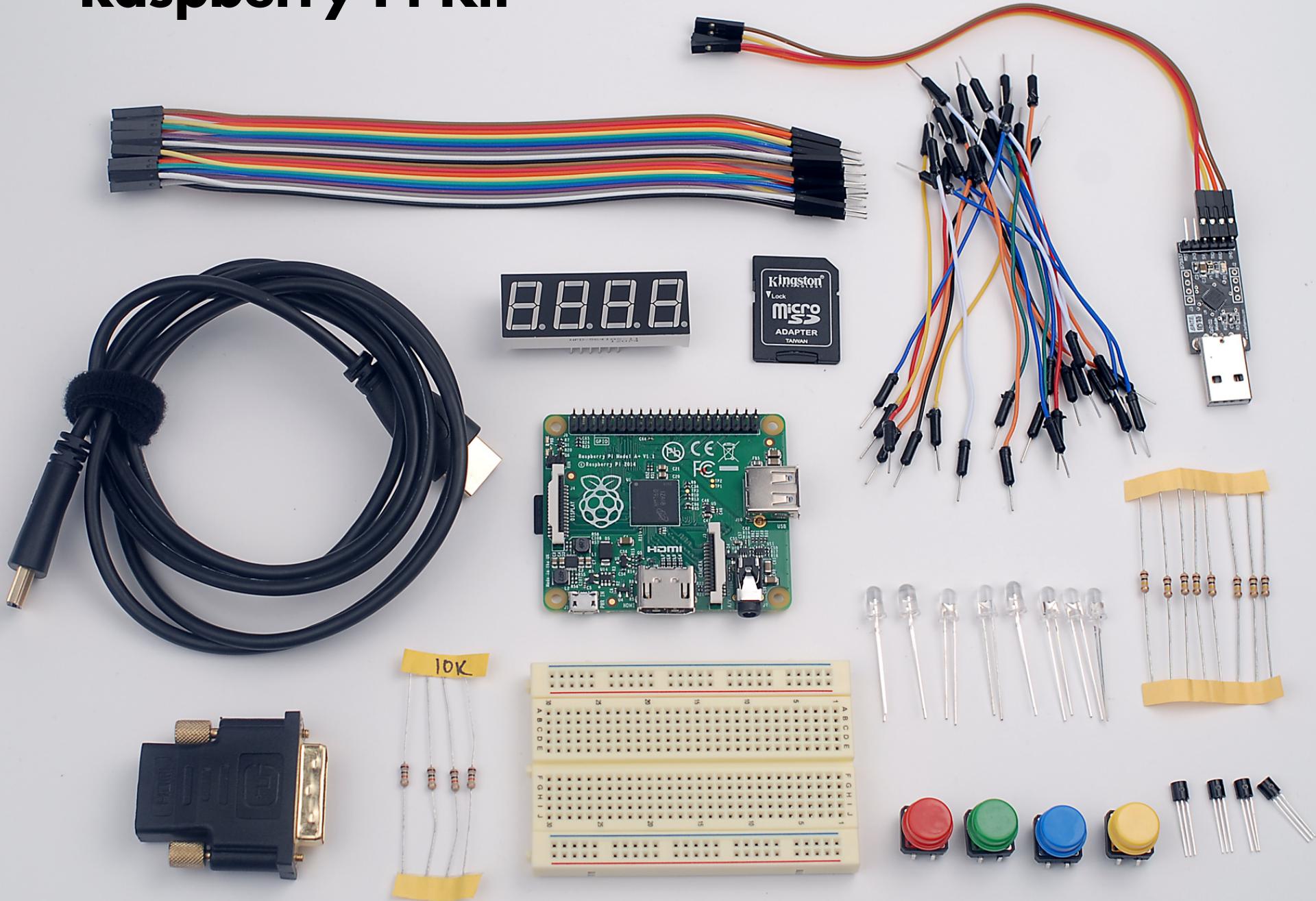
Bare Metal on the Raspberry Pi

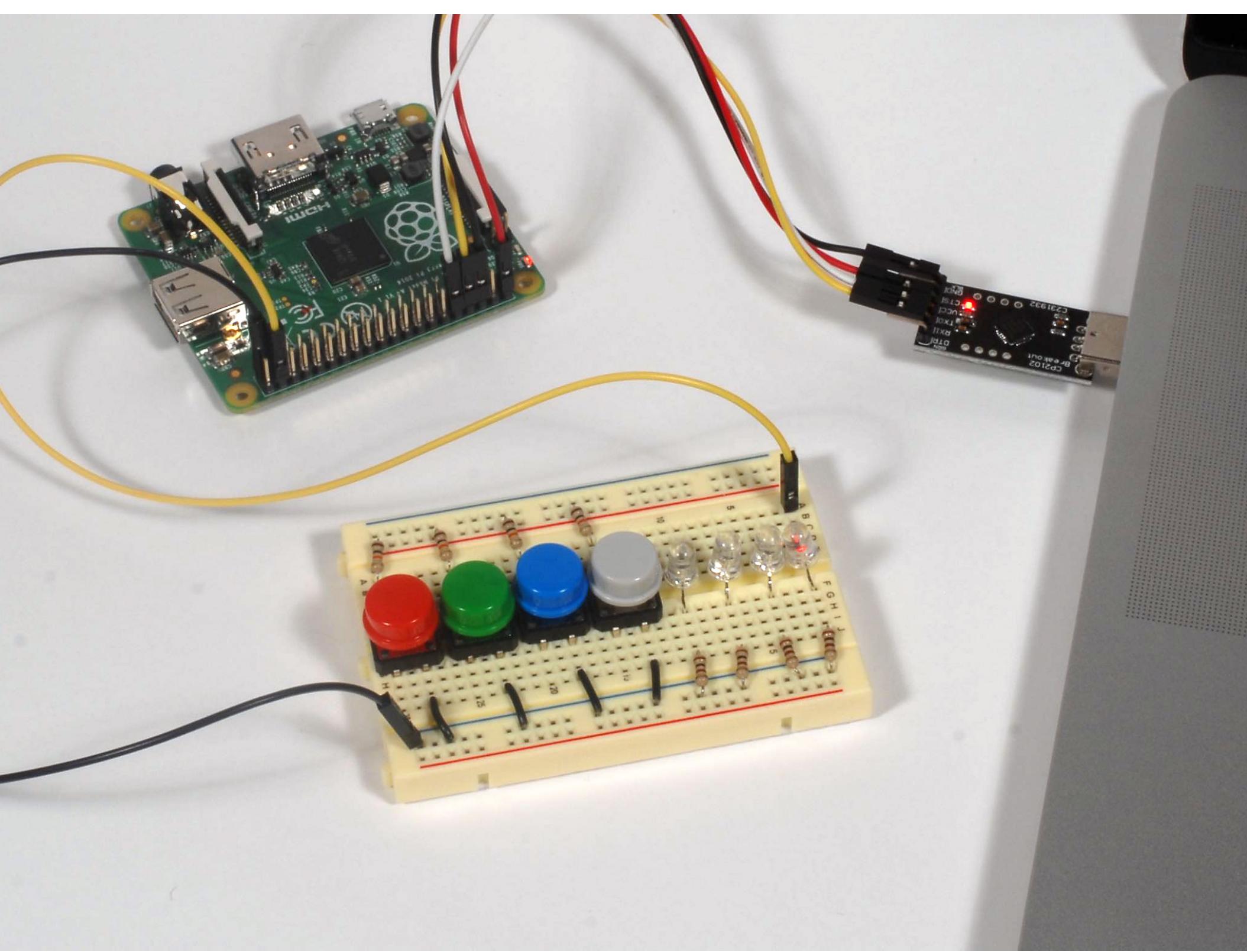
Definition: Bare metal programming involves no operating system (programmer constructs libraries)

Bare metal programs boot and startup on their own, and directly control peripherals



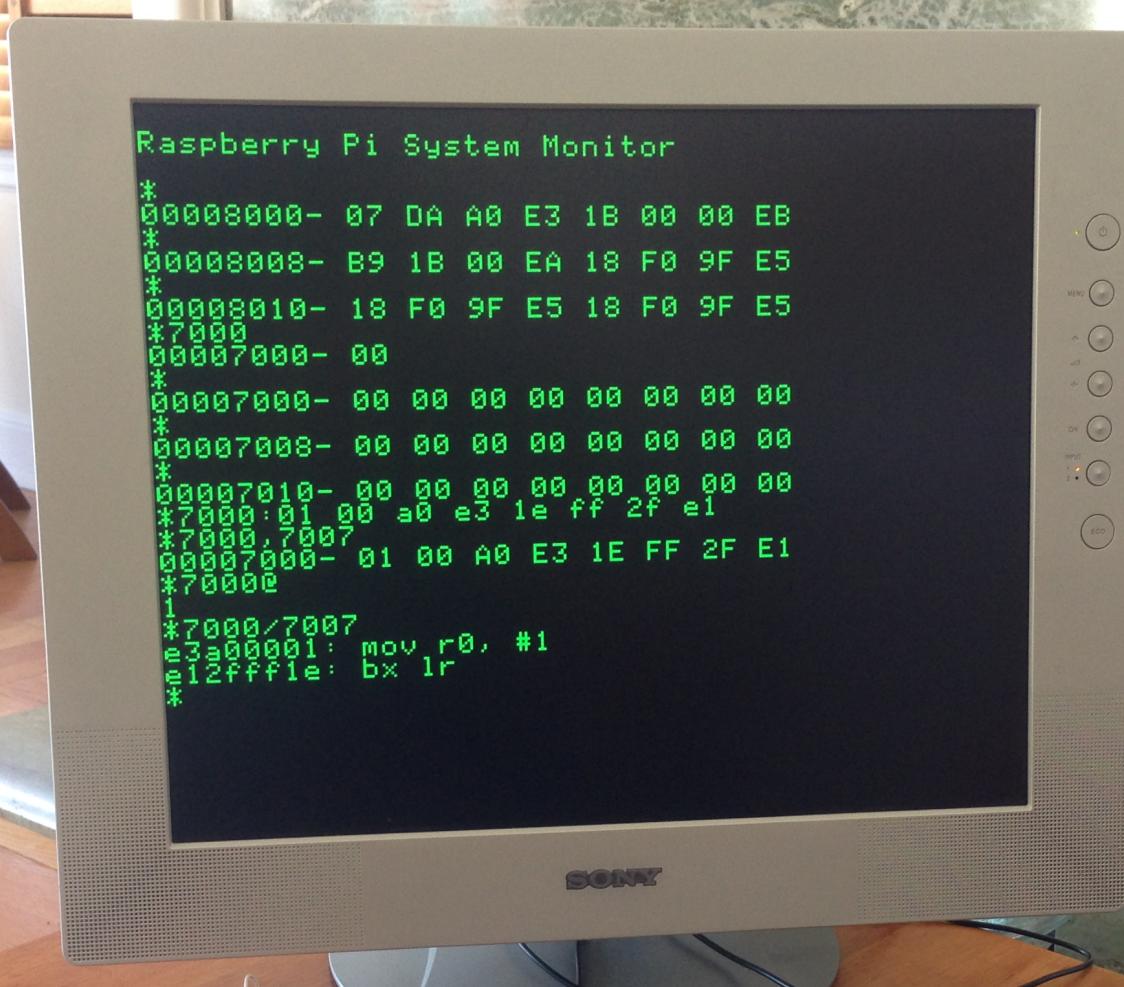
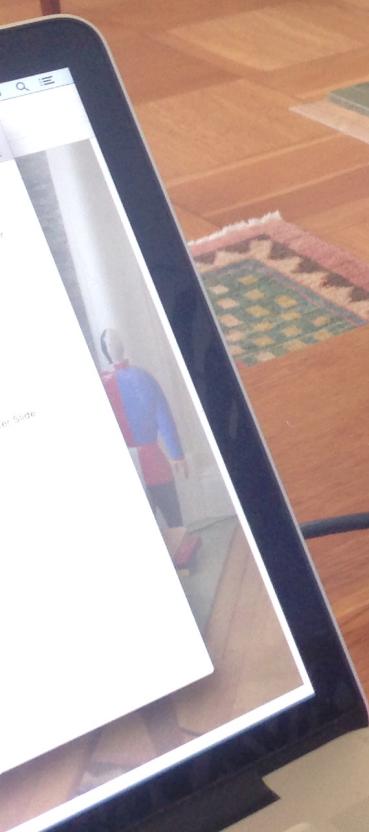
Raspberry Pi Kit





Raspberry Pi Shell

```
Raspberry Pi System Monitor  
*  
00008000- 07 DA A0 E3 1B 00 00 EB  
*  
00008008- B9 1B 00 EA 18 F0 9F E5  
*  
00008010- 18 F0 9F E5 18 F0 9F E5  
*7000  
00007000- 00  
*  
00007000- 00 00 00 00 00 00 00 00  
*  
00007008- 00 00 00 00 00 00 00 00  
*  
00007010- 00 00 00 00 00 00 00 00  
*7000:01 00 a0 e3 1e ff 2f e1  
*7000,7007  
00007000- 01 00 A0 E3 1E FF 2F E1  
*70000  
1  
*7000/7007  
e3a00001: mov r0, #1  
e12ffff1e: bx lr  
**
```



Learning Goal 2

Master your tools

Software Tools

UNIX command line: bash, cd, ls, ...

Programming languages: C, ...

gcc

as

ld

binutils: nm, objcopy, objdump, ...

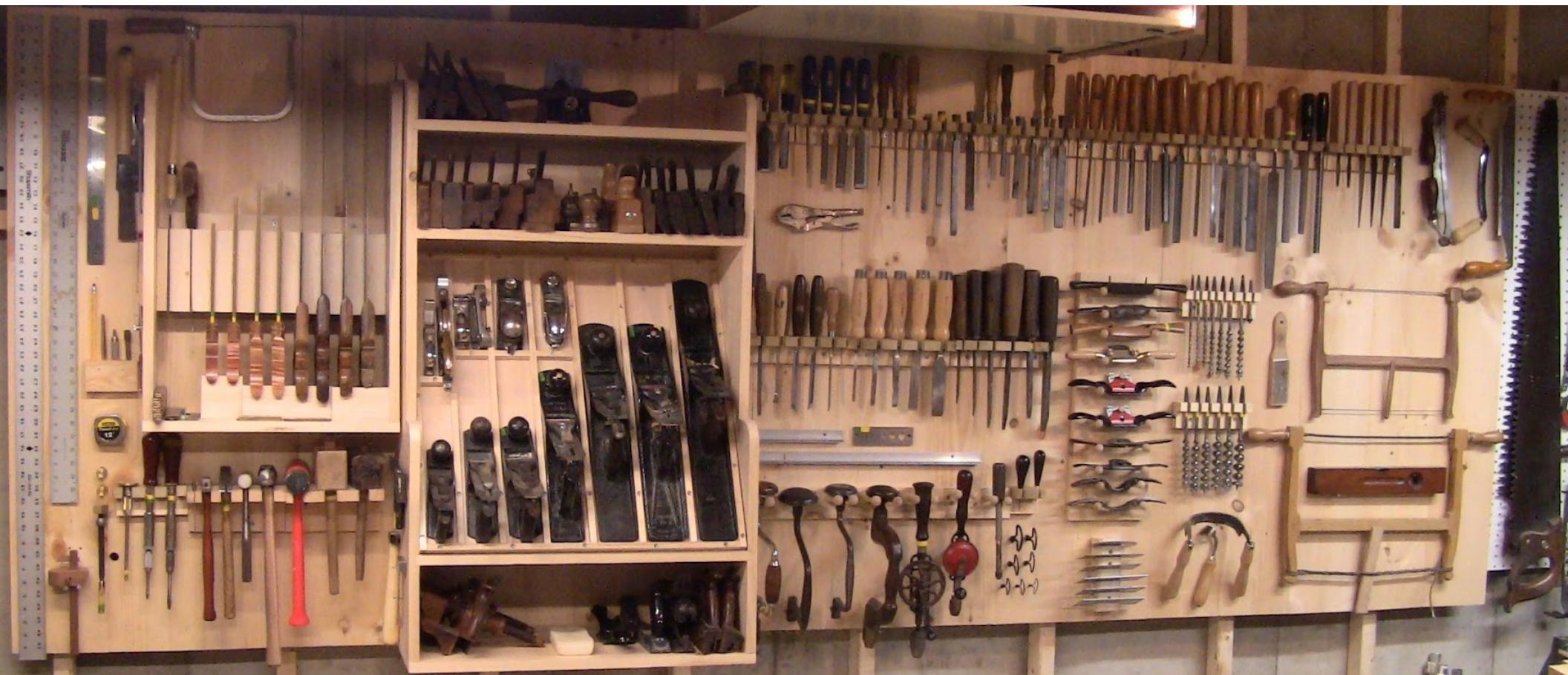
make

git **and** github.com

documentation: markdown



Different Tools for Different Jobs



<http://dans-woodshop.blogspot.com/>

Organized Development Environment



<http://amhistory.si.edu/juliachild/>

A close-up photograph showing a person's hands working on a piece of wood. One hand holds a chisel, and the other hand stabilizes a metal workbench vise that is clamping the wood. The wood has a rectangular cutout in its center. The background shows a workshop environment with a bottle of water on the right.

Practice the Craft

<https://paulsellars.com/tag/gouge/>

Debugging and Troubleshooting



Course Topics

cs107e.github.io

§1 Bare Metal Programming

- 1. ARM processor and memory architecture**
- 2. ARM assembly language and machine code**
- 3. C**
- 4. Functions**
- 5. Serial communication**
- 6. Linking and loading**
- 7. Memory allocation**

§2 Personal Computer

1. Keyboard

2. Graphics

3. Interrupts

Goal: Build Raspberry Pi shell

§3 Additional Topics

1. Sensors

2. Performance

3. Towards Linux and beyond

And a special guest lecture!

Administration

Weekly Cadence

Each week has a focus topic

Pair of coordinated lectures on Fri and Mon

**Mandatory lab on Tue/Wed evening from
6:30-8:30 pm in Gates B21**

**Assignment handed out Wed evening
(after lab), YEAH hours on Thu, assignment
due following Tue at 6 pm (before Tue lab)**

Laboratories

Gates B21: Attendance is **mandatory**

Do exercises and complete check-list

Leave ready to do assignment

Philosophy: lots-of-help, hands-on, collaborative

Lab: access to tools and supplies

Lab fee: \$75 (the kit is yours)

Assignments

7 assignments

- **Build on each other**

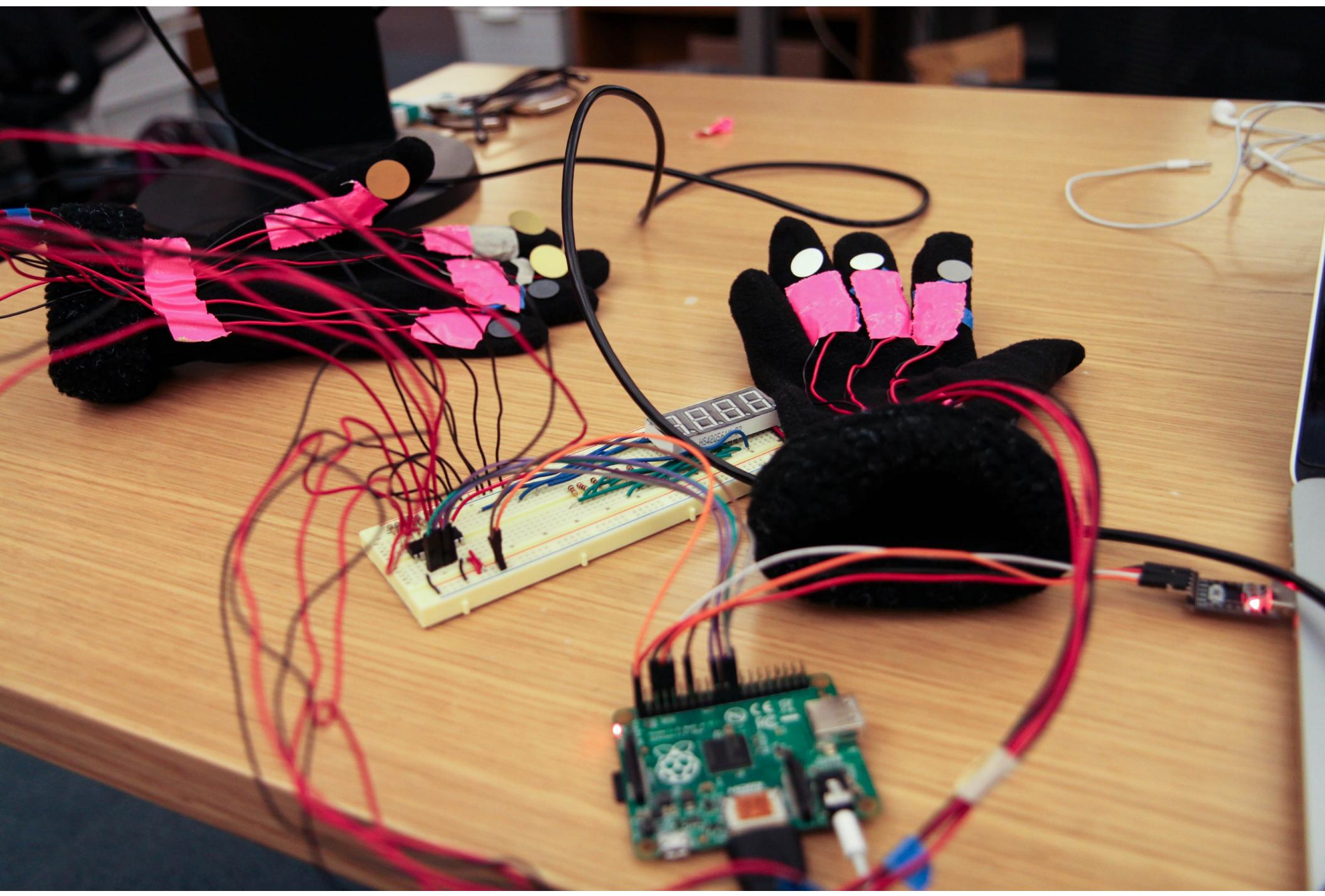
Two parts for each assignment

- **Basic**
- **Extension**

Final project demonstrations

- **Fri Mar 22nd at 9 am (mandatory)**

NO EXAMS

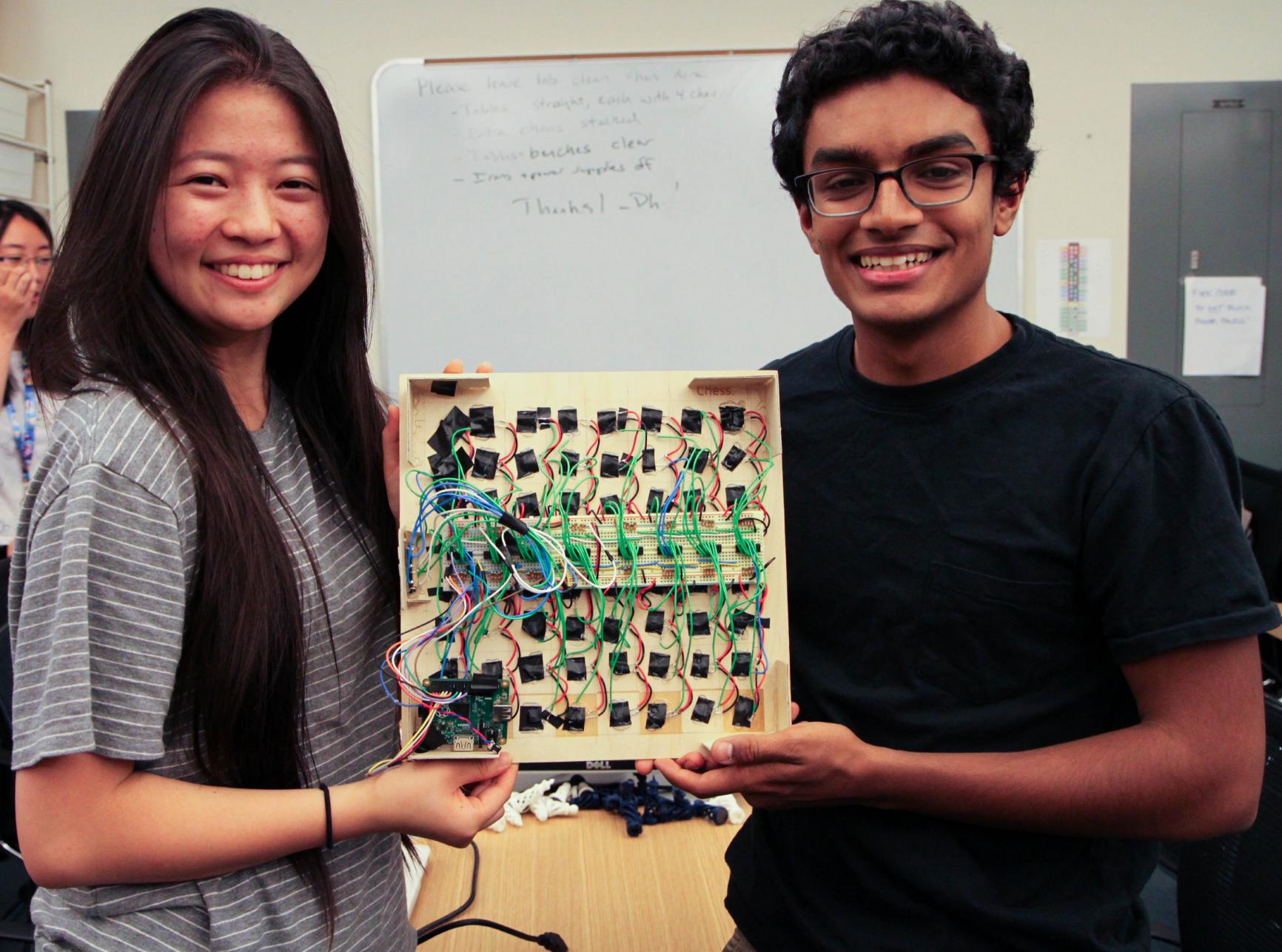




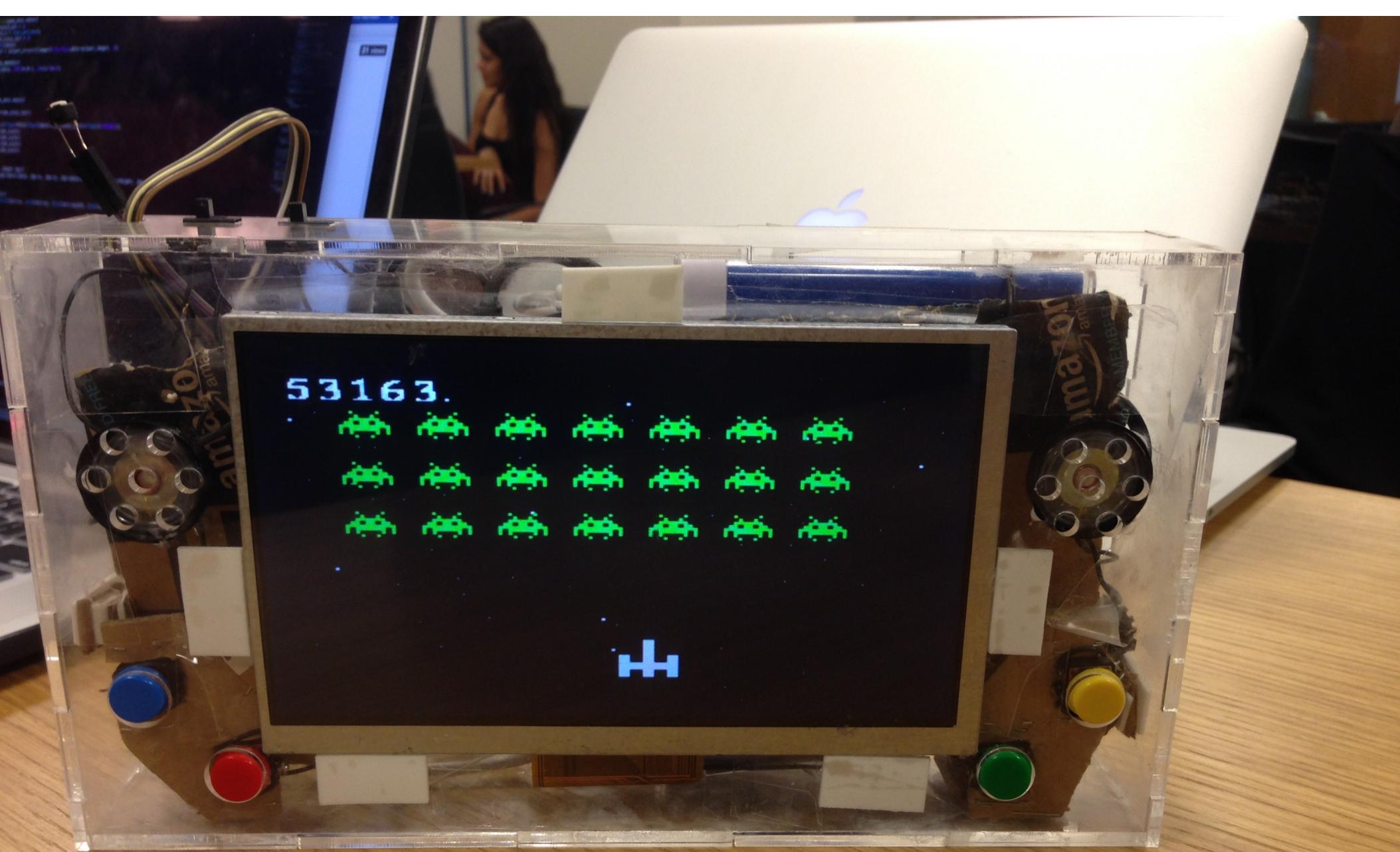


Please leave box clean when done
-Tables straight, each with 4 chairs
-Extra chairs stacked
-Tissue boxes clear
-Irons + ironing supplies off

Thanks! -Dh!







First Week

Assignment 0

TODOs

- Create github account and send us your GitHub id
- Submit your lab preference (we will do our best to get you the lab you want)
- Subscribe to cs107e in piazza
 - <https://piazza.com/class/jqfaue5sl31ok>

Read and understand basic guides

Watch cs107 UNIX videos

- <http://web.stanford.edu/class/cs107/unixref/>

Number Representations

Binary representation

Hexadecimal

Bit operators

Guide: number.md

Basic Electricity

Voltage and current

Ohms Law : $V = I R$

Power : $P = I V$

Driving an LED

Transistor switches

Breadboarding

Guide: [electricity.md](#)

Unix Command Line

Moving around the file system

Creating, moving, and deleting files

Compiling and running programs

Profiles and paths

Guide: unix.md

Note: Watch cs107 UNIX videos!

Questionnaire

Will email "Accepts" by Tue