INTRODUCTION TO EMBEDDED SOFTWARE ENGINEERING

Day 1

WHAT IS EMBEDDED SOFTWARE?

EMBEDDED SOFTWARE RUNS ON DEVICES THAT DO NOT FIT THE TYPICAL IMPRESSION OF A COMPUTER.

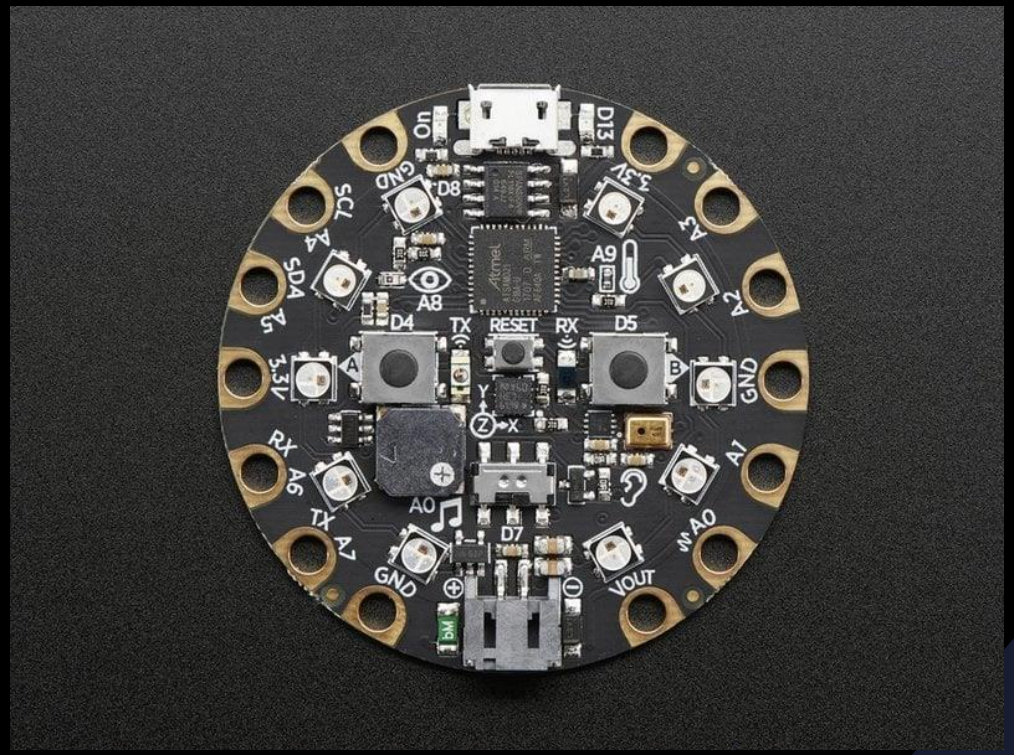
The challenges of Embedded Software

- Low power (often 5V, 3.3V, even 1.8V)
- Low memory and storage (less space for code)
- Real time (timing and precision required)

Circuit Playground

Adafruit board for experimenting with hardware and software interactions.

[Overview | Adafruit Circuit Playground Express | Adafruit Learning System]



Light Emitting Diodes (LEDs)

- Emits light when current (electricity) flows through.
- Semiconductor like silicon
- Vary in colors and brightness.

Capacitive Touch

- There are two main types of touch sensors – capacitive vs resistive.
- Capacitive touch allows items containing water to trip the sensor.
- Resistive touch relies on pressure to trip the sensor.
- Capacitive sensors can be tripped not just by your finger, but also by items like fruit.

View the Example Code

1

Plug your Circuit Playground into the computer.

2

Navigate to the device and open the code.py file.

You can open the file in any IDE (Visual Studio Code, Replit, even Notepad).

3

To make changes, save the file. It must always be named code.py

Understand Example Code

The example code pre-loaded onto the board takes capacitive touch input from the user, and lights corresponding LEDs.

The LEDs have two primary settings

Brightness: from 0.0 to 1.0

Color: OFF (0,0,0) to WHITE (255, 255, 255)

Challenges

Change	Change the colors of the LEDs
Change	Change the brightness of the LEDs • Do not directly look at the LEDs above brightness 0.2. Use the provided paper above the LED.
Identify	Identify at least one area of the code which could be optimized for space. (For example, using a for loop instead of repeating lines)

References

- What is an LED? | All About LEDs | Adafruit Learning System
- Using Capacitive Touch | Make It Sense | Adafruit Learning System
- Overview | Adafruit Circuit Playground Express | Adafruit Learning System

INTRODUCTION TO EMBEDDED SOFTWARE ENGINEERING

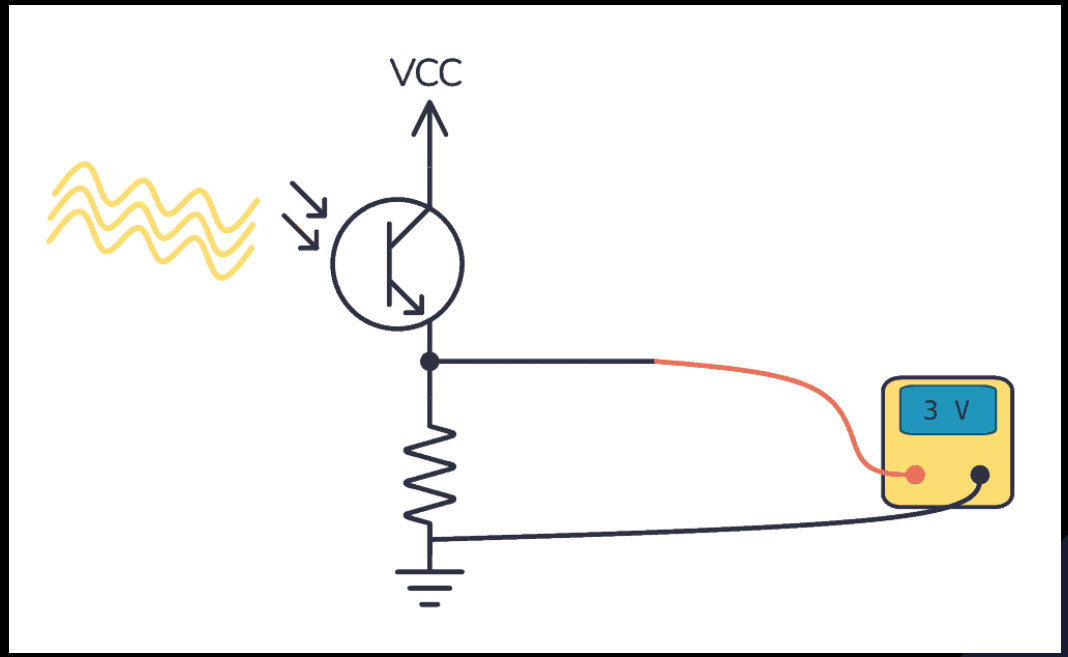
Day 2

REVIEW DAY 1

Questions?

Phototransistors

- Convert the amount of light received into current.
- Generally can detect differences like light vs dark but not differences in color like blue vs red.



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Understand Example Code

The example code measures the input to the light sensor, and changes the color of an LED dependent on the amount of light seen by the sensor.

Challenges

Understand	What is the maximum value of the light sensor reading?
Change	Change the code to have more than two states (light vs no light)
Identify	Identify at least one area of the code which could be optimized for space. (For example, using a for loop instead of repeating lines)

References

- Playground Light Sensor | Adafruit Circuit Playground Express | Adafruit Learning System
- Phototransistor - A Newbie's Guide (build-electronic-circuits.com)

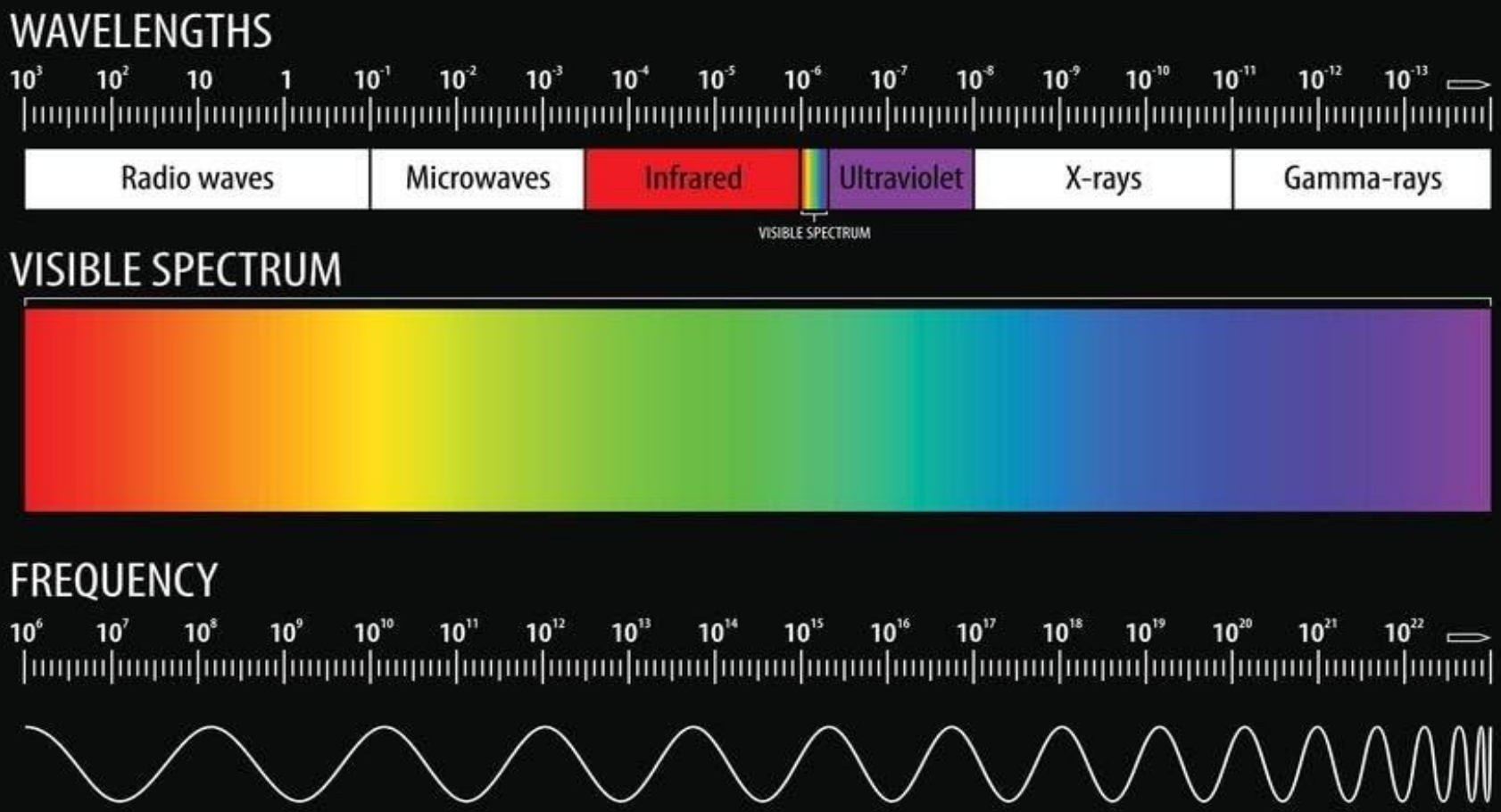
INTRODUCTION TO EMBEDDED SOFTWARE ENGINEERING

Day 3

REVIEW DAY 2

Questions?

ELECTROMAGNETIC SPECTRUM



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Understand Example Code

The example code detects the IR code transmitted by the remote, and toggles the color of the LED associated with that button, if applicable.

Values for the IR transmission are an array of 4 8 bit numbers.

Challenges

Understand	What is the maximum value of each of the transmission values?
Change	Use the volume up/down buttons to change the intensity of the lights.
Identify	Identify at least one area of the code which could be optimized for space. (For example, using a for loop instead of repeating lines)

References

- Overview | Infrared Receive and Transmit with Circuit Playground Express | Adafruit Learning System
- Electromagnetic spectrum - Wikipedia