Hardware platforms

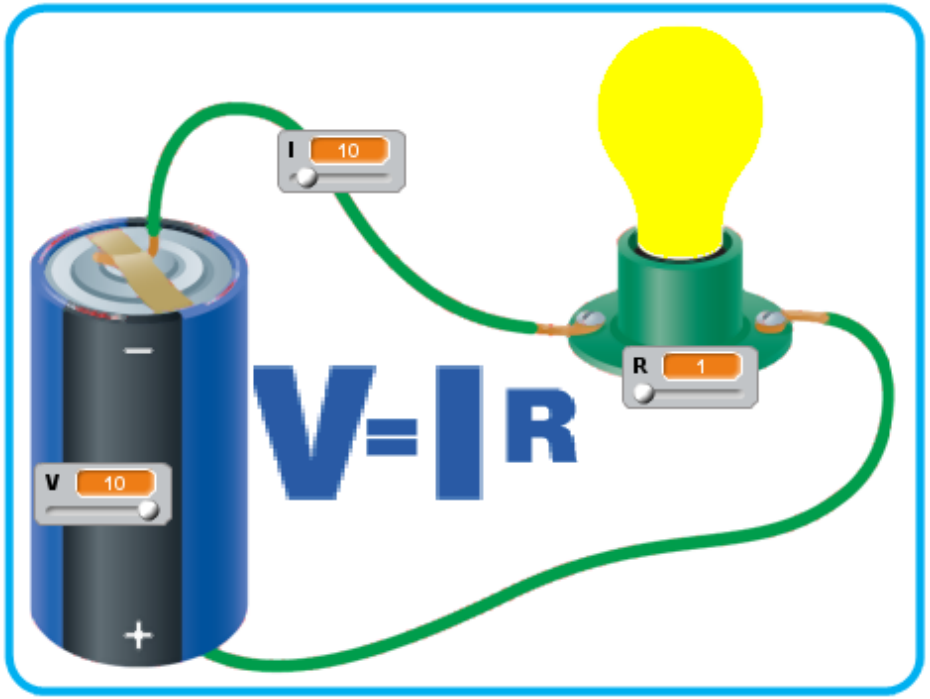
Overview and ESP8266

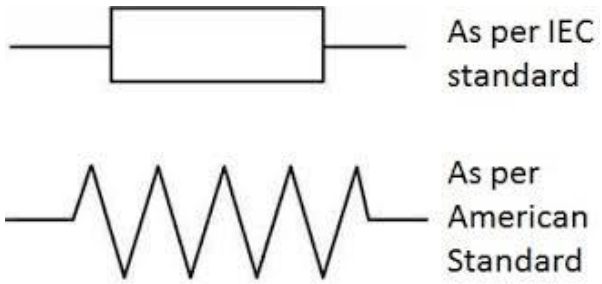
Some circuit theory

- Ohm’s law: voltage, current and resistance
- A word about capacitors and inductors
- Switch (e.g. button)
- LED

Ohm's law

- Key concept: **resistance** (R)
- **I = V / R**
  - **More** voltage -> **more** current
  - **Less** resistance -> **more** current
- Useful analogy: **water & pipes**
  - Pressure <-> Voltage
  - Flow <-> Current
  - Pipe diameter <-> Resistance
- Resistor element

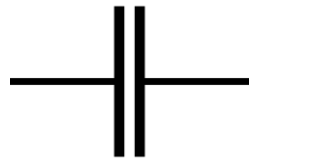


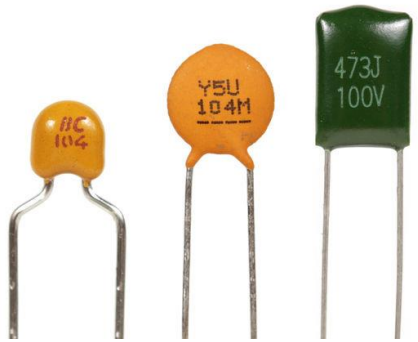


https://scratch.mit.edu/projects/17822395/

Capacitors & Inductors

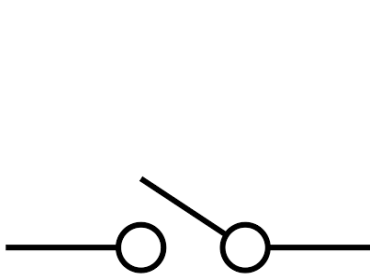
- Concept: Energy builds up in time
- Capacitor
  - builds up voltage
  - May be **polarized**
- Inductor
  - builds up current
  - non-polarized
- Common uses:
  - Filter
  - Energy buffer/store



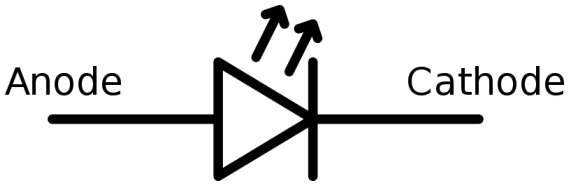


Switch & LED

- Switch
  - Turns electricity on/off
  - May come in many physical forms
  - Normally open (NO) vs Normally closed (NC)

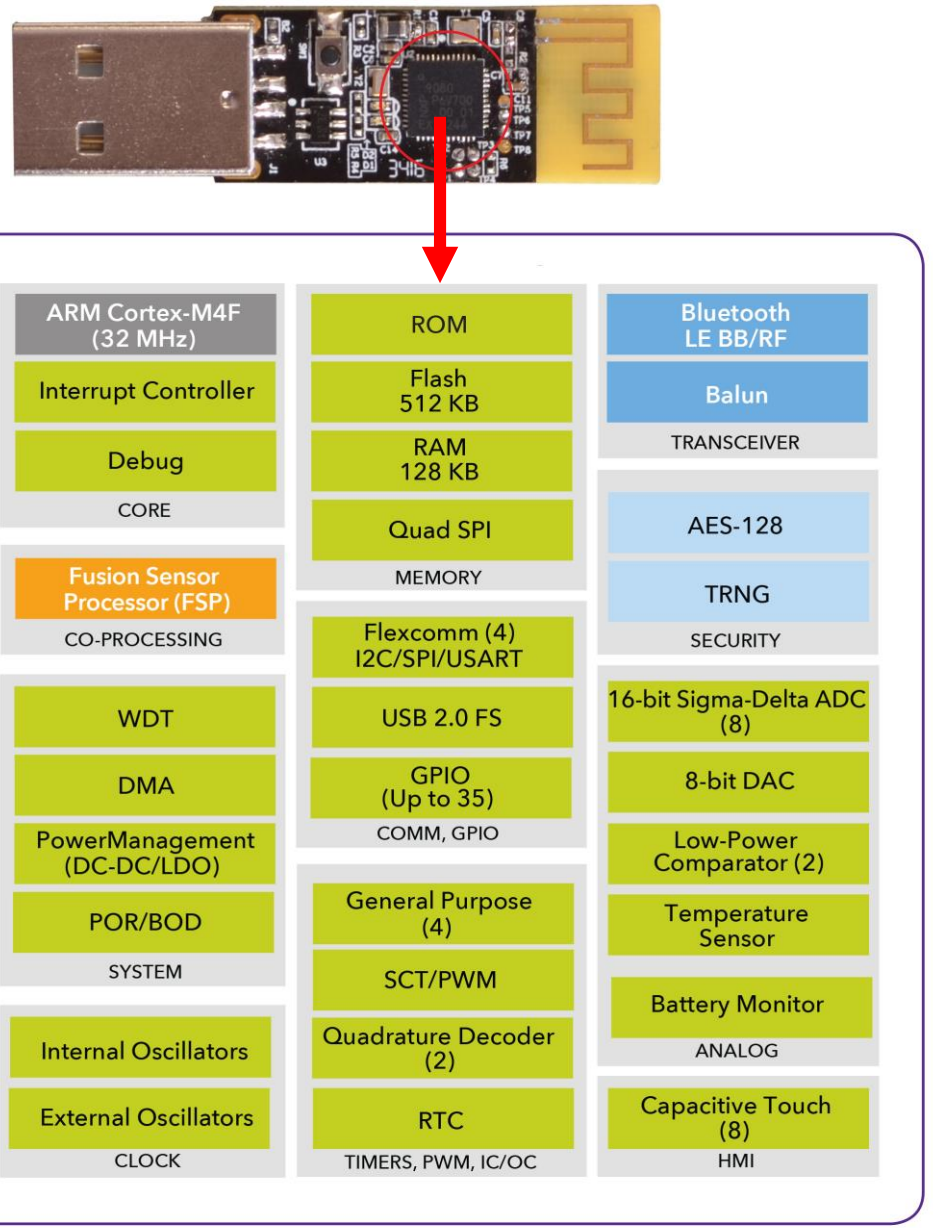


- LED = Light Emitting Diode
  - Like a bulb, but **polarity matters**
  - Different colors and sizes
  - Sometimes more than one in a single package



Programmable systems

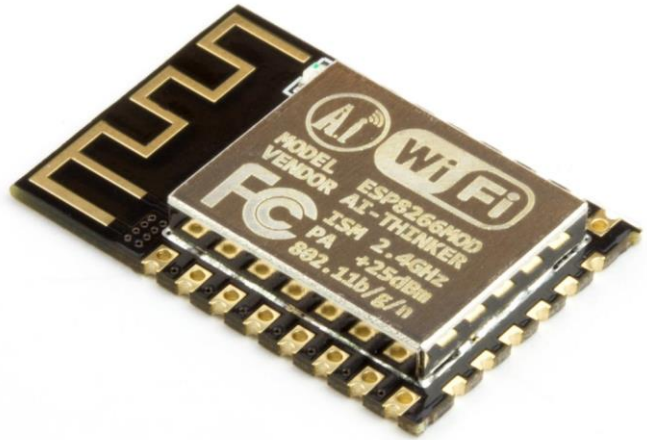
- System on Chip (SoC)
- System on module (SoM)
- Microcontroller (MCU)
- General purpose I/O (GPIO)
- Analog to digital converter (ADC)
- Over the air (OTA)
- Power on reset (POR)
- Brown out detection (BOD)
- Watchdog timer (WDT)



https://www.nxp.com/products/wireless-connectivity/bluetooth-low-energy-ble/a-highly-extensible-platform-for-application-development-of-qn908x:QN9080DK

Example: Wearable SoC / SoM

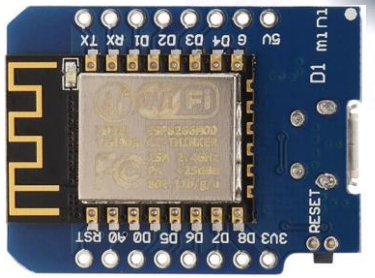
ESP8266: our SoC



- **CPU**: 32 bit, 80/160 MHz
- **RAM**: ~36k
- **Flash**: 4MB (shared, different layouts possible)
- **I/O**: 8 GPIO, 10 bit ADC, PWM, UART, SPI, I2C, I2S
- **Network**
  - WiFi, (WPA/WPA2, STA/AP/STA+AP)
  - TCP/IP (+HTTP, MQTT etc libs)
- **Operating temperature**: -40 to 125

ESP8266: our lab modules

- Programmed mostly in C, Arduino (also Lua ..)
- OTA updates
- Power:
  - 3.3V (5V tolerant GPIO?)
  - Deep sleep (10 uA)
  - Our modules are powered by USB



Exercises

1. Print “Hello world”
2. Blink an LED
3. Read a button
4. Interrupts
5. Advanced (find the docs yourself)
    1. Watchdog (feed the dog ☺)
    2. Flash (EEPROM, SPIFFS)
    3. Additional guidelines