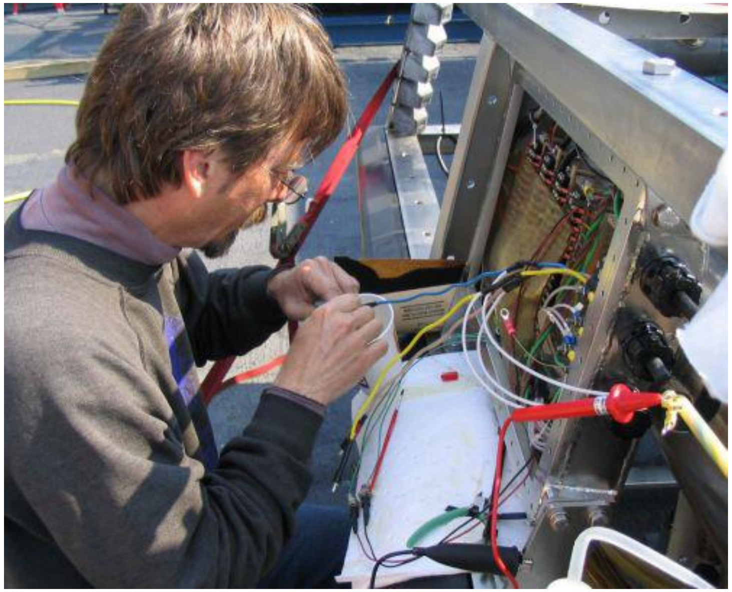
A Light and An API

An Intro to Physical Computing

I’m an electrical engineer!

(like this)



(not like this)

SONOS

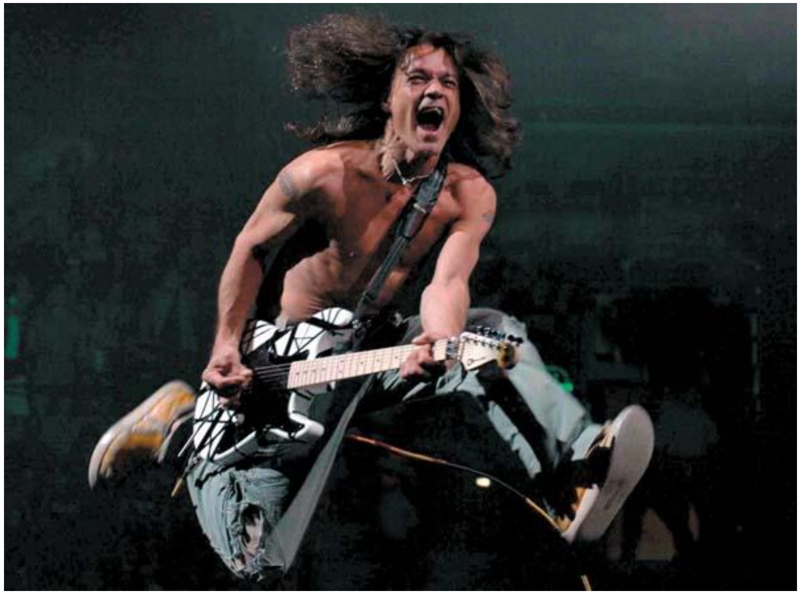
THE WIRELESS HiFi SYSTEM

(we’re hiring!)

I’m a musician!

(like this)

(not like this)



I love beer!

(like this) (and this) (and this) (and this)

(And I’d love to grab one and chat after this!)

Conspicuously absent from this list…

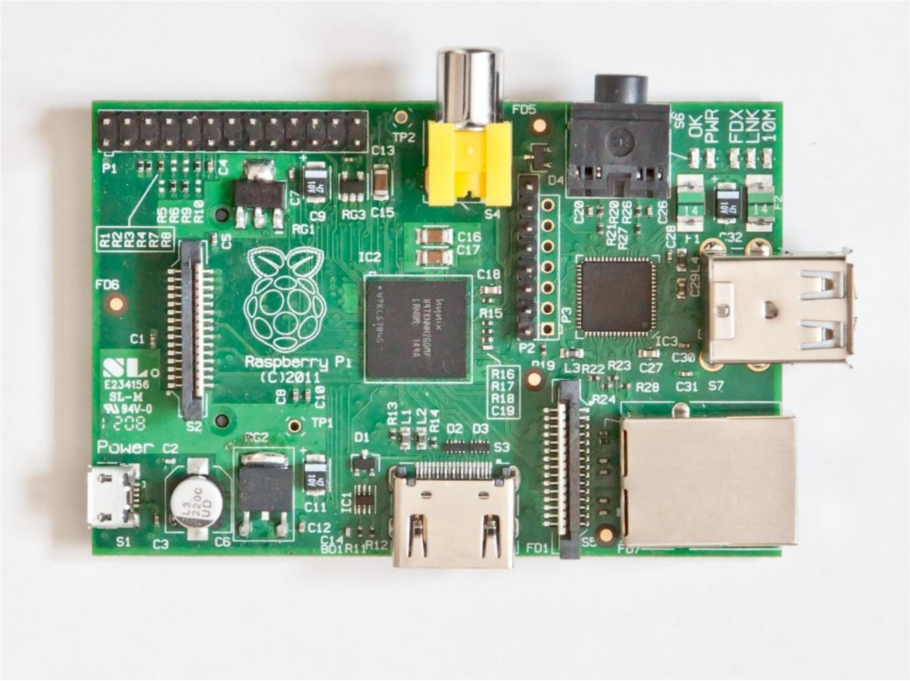
(professional software developer)

Conspicuously absent from this list…

(pro per)

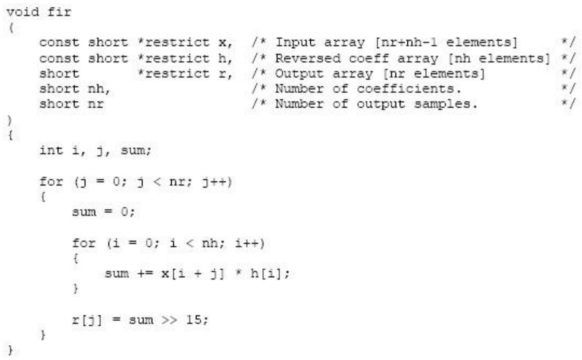
Why Raspberry Pi?

- Cheap!
- Networked!
- Python comes standard!



Why Python?

- Easy to do interesting things
- Easy to come back to after a few weeks
- C is ***hard***

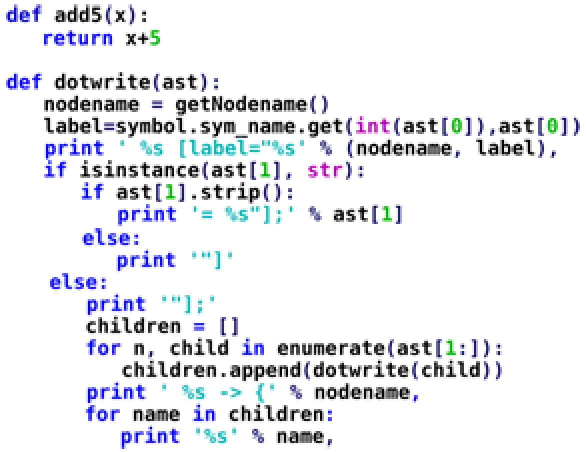


```c
void fir
(
    const short *restrict x,  /* Input array [nr+nh-1 elements]     */
    const short *restrict h,  /* Reversed coeff array [nh elements] */
    short       *restrict r,  /* Output array [nr elements]         */
    short nh,                 /* Number of coefficients.            */
    short nr                  /* Number of output samples.          */
)
{
    int i, j, sum;

    for (j = 0; j < nr; j++)
    {
        sum = 0;

        for (i = 0; i < nh; i++)
        {
            sum += x[i + j] * h[i];
        }

        r[j] = sum >> 15;
    }
}
```



```python
def add5(x):
    return x+5

def dotwrite(ast):
    nodename = getNodename()
    label=symbol.sym_name.get(int(ast[0]),ast[0])
    print ' %s [label="%s' % (nodename, label),
    if isinstance(ast[1], str):
        if ast[1].strip():
            print '= %s"];' % ast[1]
        else:
            print '"]'
     else:
        print '"];'
        children = []
        for n, child in enumerate(ast[1:]):
            children.append(dotwrite(child))
        print ' %s -> {' % nodename,
        for name in children:
            print '%s' % name,
```

A Quick Overview

- Project 1 – Blink an LED
- Project 2 – Track the 87 Bus
- Project 3 – Sonos Alarm Clock
- Q/A

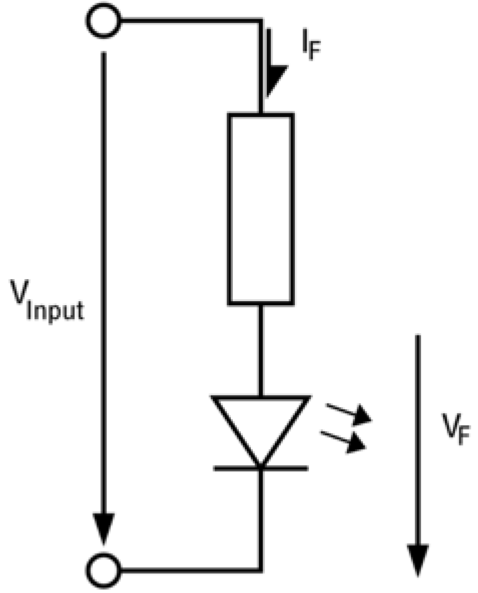
Blinking an LED

- The “Hello World” of Hardware
- Blink an LED!

A Word of Warning

- The Golden Rule of LEDs and RPi – GPIO current
  - Vd = ~0.7V for most LEDs
  - Pick R wisely!

$$\frac{(3.3V - V_{diode})}{R} < 0.002\,A$$



- Don’t break your Pi! (or do, because that’s fun sometimes :D)

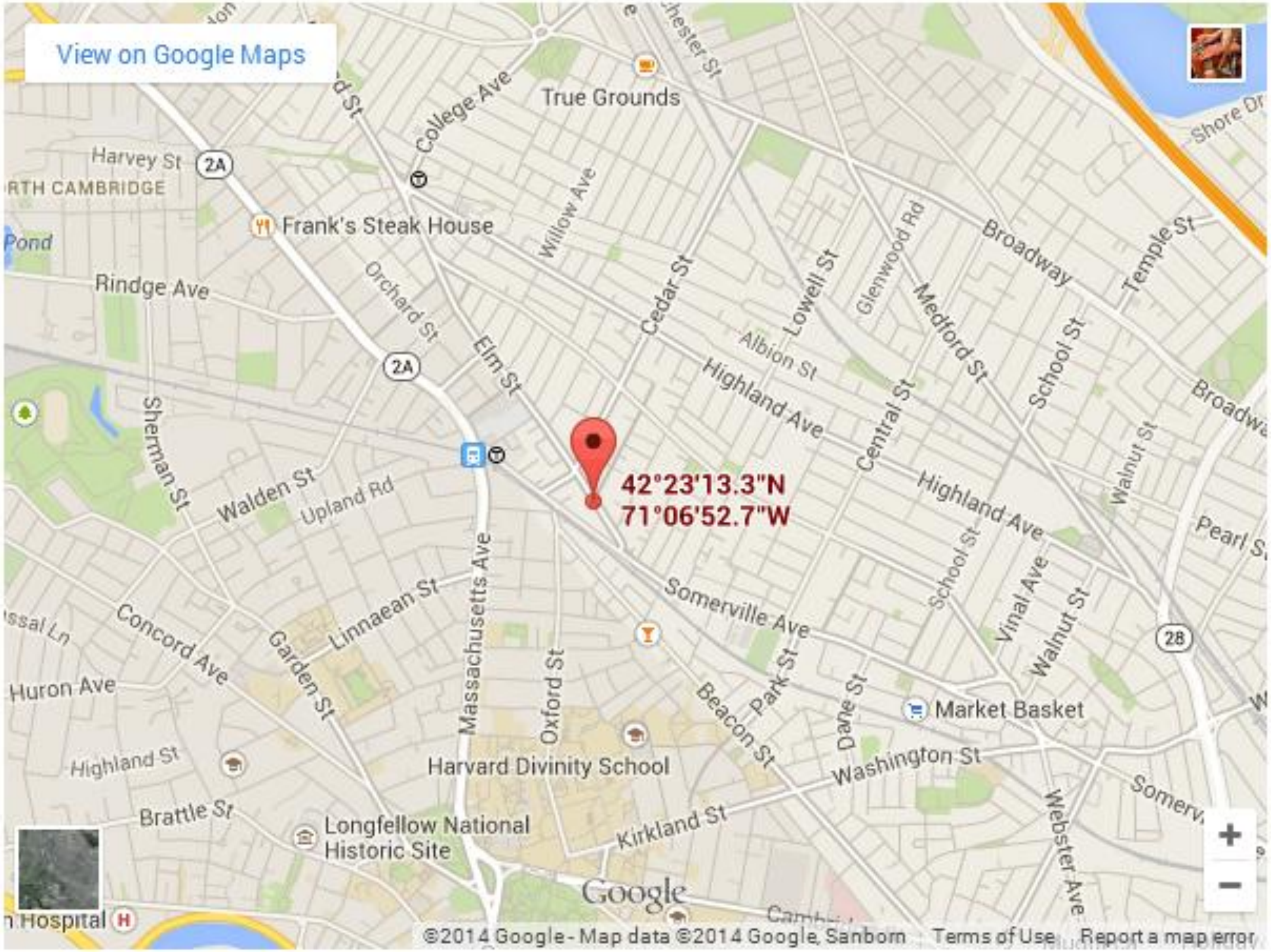
How Can We Make It Better?

Answer: Make the blinks mean something!

Blinking + Thinking

- Bus Tracker Physical Widget
  - Based on BostonBusMap Android app
- Blinks an LED when bus is en route
  - Red = inbound
  - Blue = outbound
- Get present bus location relative to Union and Davis Square

$$d = 2r \arcsin\left(\sqrt{\operatorname{haversin}(\phi_2 - \phi_1) + \cos(\phi_1)\cos(\phi_2)\operatorname{haversin}(\lambda_2 - \lambda_1)}\right)$$


View on Google Maps
42°23'13.3"N
71°06'52.7"W
True Grounds
College Ave
Harvey St
2A
RTH CAMBRIDGE
Frank's Steak House
Pond
Rindge Ave
Willow Ave
Orchard St
Elm St
Cedar St
Lowell St
Glenwood Rd
Albion St
Medford St
Broadway
Temple St
Shore Dr
School St
Highland Ave
Central St
Walnut St
Sherman St
Walden St
Upland Rd
Somerville Ave
Pearl St
Vinal Ave
28
ssal Ln
Concord Ave
Garden St
Linnaean St
Massachusetts Ave
Oxford St
Beacon St
Park St
Dane St
Market Basket
Huron Ave
Highland St
Harvard Divinity School
Washington St
Webster Ave
Brattle St
Longfellow National Historic Site
Kirkland St
Google
Hospital
+
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Report a map error

How Can We Make It Better?

- Higher Sampling Rate of Bus Positions
  - API is rate limited to a call every 10 seconds
- Predictive Analytics Based on Bus Logs
  - I log all of the bus distances and LED states using the logging module
  - Use pandas to tune LED turn on times

Sonos Alarm Clock

- I use my Sonos system as an alarm
- Snoozing/Sleeping The Alarm Isn’t Easy When Half Awake
  - Fumbling through the UI sucks
  - Running across the room sucks more
- Solution – make a networked bedside alarm clock based on RPi

How Can We Make It Better?

- Faster button press response
  - Add some debounce hardware
  - Replace some software with C for speed
- Better clockface
  - Bigger font for the time
  - Artist/Song/”Now Playing” information
- Better Wifi
  - Wifi signal could be factor in response speed
  - Signal could drop occasionally
- Better Casing

“What do you wish someone would make for you?”
- Paul Graham

- Questions?
- Keep in touch!
  - – Email – nrc.reilly@gmail.com
  - – Twitter - @cushychicken
  - – Github – github.com/Cushychicken
    - Also at cushychicken.github.io
    - You can find this presentation and source code there!