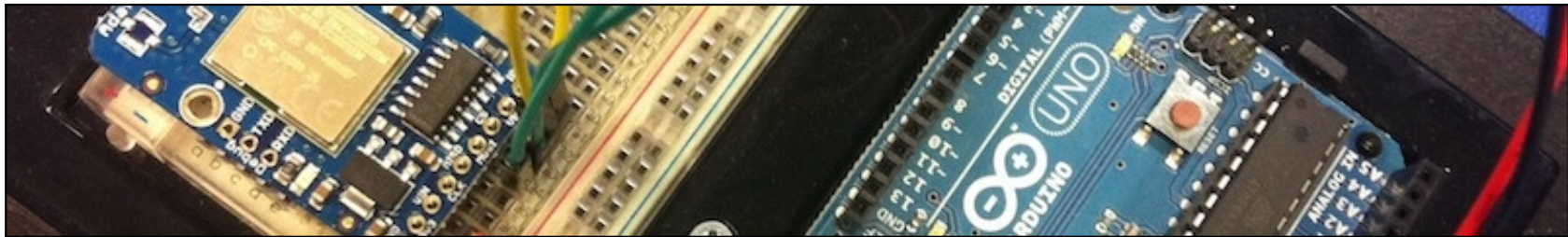


CURIE Academy 2014

Design Project: Exploring an Internet of Things



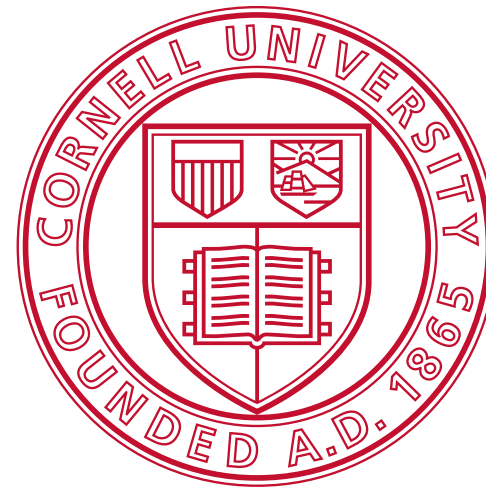
Christopher Batten
School of Electrical and Computer Engineering
Cornell University

<http://www.csl.cornell.edu/curie2014>

CURIE Design Project Sponsors



Funding partially provided by
the National Science
Foundation through NSF
CAREER Award #1149464



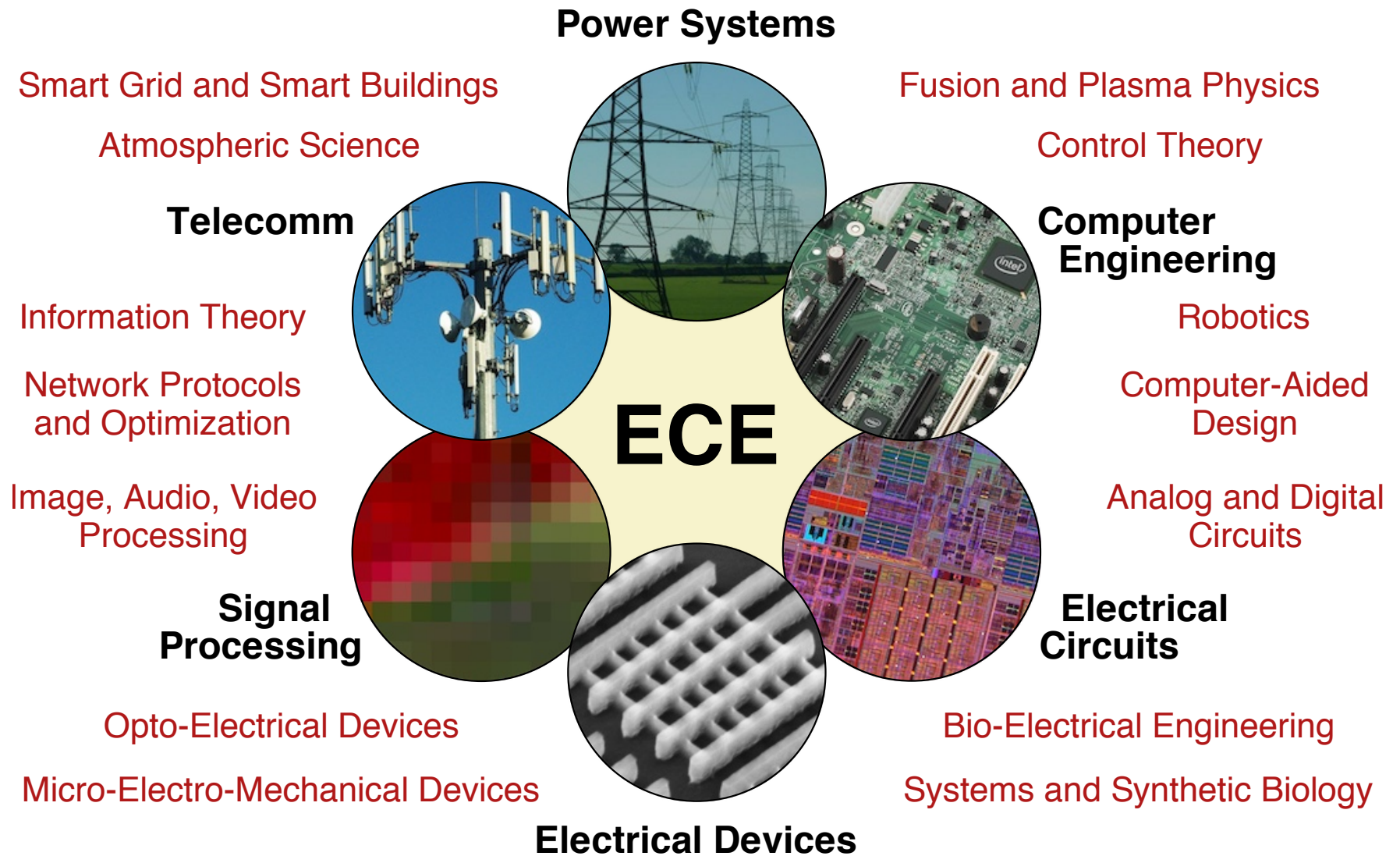
Laboratory facilities provided
by the School of Electrical
and Computer Engineering
at Cornell University

CURIE Design Project Staff

- ▶ Patrick Cao, ECE Sophomore
- ▶ Olivia Gustafson, ECE Senior
- ▶ Victoria Hu, BEE Sophomore
- ▶ Laura Johnson, ECE Ph.D.
- ▶ Christopher Torng, ECE Ph.D.
- ▶ Jon Tse, ECE Ph.D.



ECE is the Study and Application of Electricity, Micro-Electronics, and Electro-Magnetism

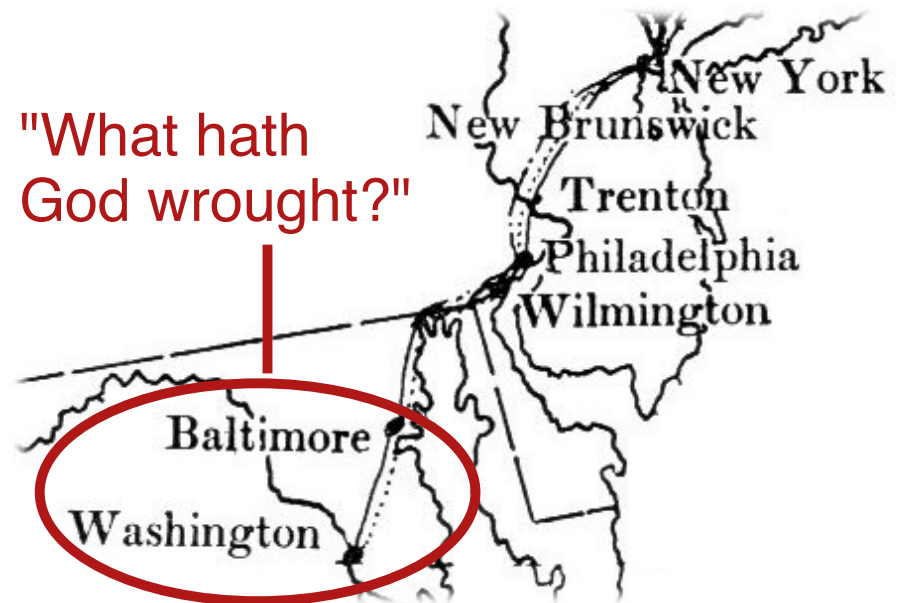


Cornell was founded because of ECE!

Samuel Morse invented the telegraph (a digital communication device), but needed help building the network



Ezra Cornell built the first telegraph line (the beginning of telecommunications), and invested in the Western Union Telegraph Co



Ezra Cornell's investments created the fortune that eventually enabled the founding of Cornell University

“Optional Homework”



- ▶ Visit the statue of Ezra Cornell on the Arts Quad
- ▶ Does something on the back of the statue relate to ECE?

Computer Engineering

Power Systems

Smart Grid and Smart Buildings

Atmospheric Science

Fusion and Plasma Physics

Control Theory

Telecomm

Information Theory

Network Protocols
and Optimization

Image, Audio, Video
Processing

Signal Processing

Opto-Electrical Devices

Micro-Electro-Mechanical Devices

Electrical Devices

Computer Engineering

Robotics

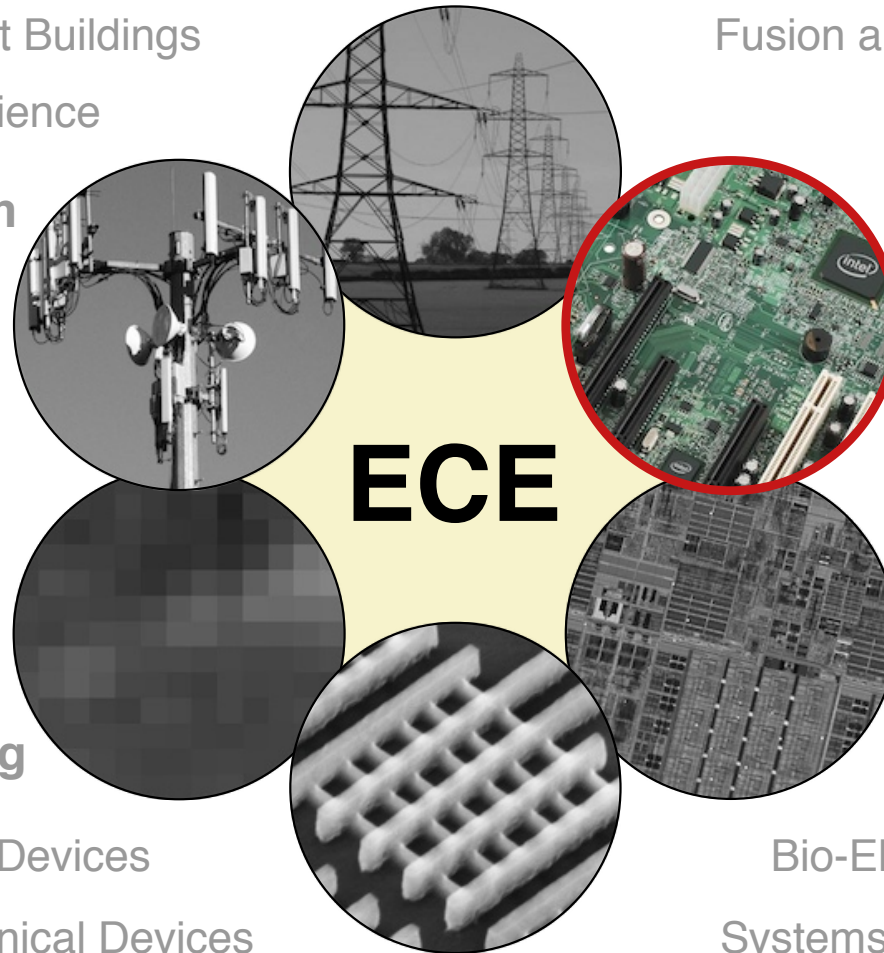
Computer-Aided
Design

Analog and Digital
Circuits

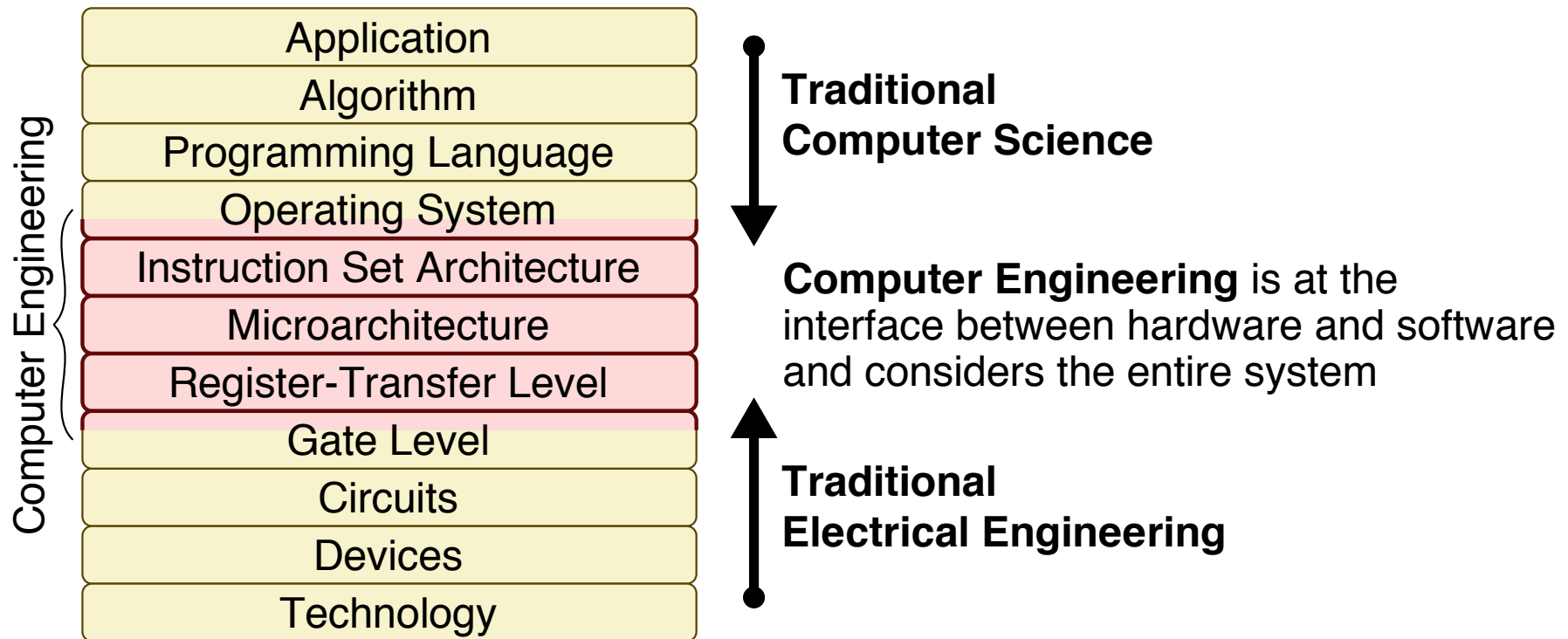
Electrical Circuits

Bio-Electrical Engineering

Systems and Synthetic Biology



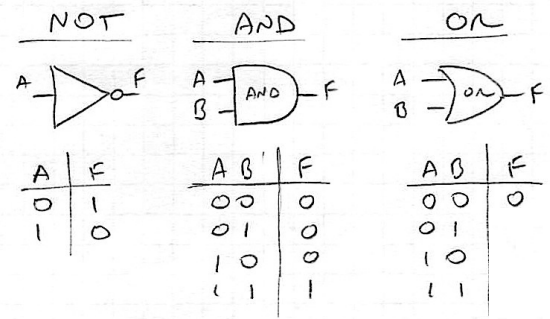
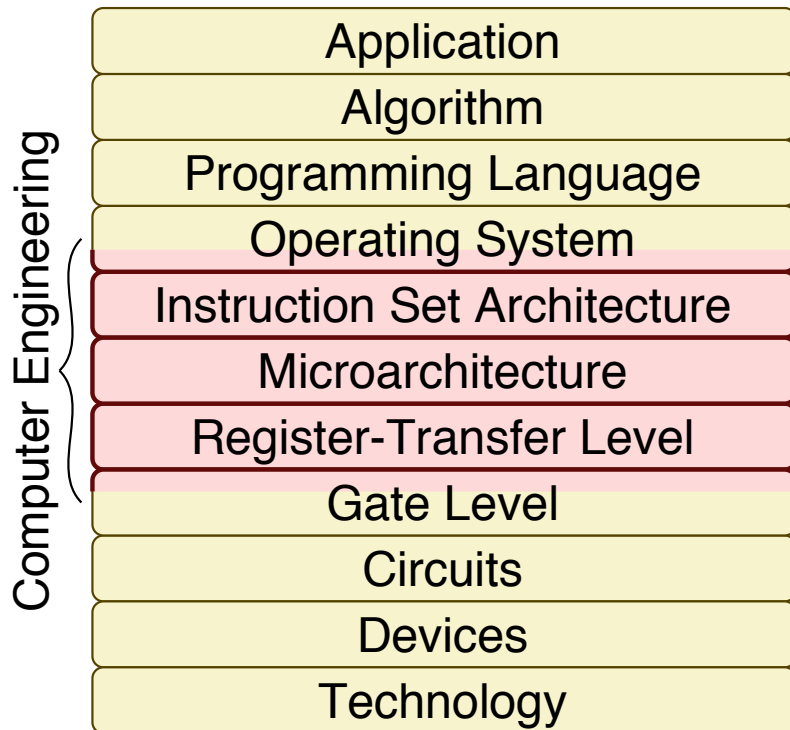
Computer Systems: CS vs. EE vs. CE



In its broadest definition, computer engineering is the **development of the abstraction/implementation layers** that allow us to execute information processing **applications** efficiently using available manufacturing **technologies**

Monday Lab Session

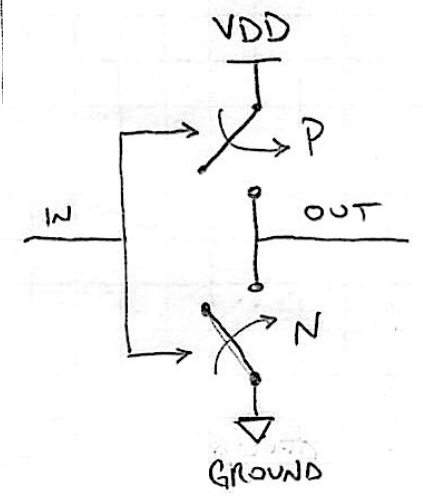
Computer Engineering – Hardware Perspective



Boolean logic gates and functions

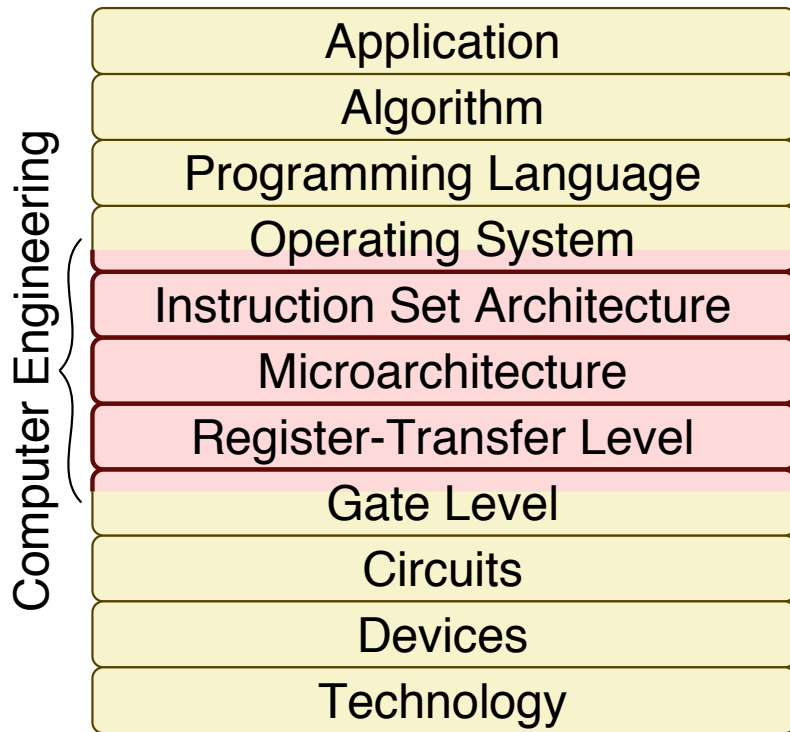
Combining devices to do useful work

Resistors, LEDs, Transistors

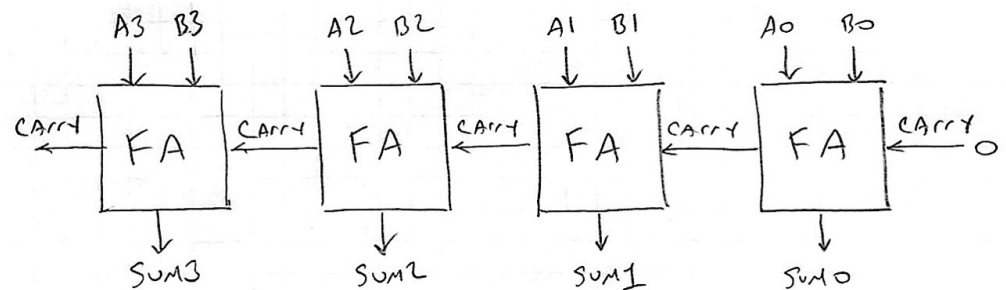
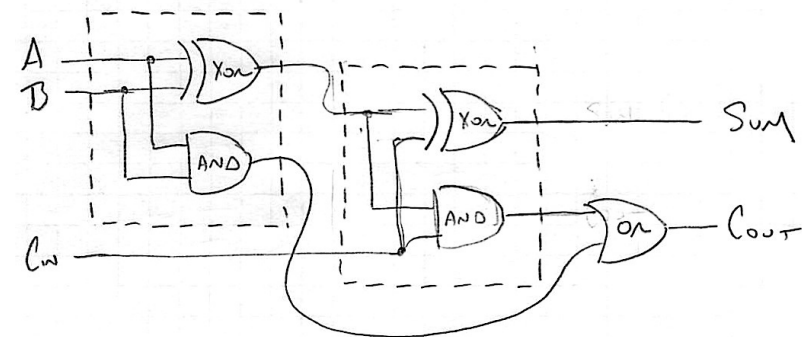


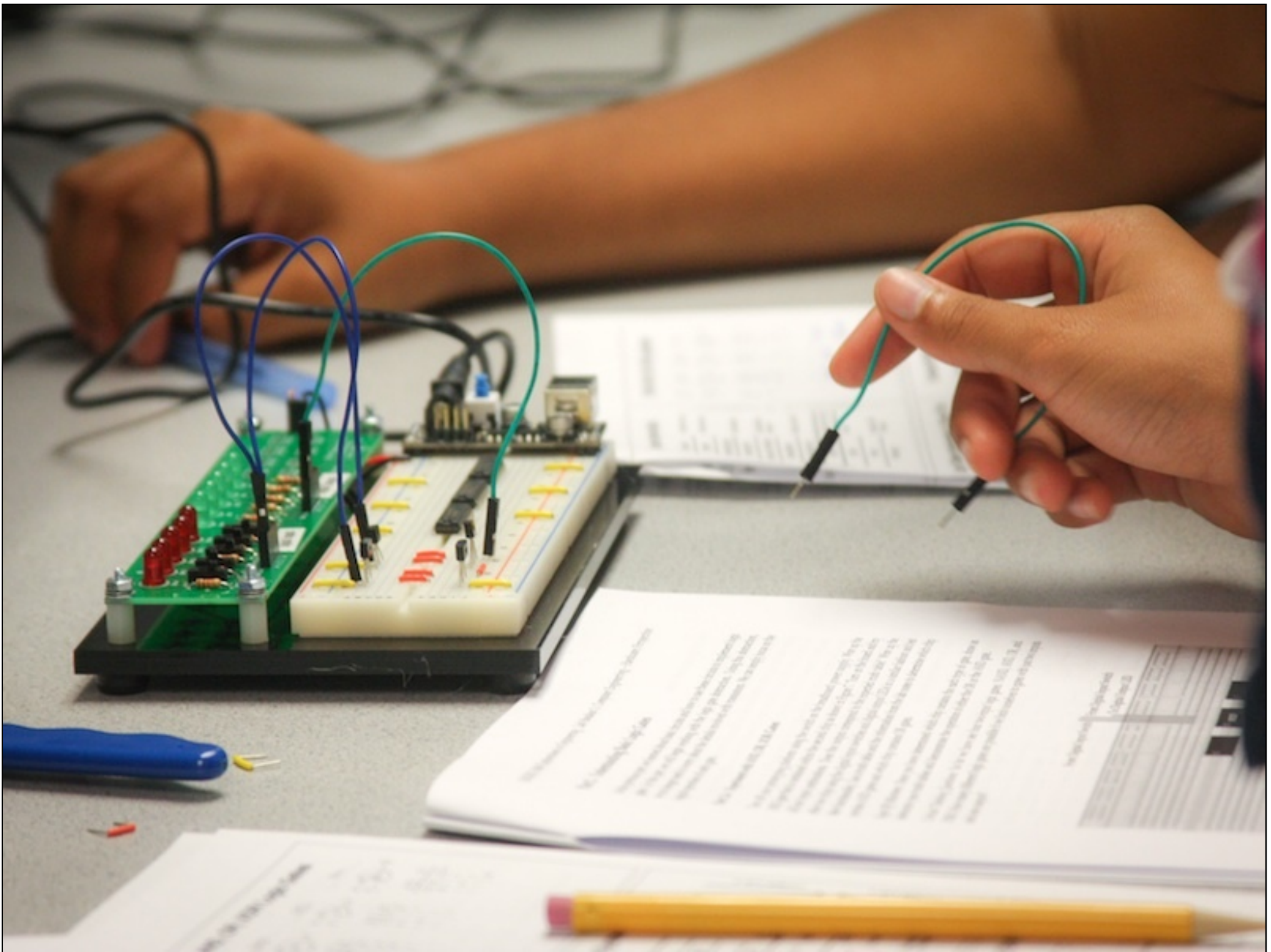
Monday Lab Session

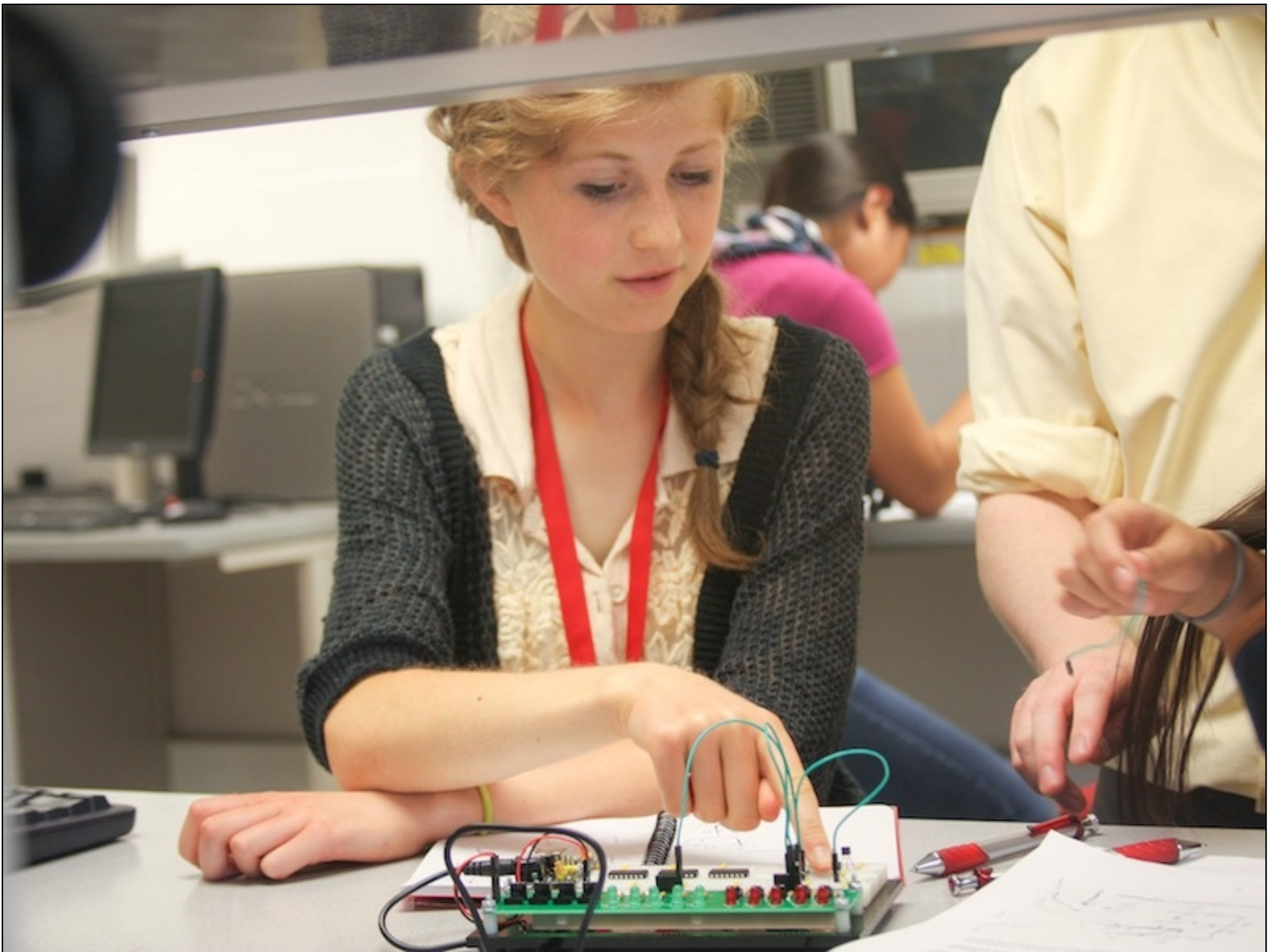
Computer Engineering – Hardware Perspective



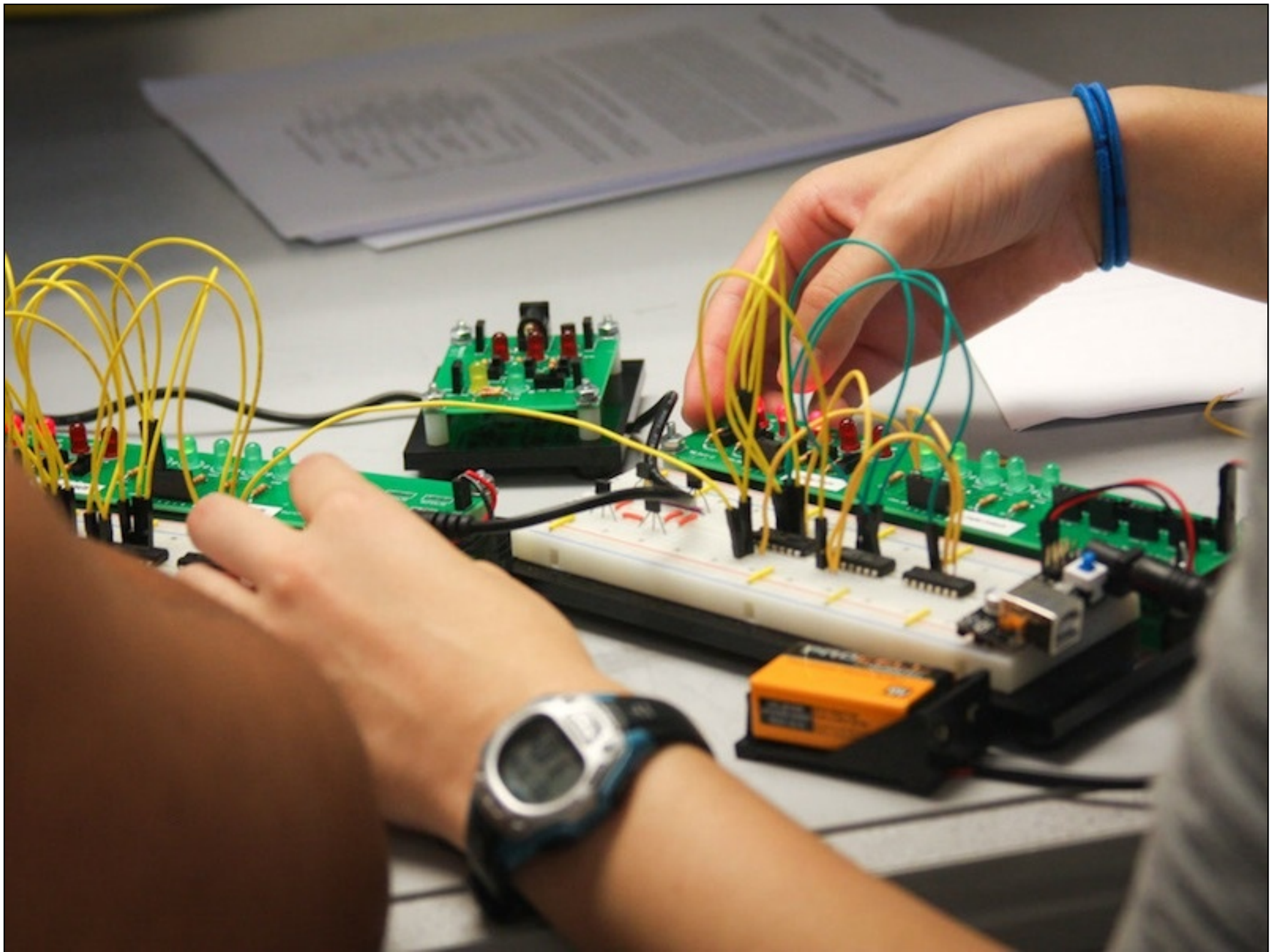
How data flows through system, specifically how to do binary addition

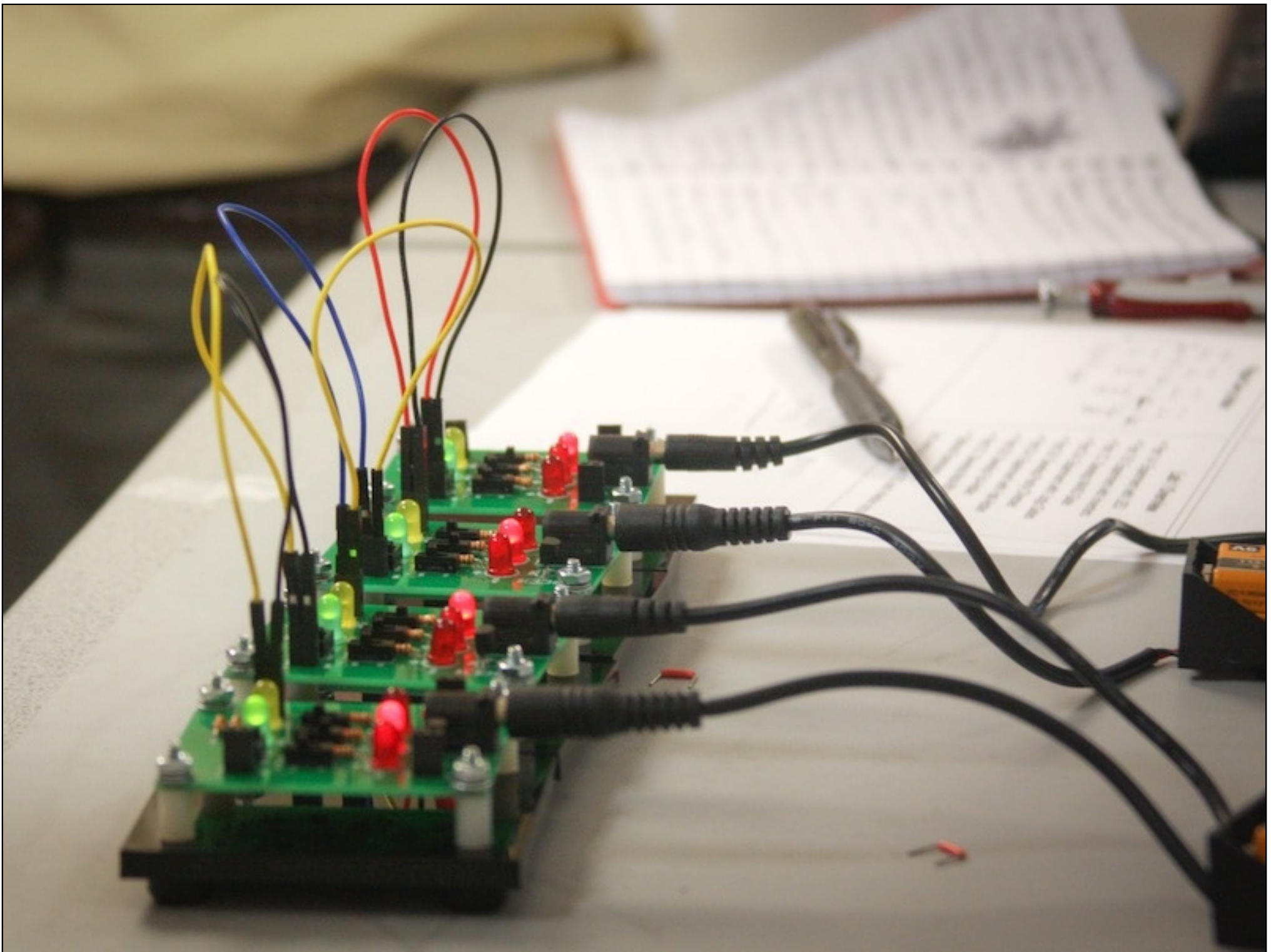






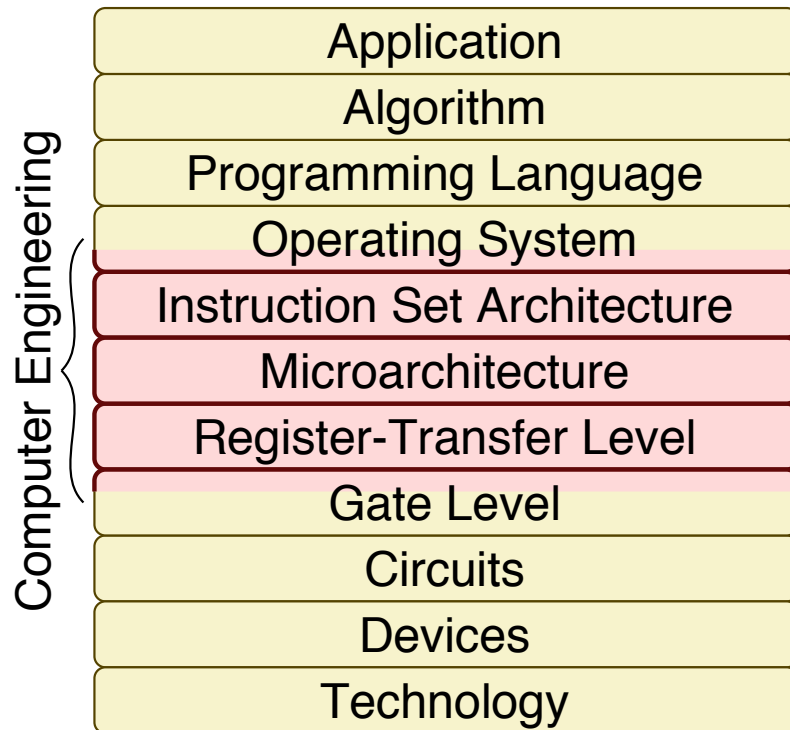




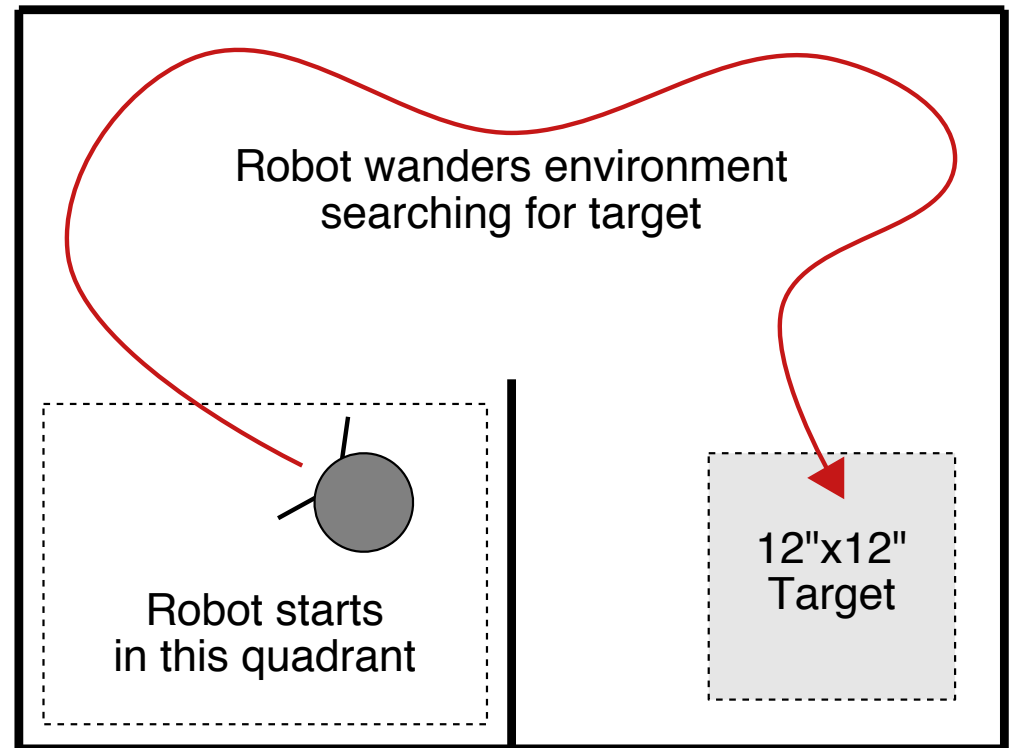


Tuesday Lab Session

Computer Engineering – Software Perspective

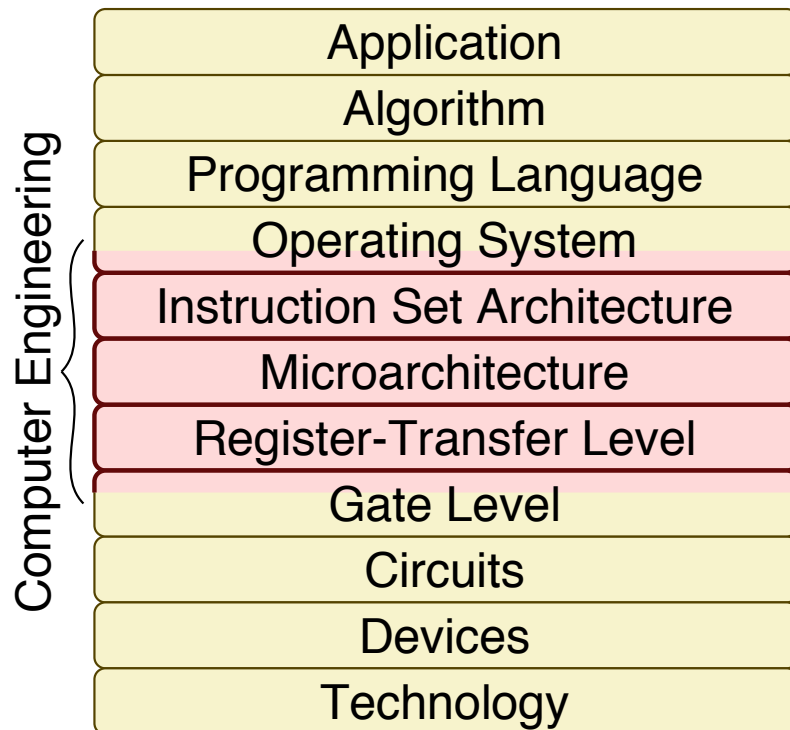


Mobile Robot Control Application

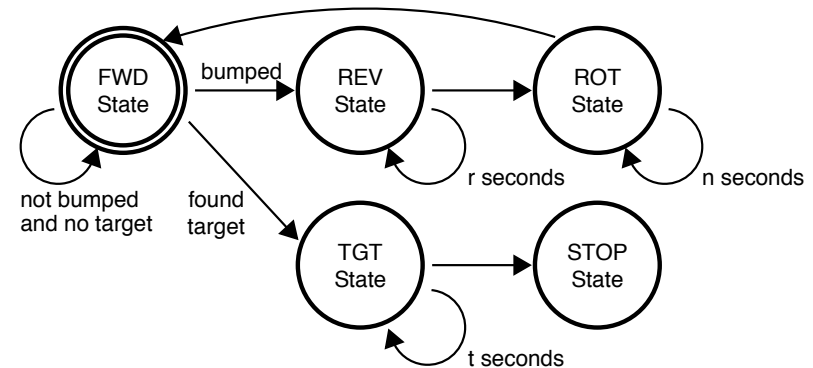


Tuesday Lab Session

Computer Engineering – Software Perspective



Finite-state-machine control algorithm



Arduino-code to implement algorithm

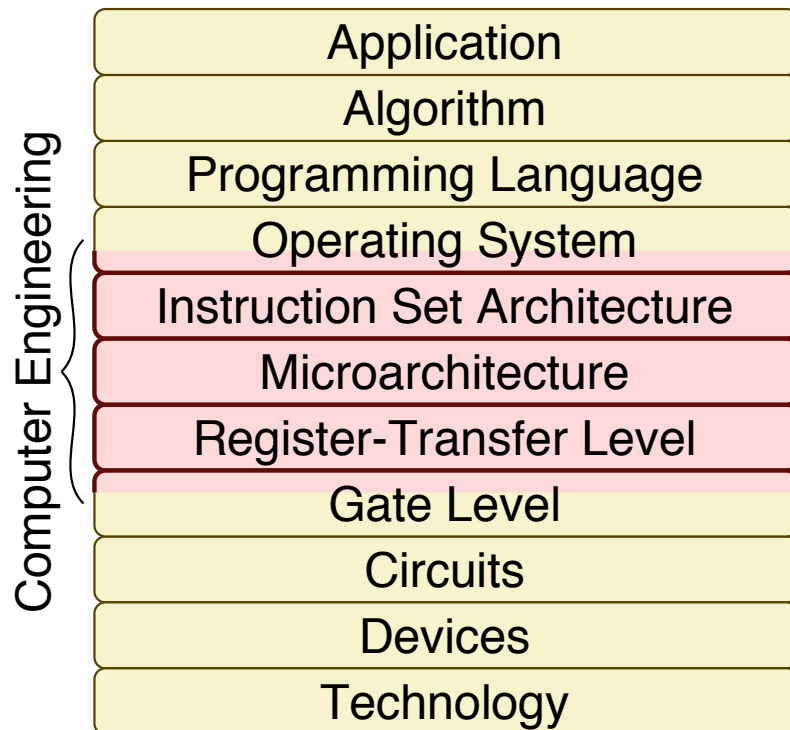
```
// Move forward for two seconds
```

```
digitalWrite( pin_motor_left_dir, LOW );
digitalWrite( pin_motor_right_dir, LOW );
analogWrite( pin_motor_left_speed, 100 );
analogWrite( pin_motor_right_speed, 100 );
```

```
delay(2000);
```

Tuesday Lab Session

Computer Engineering – Software Perspective



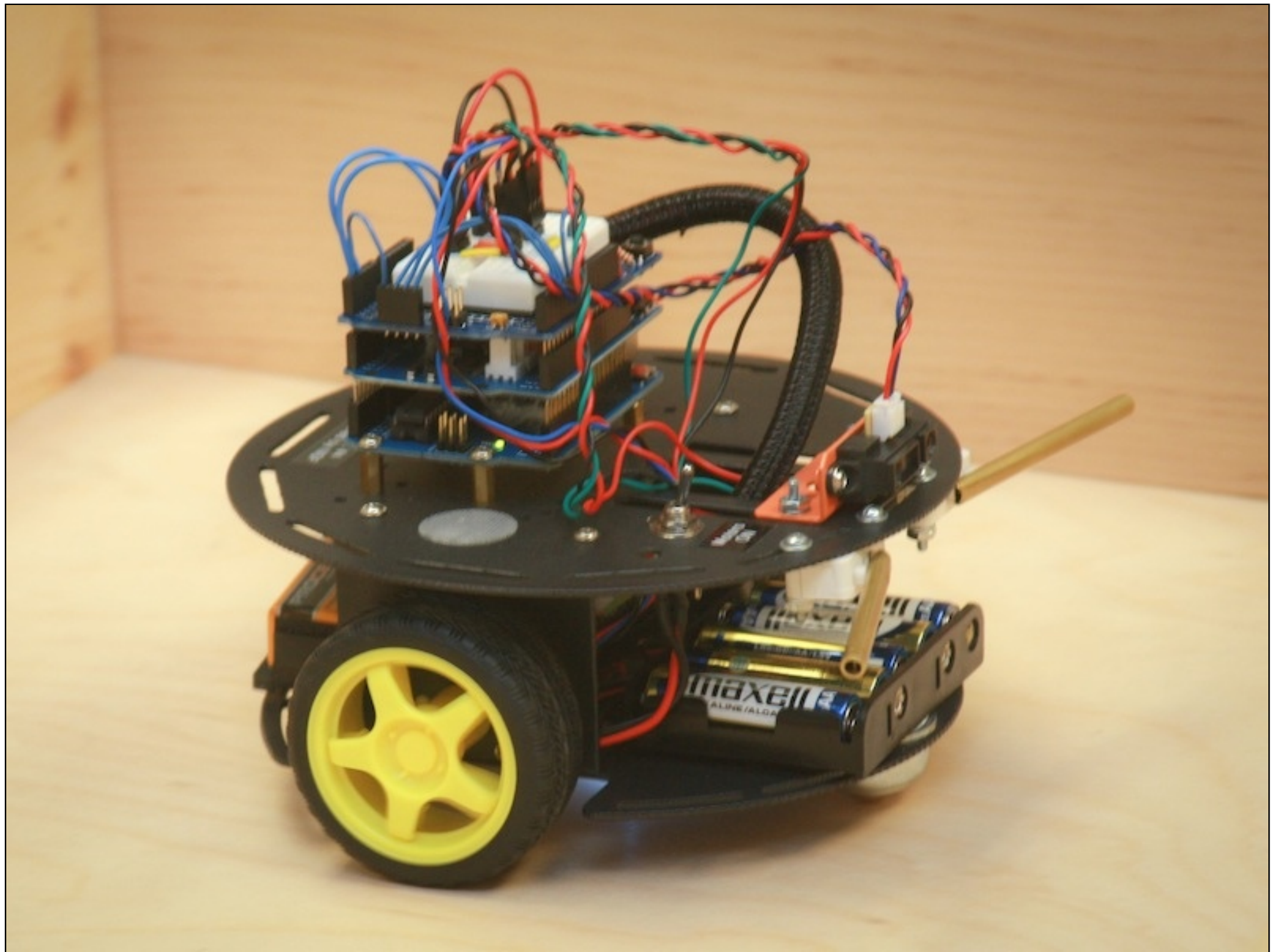
Arduino machine instructions

```
00000100 <loop>:
100: push r28
102: push r29

# load values from memory into registers
104: lds r24, 0x0103
108: lds r25, 0x0102

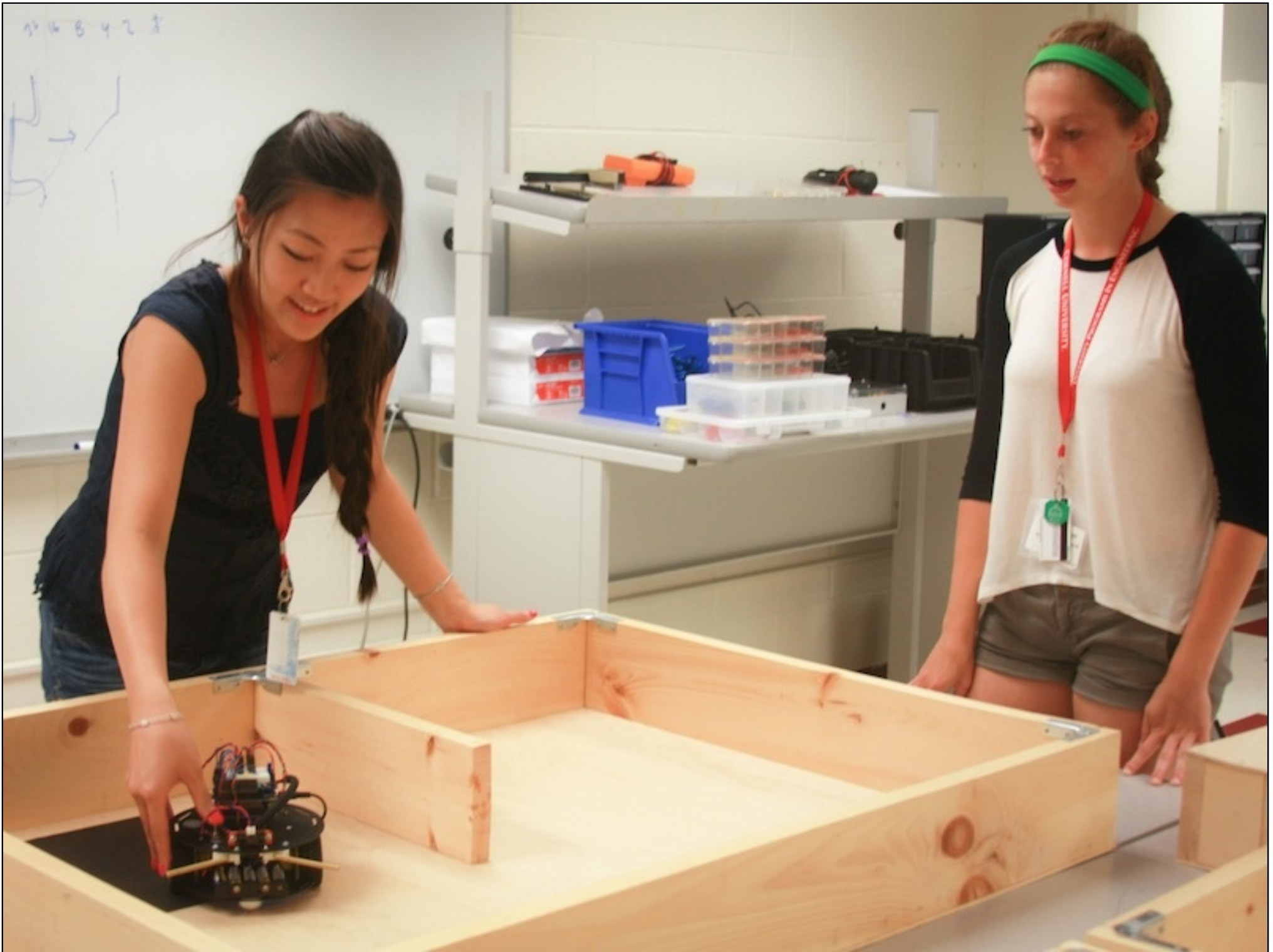
# do the actual addition
10c: add r24, r25

# store sum from register to memory
10e: sts 0x0104, r24
```



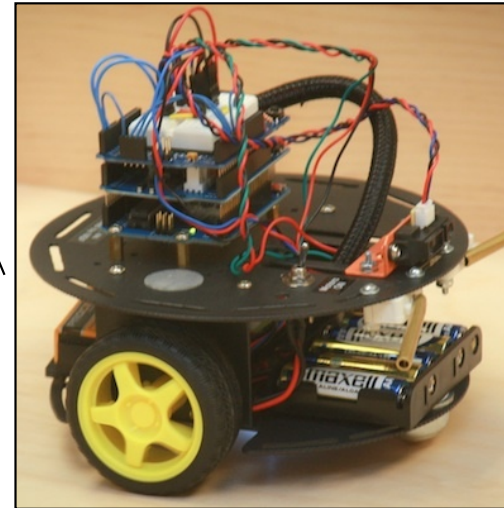
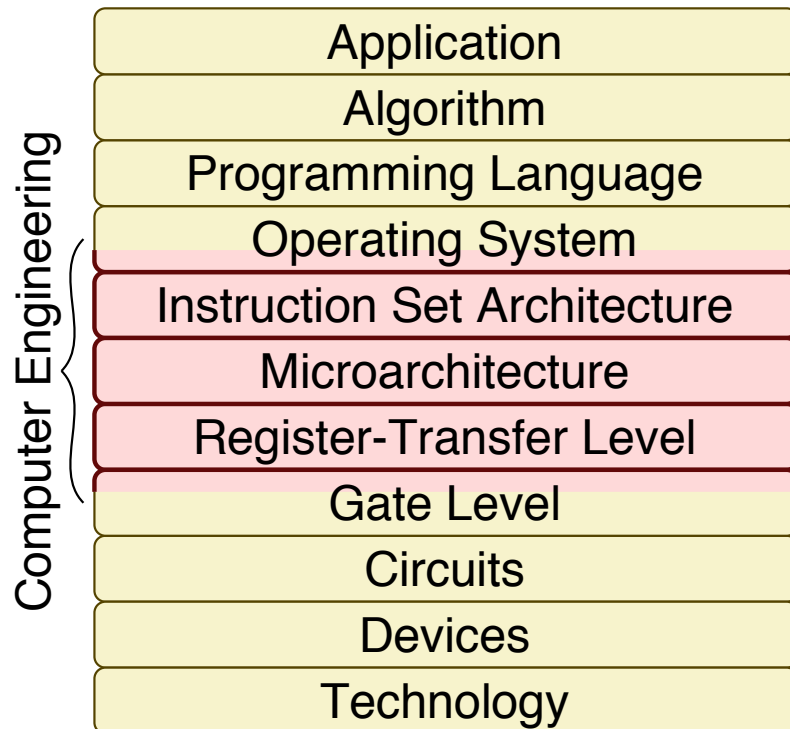






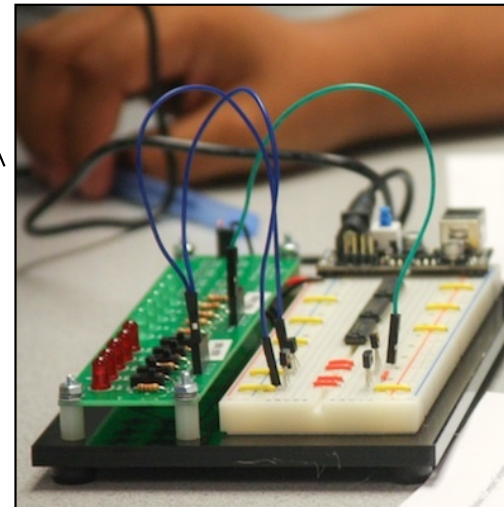


Lab Sessions on Computer Engineering



Lab 2

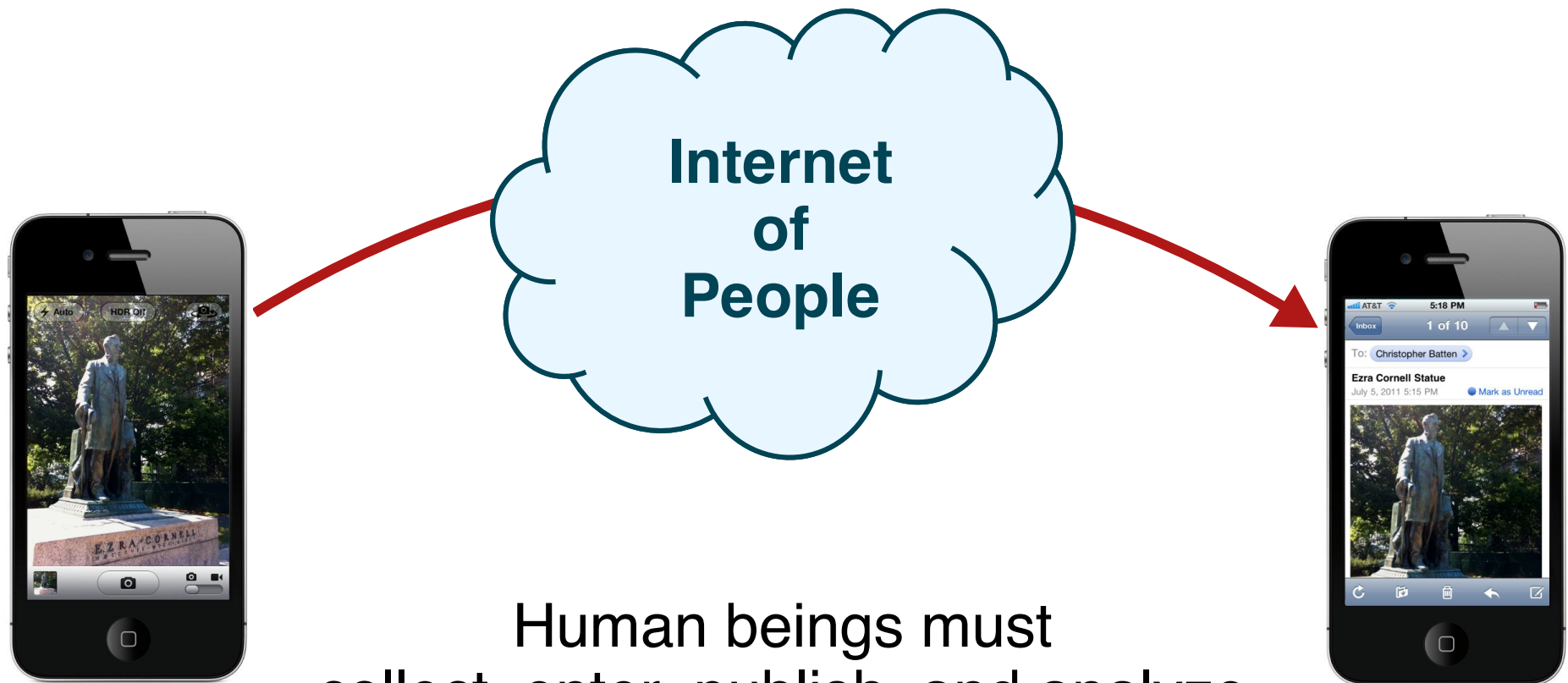
Software pushing towards hardware (CS,CE)



Lab 1

Hardware pushing towards software (EE,CE)

The “Traditional” Internet

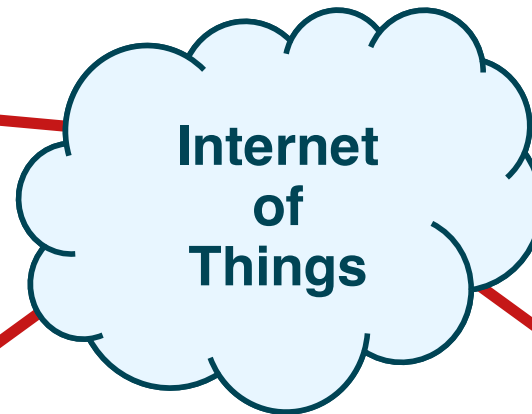


Human beings must collect, enter, publish, and analyze almost all of the information that is transmitted over the Internet

Emerging Trend Towards an Internet of Things



Smart Home



Wearable Health Monitor



Smart Power Distribution Grid



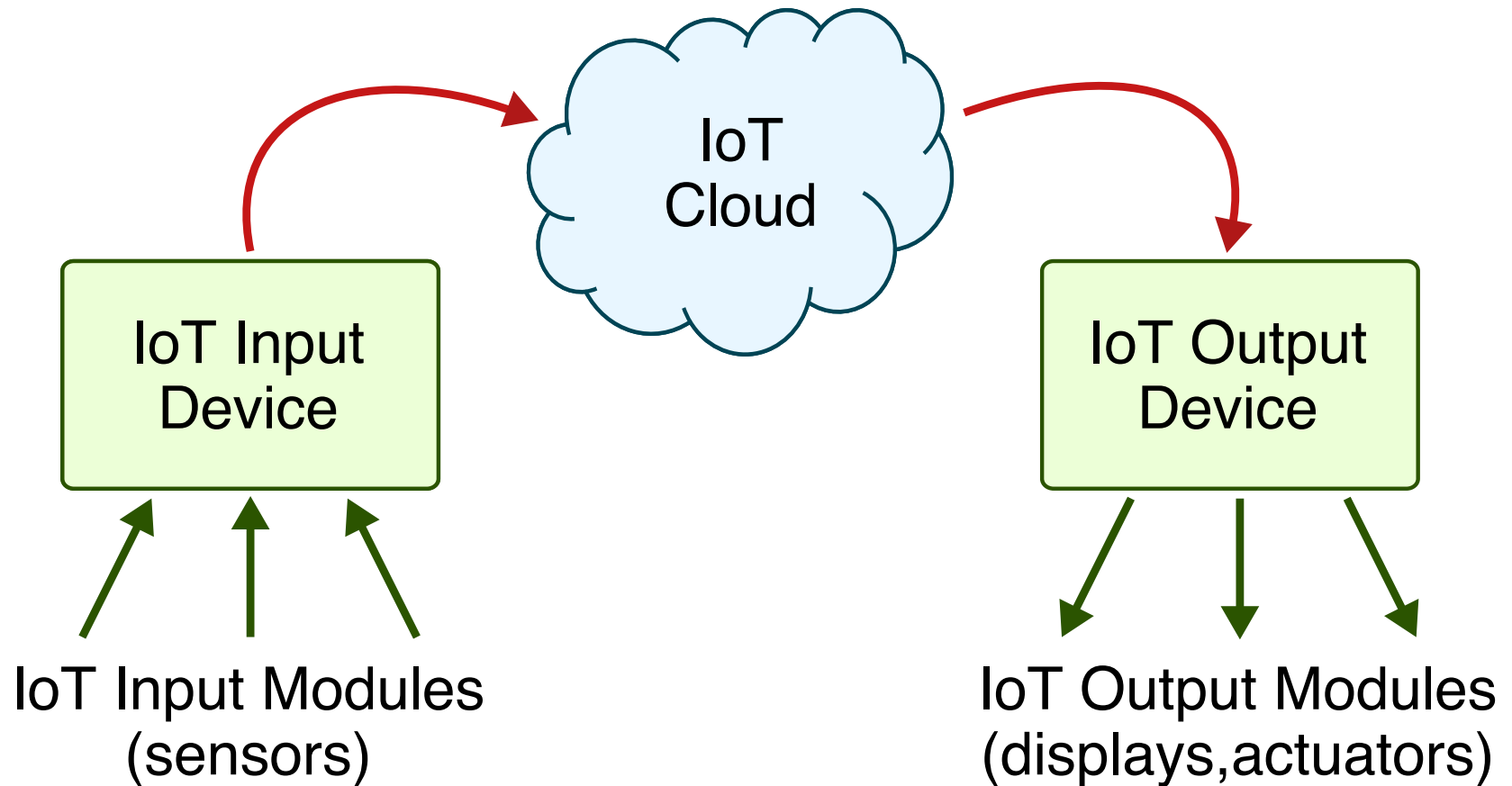
Early Disaster Warning System

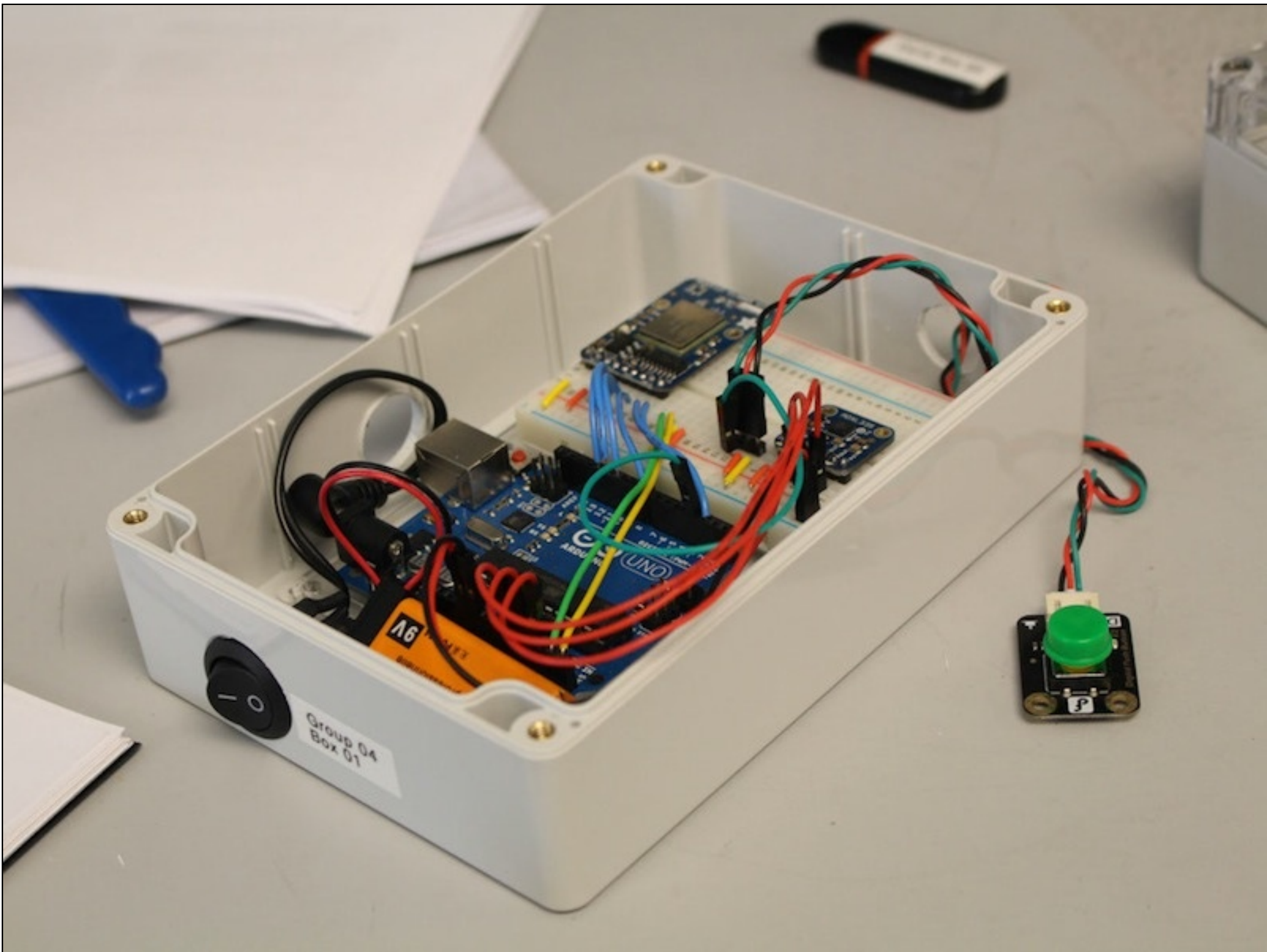


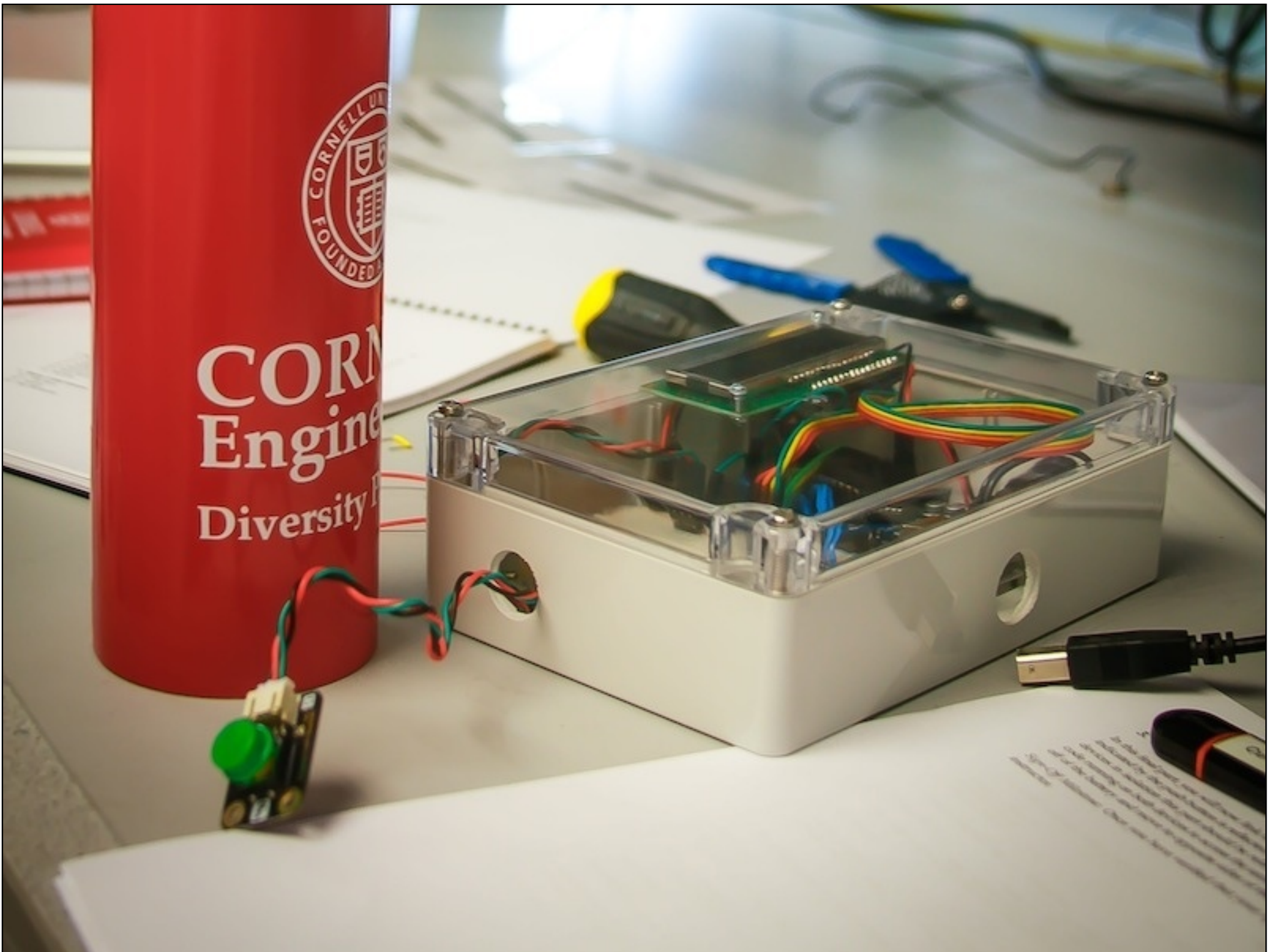
Wildlife Tracking System

Interconnected "things" augmented with inexpensive embedded controllers, sensors, actuators to collect information and interact with the world

CURIE IoT Design Projects









CURIE Group 1

Private Device

Product ID lltWzhlAw96x_uUqO9J5
Product Secret f70bfc5728c5d15797aea0cc8f4eb3e4f5204875
Serial Number 62T24EF4D23Y
Activation Code a28a26b7d2bba920c03a8aa0323011a17796a83c

[Learn about the Develop stage](#)

Activated [Deactivate](#)

at 10-07-2014 11:11:01

Deploy

Feed ID 1109083764
Feed URL <https://xively.com/feeds/1109083764>
API Endpoint <https://api.xively.com/v2/feeds/1109083764>

Channels Last updated 3 minutes ago

[Graphs](#)



Request Log [Pause](#)

200	GET	channel test_value	01:23:14 -0400
201	POST	feed	01:23:13 -0400
200	GET	channel counter	01:23:04 -0400
200	PUT	channel counter	01:23:03 -0400
200	GET	channel counter	01:23:01 -0400

API Keys



Agenda

- ▶ Group 2 : Smart Home
- ▶ Group 7 : Wearable Health Monitor
- ▶ Group 6 : Wildlife Monitoring System
- ▶ Group 4 : Early Disaster Warning System
- ▶ Group 3 : Smart Power Distribution Grid
- ▶ Group 1 : Smart Home
- ▶ Group 8 : Wearable Health Monitor
- ▶ Group 5 : Early Disaster Warning System