

CS107E: Computer Systems from the Ground Up

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Phil



Jean-Luc



Jane



Chris



Lenny

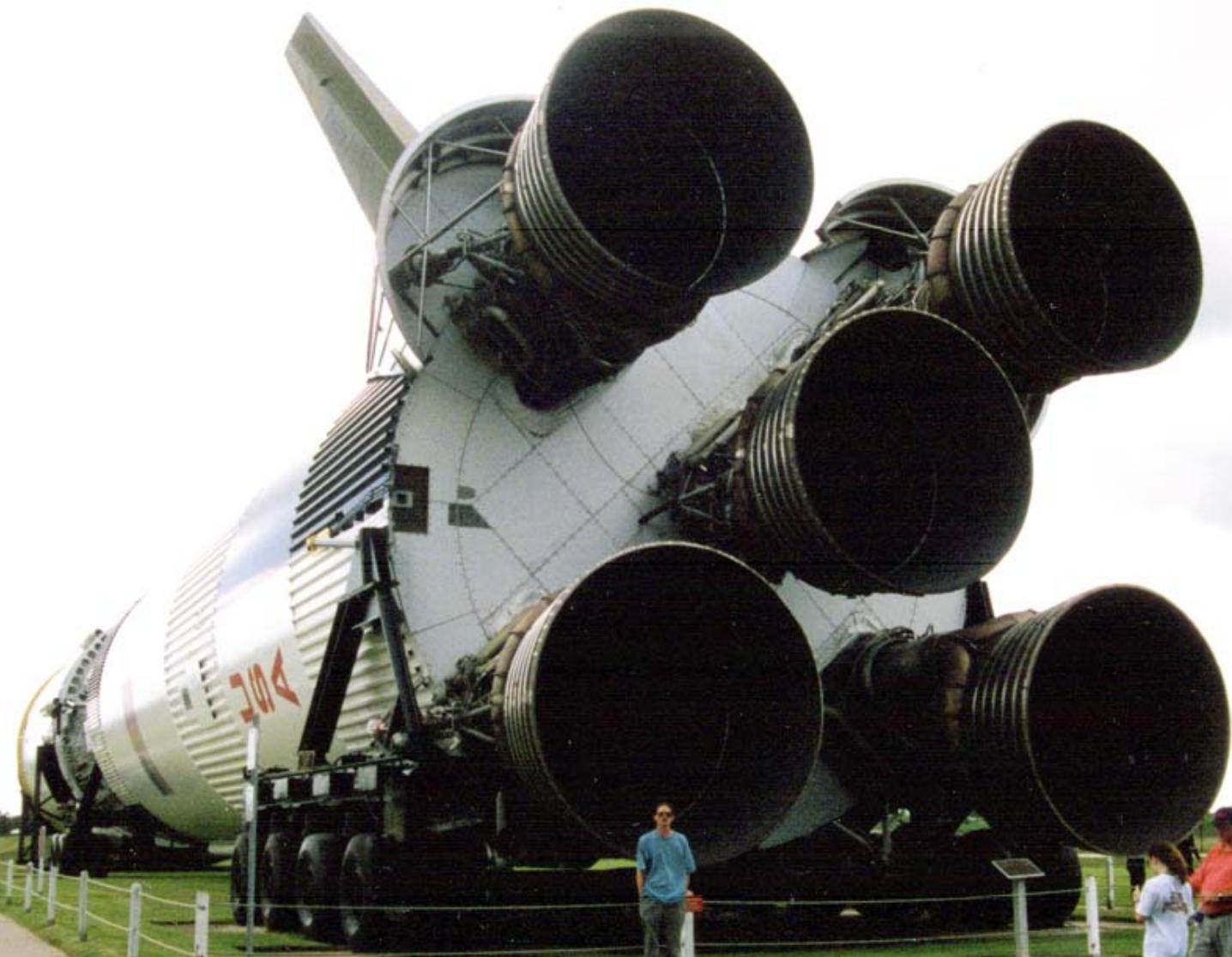


Matt

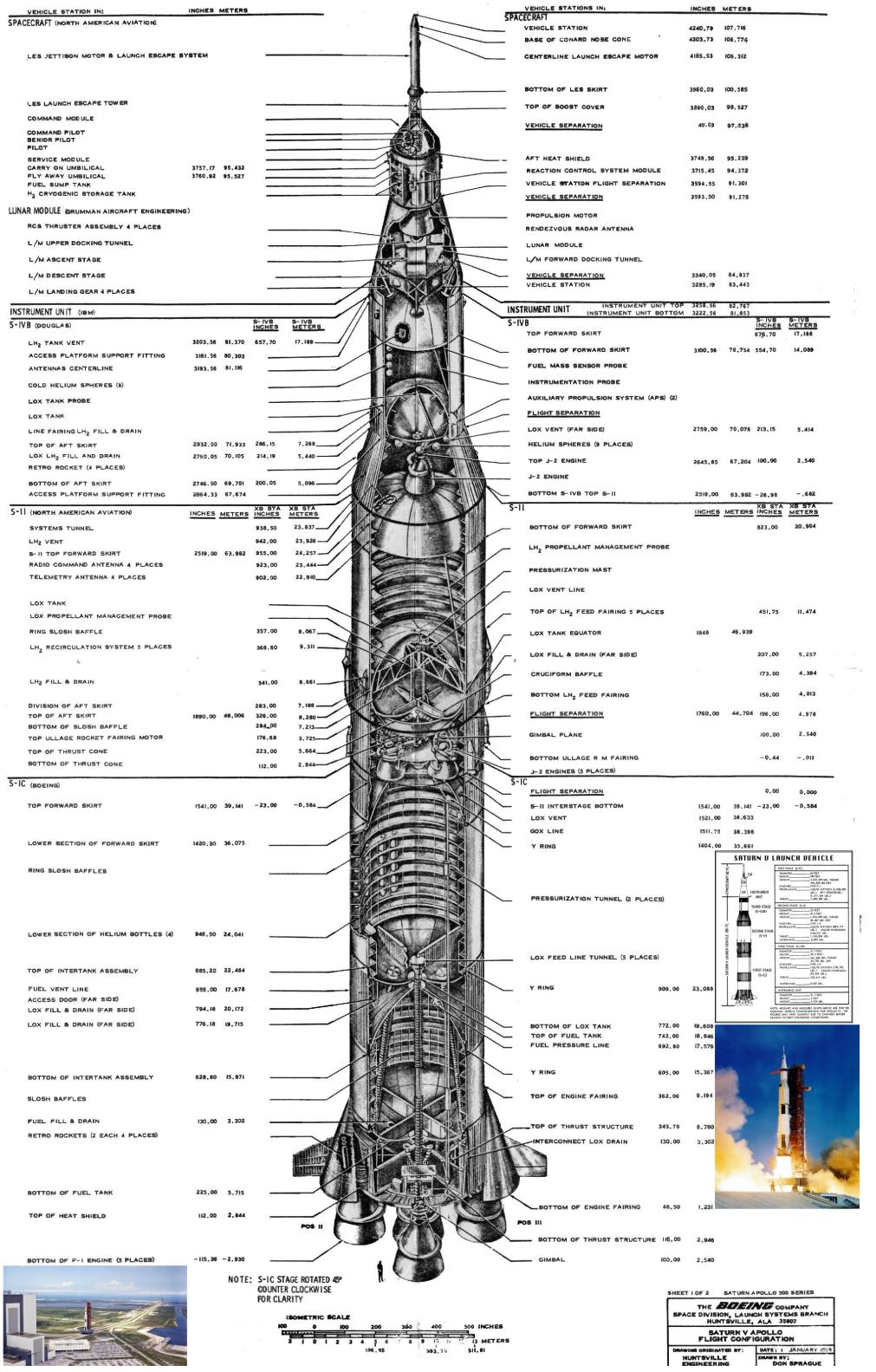


Learning Goal I

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



304



Command Module 64,000 lbs

Saturn V 6,200,000 lbs

Payload 1.5% of total weight

Falcon 9



Elon Musk



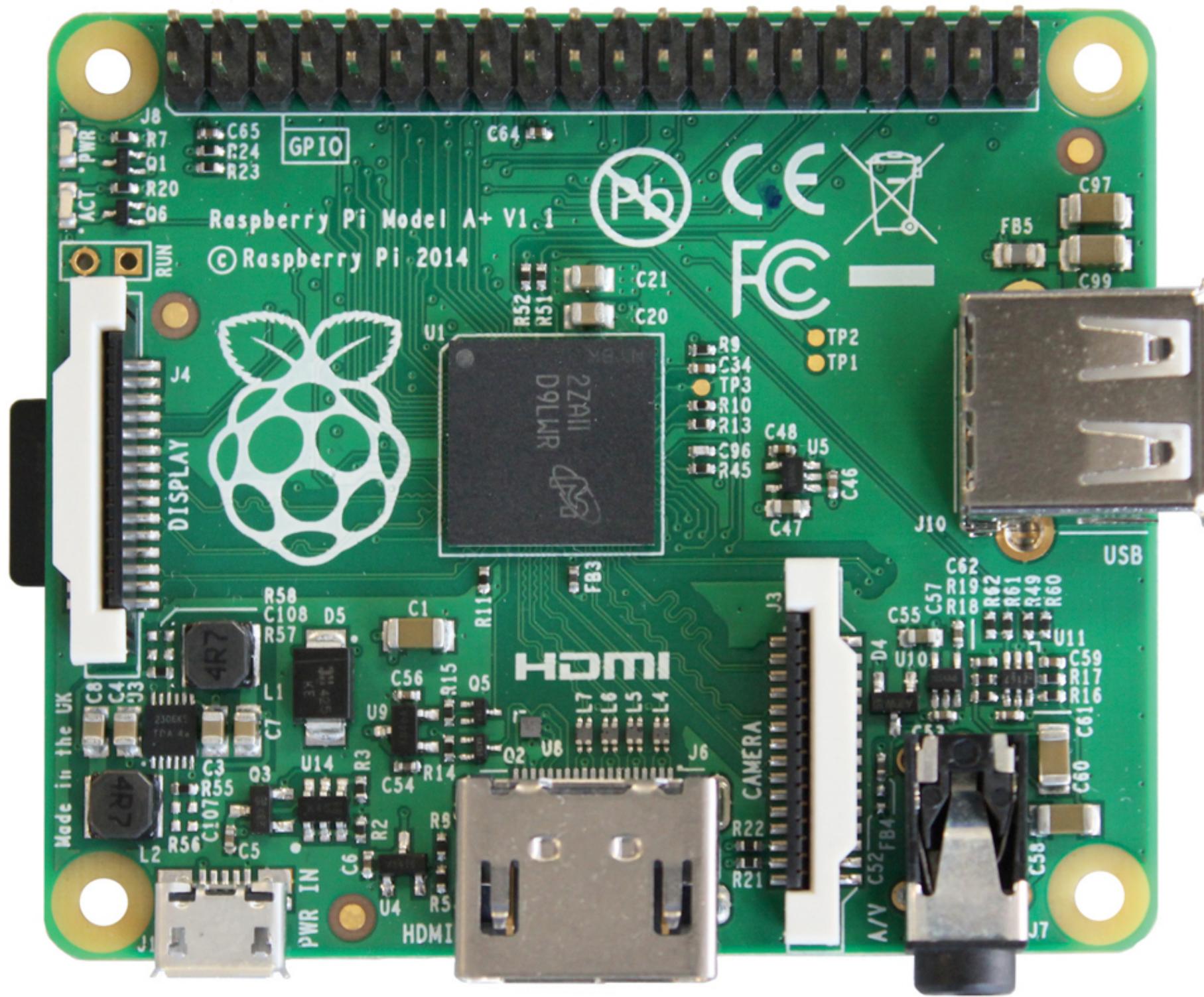
Mastery is Power

Goal: Mastery of your Computer

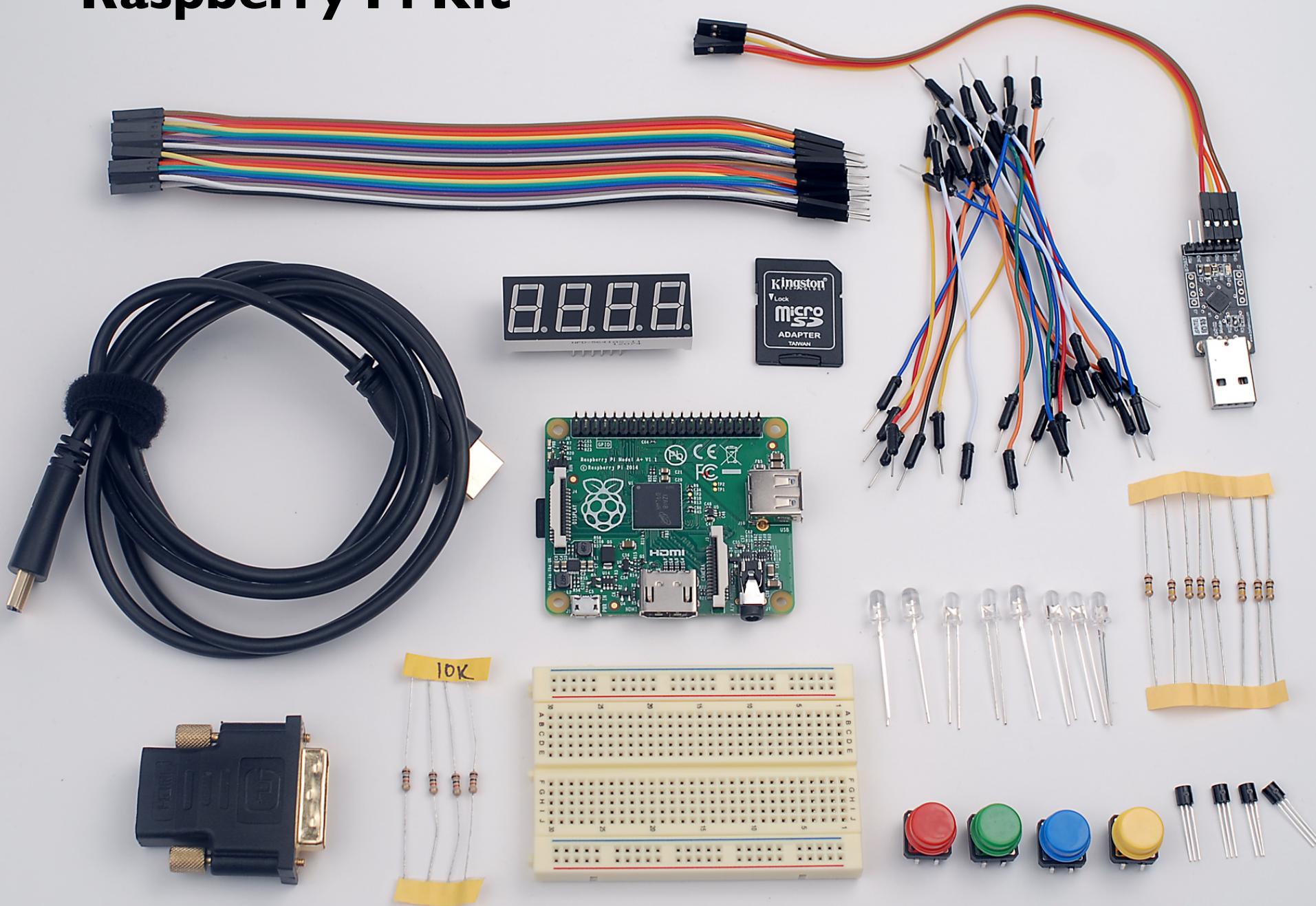
Bare Metal on the Raspberry Pi

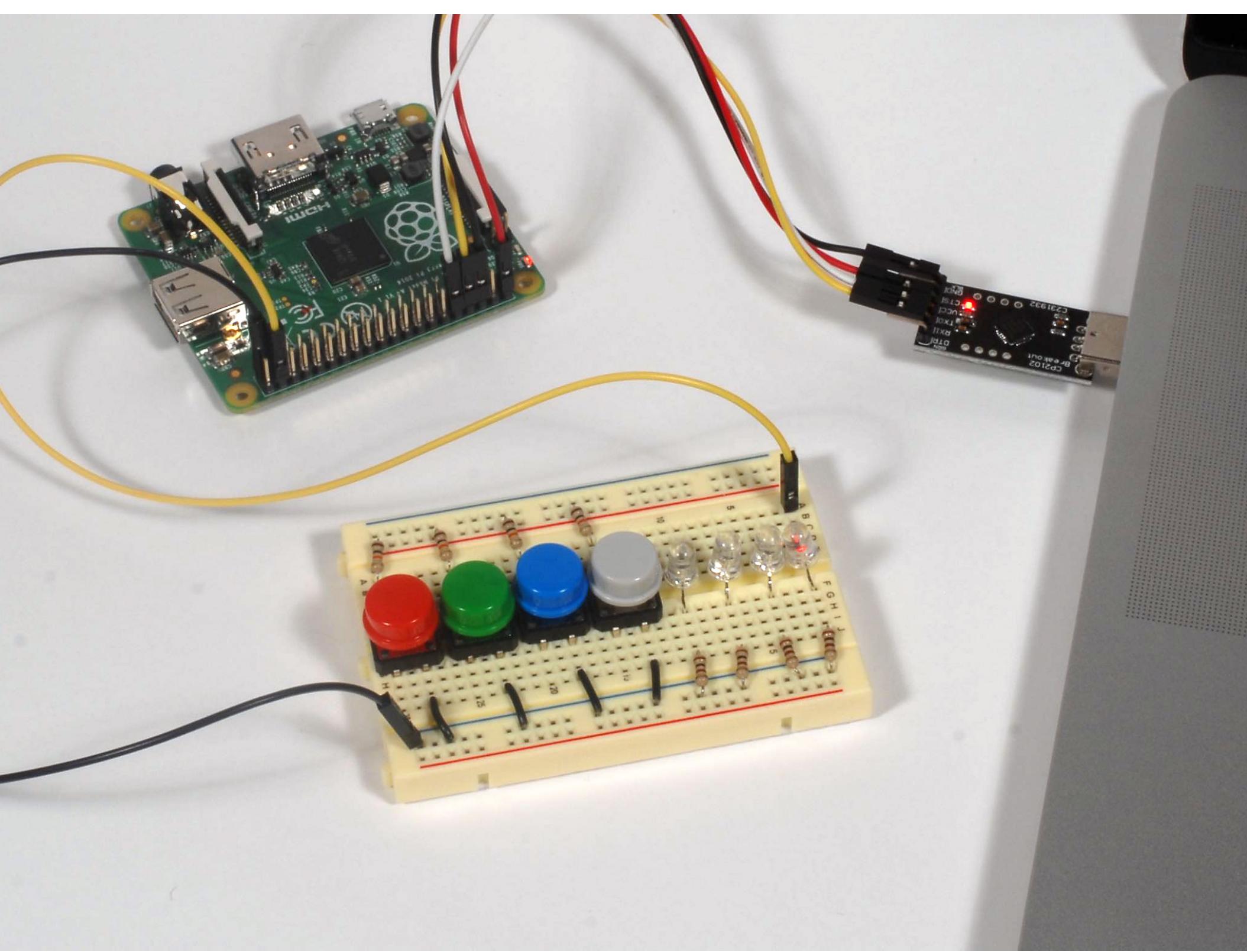
Definition: Bare metal programming involves no operating system (programmer constructs libraries)

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



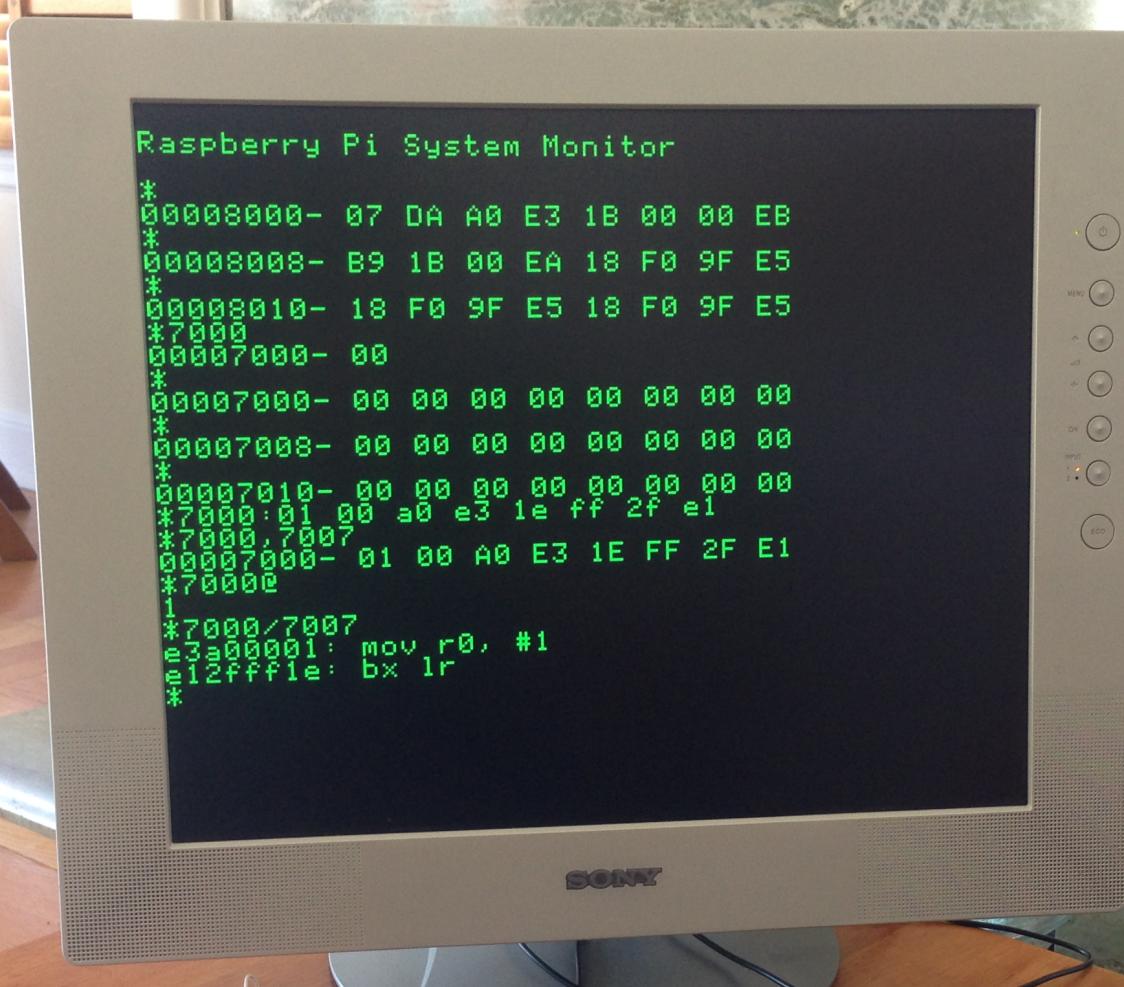
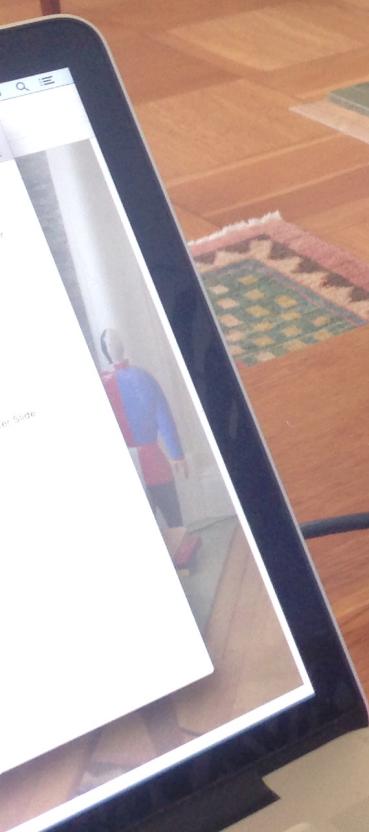
Raspberry Pi Kit





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  
*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, python

gcc

as

ld

binutils: nm, size, ...

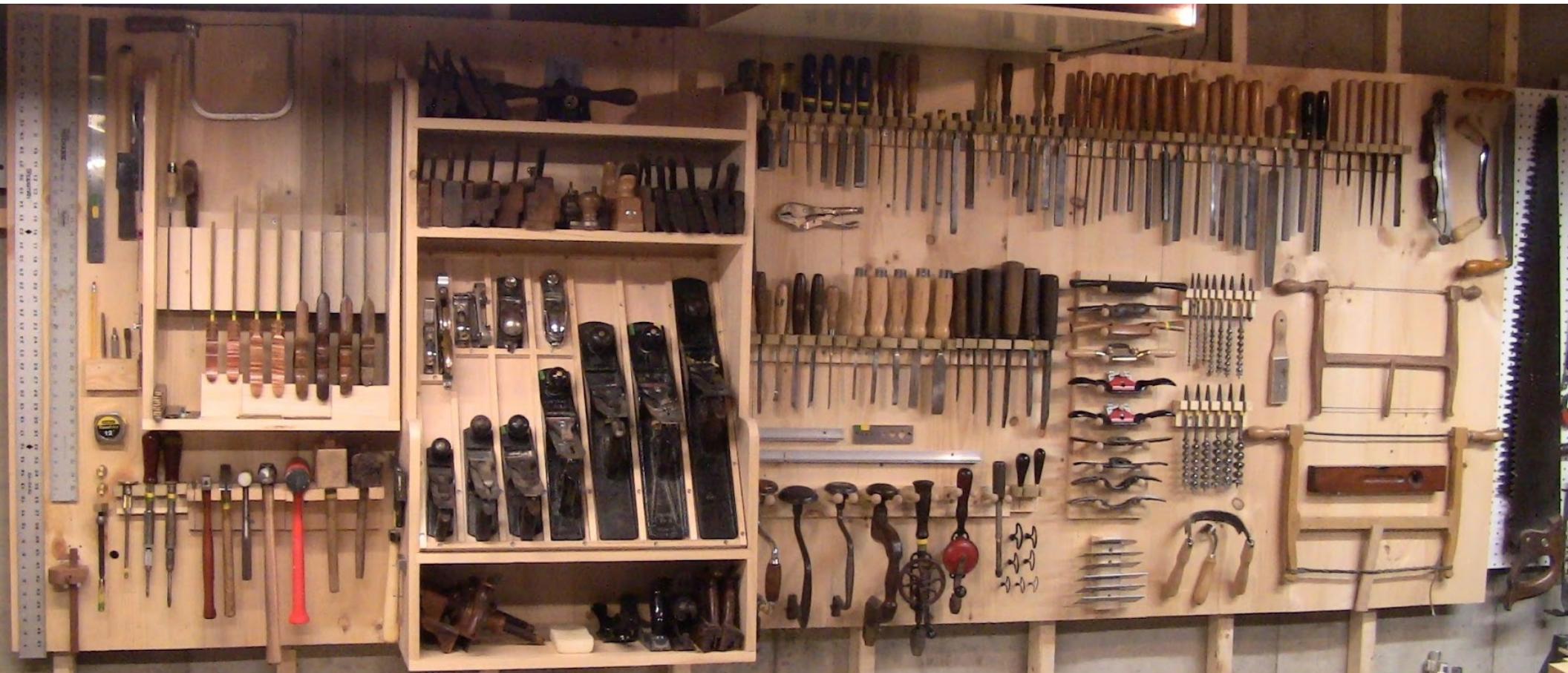
make

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 that is resting on a larger, light-colored wooden board. The background shows a workshop environment with various tools and equipment.

Master the Craft

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

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

- 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 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: \$50 (the kit is yours)

Assignments

7 assignments

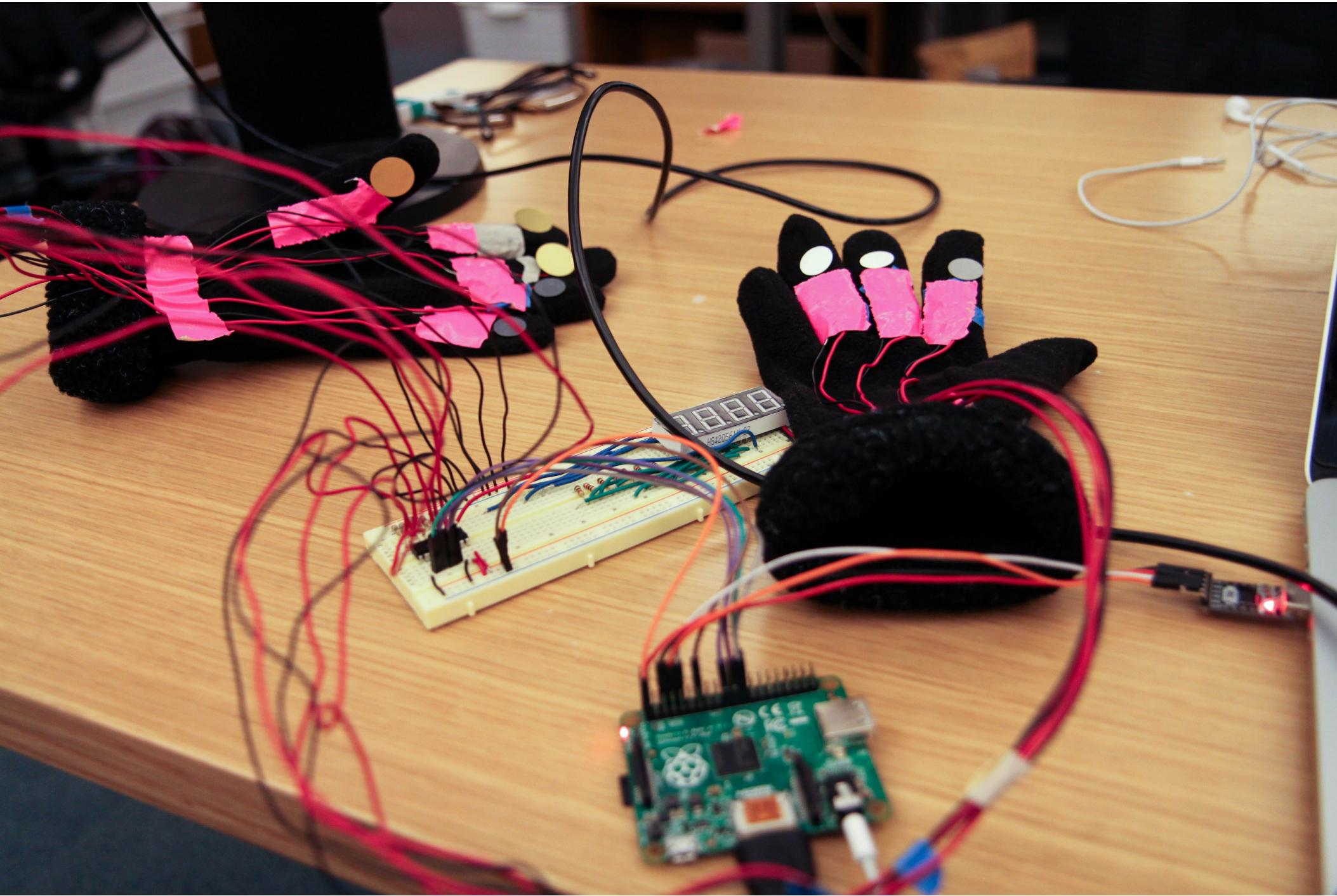
- Build on each other

Two parts for each assignment

- Basic
- Extension

Final project

NO EXAMS



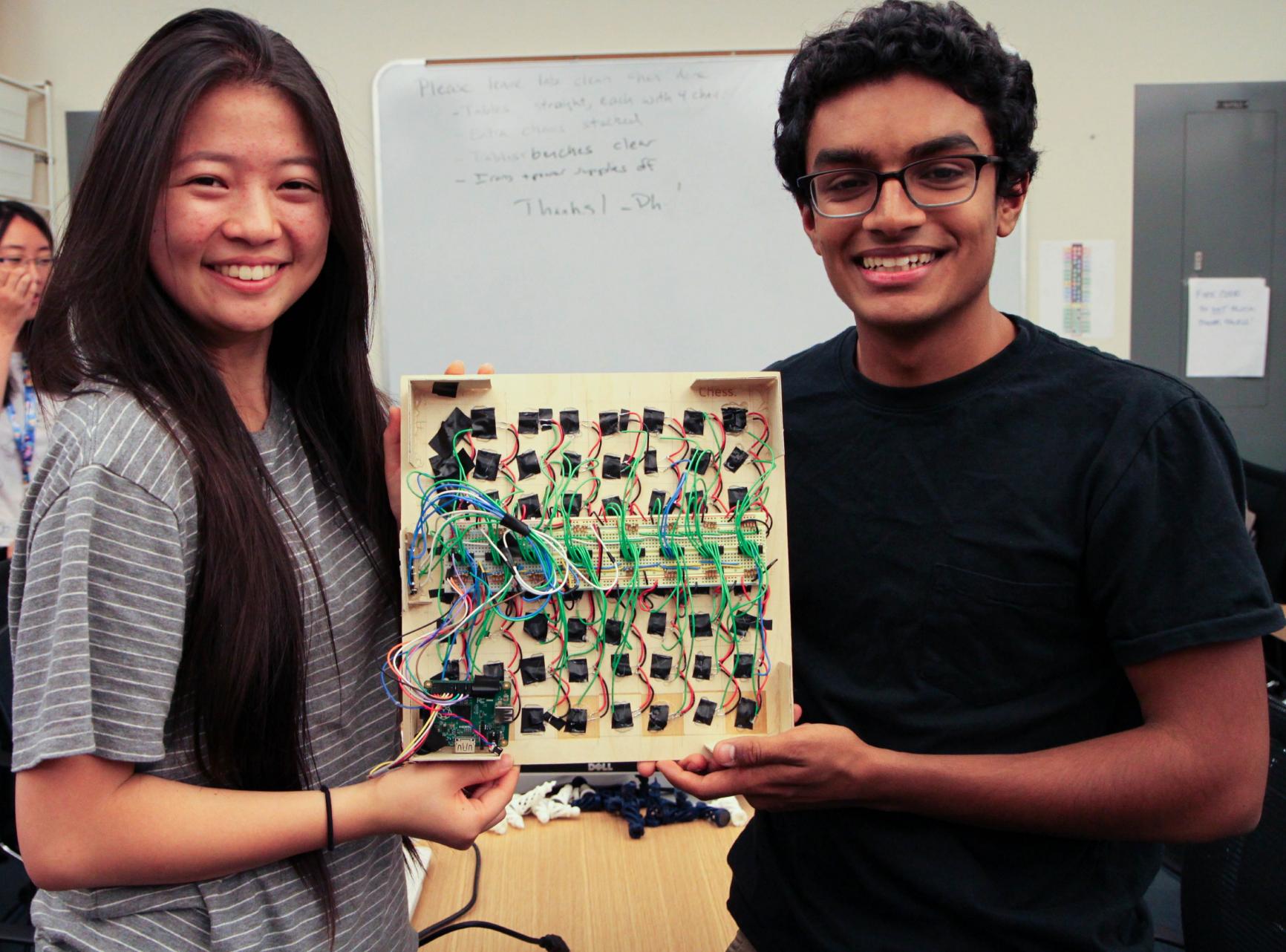




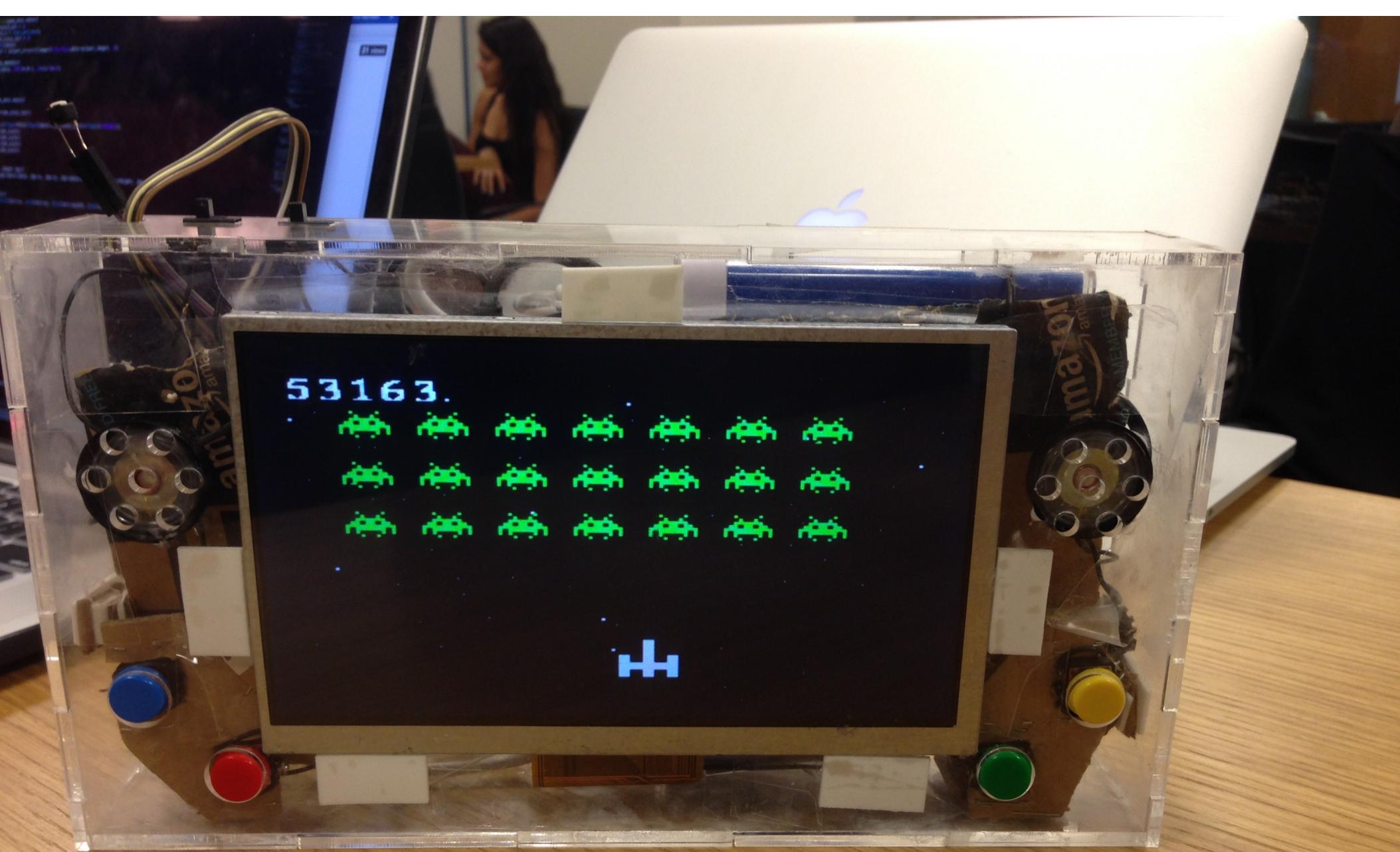
Do Not Observe the
Electrical Panel

Please leave the clean "bar" area
-Tables straight, each with 4 chairs
-Extra chairs stacked
-Tissue boxes clear
-Irons + ironing supplies off

Thanks! -Dh!







First Week

Assignment 0

Subscribe to cs107e in piazza

Attend cs107 UNIX labs

Assignment 0

- Using git and github
- Submit your lab preference

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: Attend cs107 labs this week

Questionnaire

Will email "Accepts" by Tue