Warmup

3.3V

10kΩ

330Ω) Voltage?
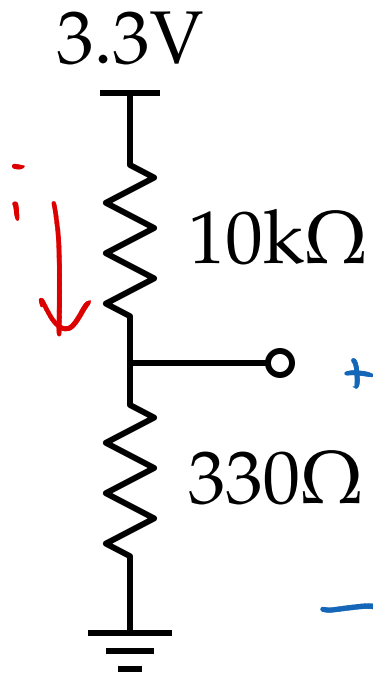
+

−

What is the voltage here?

$R_{total} = 10.33 \text{ k}\Omega$

$i = \dfrac{3.3\text{V}}{10.33\text{ k}\Omega} = 0.32 \text{ mA}$

$V_{out} = 330\Omega \cdot 0.32 \text{ mA} = 0.1\text{V}$

EN 1: Engineering in the Kitchen

Steven Bell
11 October 2023

Tufts
UNIVERSITY

Roadmap

Basic circuits (ES 3 / EE 20)

Python, using a microcontroller (ES 2, EE 14)

We are here!

Measuring stuff with sensors (ME 30/31)

Making outputs do stuff (ME 30/31)

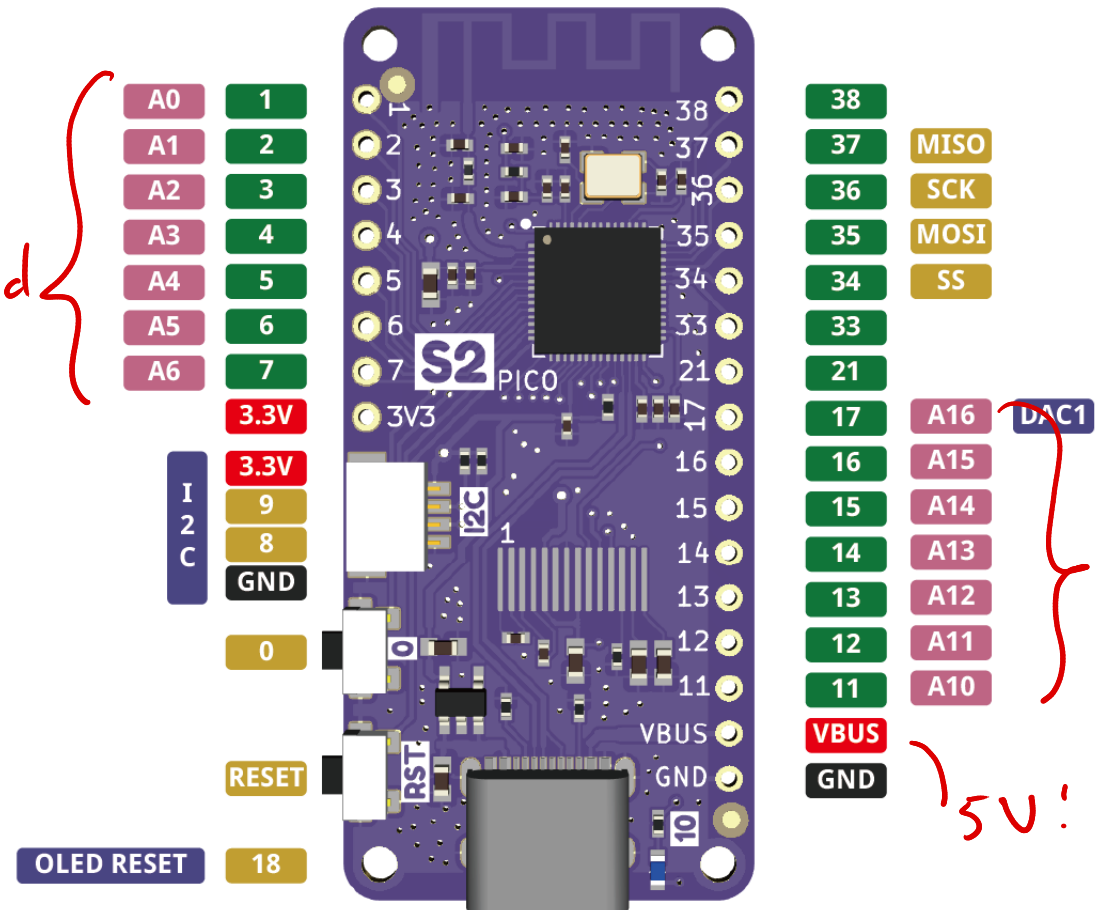Controlling outputs precisely (EE 105, ME 80)

Networking, IoT and security (COMP 112, COMP 116, and more)

Measuring voltages
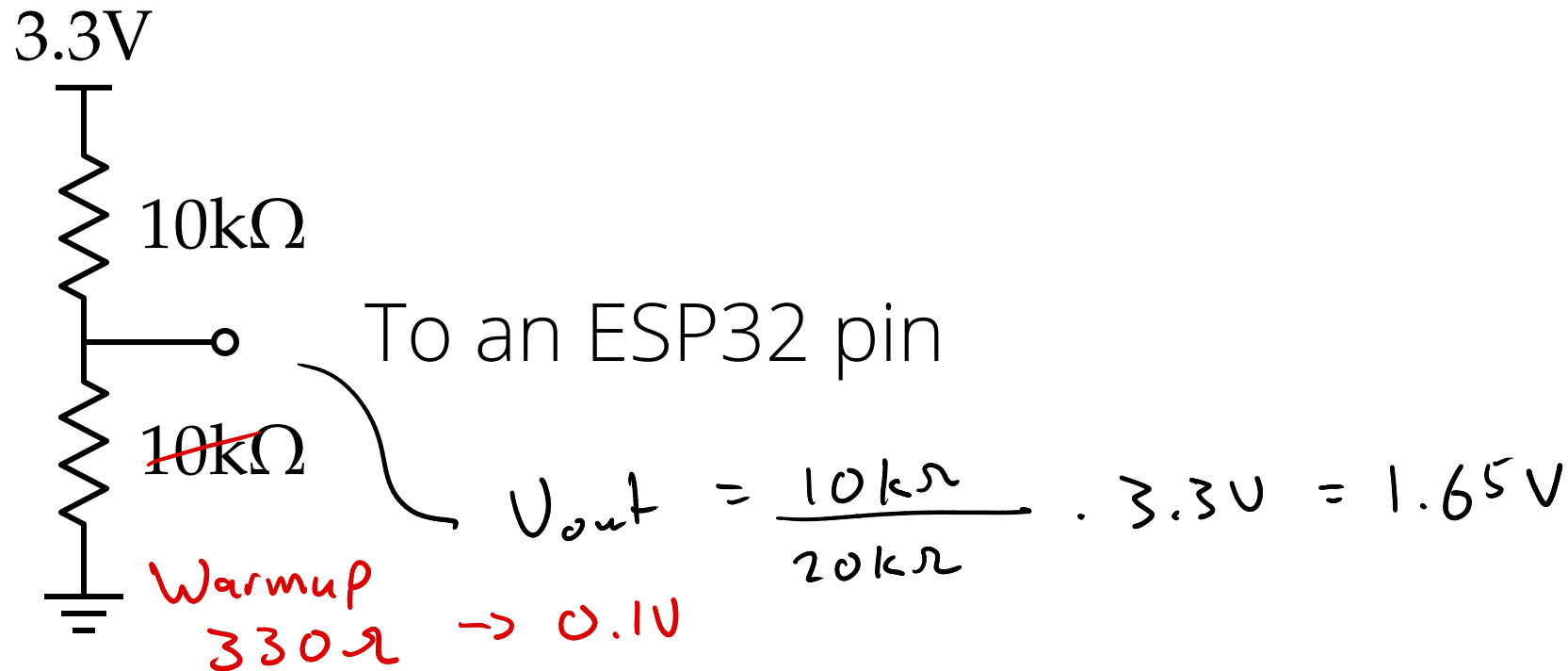
The ESP32 can read analog voltages on some pins

```python
from machine import ADC, Pin
adc = ADC(Pin(35))
print(adc.read())
```

Creating analog voltages

Build this on your breadboard:

3.3V

10kΩ

To an ESP32 pin

10kΩ

$$V_{out} = \frac{10k\Omega}{20k\Omega} \cdot 3.3V = 1.65V$$

Warmup
330Ω → 0.1V

What numbers do you read? Try other resistor combinations!

Ok, but what does that number mean?

ADC has a voltage range of 1.0V (by default)

Readings are 13 bits (0-8191)

$$1 \quad 10^N$$

$$2$$

$$3$$

$$\vdots$$

$$9$$

$$10$$

$$11$$

$$0 \quad 2^N$$

$$1$$

$$10$$

$$11$$

$$100$$
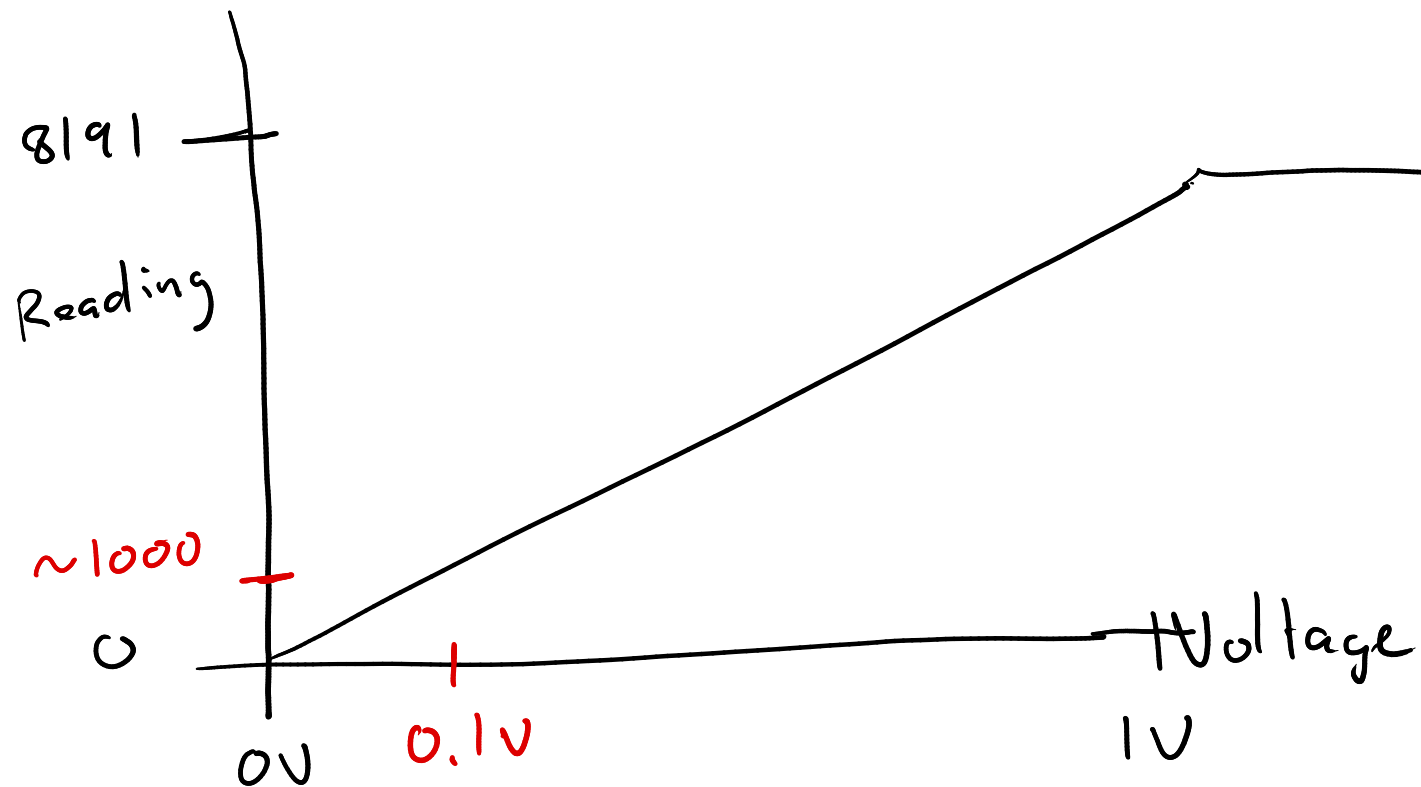
$$101$$

$$110$$

$$111$$

$$\vdots$$

$$2^{13} = 8192$$

$$0 \text{ to } 8191$$

Ok, but what does that number mean?

ADC has a voltage range of 1.0V (by default)
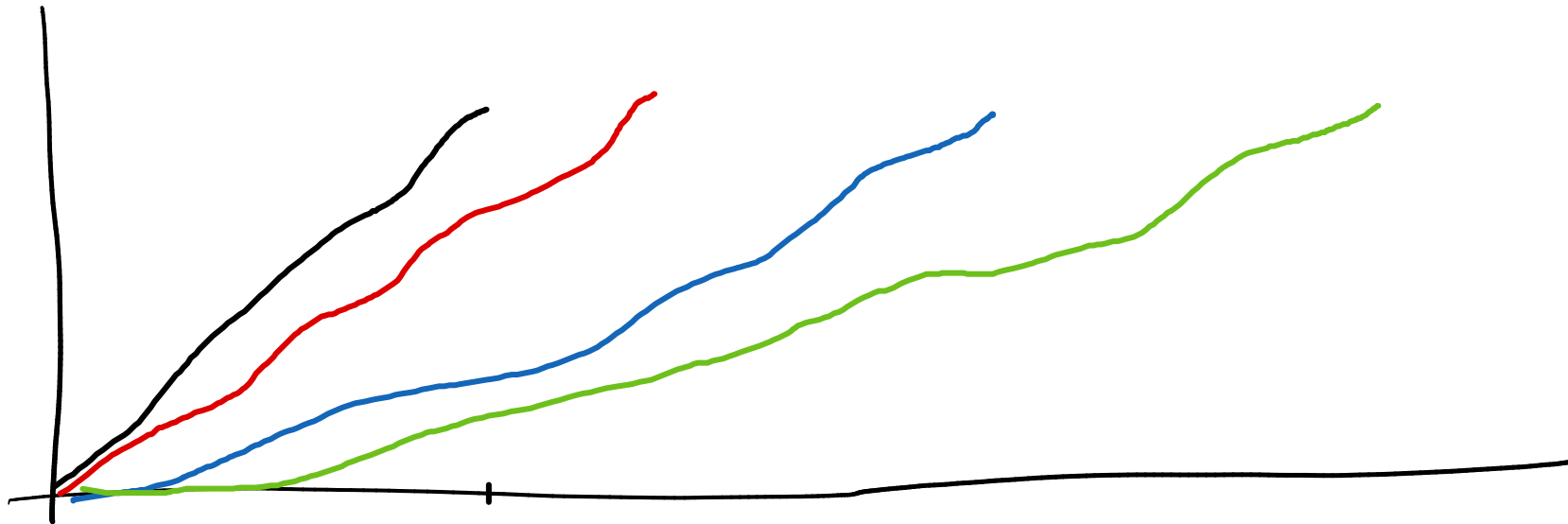
Readings are 13 bits (0-8191)

Changing the scales
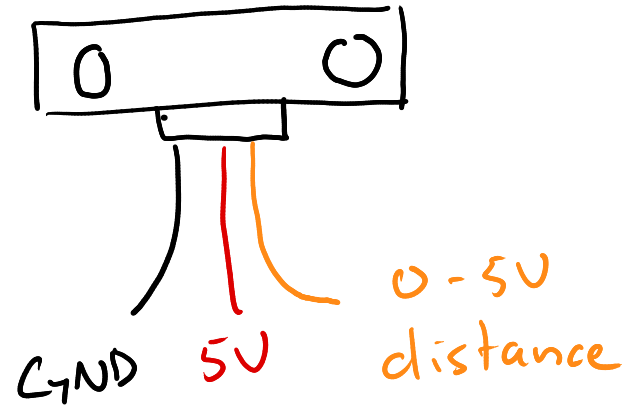
```
adc.atten(ADC.ATTN_2_5DB) # ~ 1.34V
adc.atten(ADC.ATTN_6DB) # ~2.00V
adc.atten(ADC.ATTN_11DB) # ~3.6V (careful!)
```

Using this to measure stuff

GND 5V 0-5V
distance

Build a night light

For next time

Back in Crane Room

Put your state diagram + concept on OneDrive