

CSI07E: Computer Systems from the Ground Up

Chris Gregg,
Jennifer Lin, Eric Yang,
Jane Lange, Matt Trost

Autumn 2018

Chris



Jennifer



Jane

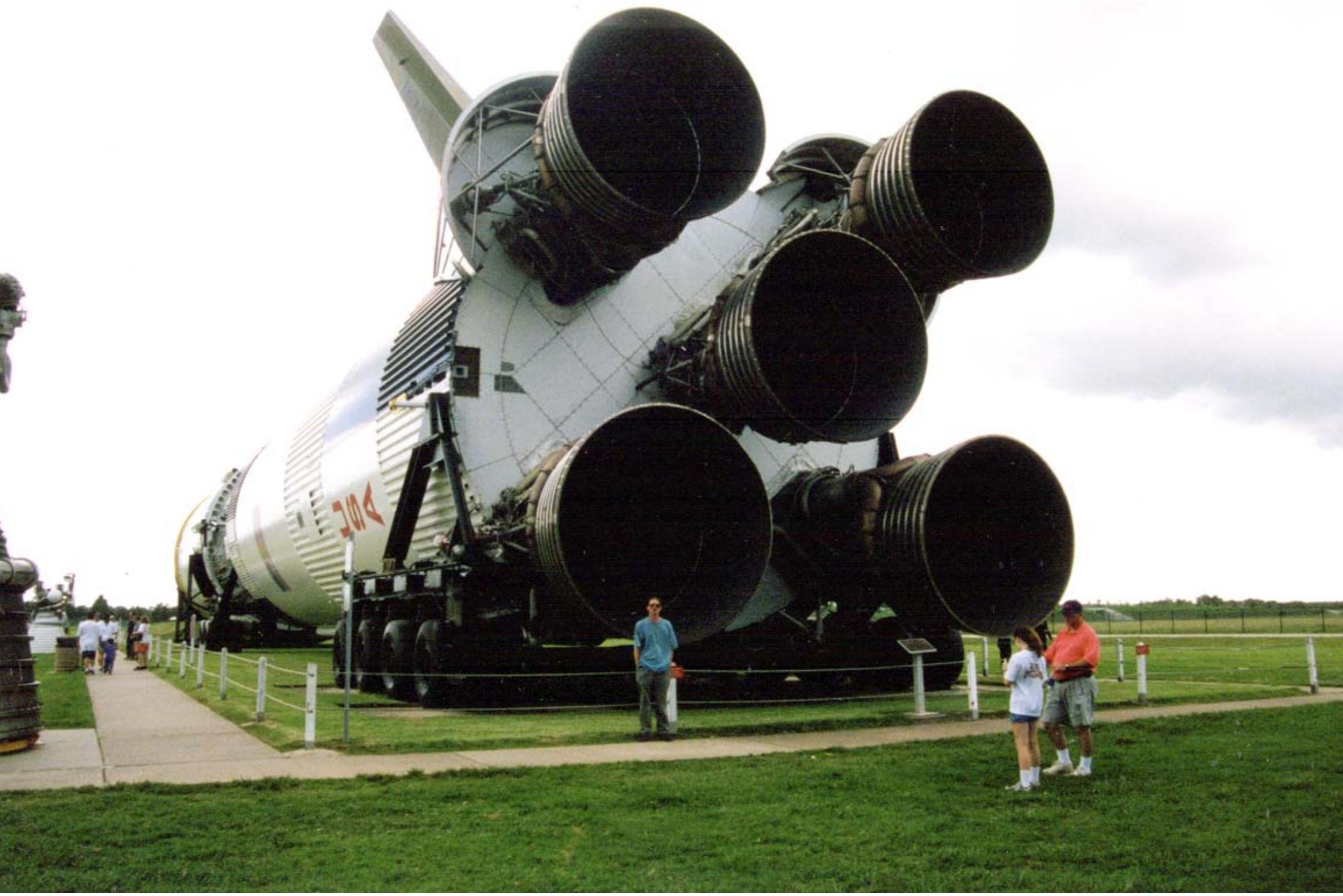


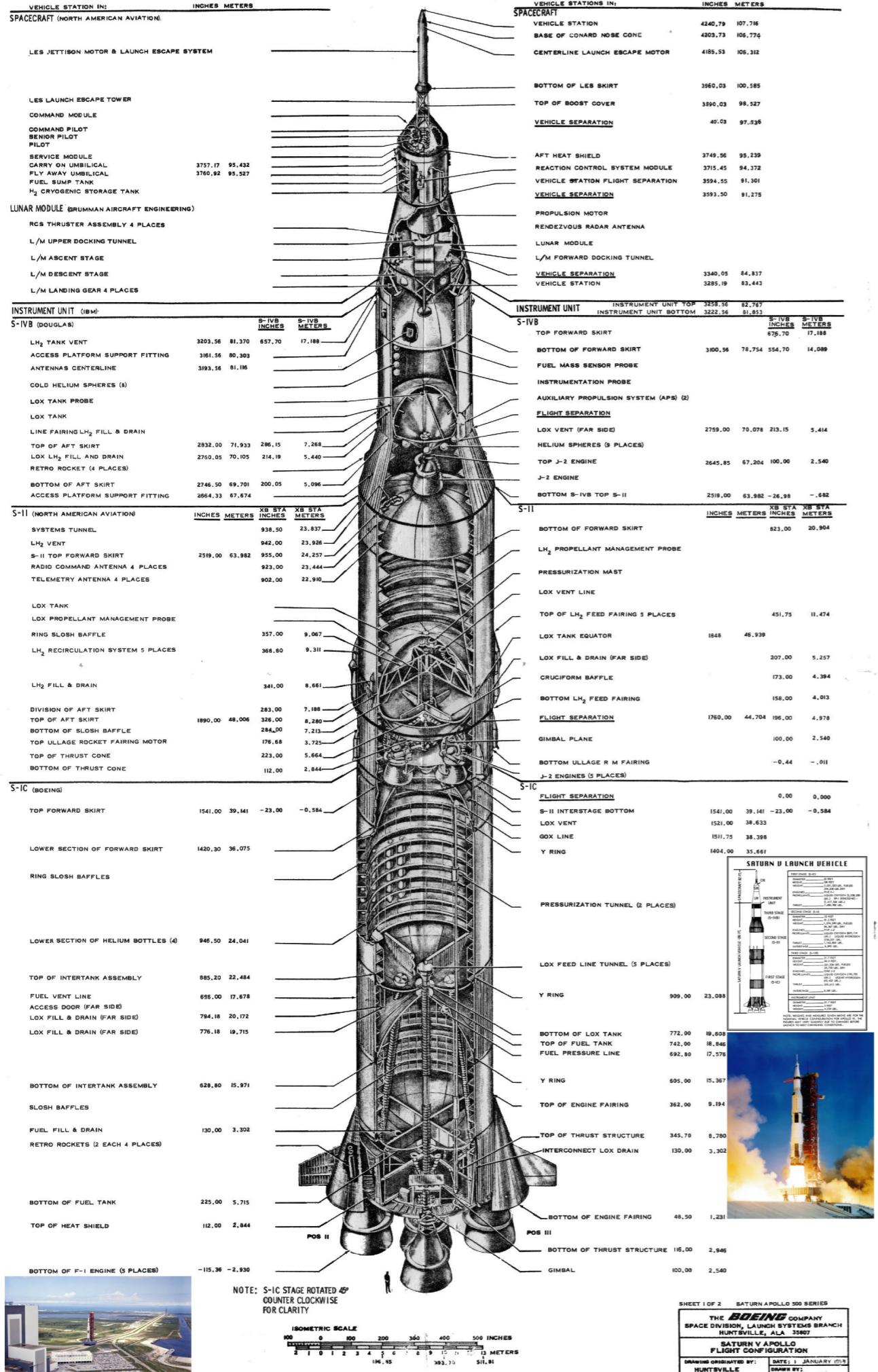
Matt



Learning Goal I

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





Command Module 64,000 lbs

Saturn V 6,200,000 lbs

Paylod 1.5% of total weight



Falcon 9



Elon Musk



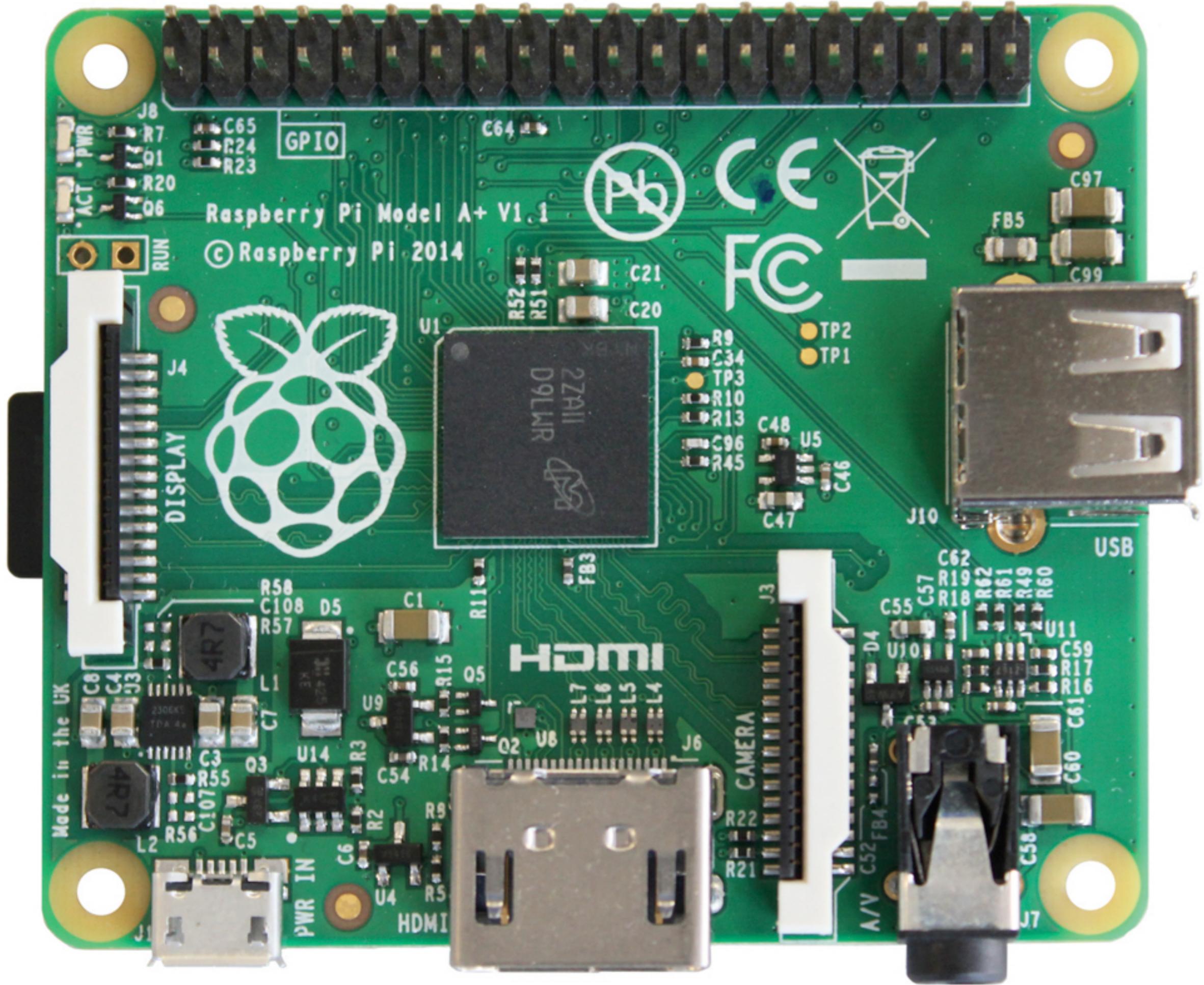
Mastery is Power

Goal: Mastery of your Computer

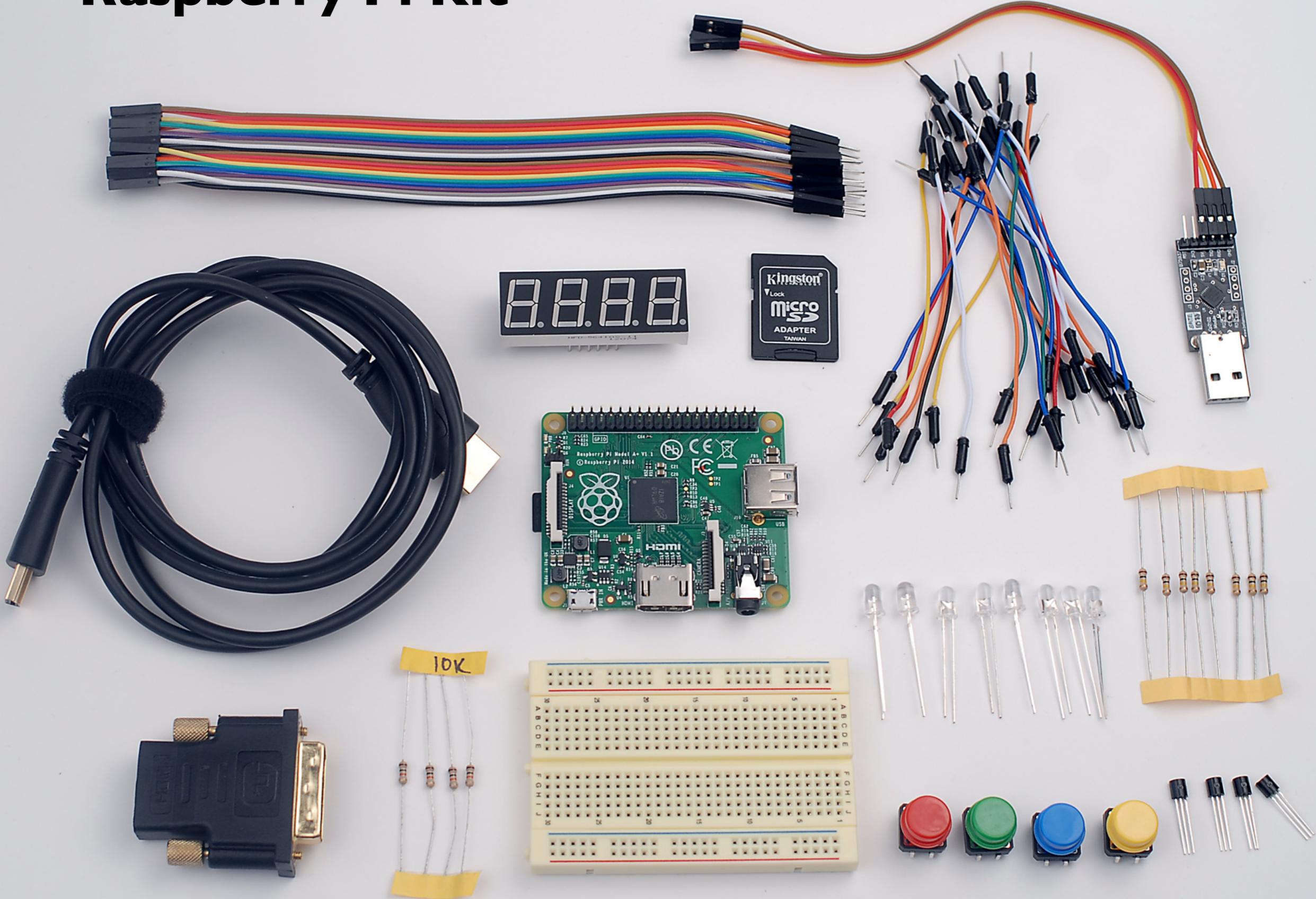
Bare Metal on the Raspberry Pi

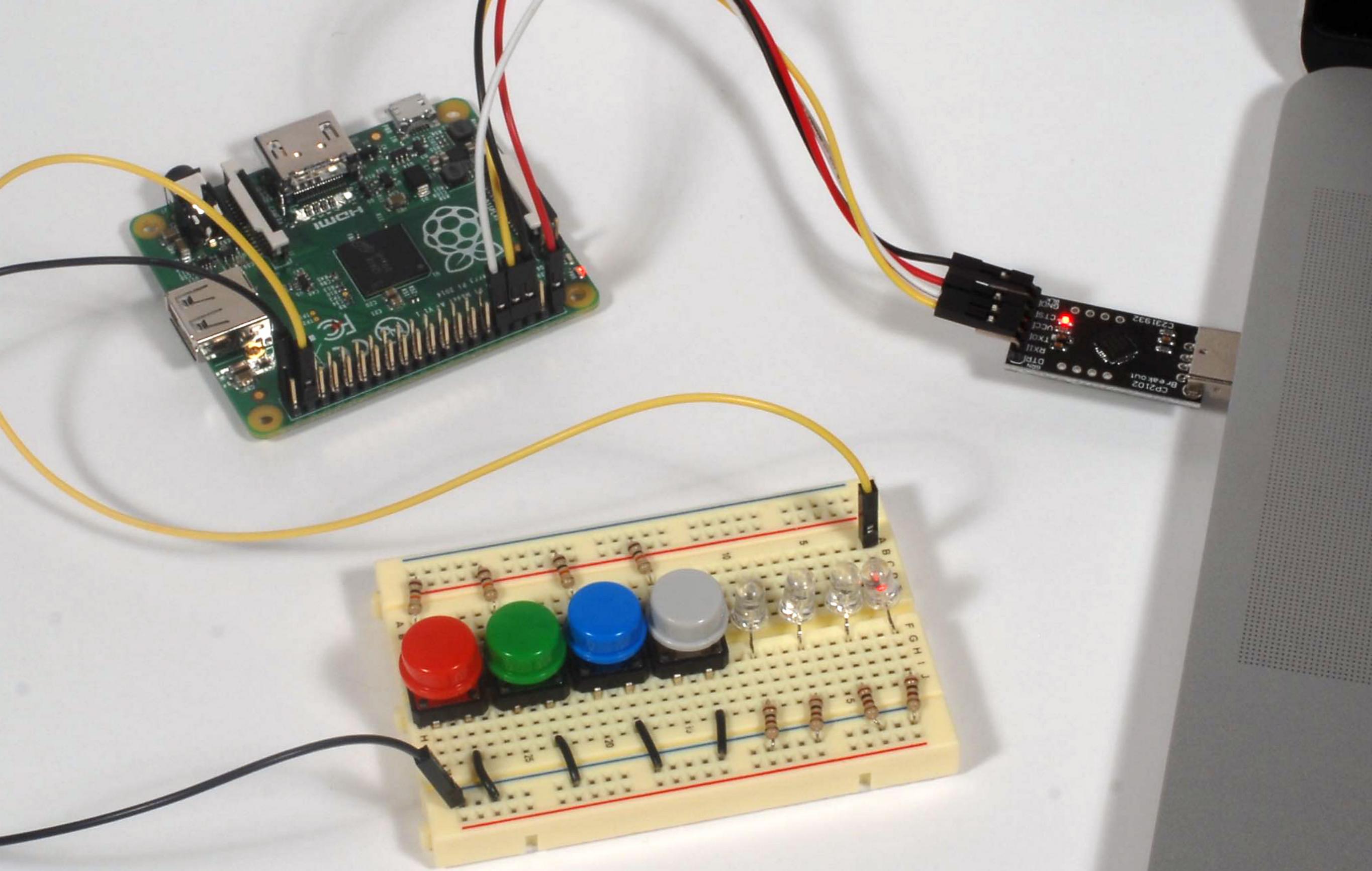
Definition: Bare metal programming involves no operating system (programmer constructs libraries)

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



Raspberry Pi Kit

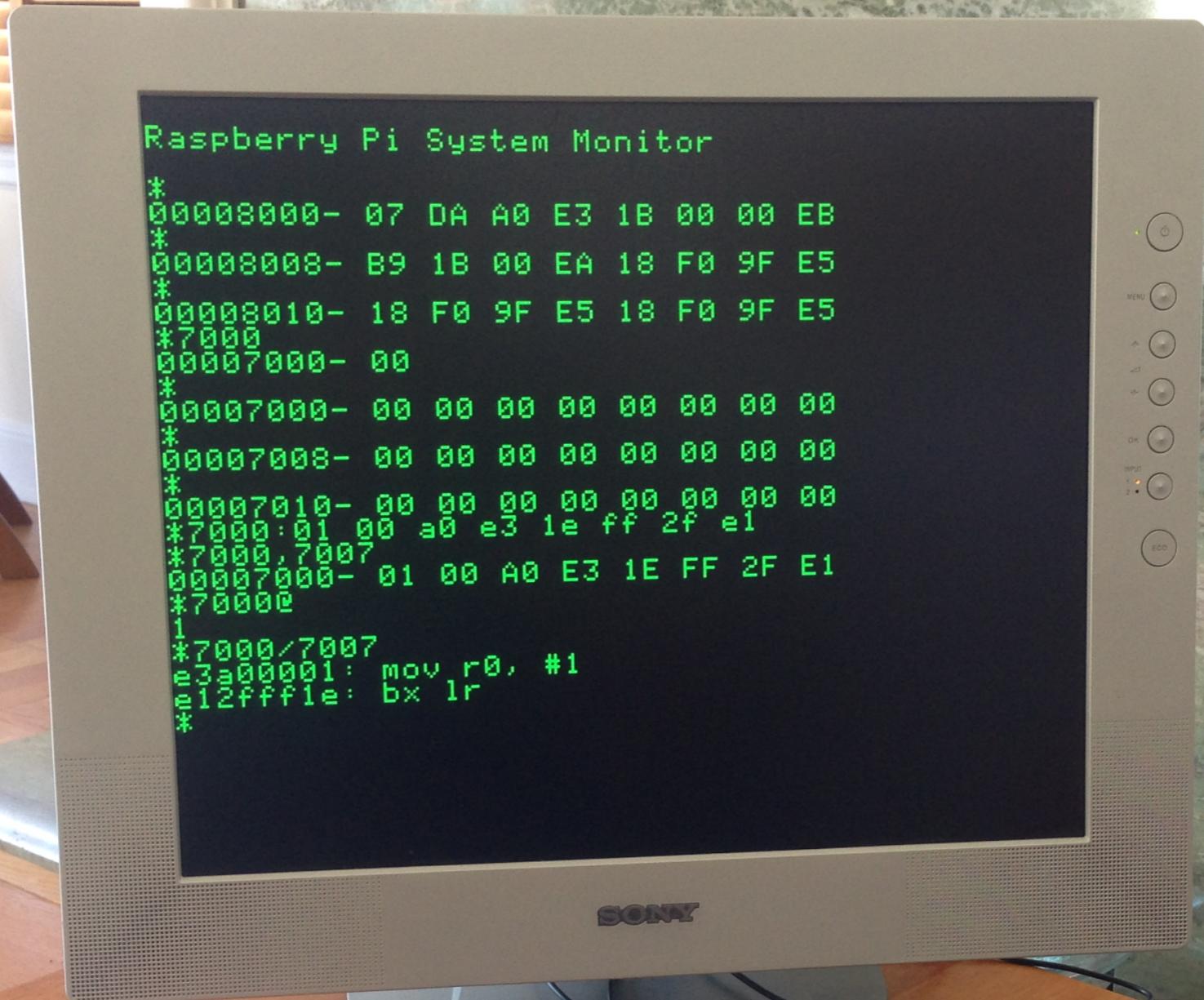
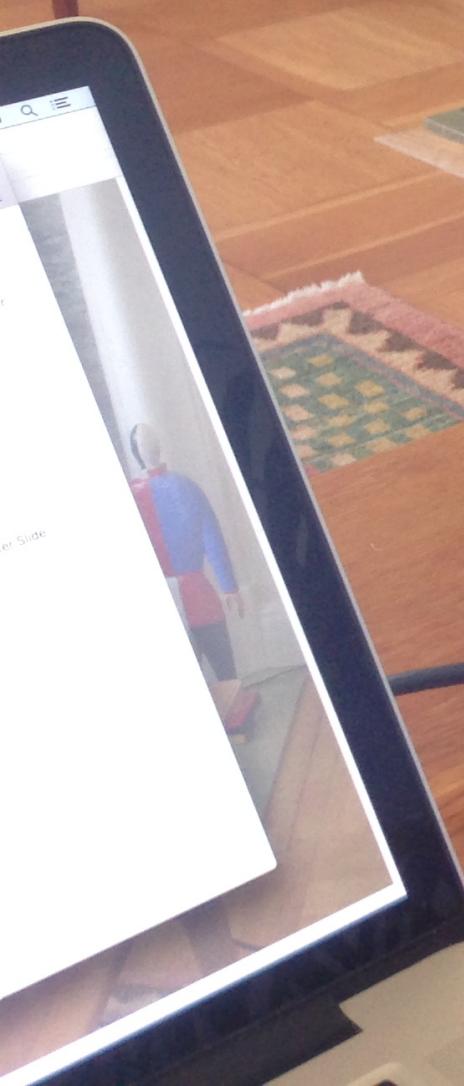




Raspberry Pi Shell

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
*$7000@
1
*$7000/7007
e3a00001: mov r0, #1
e12fffffe: bx lr
*
```



Learning Goal 2

Master your tools

Software Tools

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

Programming languages: C, python

gcc

as

ld

binutils: nm, size, ...

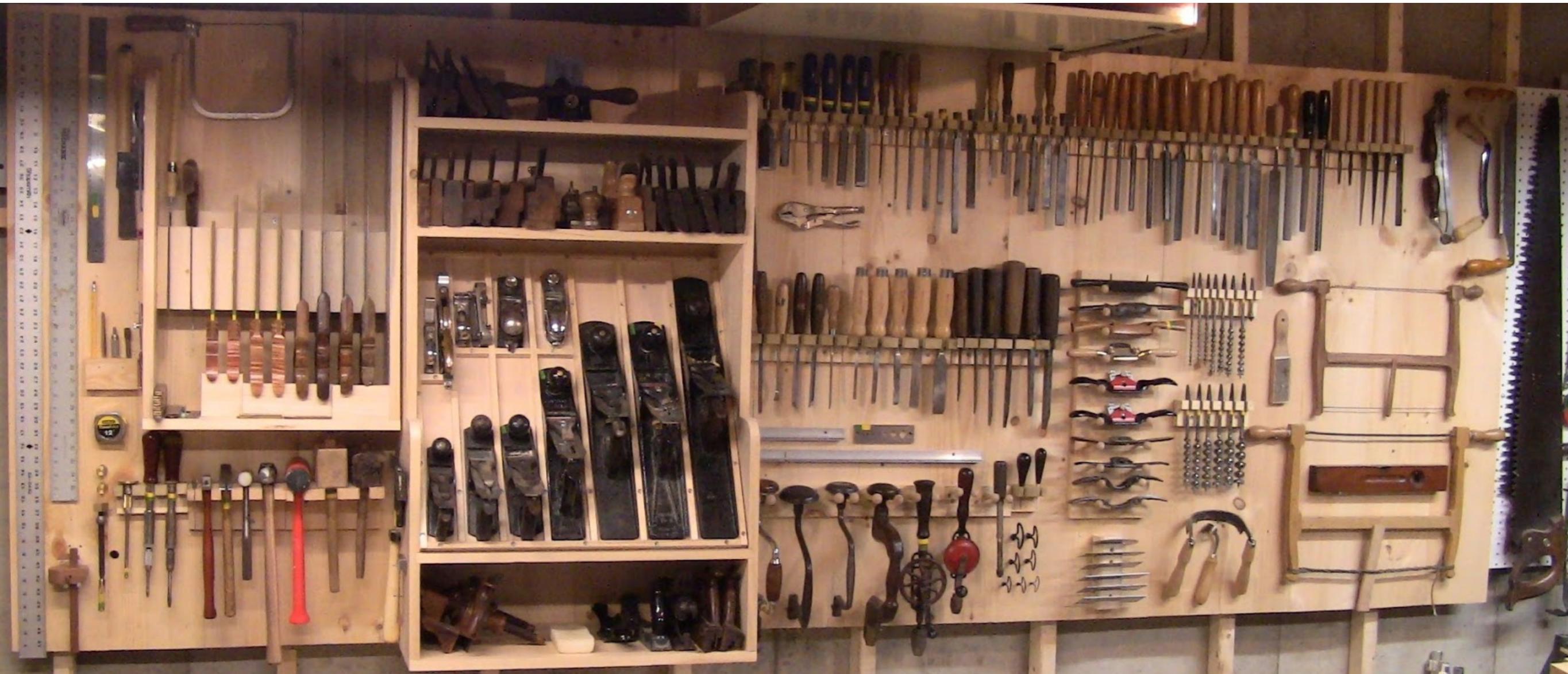
make

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. The person is using a chisel to shape a dark, rectangular block of wood. The wood is clamped to a light-colored wooden workbench. In the background, there are various tools and materials, including a bottle of water and a box labeled 'VETATION VEC3C'.

Master the Craft

Debugging and Troubleshooting

Once you're fluent in C, coding is easy and fast

Debugging takes up 80% of development time

Improving your craft means

- Learning to code in a way that's less bug-prone
- Experience and intuition on where to look first

Debugging is *learning*

- Story: Marius Schilder@ Google, Proto2

Course Topics

cs107e.github.io

§ I 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

I. Keyboard

2. Graphics

3. Interrupts

Goal: Build Raspberry Pi shell

§3 Additional Topics

- I. 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 Mon 1pm-3pm and Fri 9am-11am
in Gates B21.

Assignment due following Mon at 1pm (before Mon lab)

Laboratories

Gates B2 I: 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: \$50 (the kit is yours)

Assignments

7 assignments

- **Build** on each other

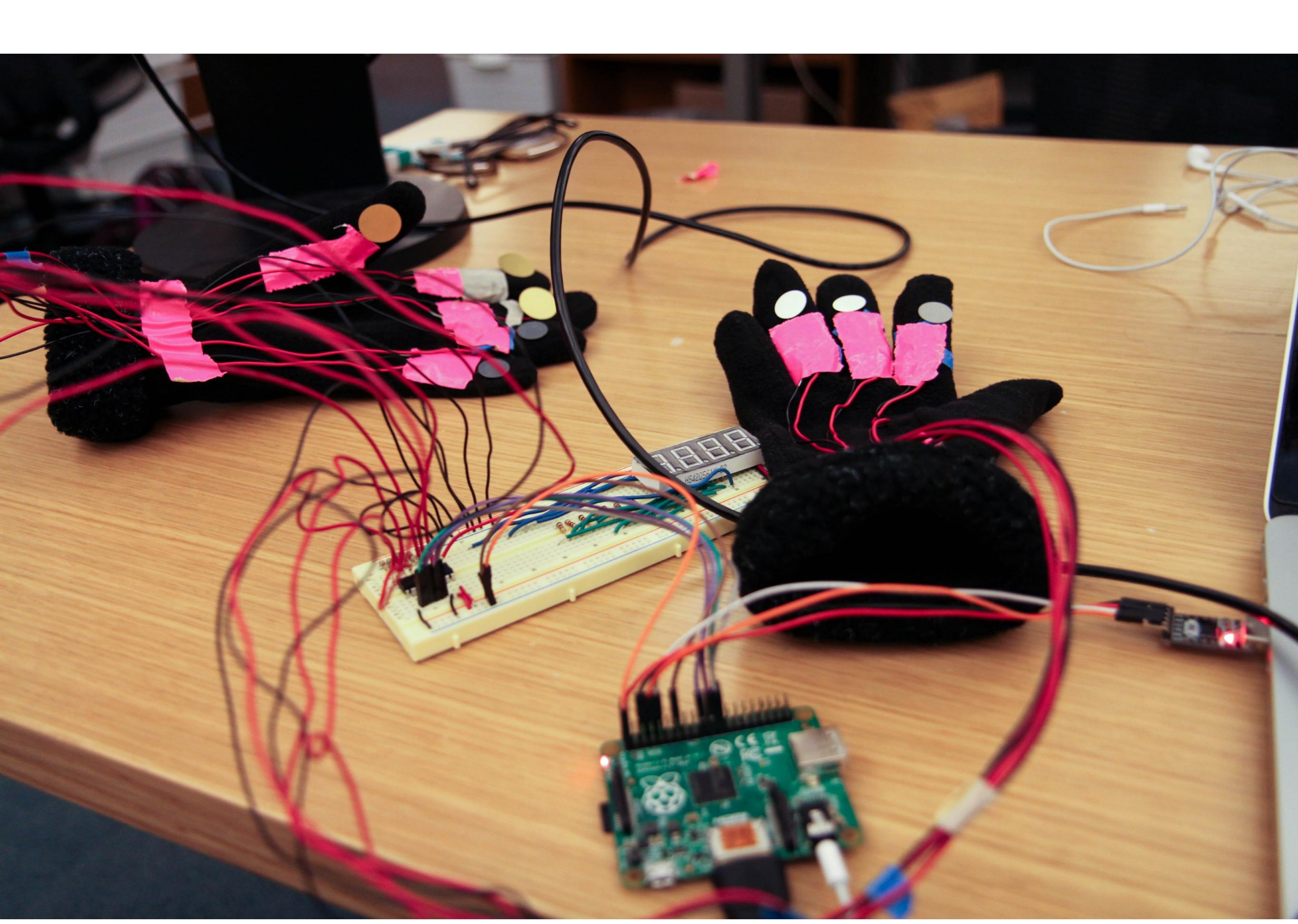
Two parts for each assignment

- Basic
- Extension

Final project, presentations Friday Dec. 14th, 9am-11:30am.

Mandatory, no exceptions. Be aware that this is the last day of final exams, so plan accordingly.

NO EXAMS

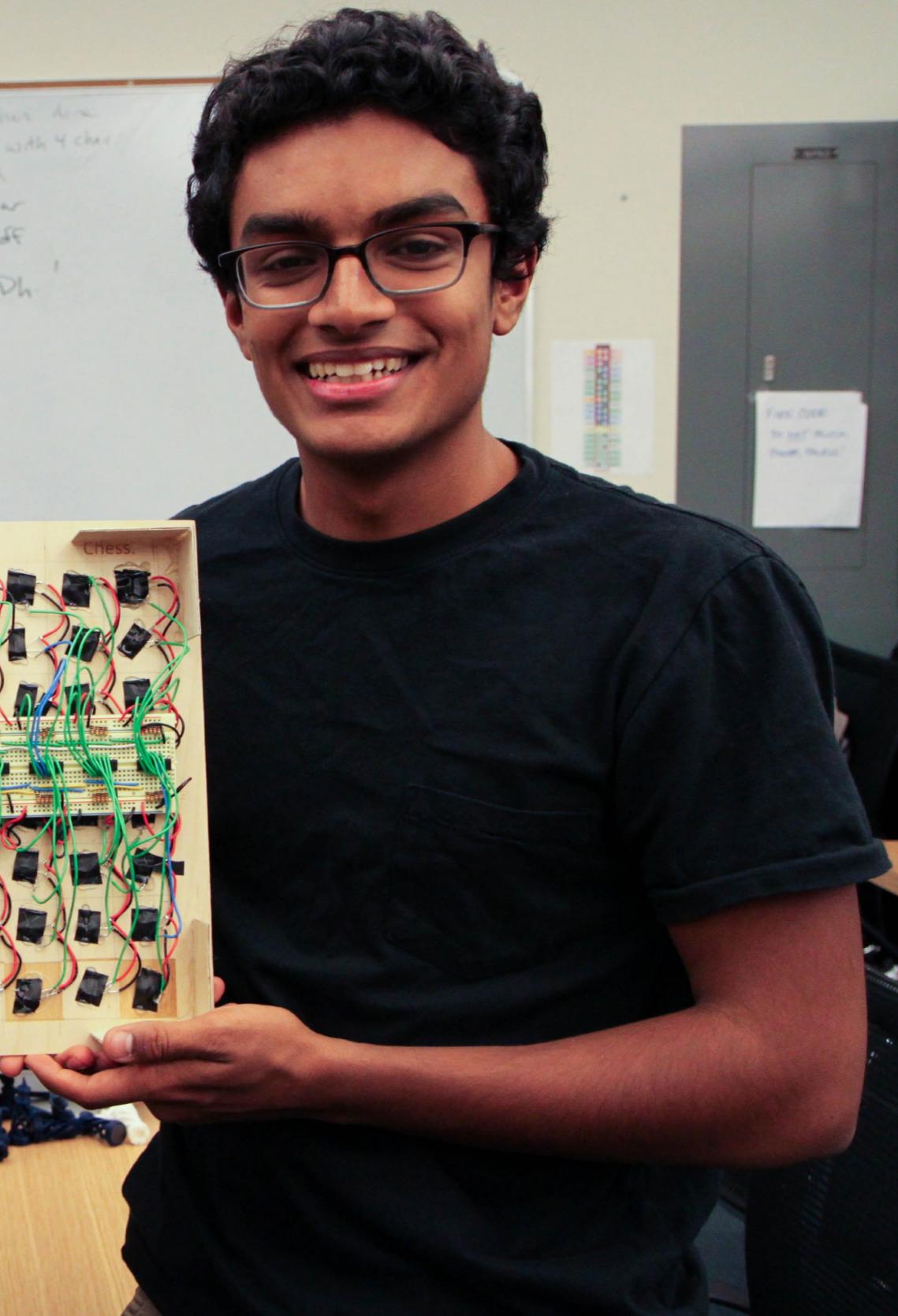
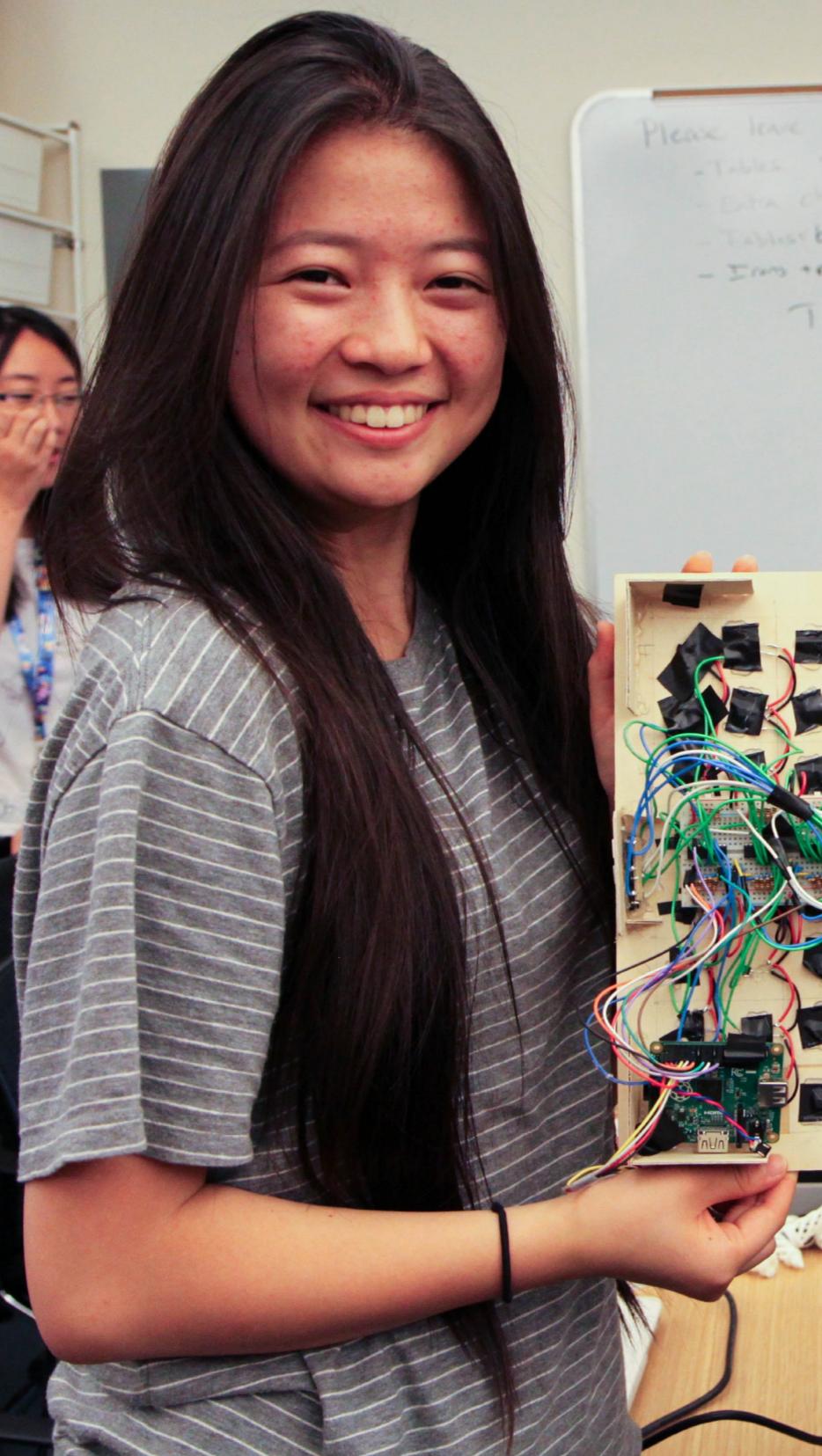
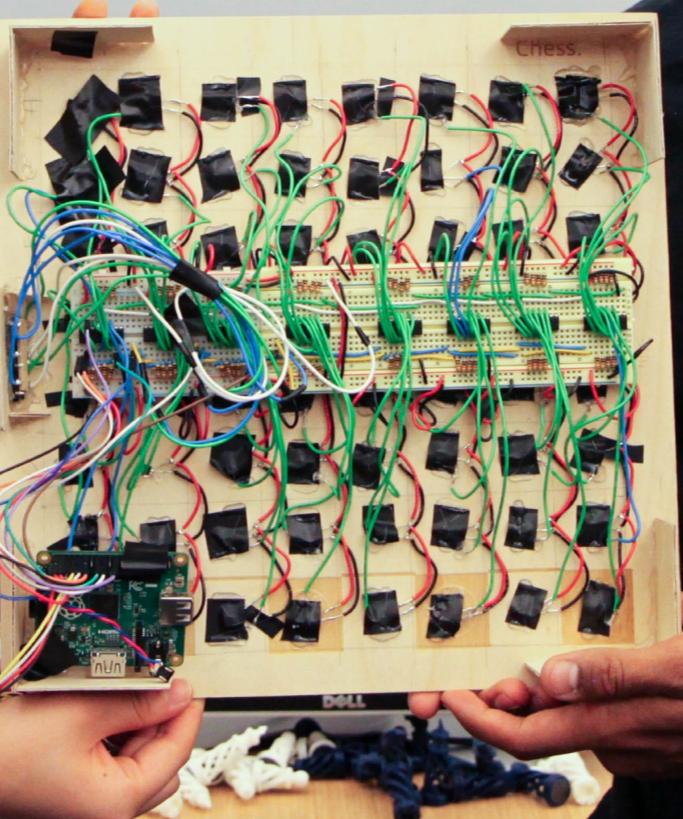






Please leave hall clear when done
-Tables straight, each with 4 chairs
-Extra chairs stacked
-Tables/bench clear
-Dress room spotless after

Thanks! -Dh'







First Week

Assignment 0

Subscribe to cs107e in piazza:

<https://piazza.com/class/jmf0trlk3t168e>

Watch cs107 UNIX videos

Assignment 0

- Using git and github
- Submit your lab preference (we will do our best to get you the lab you want)

Read and understand basic guides

Number Representations

Binary representation

Hexadecimal

Bit operators

Guide: number.md

Basic Electricity

Voltage and current

Ohms Law : $V = I R$

Power : $P = IV$

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