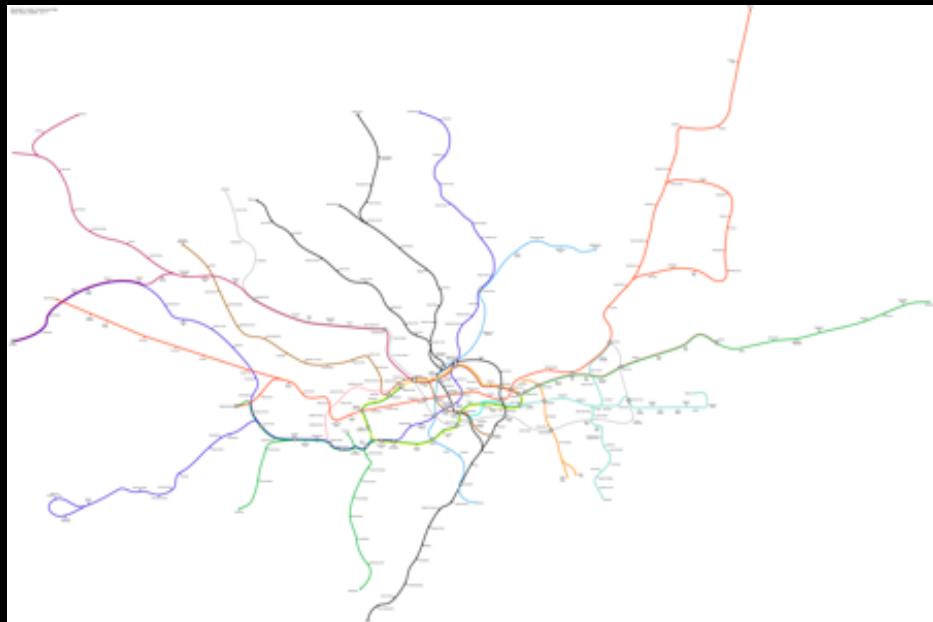


Single Board Computers

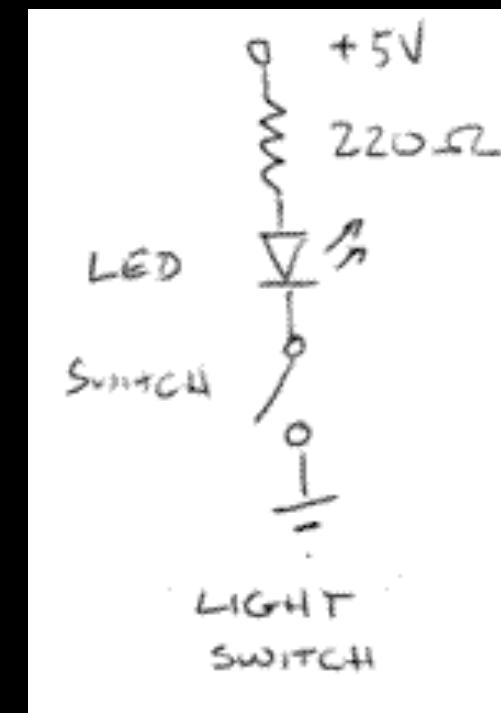
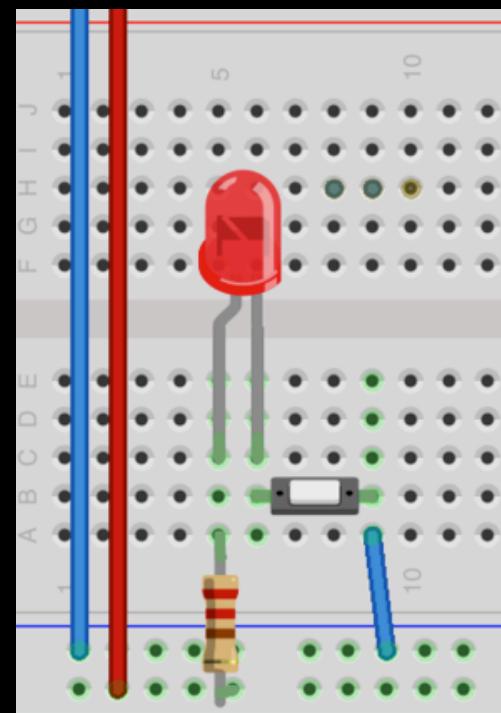
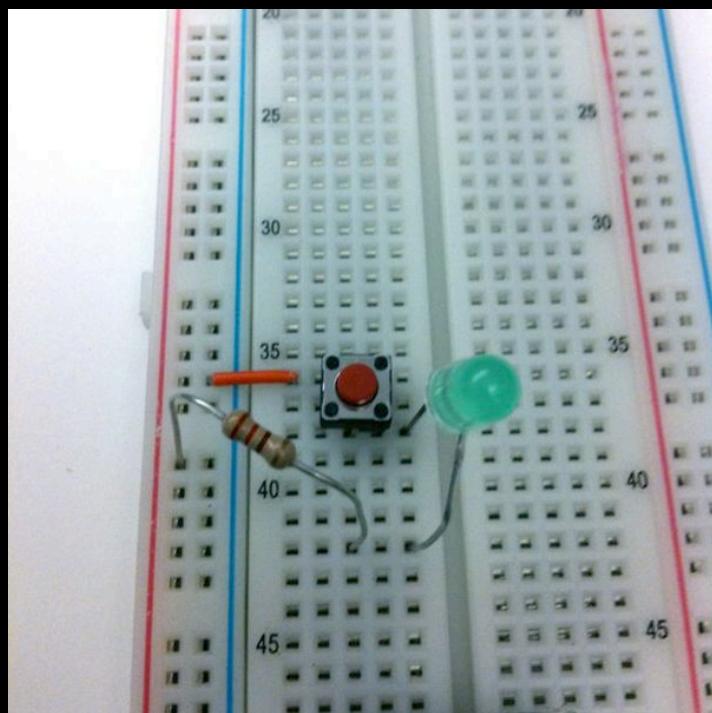
Best Practices

Developing & Designing Interactive Devices
January 31, 2018

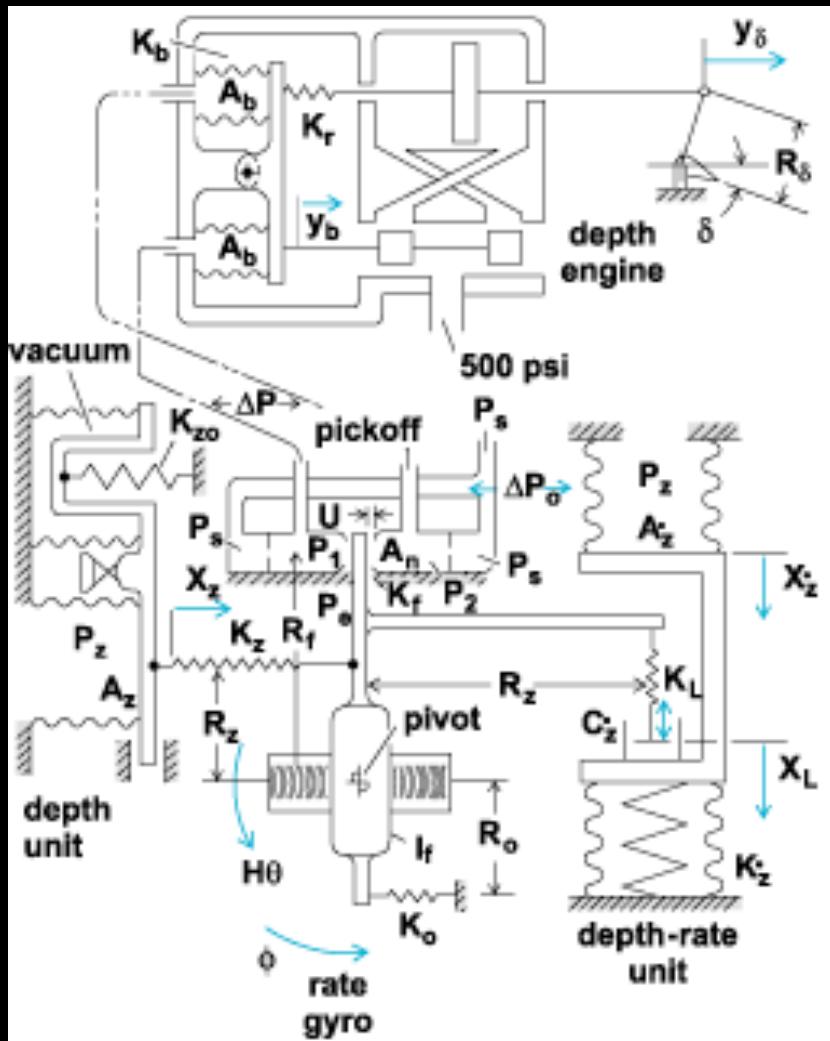
Abstraction & Sketching



images from solo2.abac.com/themole/geo_tubemap.gif



images from <http://gizmolab.pbworks.com/Arduino-Tutorial-1%3A-Buttons-and-LEDs>



Subscripts:

- | | |
|------------------------------------------|---------------------------------|
| b = differential-pressure bellows | o = ground, or reference |
| e = environment | r = ram feedback |
| f = flapper | s = supply |
| L = depth-rate linkage | z = depth unit |
| n = nozzles | ż = depth-rate unit |
| | δ = elevator |

images from <http://www.answers.com/topic/schematic-diagram-graphic-arts>



images from www.sapdesignguild.org/

What is in a computer?

CPU

Memory

I/O controllers

External storage

Raspberry Pi

From the UK, specifically for education

15 million sold (as of July 2017) * Raspberry Pi Foundation,
3rd best-selling general purpose computer

Microprocessor: ARM-based CPU, on-chip GPU

Storage: SD card

Audio, Video output: 3.5mm headphone, HDMI

Peripheral IO: USB

Networking: 802.11n, Ethernet, Bluetooth

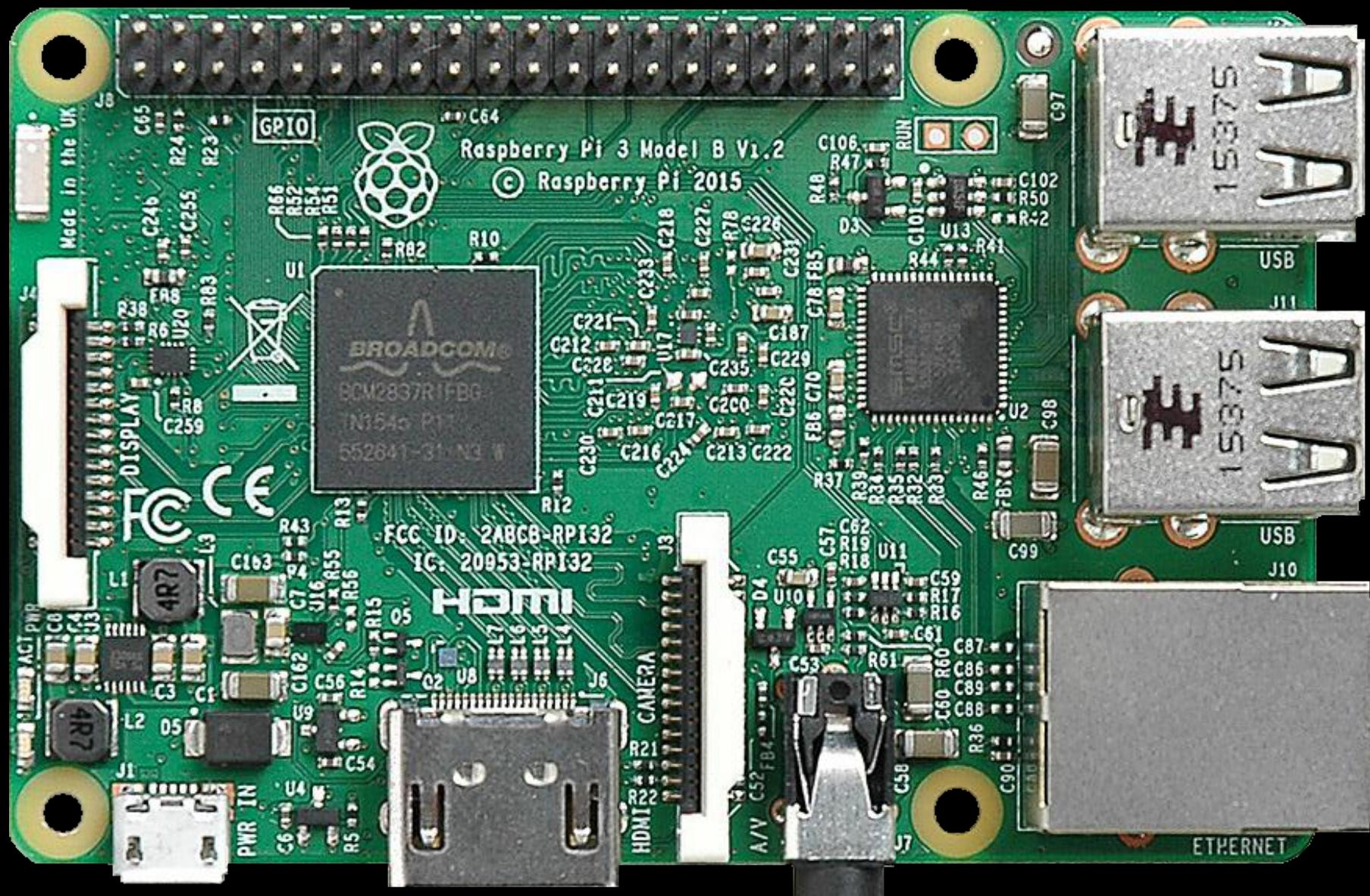


photo from Wikimedia, user Herbfargus

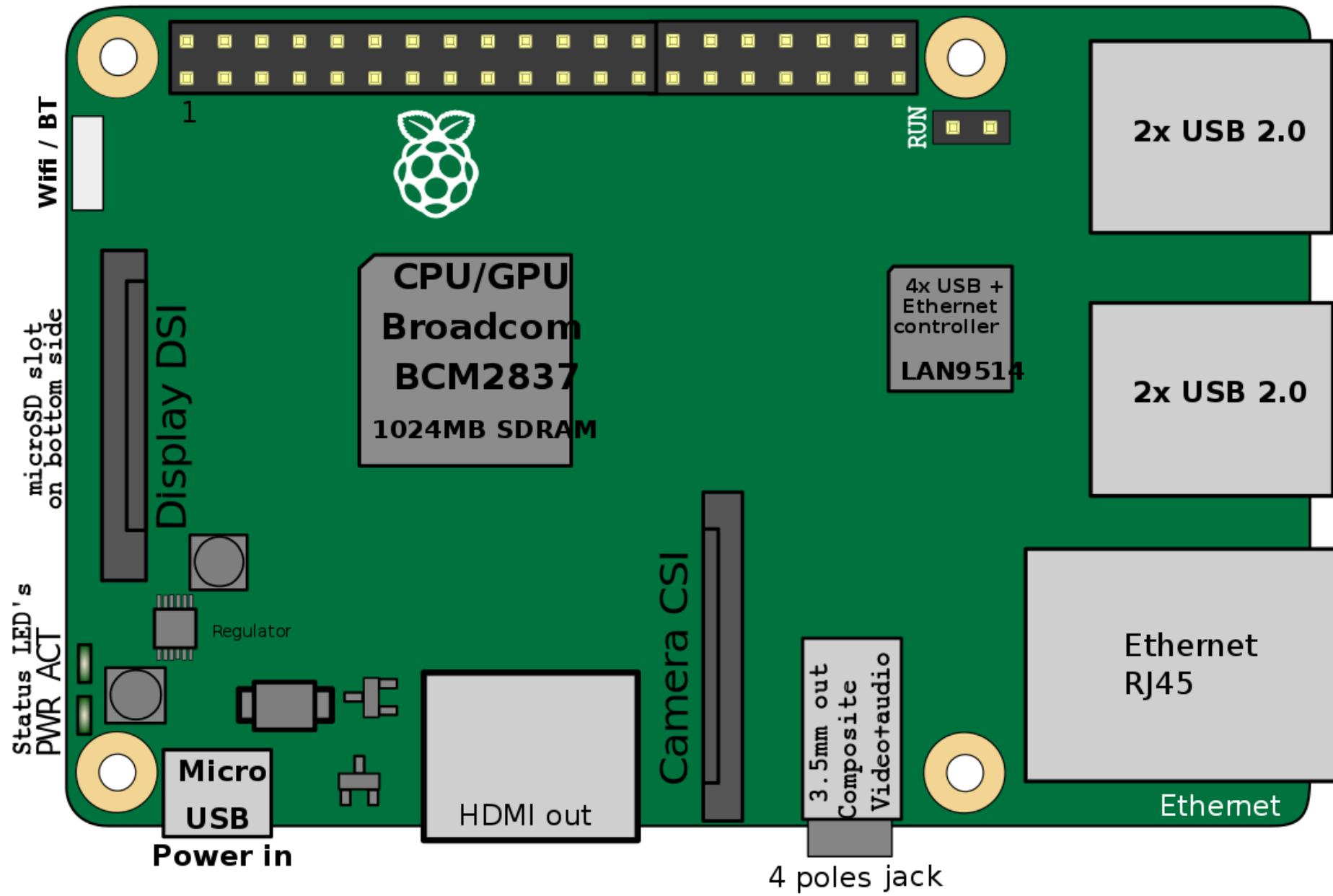


diagram from Wikimedia, user Era

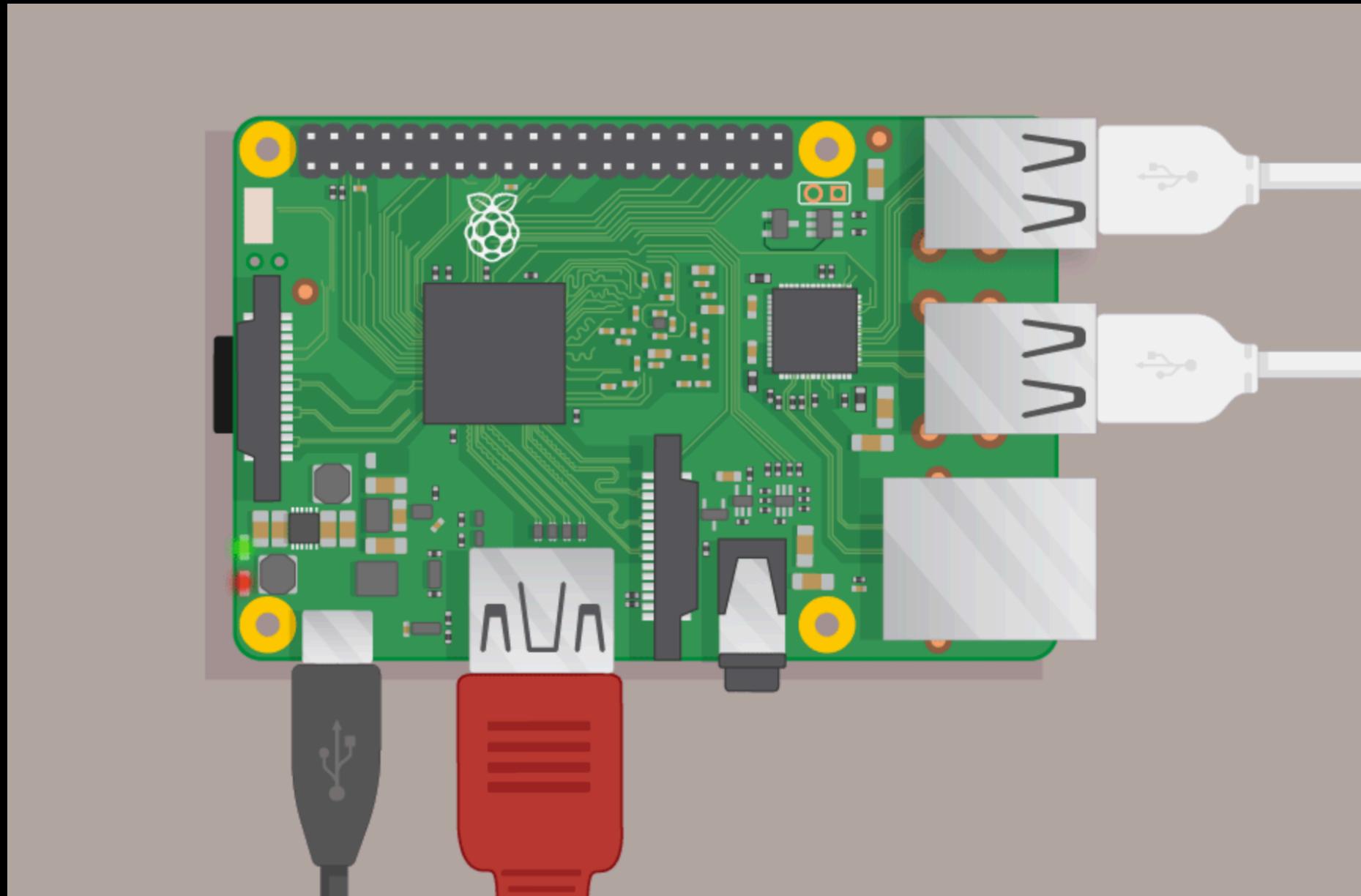


diagram from [RaspberryPi.org](https://www.raspberrypi.org)

Raspberry Pi

Uses normal computer connectors, peripherals

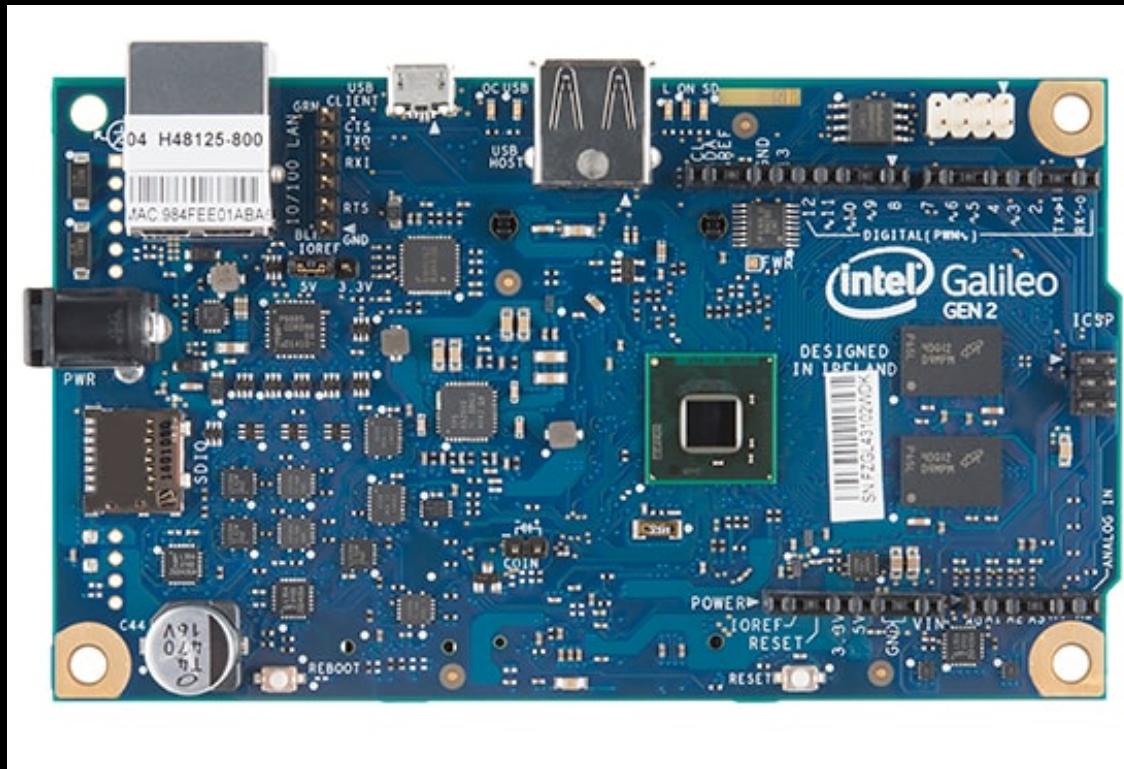
Target price: \$35

Community

Alternatives

What are competitors to the
Raspberry Pi?

Intel Galileo 2



Not currently in production, was \$70 MSRP
Used Pentium-based (X86) Quark
Yocto Linux or Windows 10
No video support

image courtesy of Intel

Beagleboard-XM

Based on ARM Cortex

Originally more
powerful than Raspberry
Pi

\$150 MSRP

Low power consumption

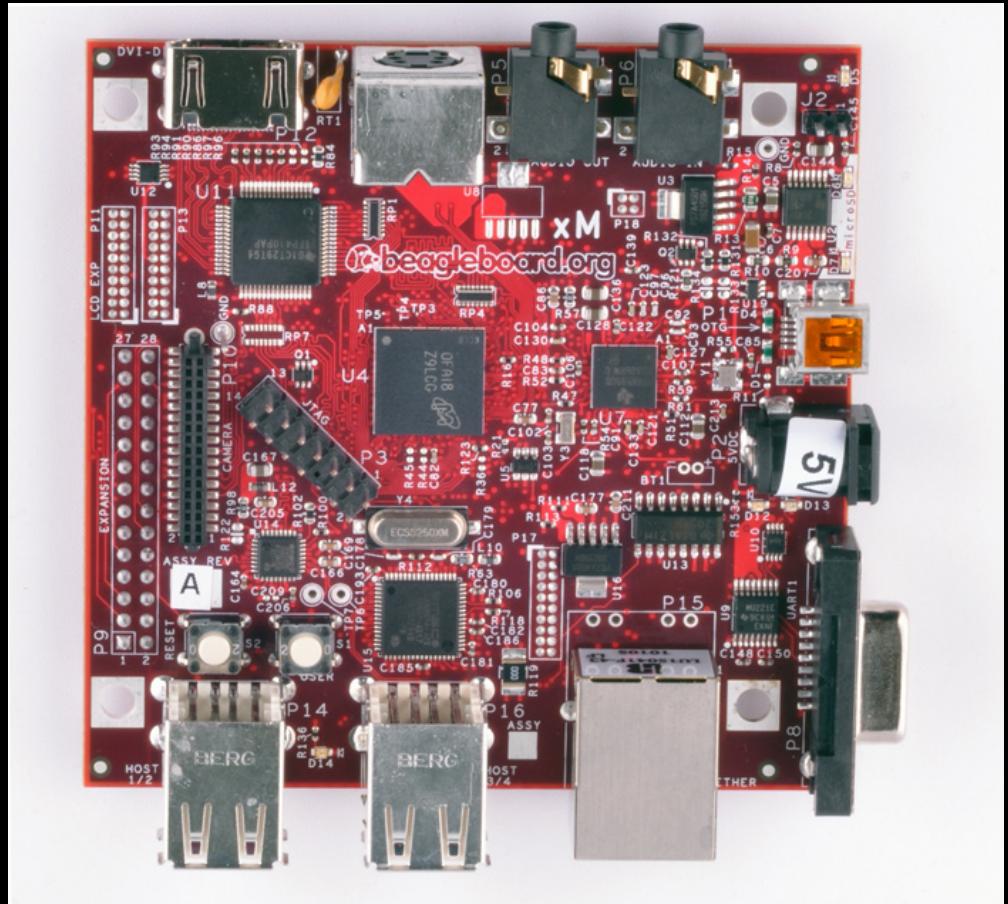


image: <http://beagleboard.org/beagleboard-xm>

Minnowboard Turbot

Based on Intel Atom

~\$150 MSRP

Focus on product integration

Open hardware

Supports Windows,
Linux, Android

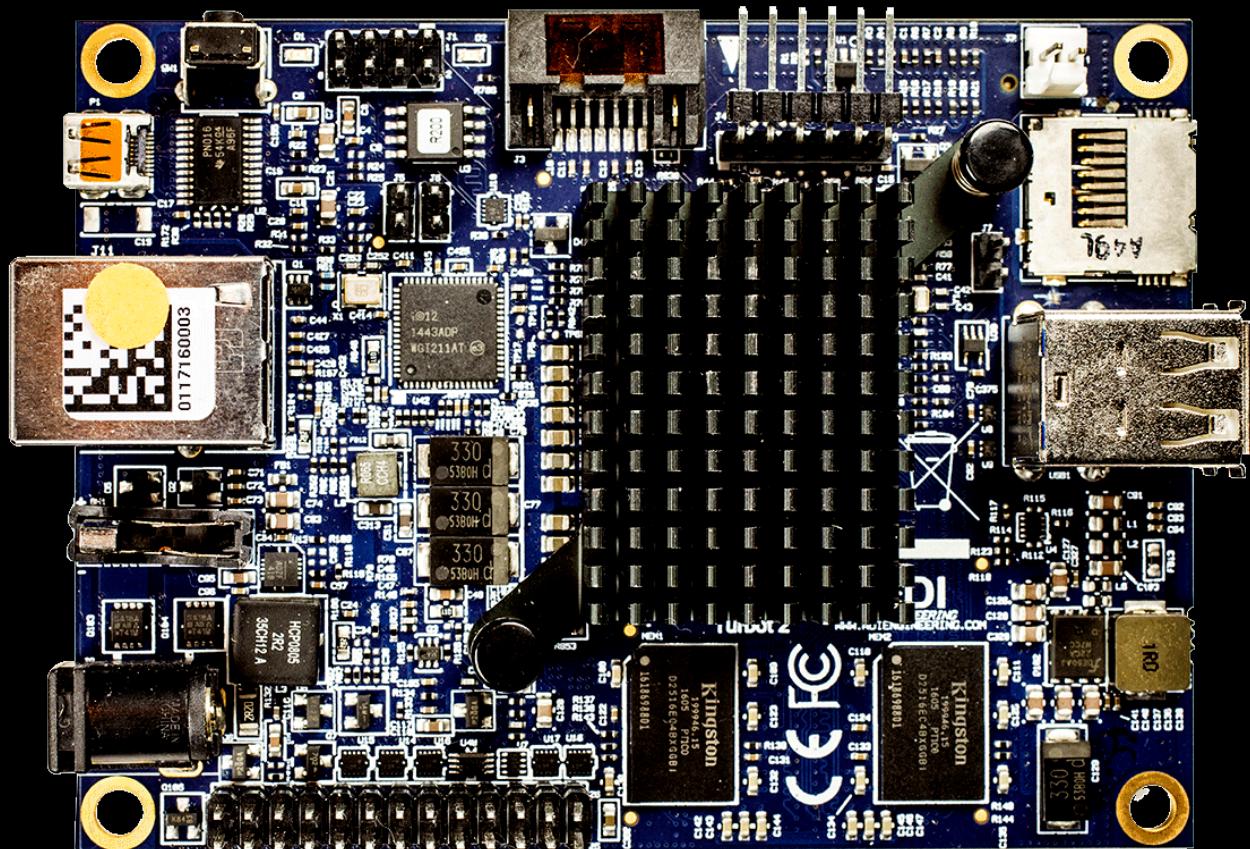


image: <https://minnowboard.org/minnowboard-turbot/technical-specs>

ODROID-XU4

Based on ARM Cortex

~\$60 MSRP

More powerful than Pi

Open hardware- less
community support

Supports Linux, Android



image: <http://www.hardkernel.com/main>

Community consensus

What are the best Raspberry Pi alternatives?

<https://www.slant.co/topics/6106/~raspberry-pi-alternatives>

image: <http://www.hardkernel.com/main>

Alternatives

Criteria for selection:

- Price
- Power consumption
- Availability
- Product roadmap
- Community
- Software support
- Operating System

Operating Systems

User Interface

3rd party software availability

Ability to integrate peripherals

Linux



Based on UNIX command set

Began in 1991 as personal project of Finnish student Linus Torvalds to make a free OS kernel based on the x86

Free

Open source

image: December 2002 issue of Linux Magazine, retrieved from Wikipedia

Android



“Linux makes up the core part of Android, but Google hasn’t added all the typical software and libraries you’d find on a Linux distribution like Ubuntu. This makes all the difference.”

Android allows central vetting of applications.

Windows Embedded (formerly WinCE)



"This is the review, but here's the takeaway: run. Run as fast as you can away from Windows IoT. It's not worth your time unless you have a burning desire to write apps for Windows, and even then you could do a better job with less effort with any Linux distro."

<https://hackaday.com/2015/08/13/raspberry-pi-and-windows-10-iot-core-a-huge-letdown/>

Before the dawn of GUI

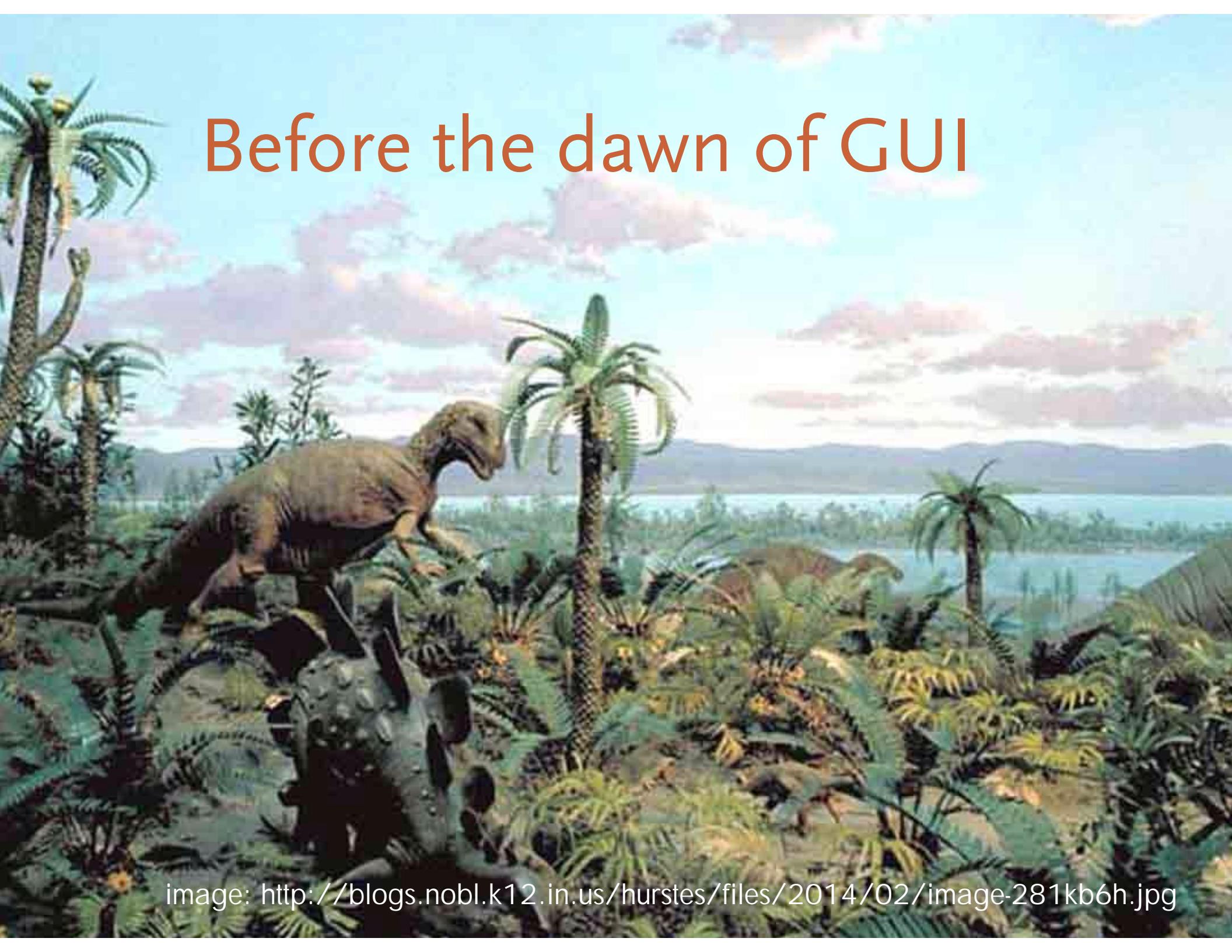
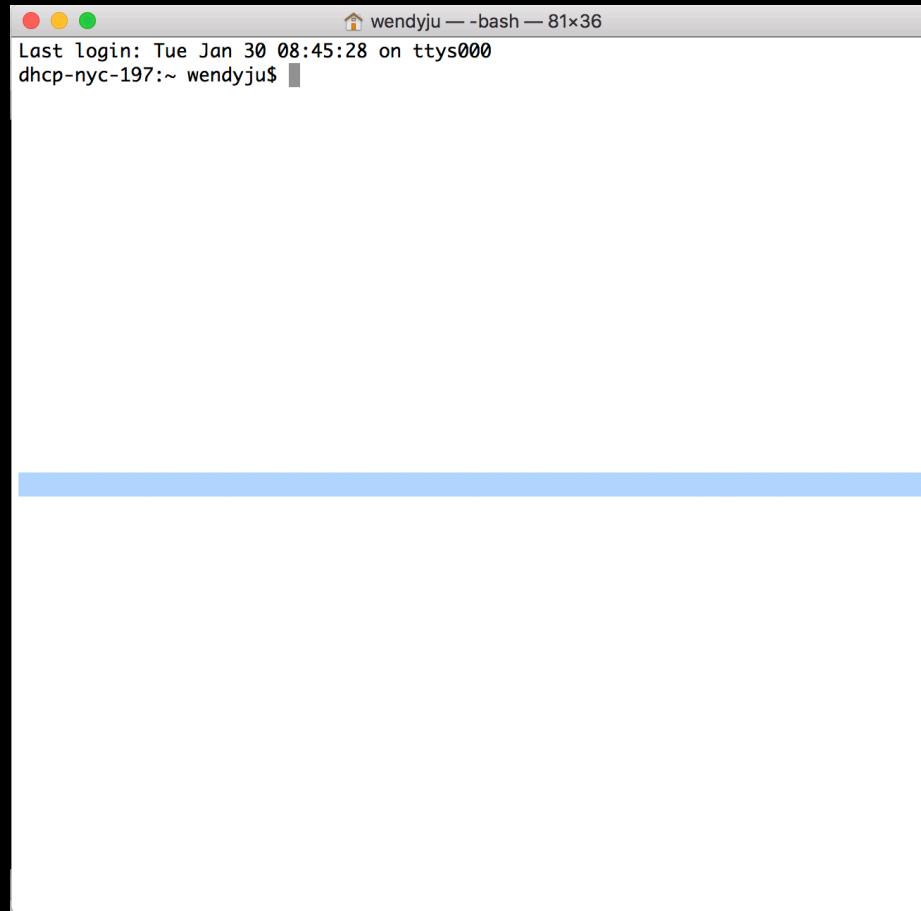


image: <http://blogs.nobl.k12.in.us/hurstes/files/2014/02/image-281kb6h.jpg>

Before the dawn of GUI



Demo in Terminal (Window users can use PuTTY)

Unix Commands

ls
cd
mkdir
cp
mv
rm
cat

Tab complete
History
Background jobs

Unix Commands

ssh - secure shell

scp - secure copy

Hardware & Software Best Practices

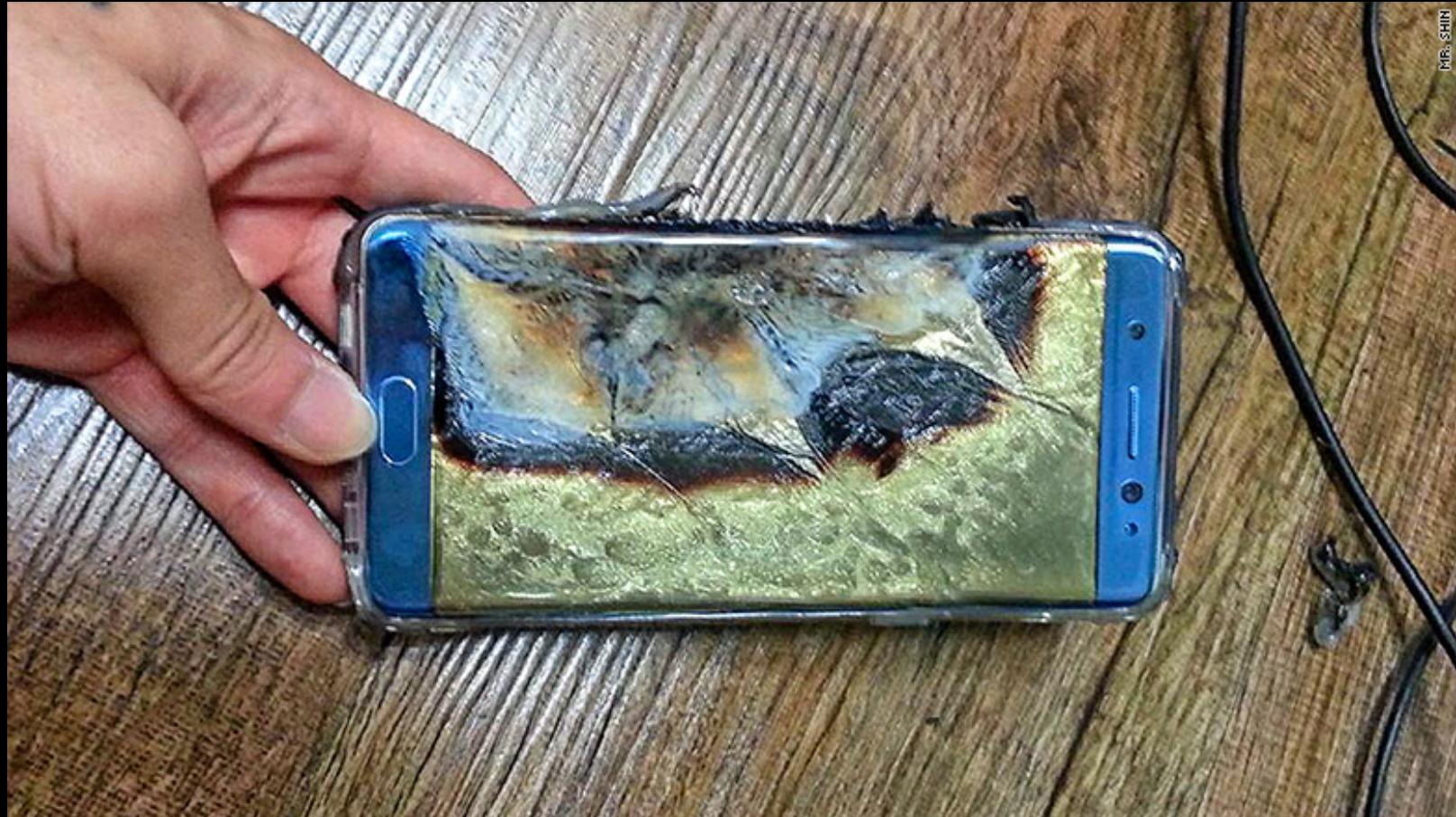


image: <http://money.cnn.com/2016/09/14/technology/samsung-galaxy-note-7-software-update-battery-fires/index.html>

Electronics safety



Electronics hazards

Low voltage DC v. 110V AC current
-battery vs. wall power

Electrical short circuits

Shock

Thermal hazards

Drop hazards: cover your feet

Electronics safety

Maintain a tidy work environment

- take time to keep things organized
- little metal chips and things can cause shorts
- check the ground beneath your feet

Route wires and cables mindfully

- make sure it's easy to debug
- stray wires cause malfunctions, shorts

Be vigilant about soldering irons, glue guns, knives

Invisible hazards: Air quality! Lead!

Electronics safety

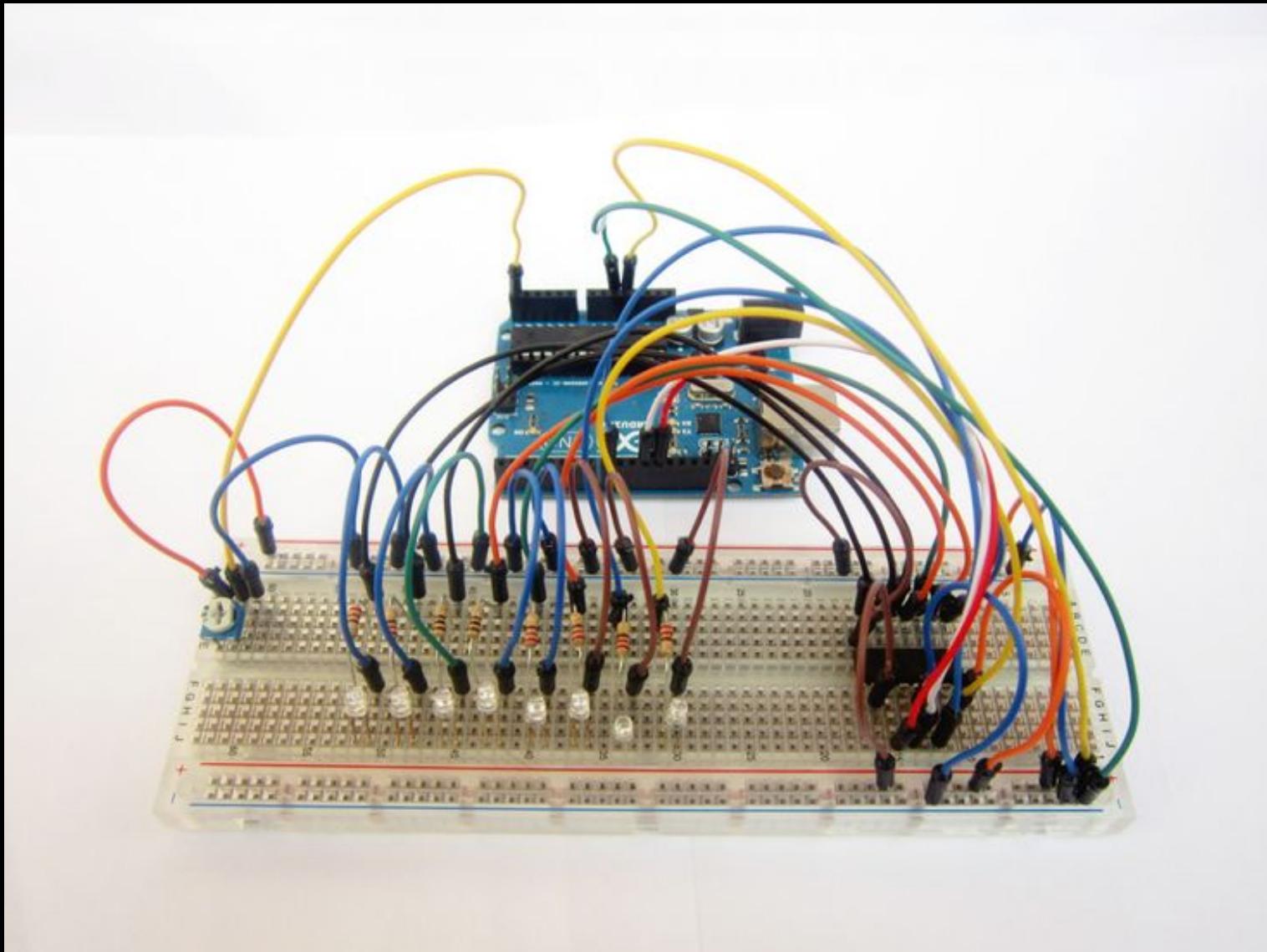


image: <https://www.pinterest.com/pin/483433341233065804>

Electronics safety

Collin's Lab: The REAL Breadboard



▶ ▶ 🔍 3:44 / 4:45

CC HD 🔍

image: <https://www.youtube.com/watch?v=HrG98HJ3Z6w>

Electronics safety

Check yourself

- be aware of tingles, heat, smells
- eye, ear, hair, foot protection
- remove dangling items

Keep the magic smoke in

Don't believe everything you read on the internet

Electronics safety

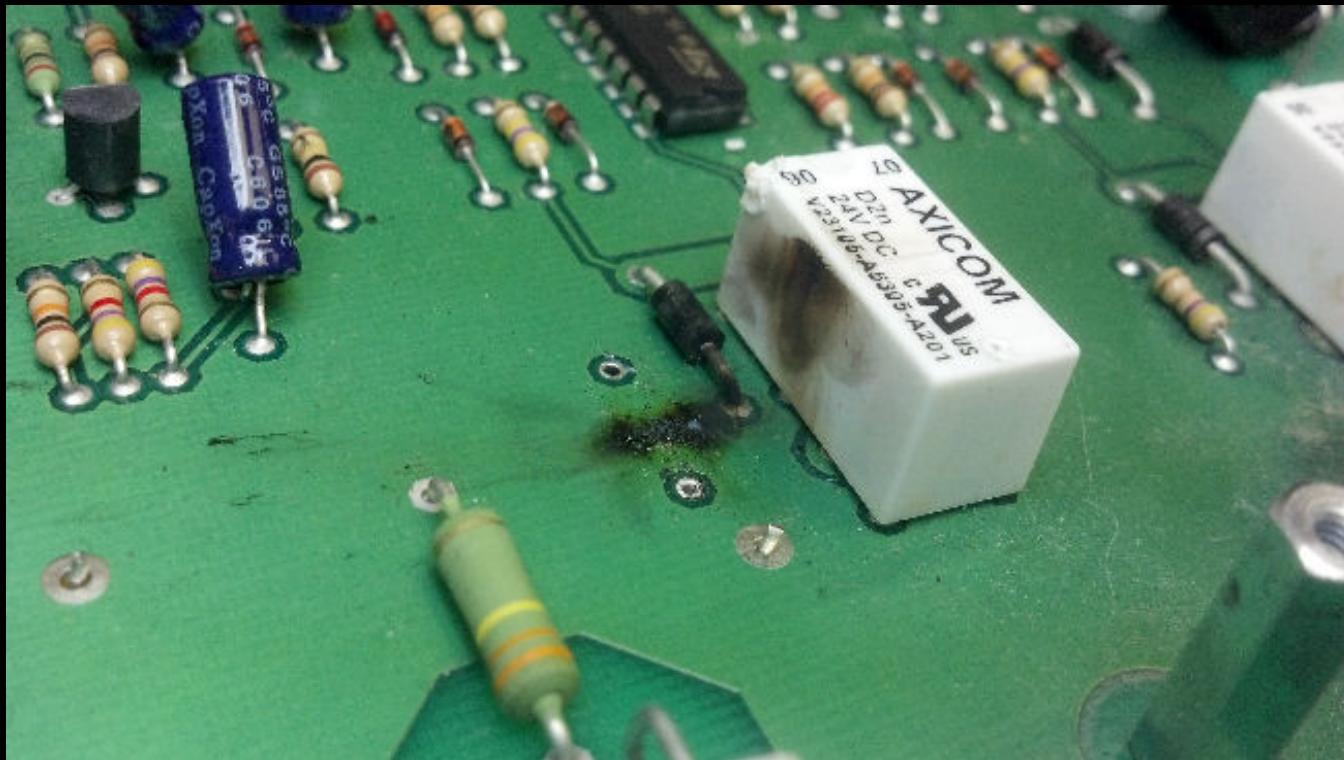
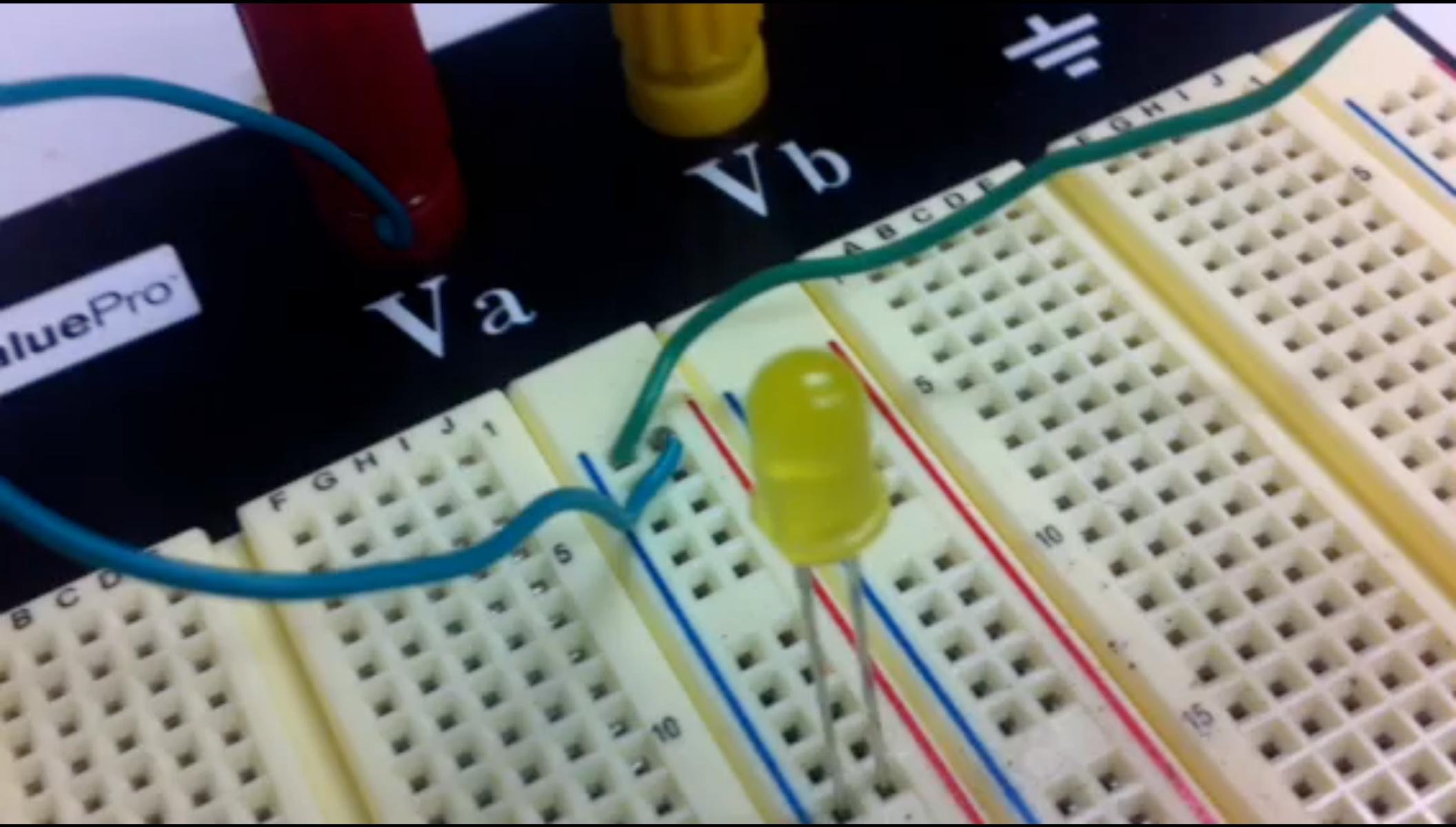


image:<https://www.unbrokenstring.com/engl-fireball-amp-head/>



Hardware safety



image: <https://visual.ly/community/infographic/other/5-essential-safety-tips-power-tools>

Hardware safety

Using classroom as lab

- power
- burn marks
- first aid kit
- fire extinguisher

Software Best Practices

Start early

- bugs are best resolved with time rather than intensity
- time enables collaboration

Make a plan, keep the plan updated

- a plan will help you when you get lost
- a plan will help you remember what you did
- a plan helps others see where you went wrong

Software Best Practices

Don't code alone

- do not beat your head on problem for more than 1 hour
- see if anyone else has had your problem
- use Blackboard, email to get help

Documentation

- write down your sources
- when you hit an error and resolve it, write it down
YOU WILL SEE IT AGAIN

Commit & Push often