

EE 193: Advanced Embedded Systems

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How to power your Internet things

- 1) Plug into the wall
- 2) A (possibly replaceable) battery
- 3) Energy harvesting

How much power are we talking about?

Phone battery 2000 mAh - 5000 mAh 3.7 - 4.1V

CR2032 coin cell ~250 mAh 3V

AA alkaline cell ~ 2500 mAh 1.5V

What consumes power?

(because we want to minimize it!)

LED

CPU

WiFi - Rx and Tx

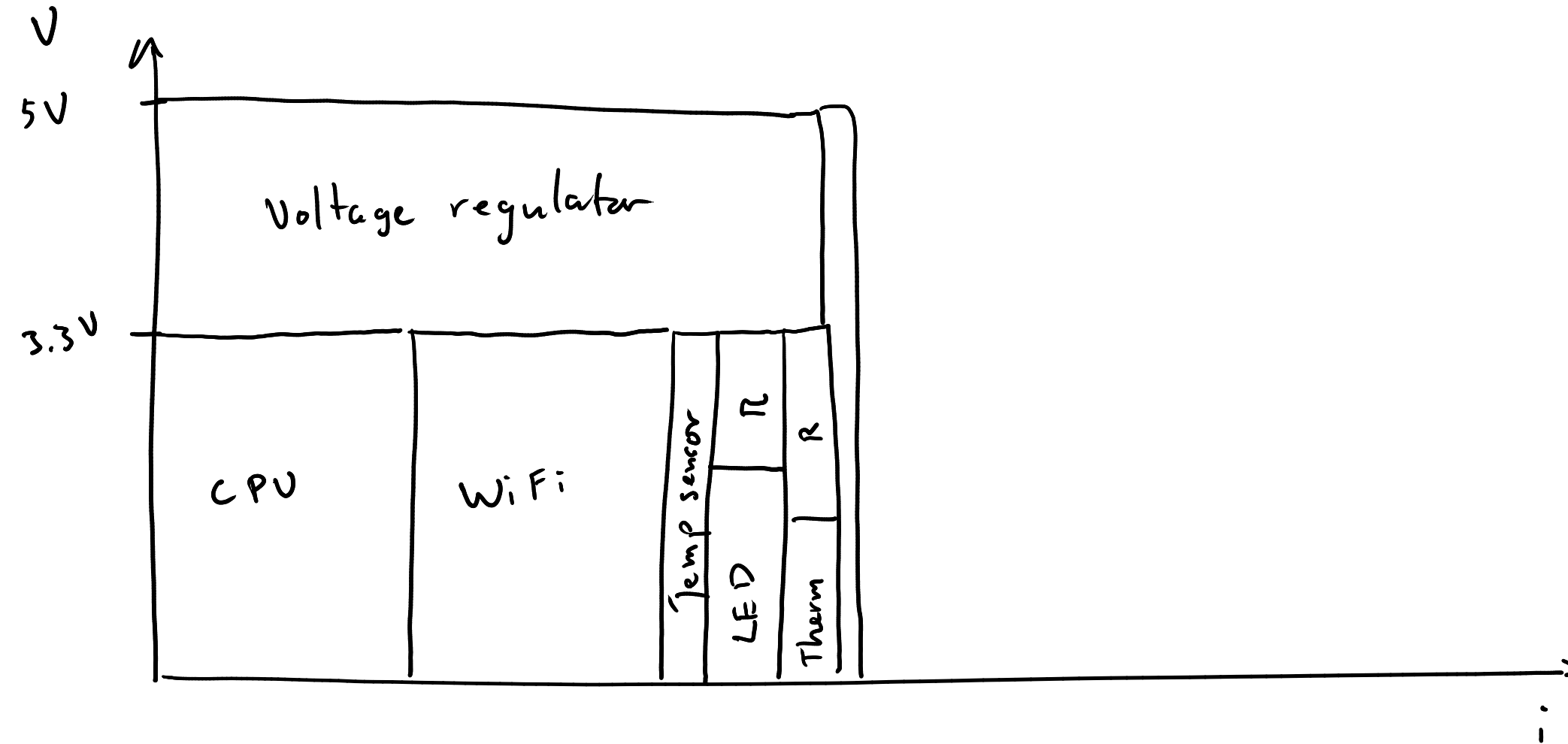
Reading temperature

USB-UART chip

Thermistor / resistor

Capacitor / RC losses

Visualizing $P = IV$



How do we save power?

CPU

WiFi / communication

USB-serial chip

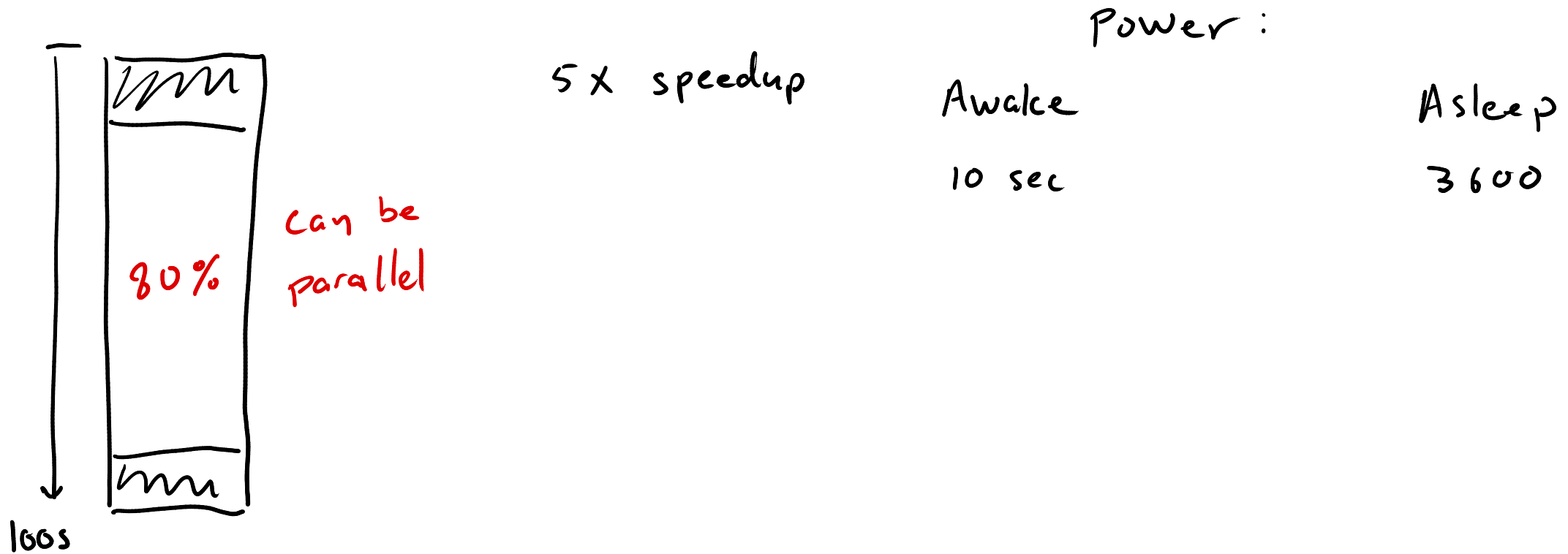
Pullup resistors

Indicator LEDs

Power regulator

Ahmdal's law

Potential speedup is limited by the fraction of the program that can be parallelized.



Saving power on the ESP32 (see section 9 of TRM)

Power gating

Selectable clocks

Low-power modes

ULP processor

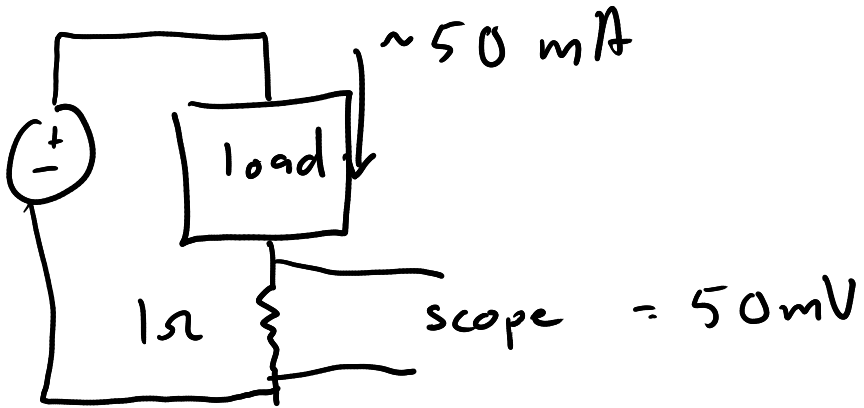
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Use a wicked fast autoranging ammeter

Introducing the Joulescope

Debugging with PlatformIO