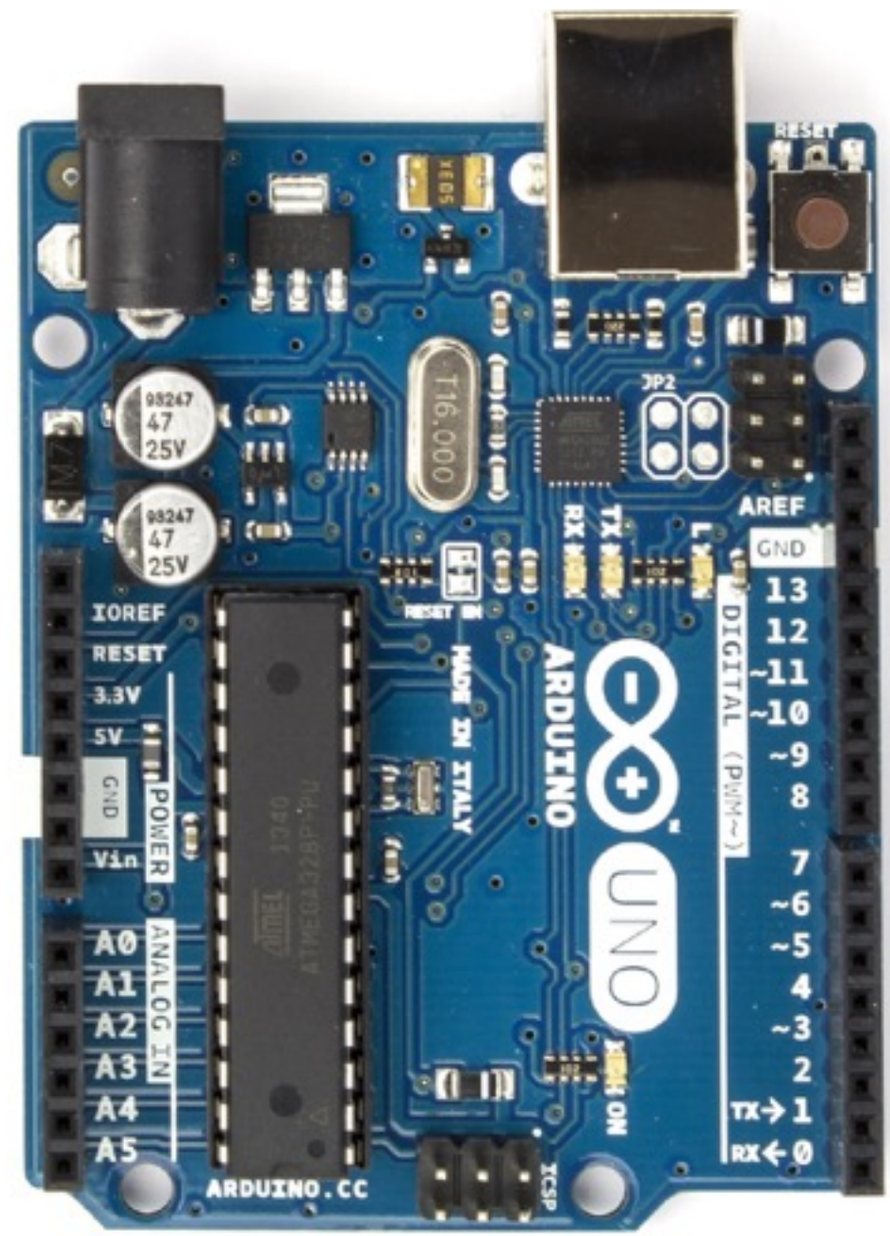
a day of Arduino

Charles Martin

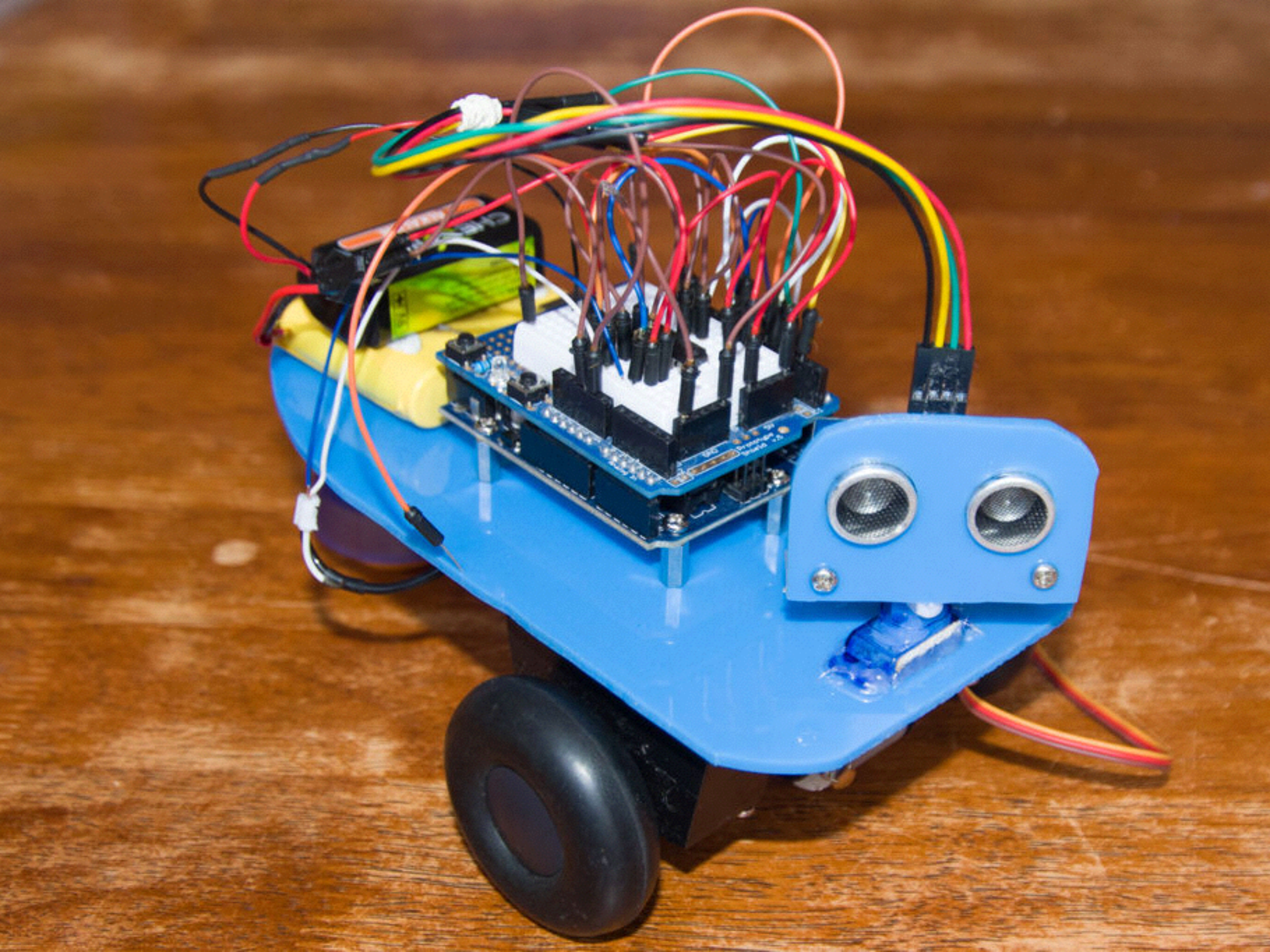
What’s Arduino

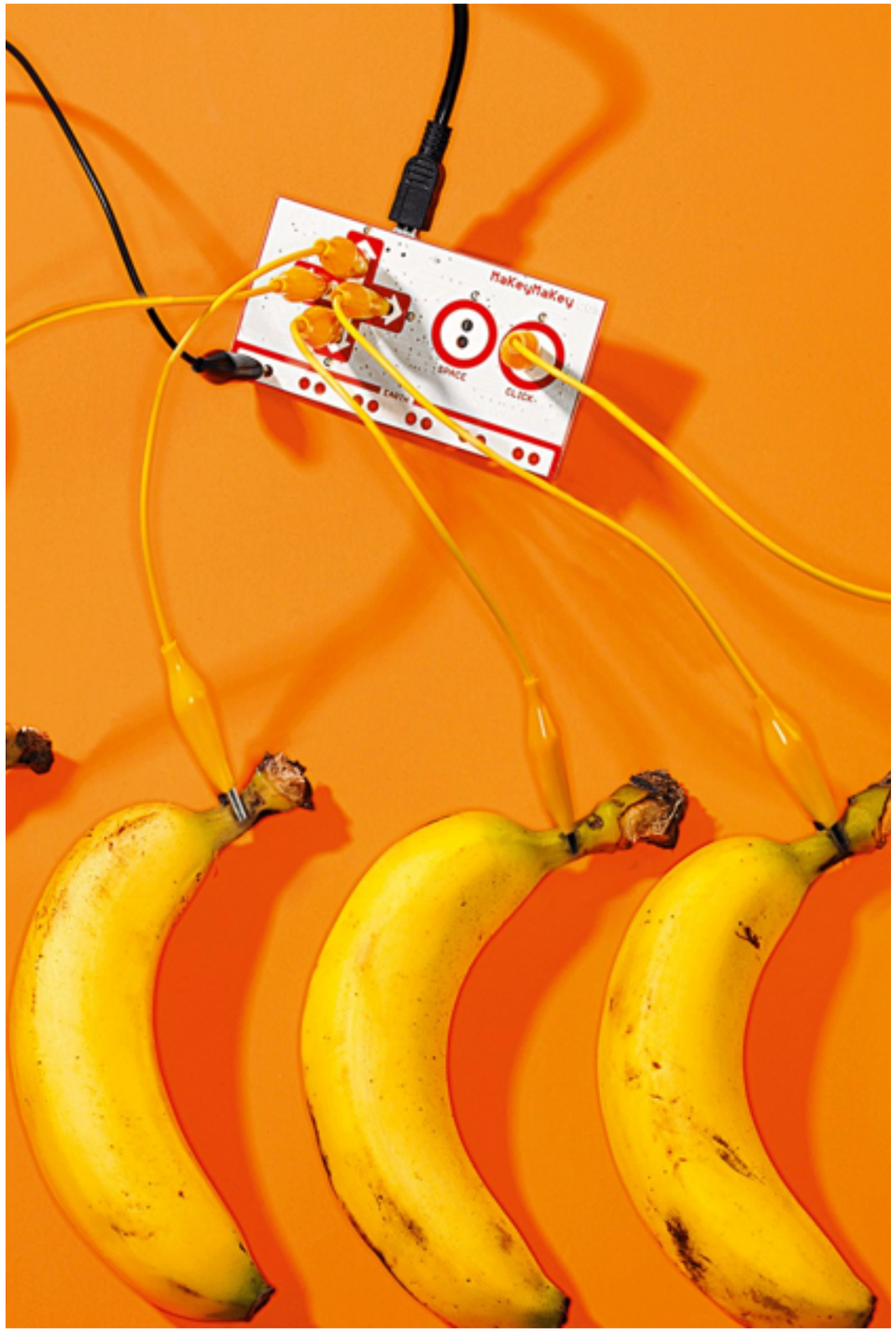
- it’s a simple computer
- you can use it to build cool things
- “physical computing” - making computers that **sense** and **control** the physical world

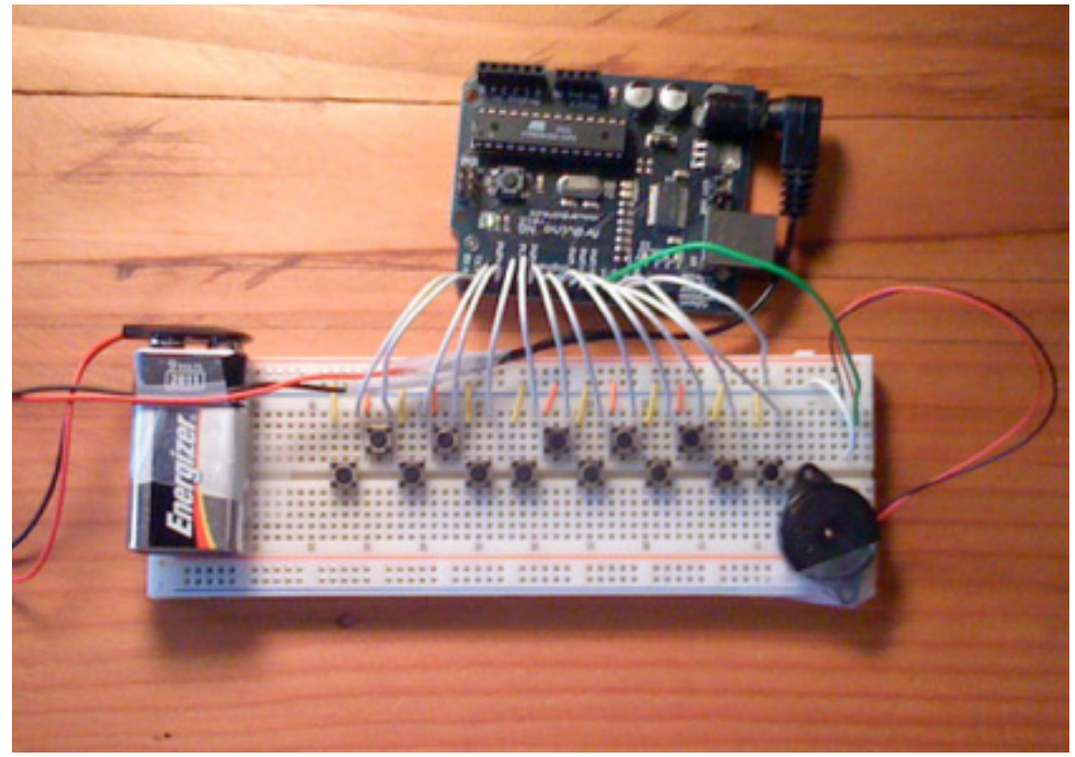


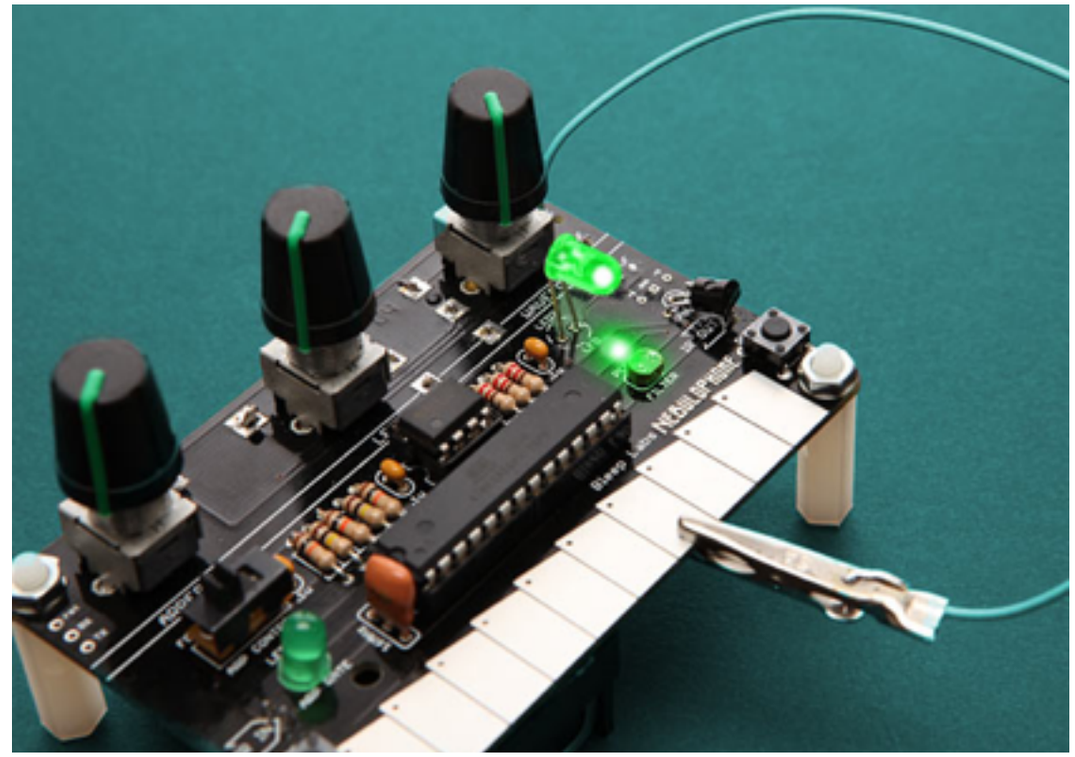
things you can make:

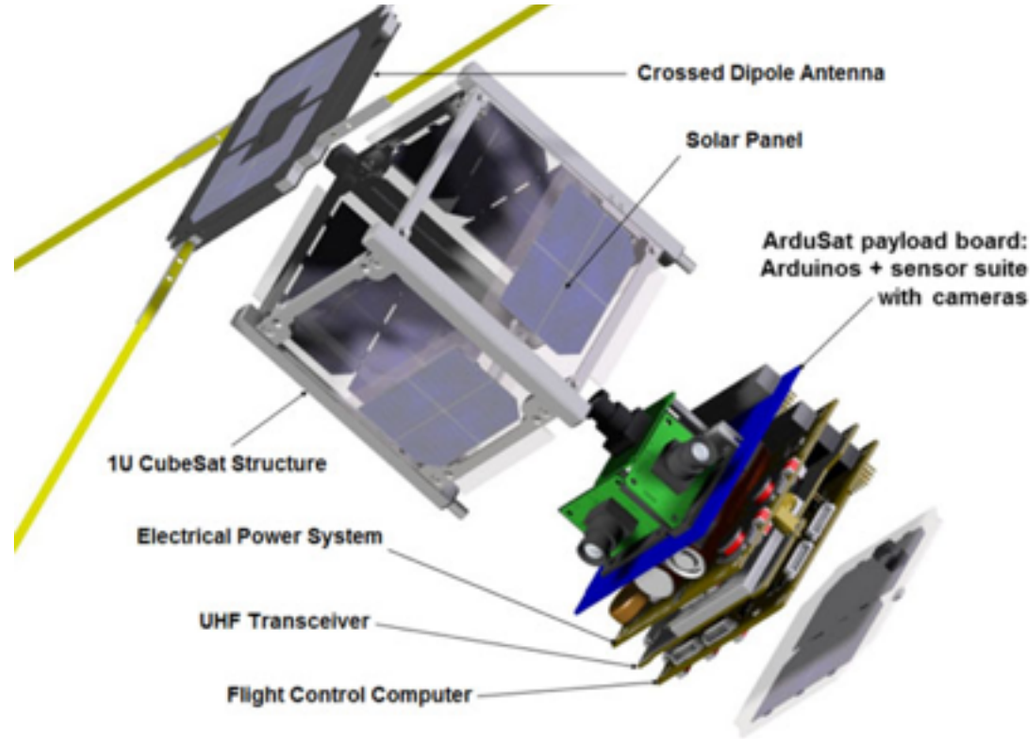
- robots
- synthesisers
- weather stations
- satellites (really.)
- heart beat monitors
- video game consoles

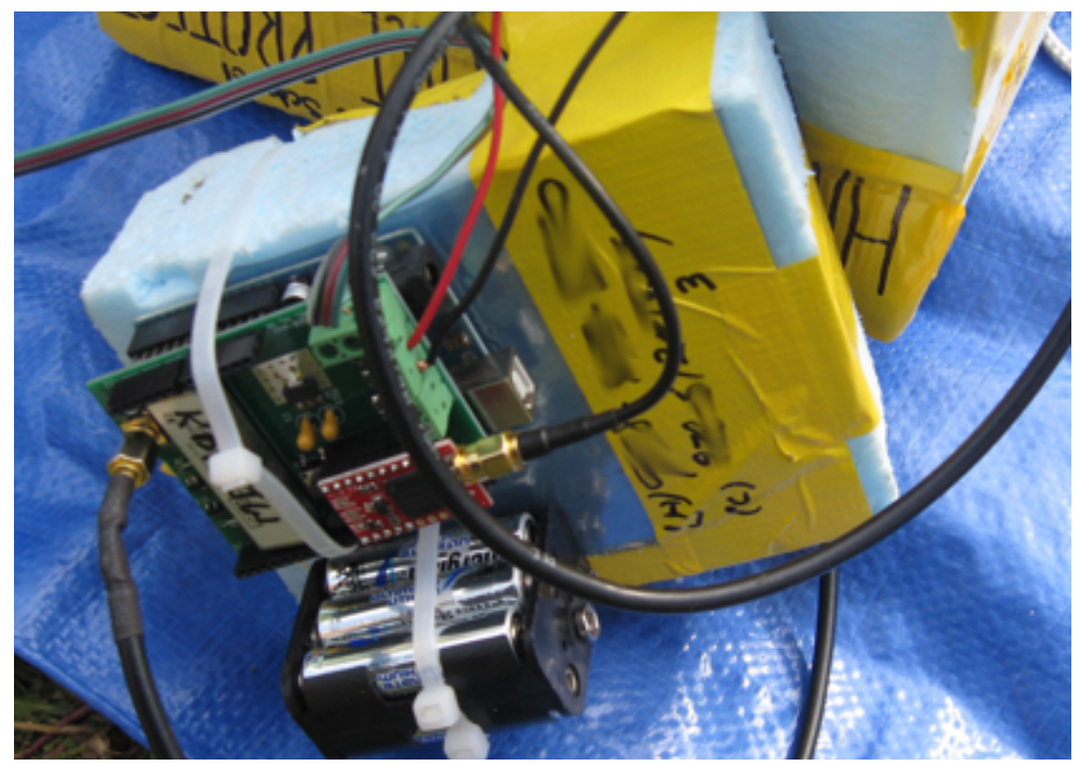


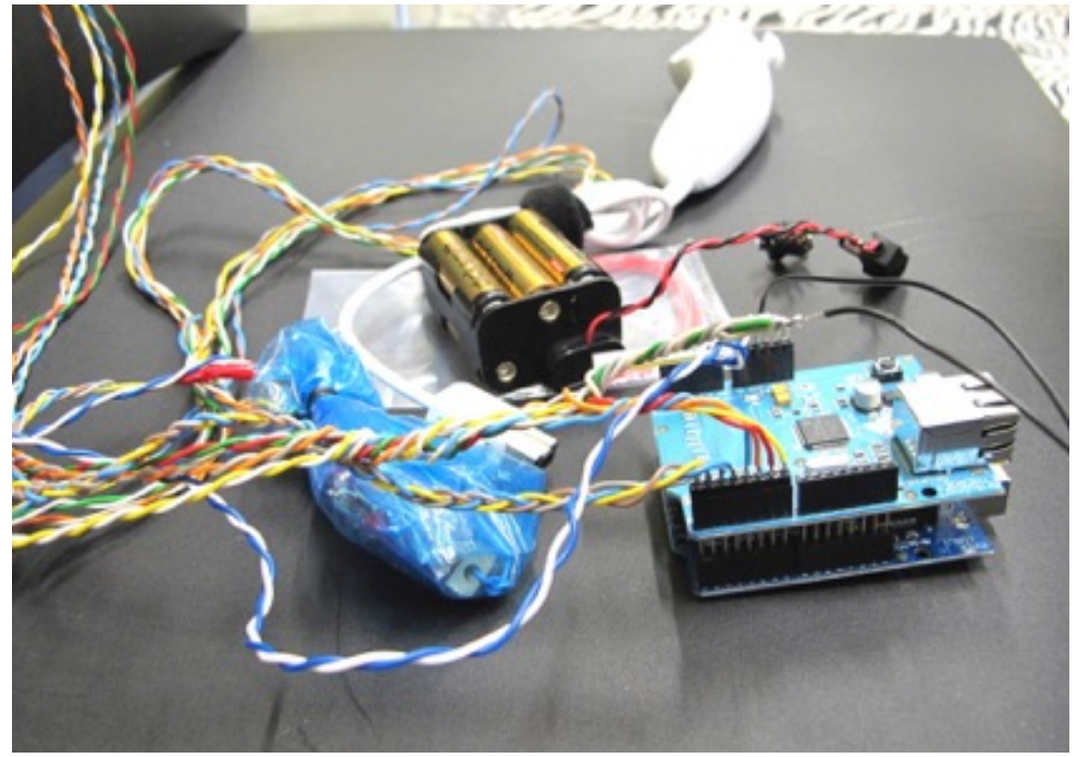

MaKeyMaKey
SPACE
CLICK
EARTH

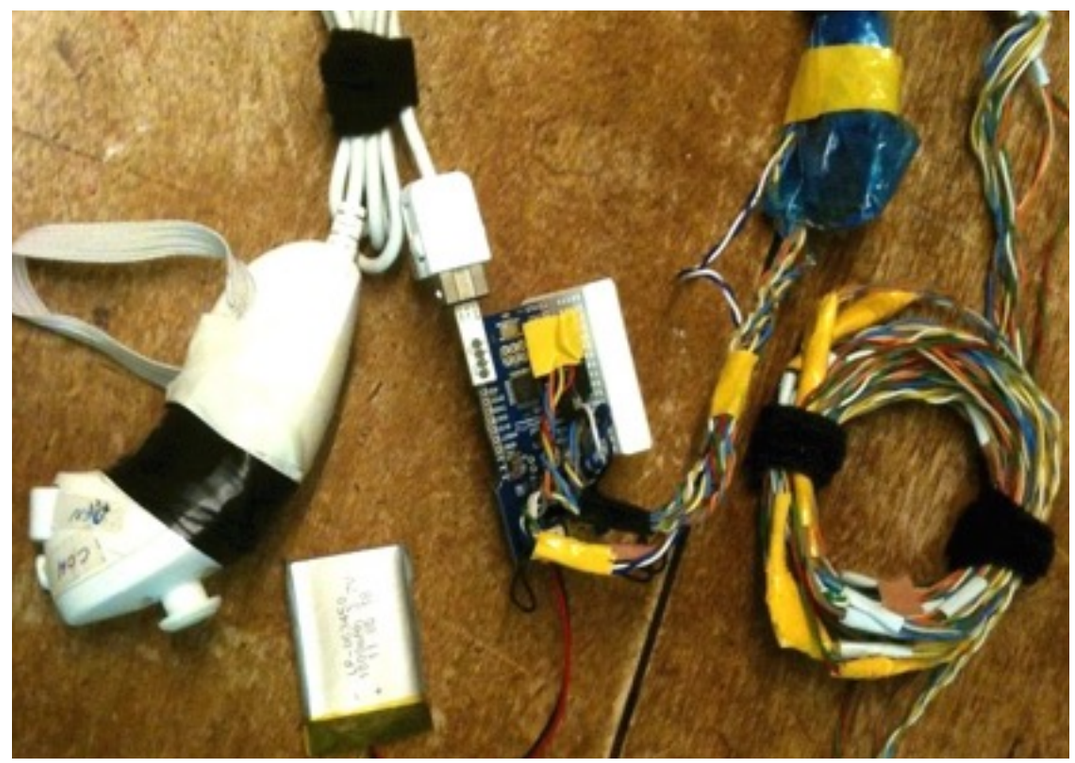

Energizer




Crossed Dipole Antenna
Solar Panel
ArduSat payload board:
Arduinos + sensor suite
with cameras
1U CubeSat Structure
Electrical Power System
UHF Transceiver
Flight Control Computer

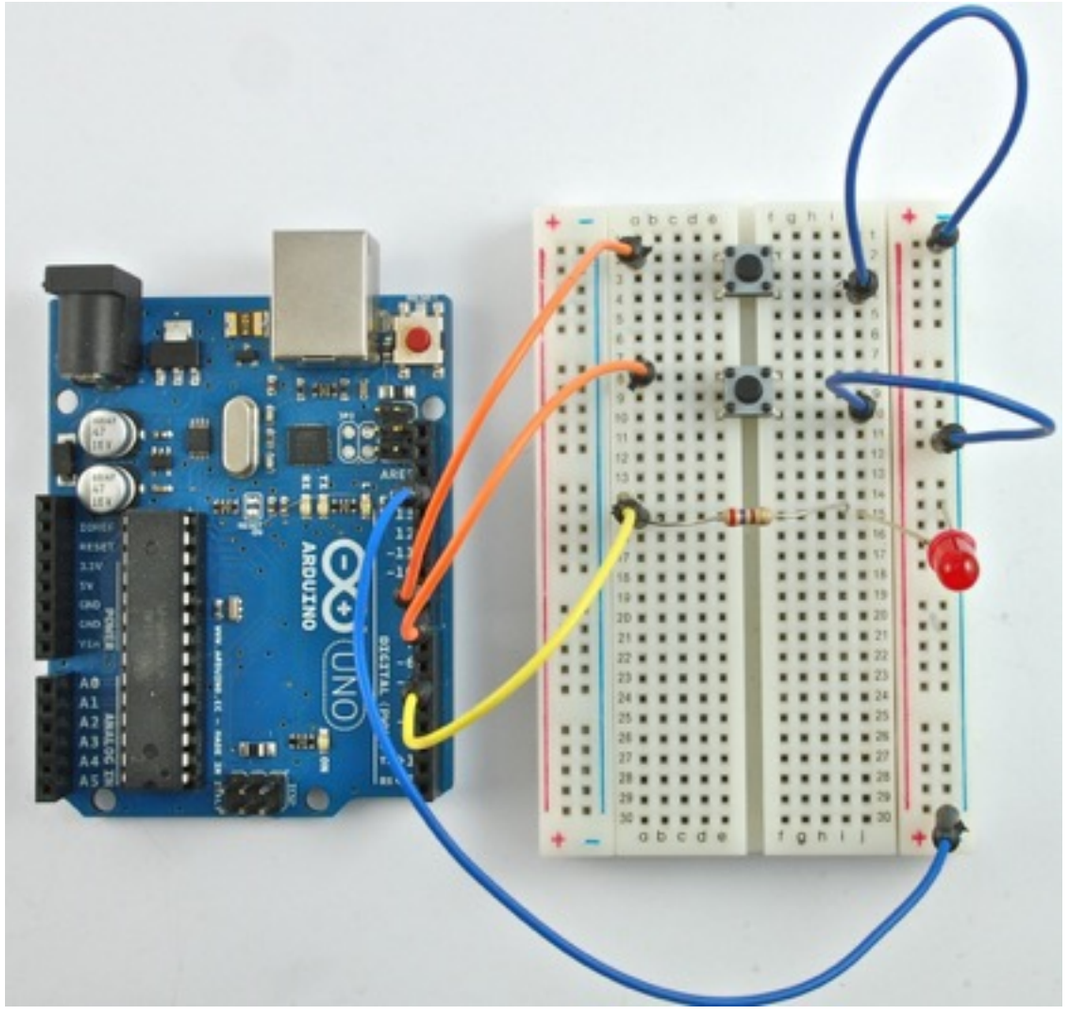






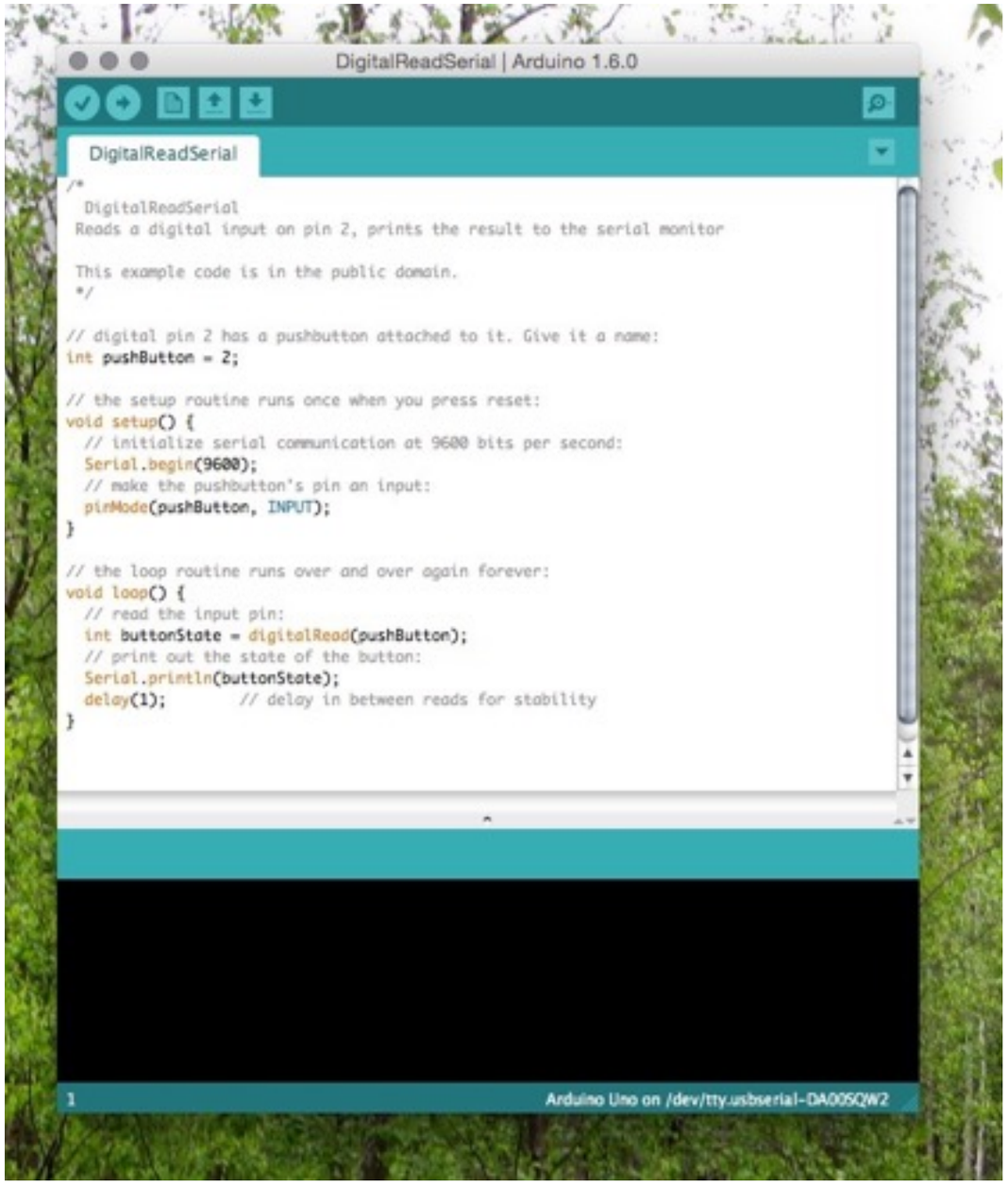
How do you build physical computers?

- build circuits with **sensors** and **actuators**
- **Sensors**
  - buttons, sliders, knobs
  - light, temperature, movement, weather, location, orientation sensors
- **Actuators**
  - Lights
  - Sounds
  - Movement

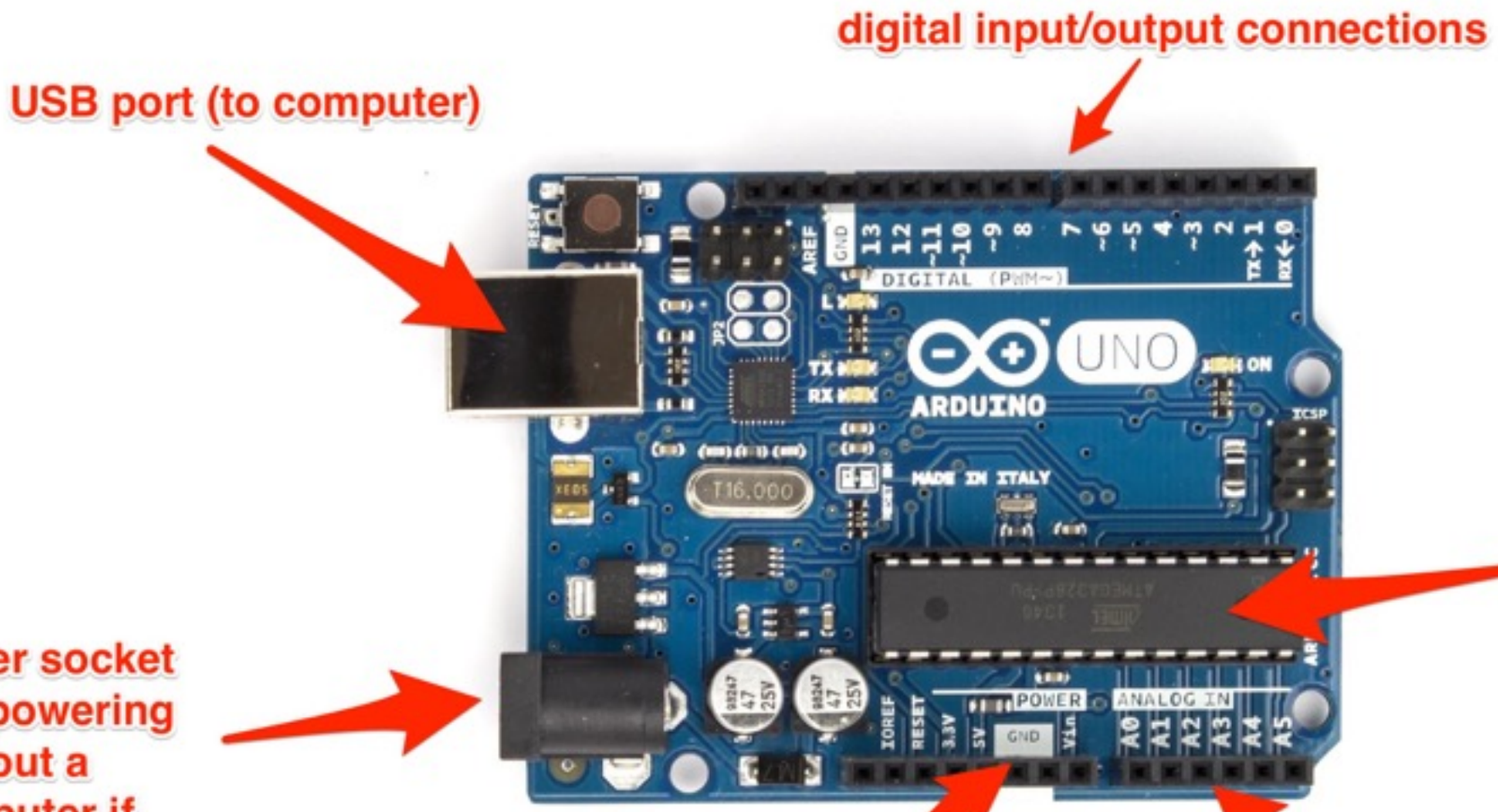


What about the software?

- you’re going to write little programs to connect everything together
- (so you need a big computer to program your Arduino which is a little computer.)
- (this is easy)

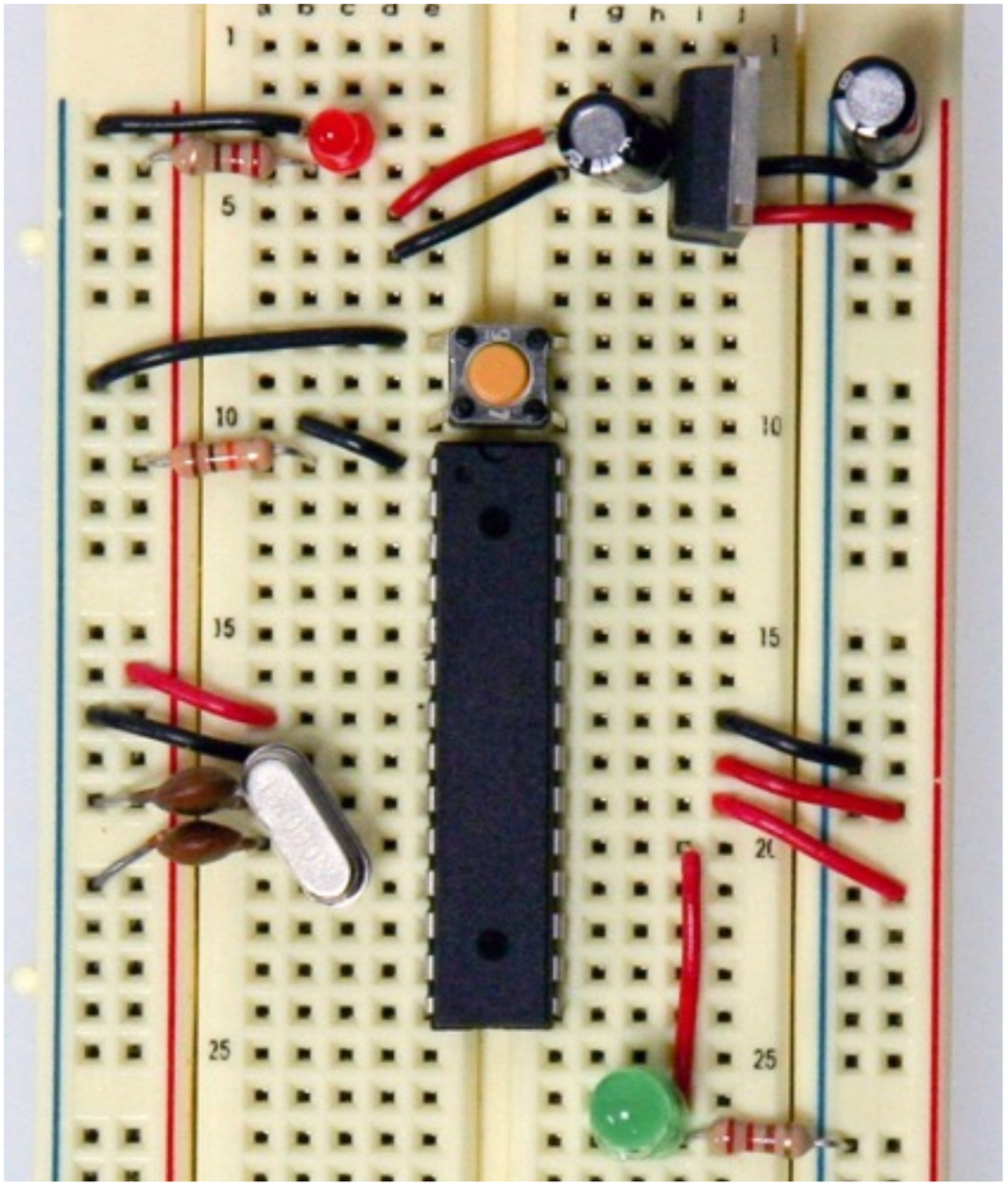


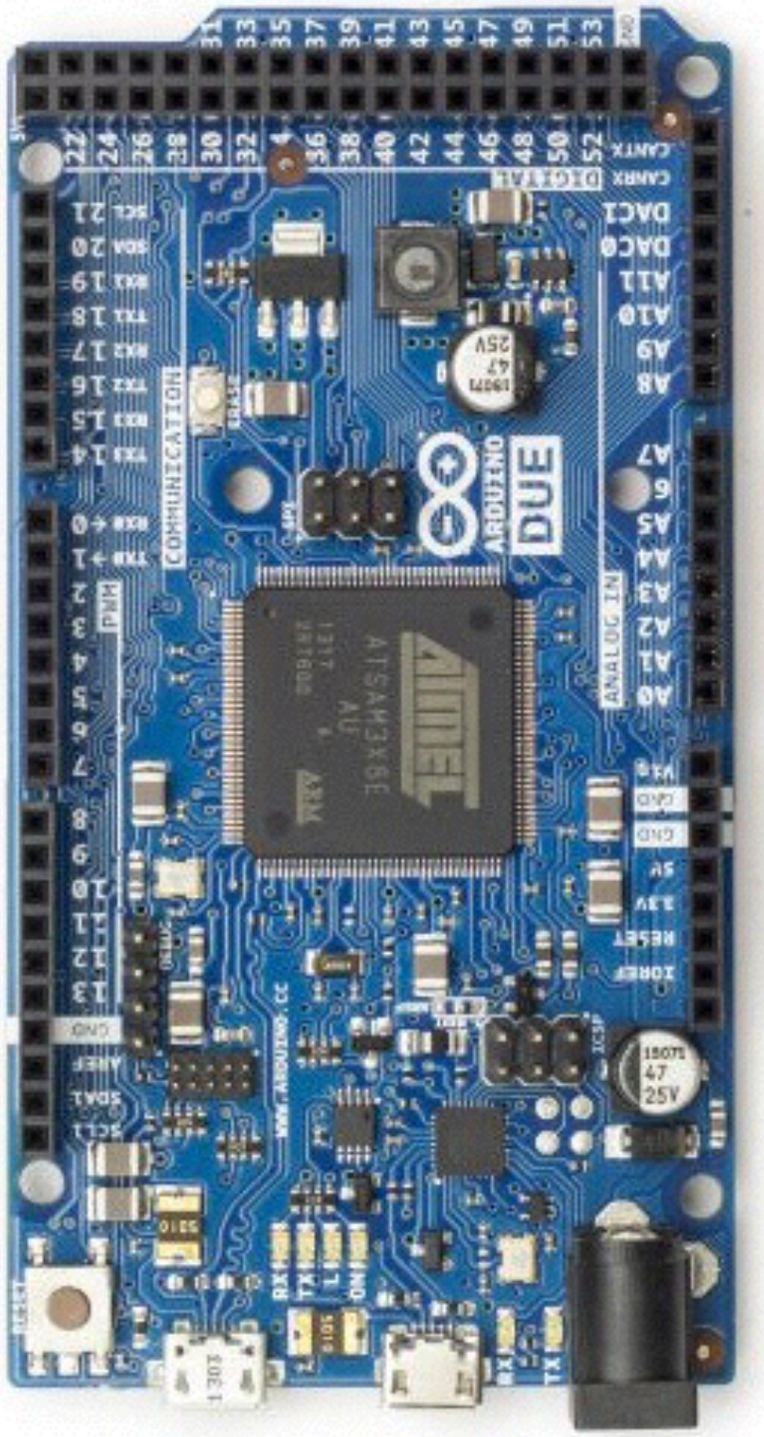
Closer look:

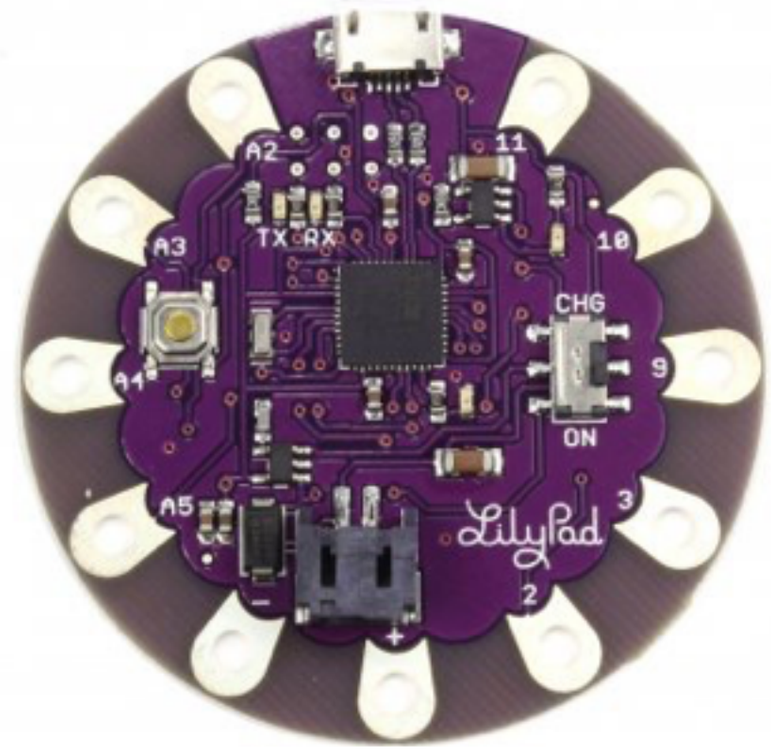

digital input/output connections
USB port (to computer)
microcontroller (simple computer that runs your program)
power socket (for powering without a computer if you want)
power and ground connections (use for adding extra circuits!)
analogue input connections
DIGITAL (PWM~)
UNO
ARDUINO
MADE IN ITALY
POWER
ANALOG IN

Microcontroller

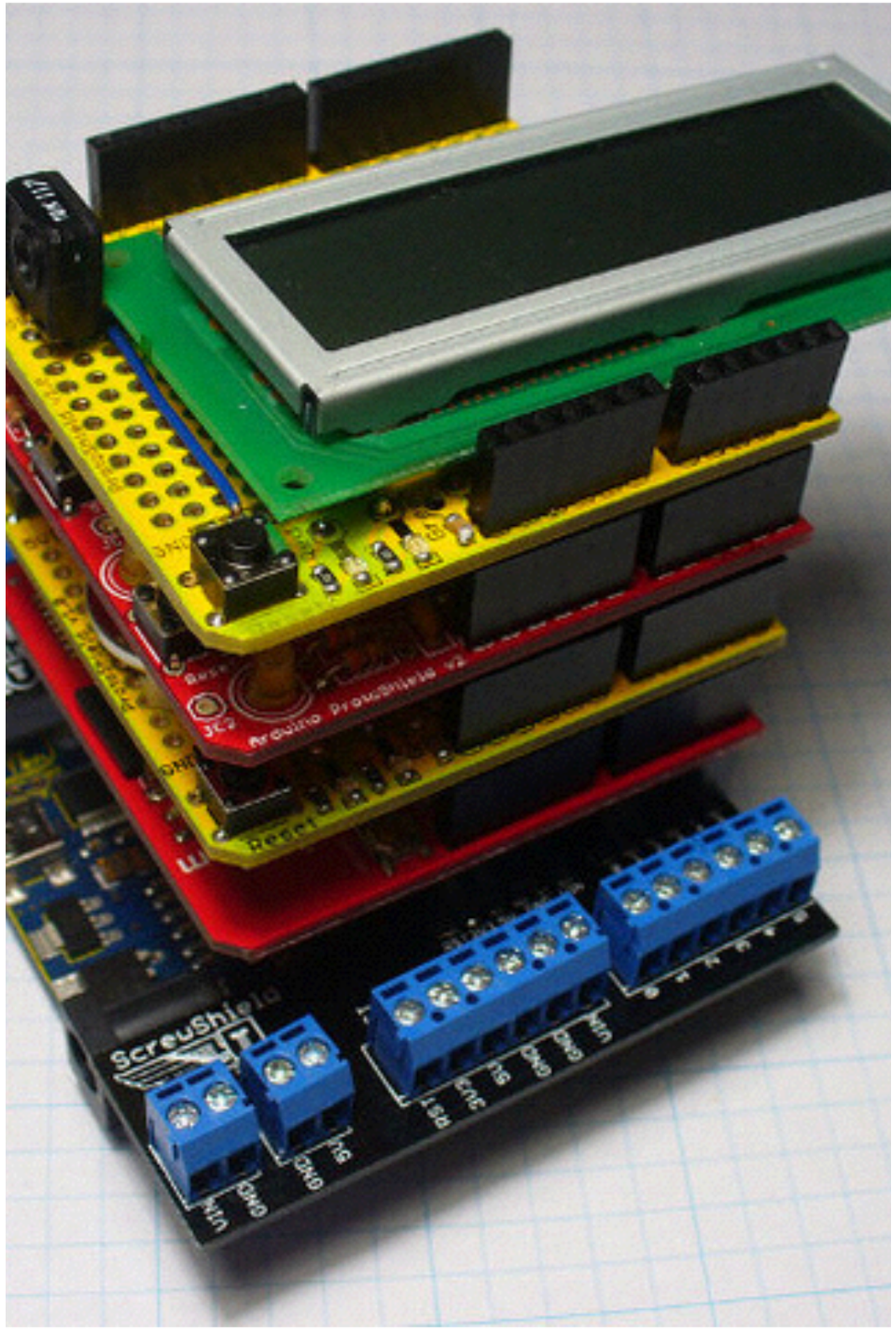
- the Microcontroller can exist independently of the Arduino board
- the point of Arduino is to make it easy to get started - without having to put together a circuit every time you want to do a new project
- Some crazy peeps still do this to make a project smaller or cheaper than with arduino boards.

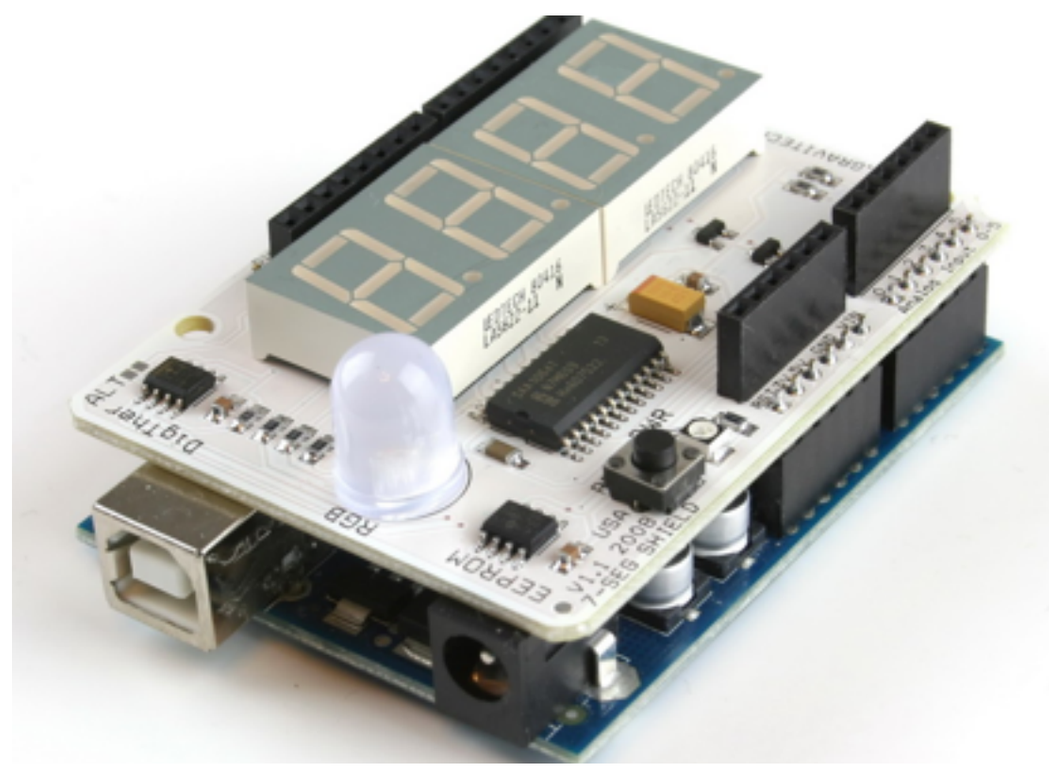



ARDUINO
DUE
COMMUNICATION
DIGITAL
ANALOG IN
PWM
ICSP
RESET
3V3
5V
GND
ATSAM3X8E
AT91SAM
WWW.ARDUINO.CC

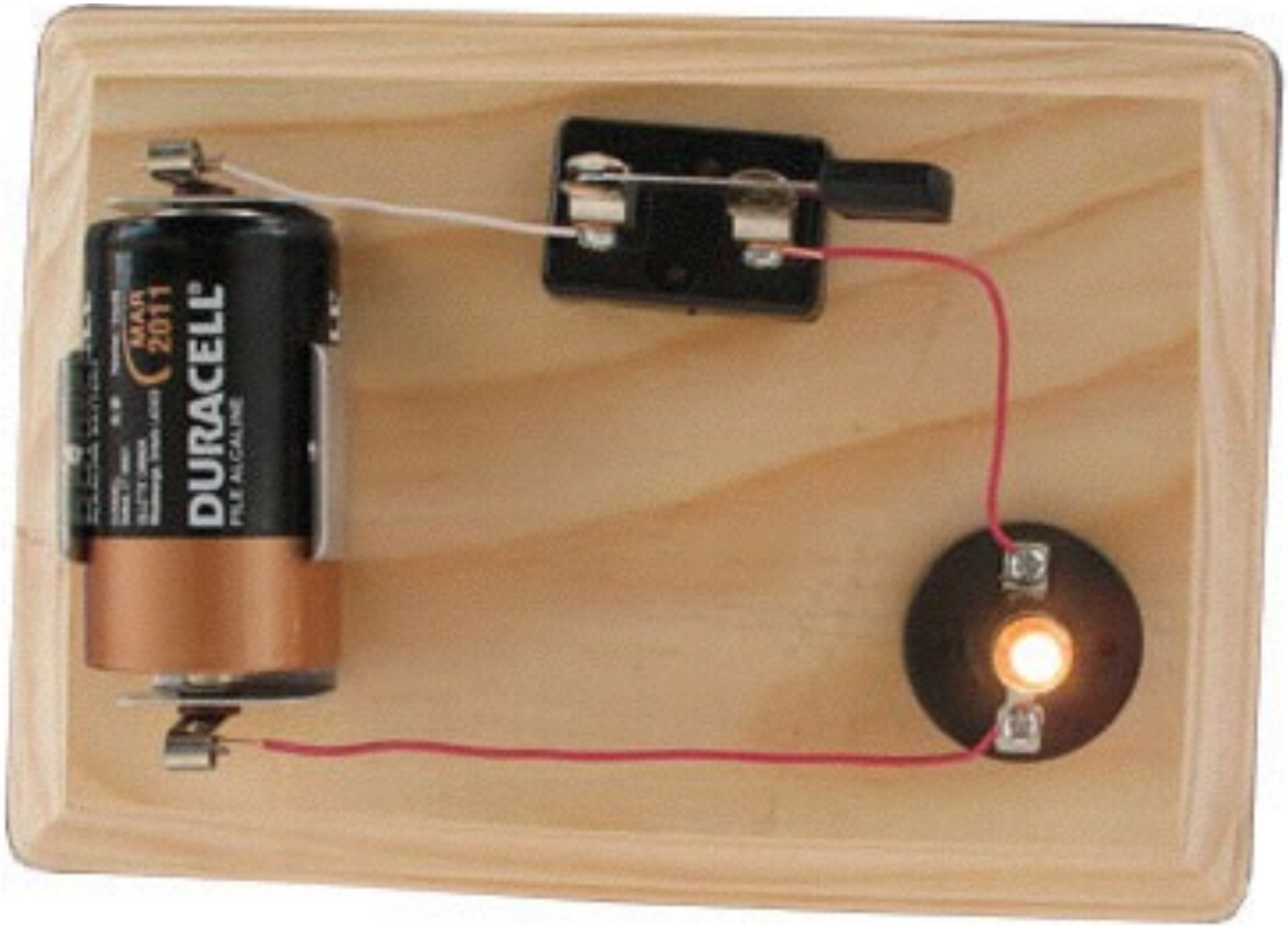

A2
A3
A1
A5
TX
RX
CHG
ON
LilyPad

Arduino Fio
3V3
GND
AREF
RXI
TXO
DTR


ScrewShield
Arduino ProtoShield v2
Reset
Vin
GND
GND
5V
3V3
RST
GND
GND
Vin


DIGITHER
RGB
EEPROM
V1.1 2008
7-SEG SHIELD

Digital Electronics: important science fact time!



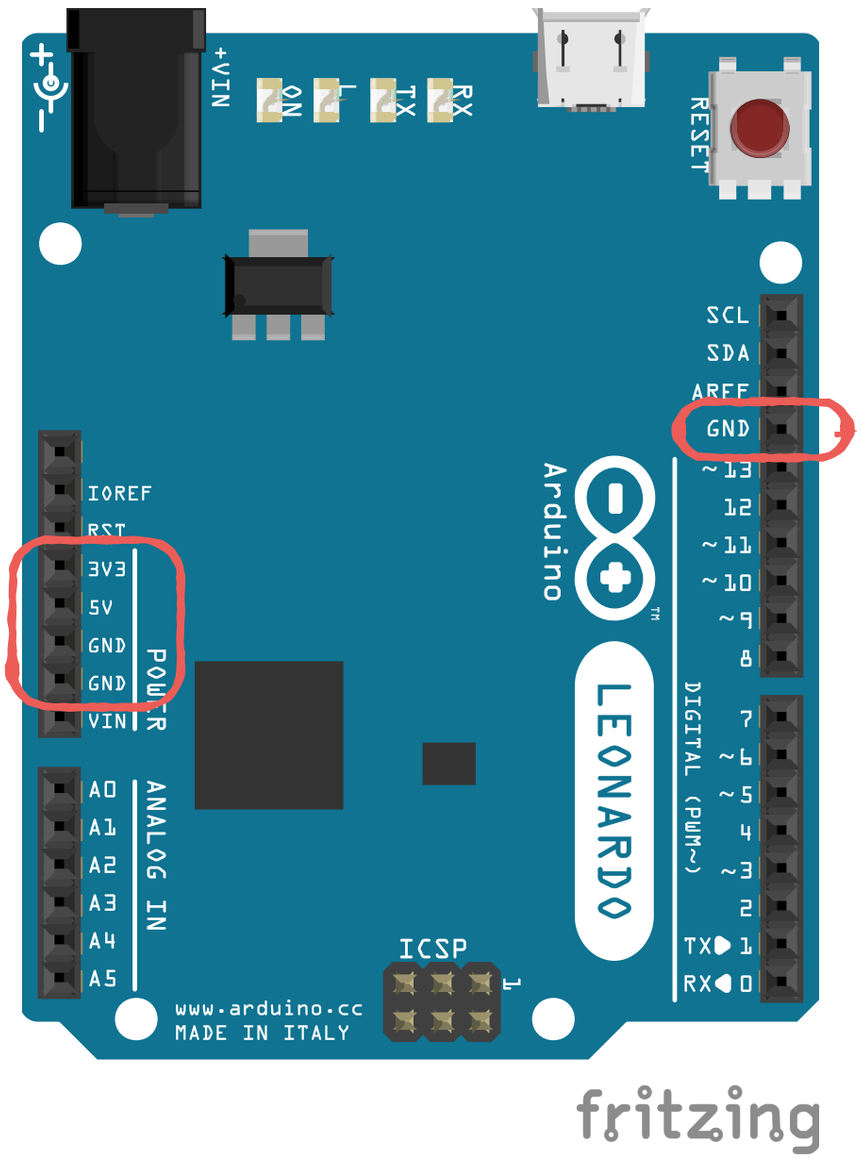
MiniScience.c

Circuits

always have a positive and
ground (negative) connection

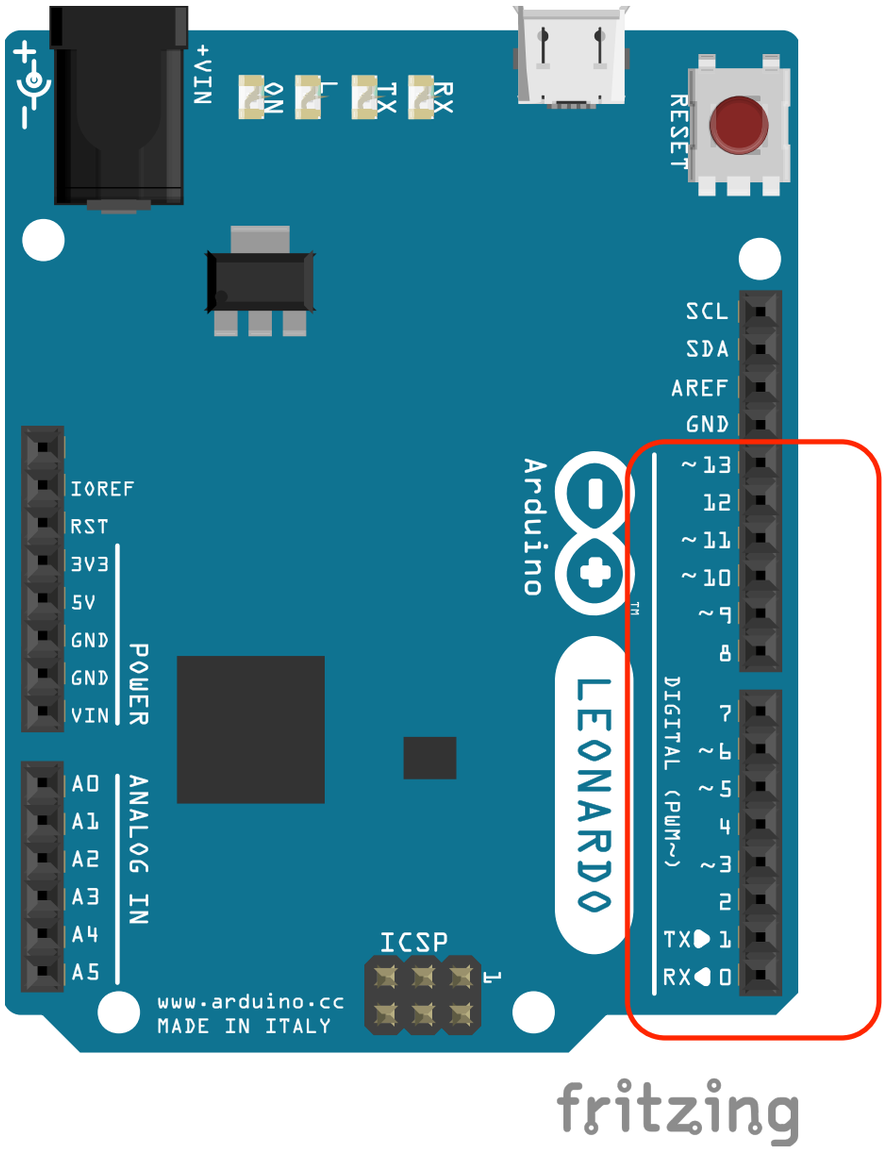
Voltage and Ground

- the Arduino has positive voltage and ground connections
- There's a power circuit on the Arduino that takes the power from the USB plug or the power connector and outputs 5 volts and 3.3 volts.
- the 3V3 pin always outputs3.3 volts
- 5V pin always outputs 5 volts.
- GND pins are always ground.



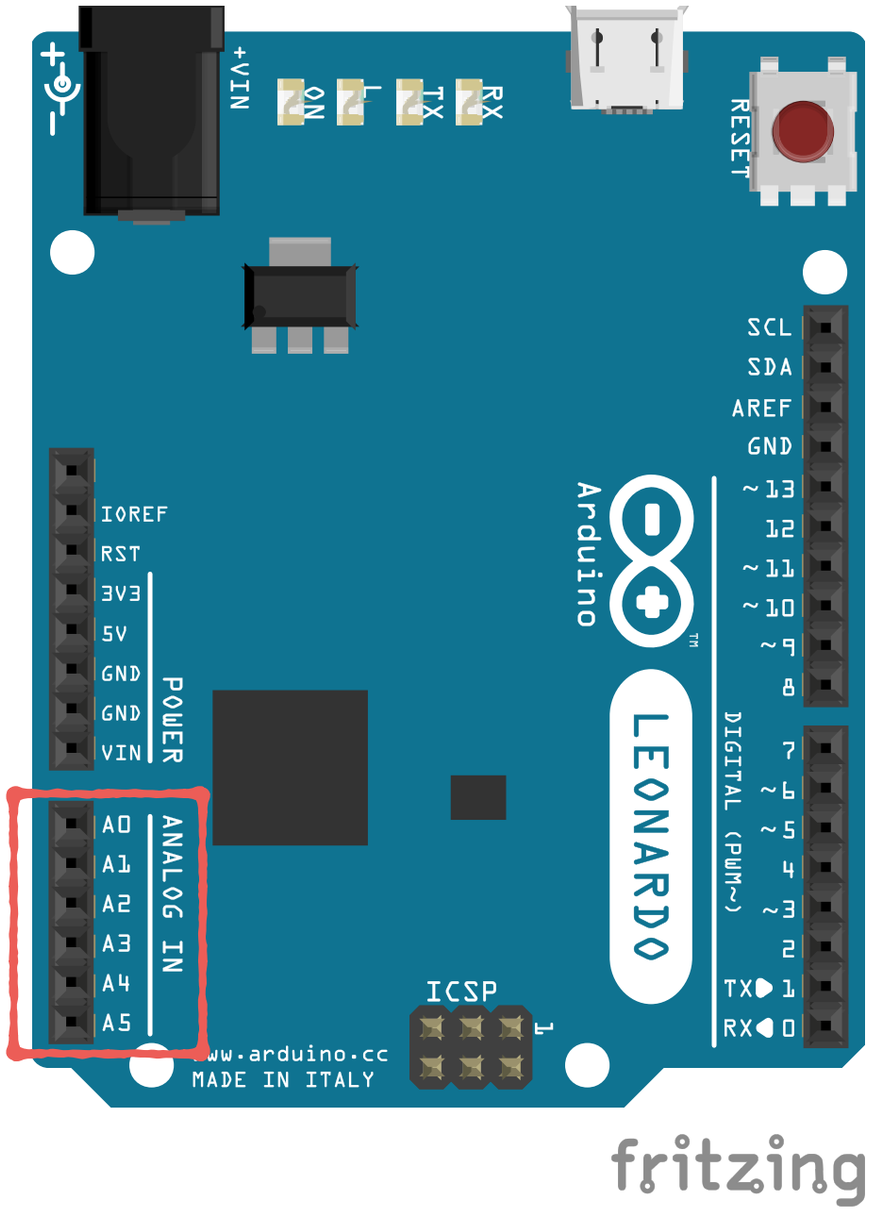
Digital Input/Output

- The 13 “digital” pins on the Arduino can be used input AND output.
- **Output mode** - they can be switched to output a voltage (5V) or not.
- **Input mode** - they can detect whether a voltage is applied or not.
- In digital terms - the voltage is not important, just whether it’s on or off
- Terminology: “HIGH” (5V) or “LOW” (ground).



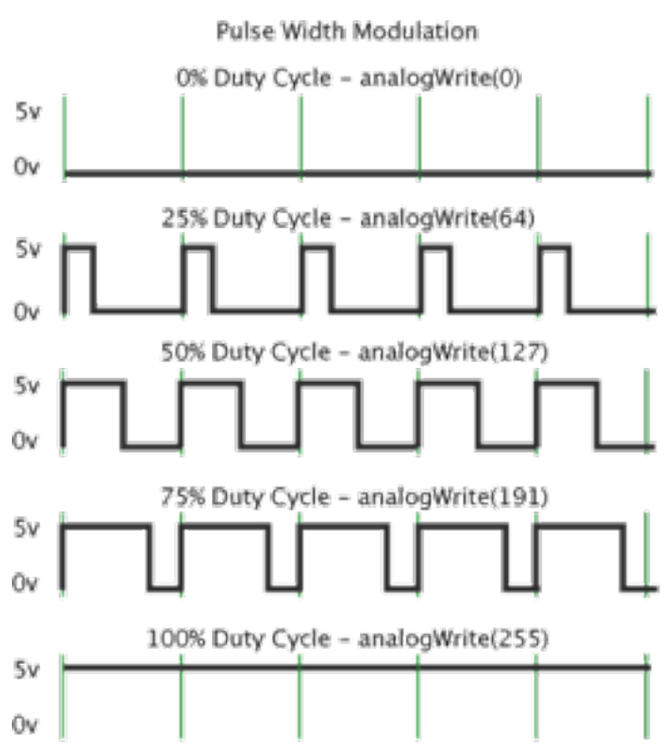
Analog Inputs

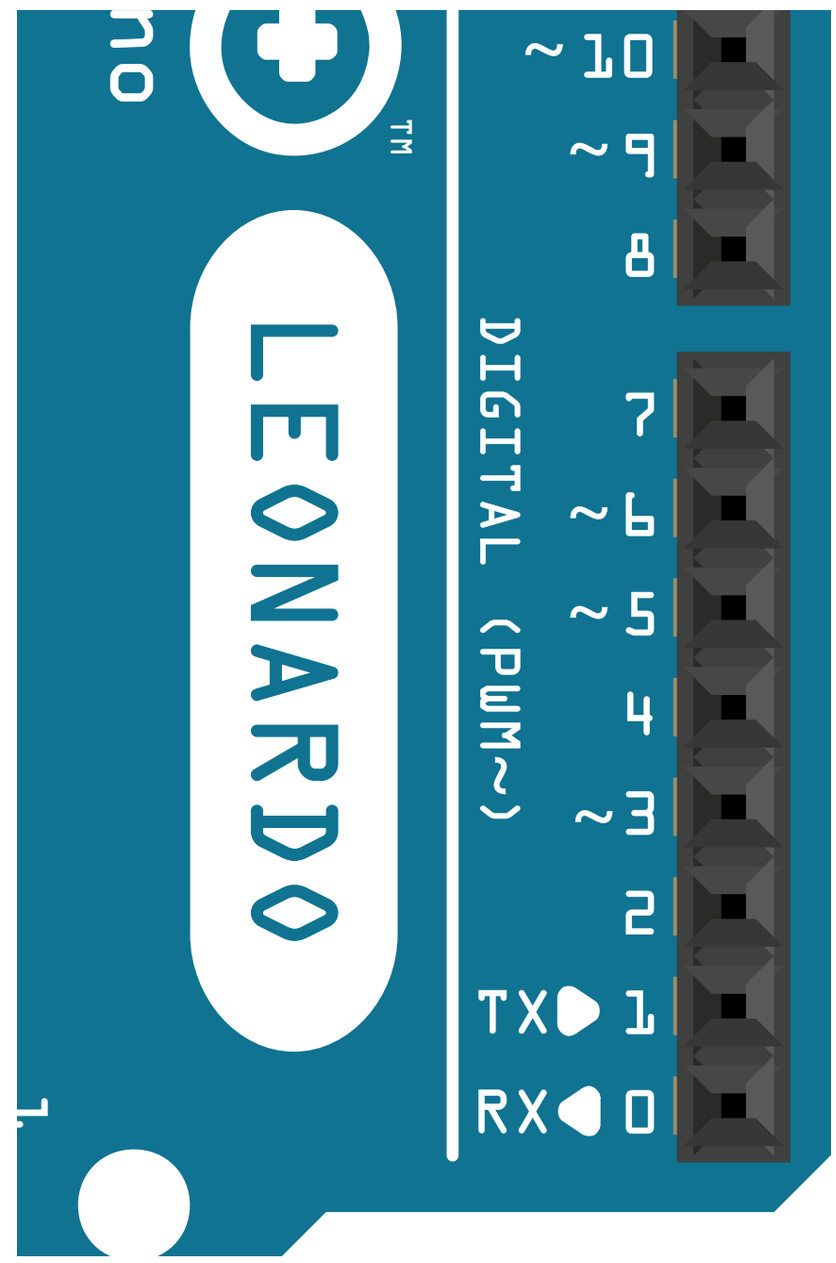
- “Analog in” pins can measure how much voltage is applied to them (between GND and 5V).
- It can detect 1024 levels in between 0 and 5V
- These pins are input only!

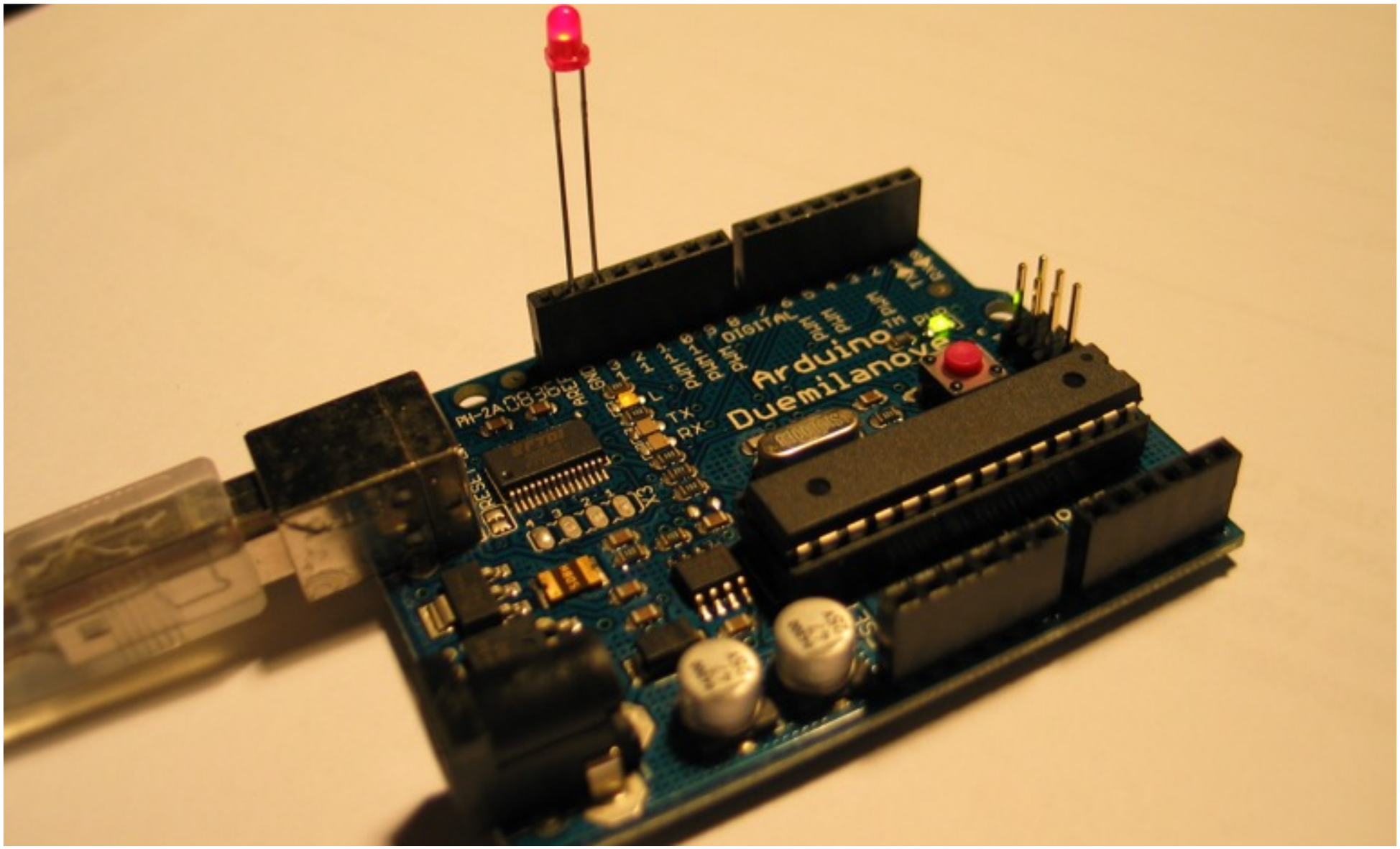


Analog output?

- The Arduino can't do a true analog output (that would be generating a any voltage between 0-5V).
- It can do a "fake" analog output using the digital pins called PWM (Pulse Width Modulation)
- Only the pins marked "~" can do PWM!





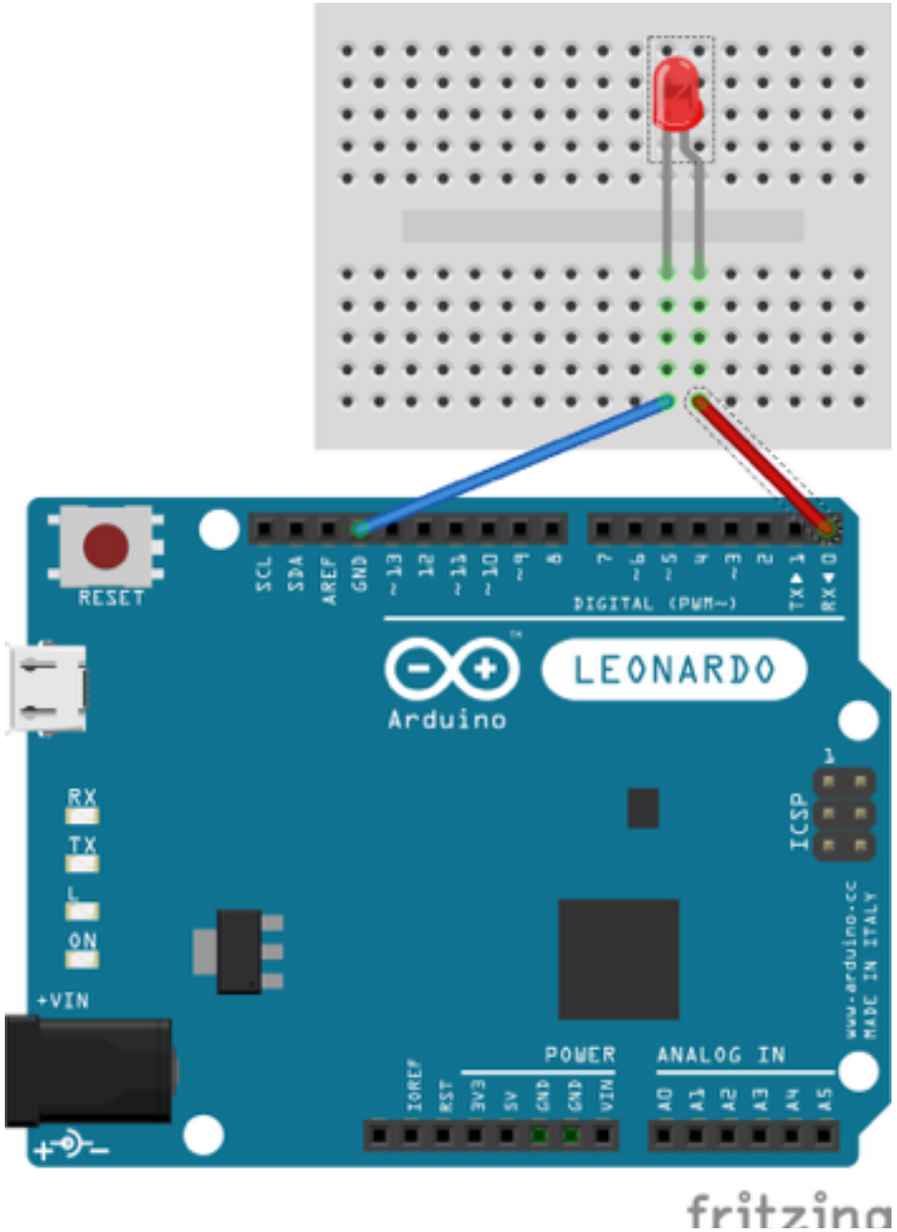


Project 1

blinking an LED

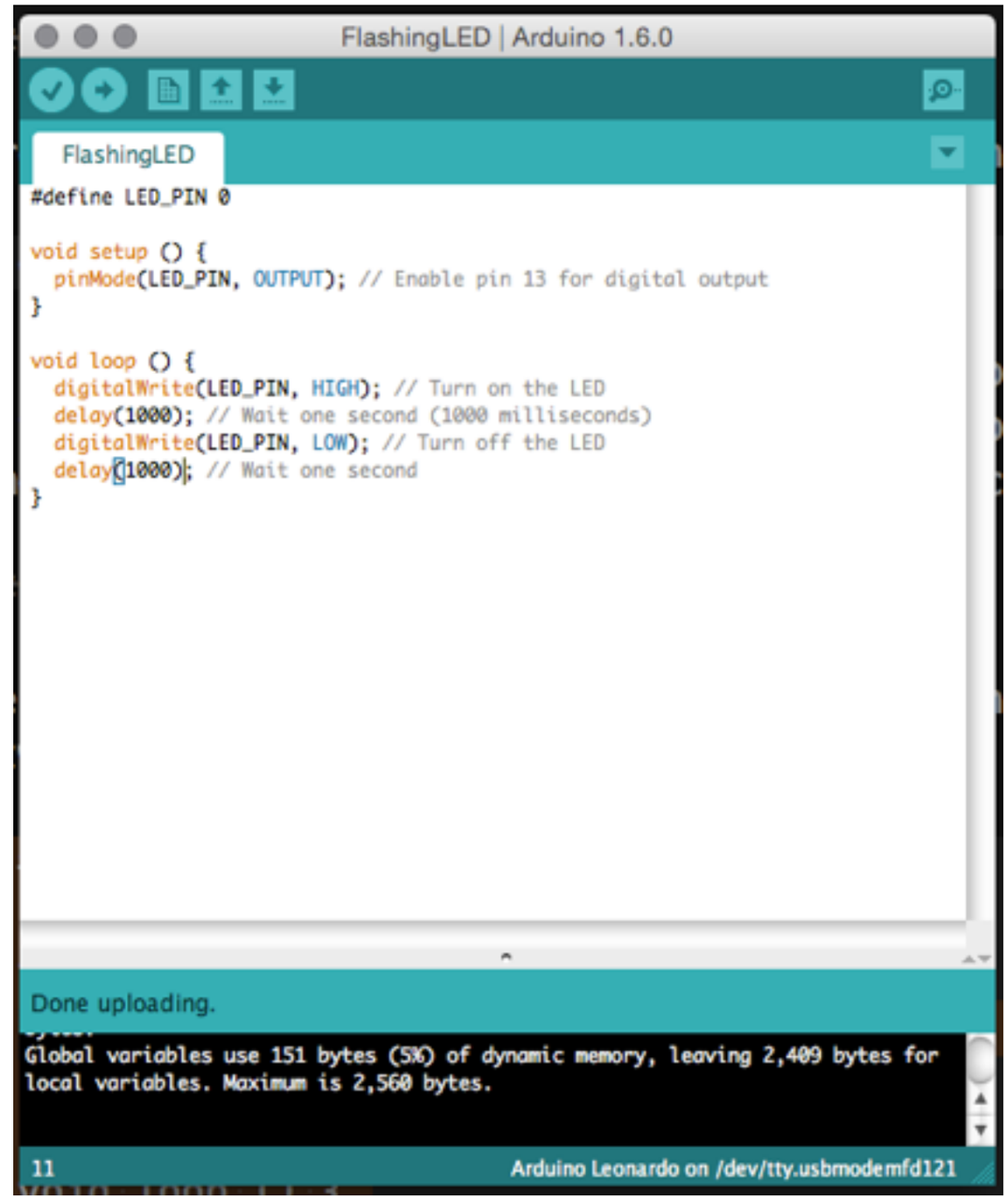
Circuit Diagram

- The plastic thing with holes is a “breadboard” - each row of 5 holes is electrically connected
- Plug an LED into the board
  - long leg is for positive voltage,
  - flat side of the LED the GND side.
- Connect the board to the Arduino with the jumper leads.
  - Digital pin 0 to the +ve side of the LED
  - -ve side of the LED to GND.



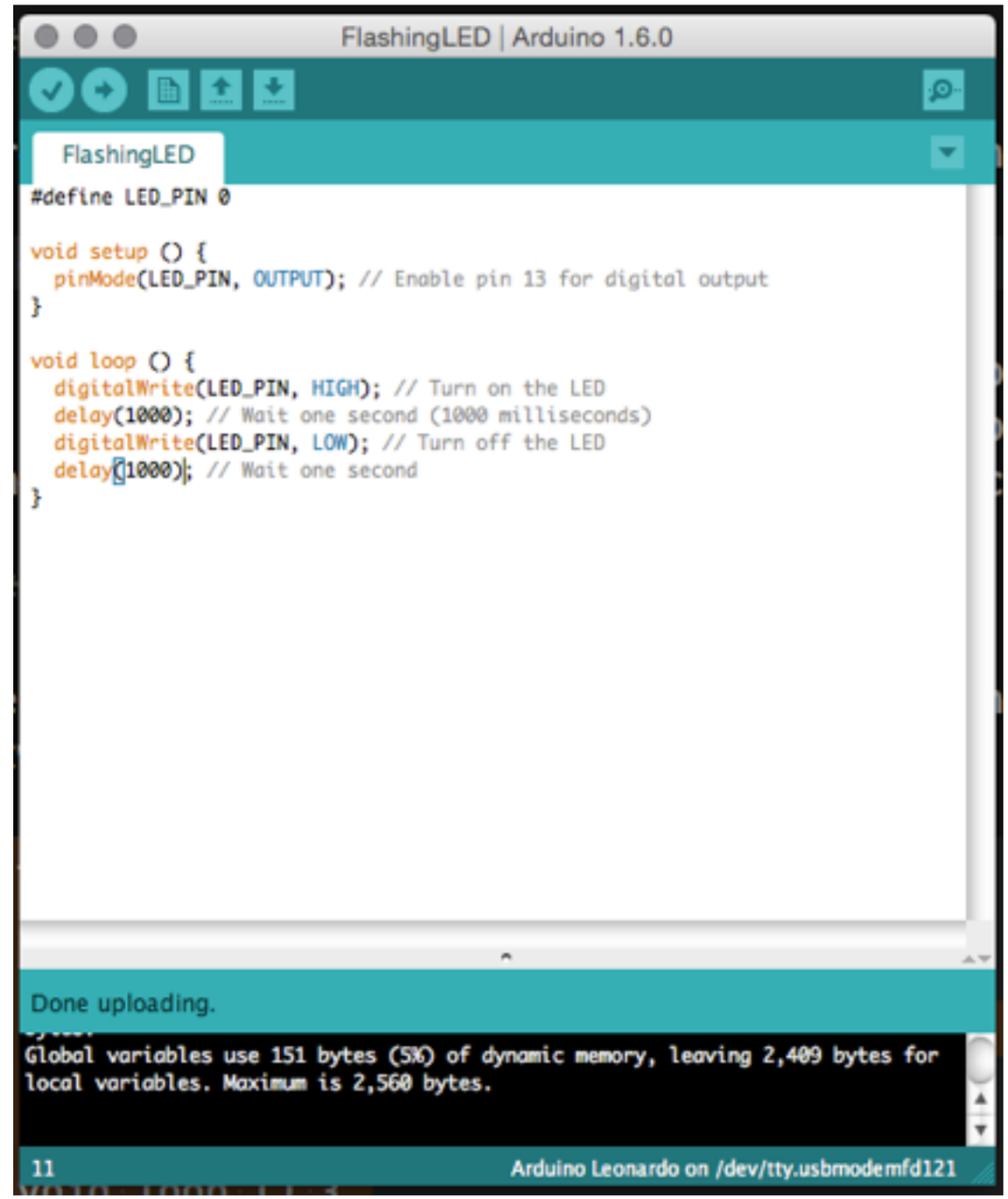
Sketch

- void setup () { … } runs once
- void loop () {…} runs over and over again forever.
- Arduinos only run one program at a time, and you can't quit or stop them. You can only "reset" or turn the power off.



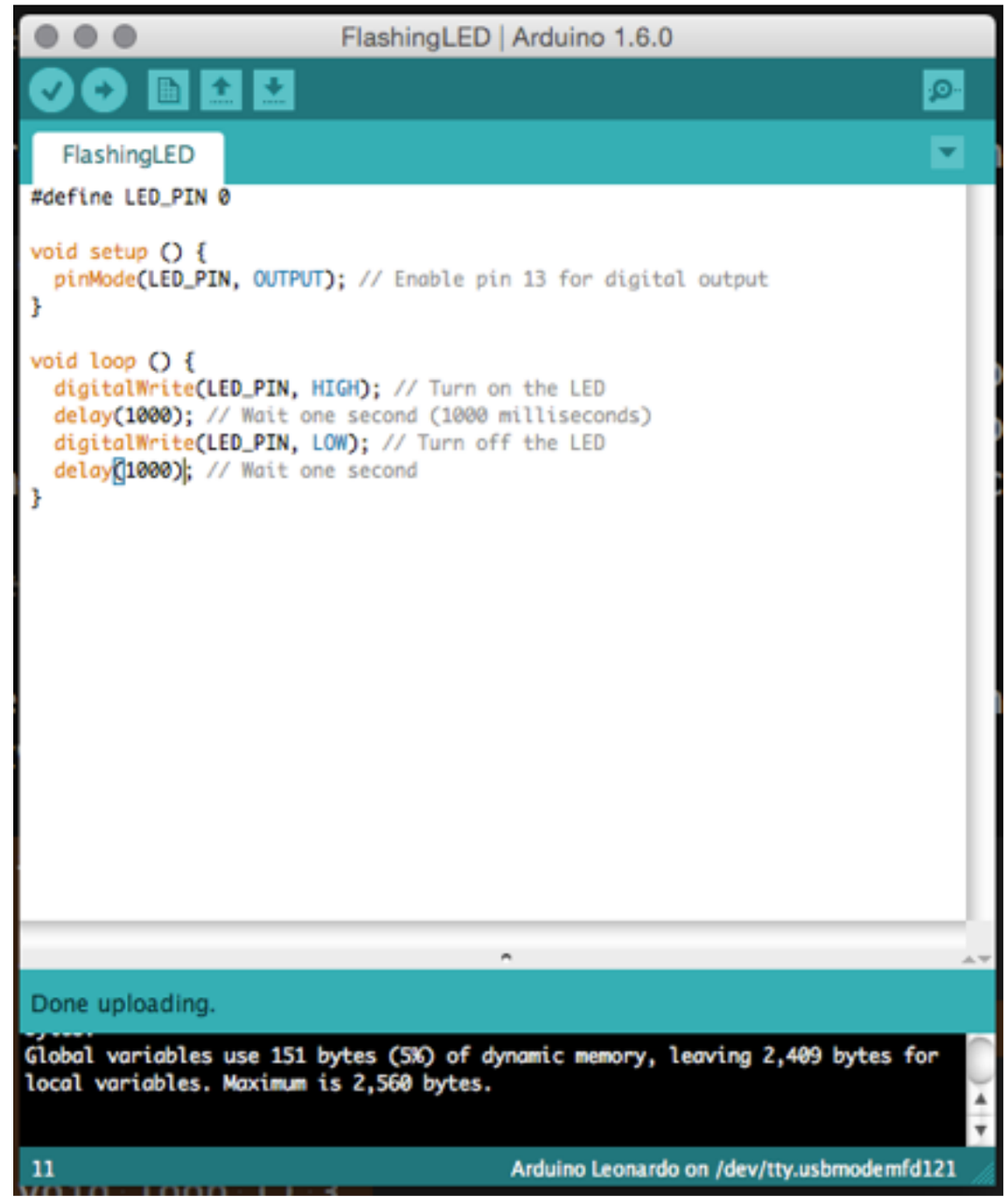
Sketch Part 2

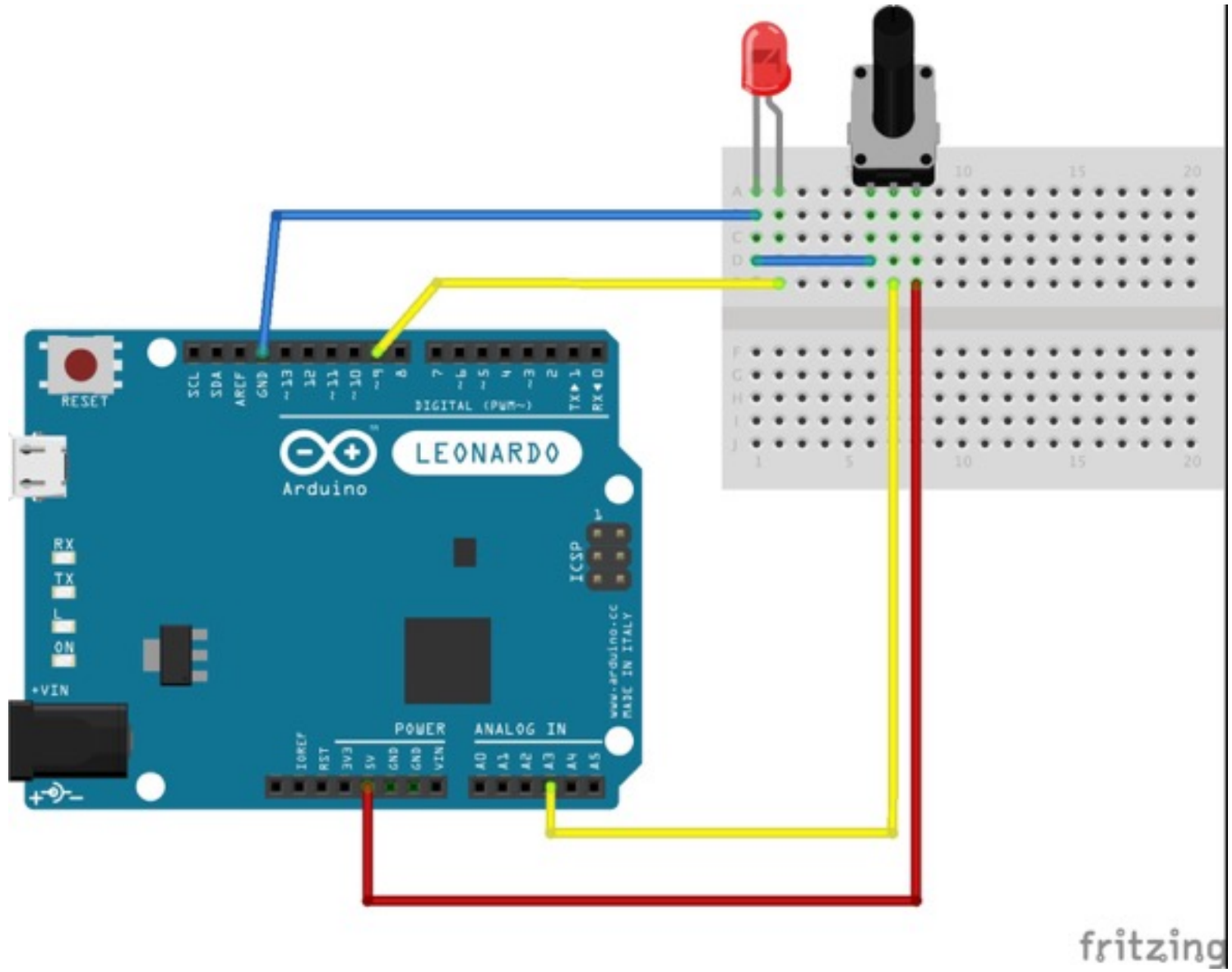
- **#define LED_PIN 0** is a handy way of keeping track of a number that will never change.
- **pinMode(LED_PIN,OUTPUT);** tell the Arduino to put digital pin 0 in output mode.
- **digitalWrite(LED_PIN, HIGH);** tells the Arduino to apply 5V to digital pin 0.
- **delay(1000);** tells the Arduino to pause for 1000ms (1 second) before going to the next instruction.



Go do it!

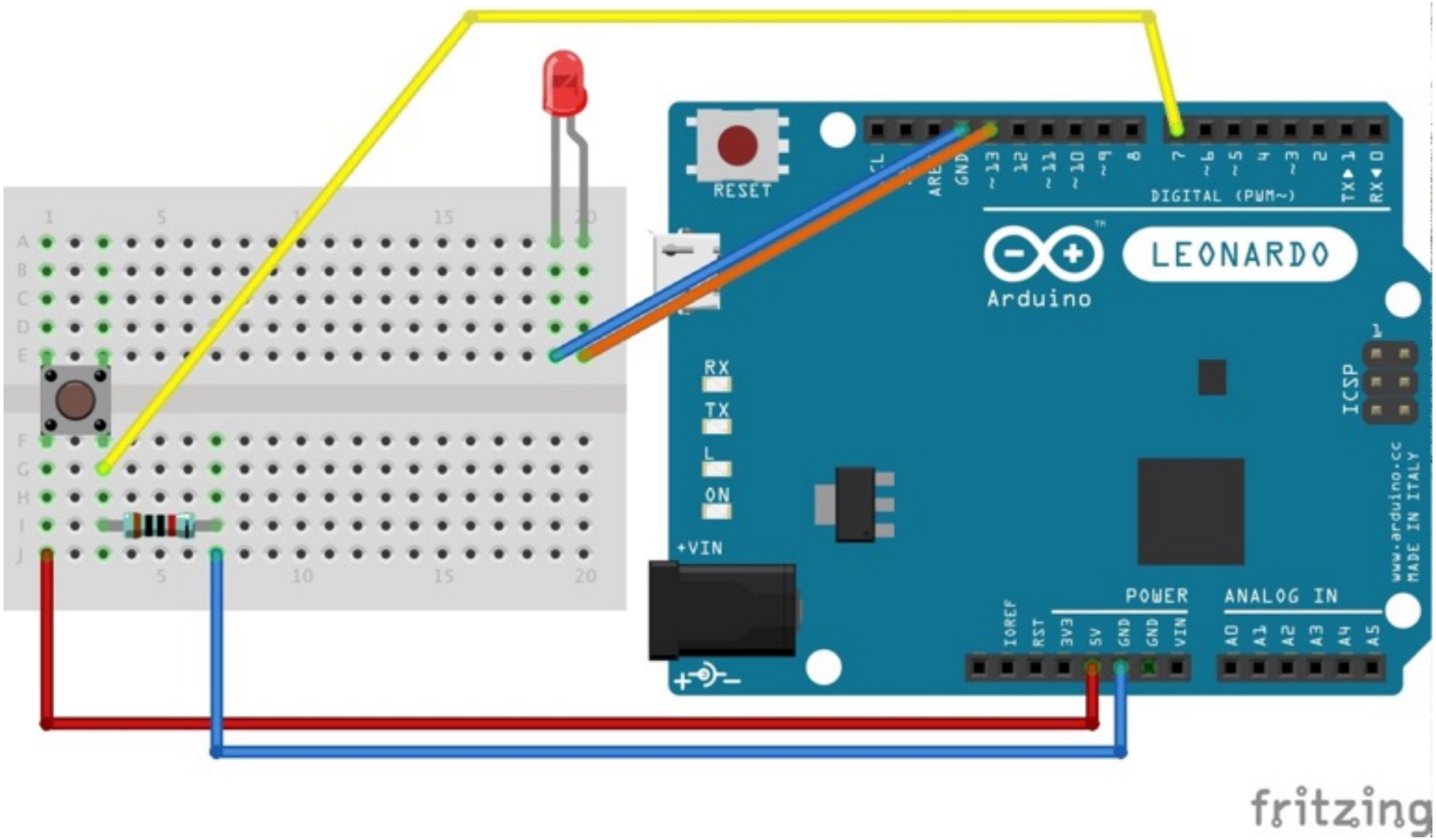
- time to give it a go!
- Arduino software: arduino.cc
- When you have your LED blinking, try changing some of the code, or look at the other examples.





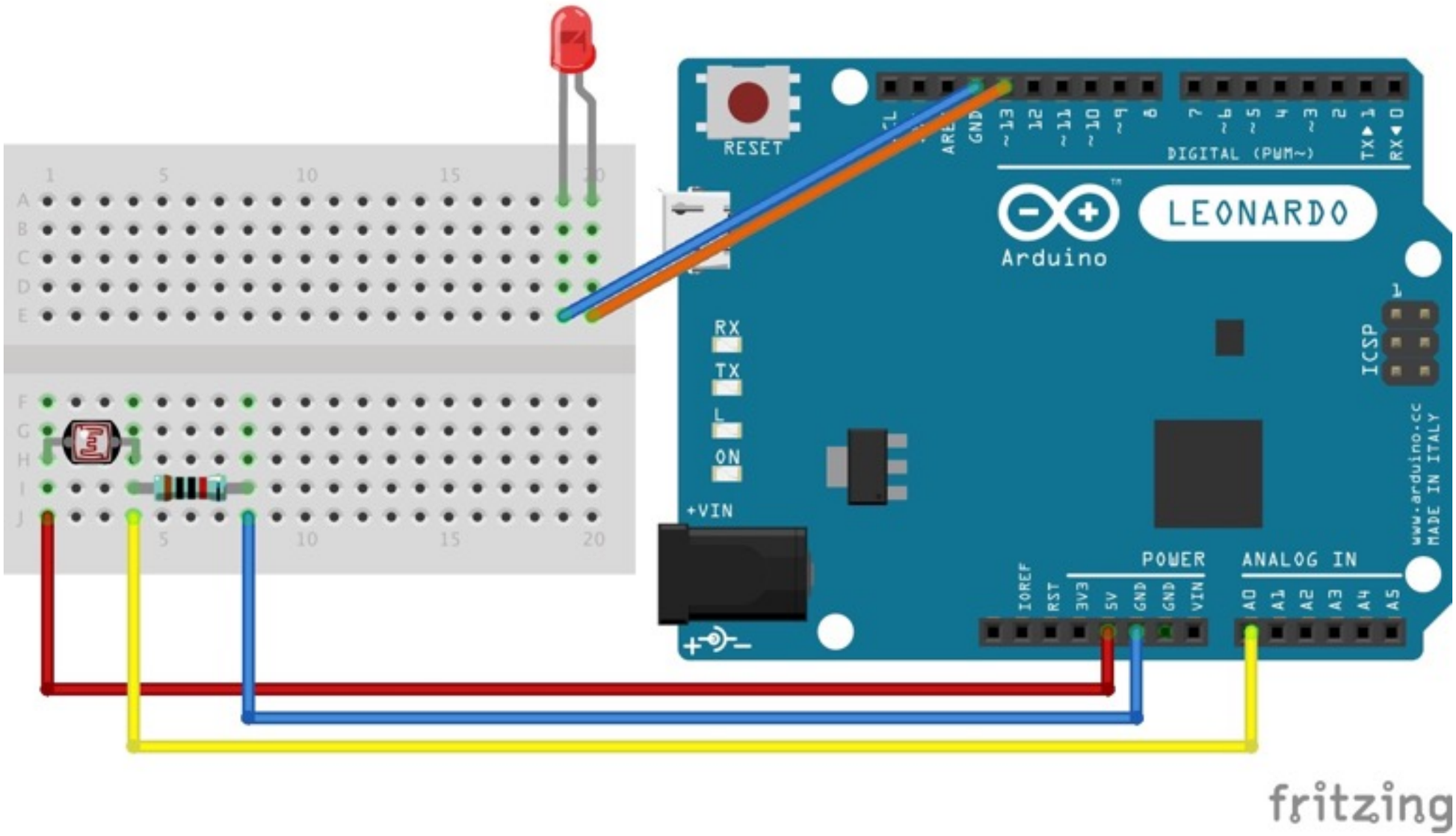
Project 2

Reading a potentiometer



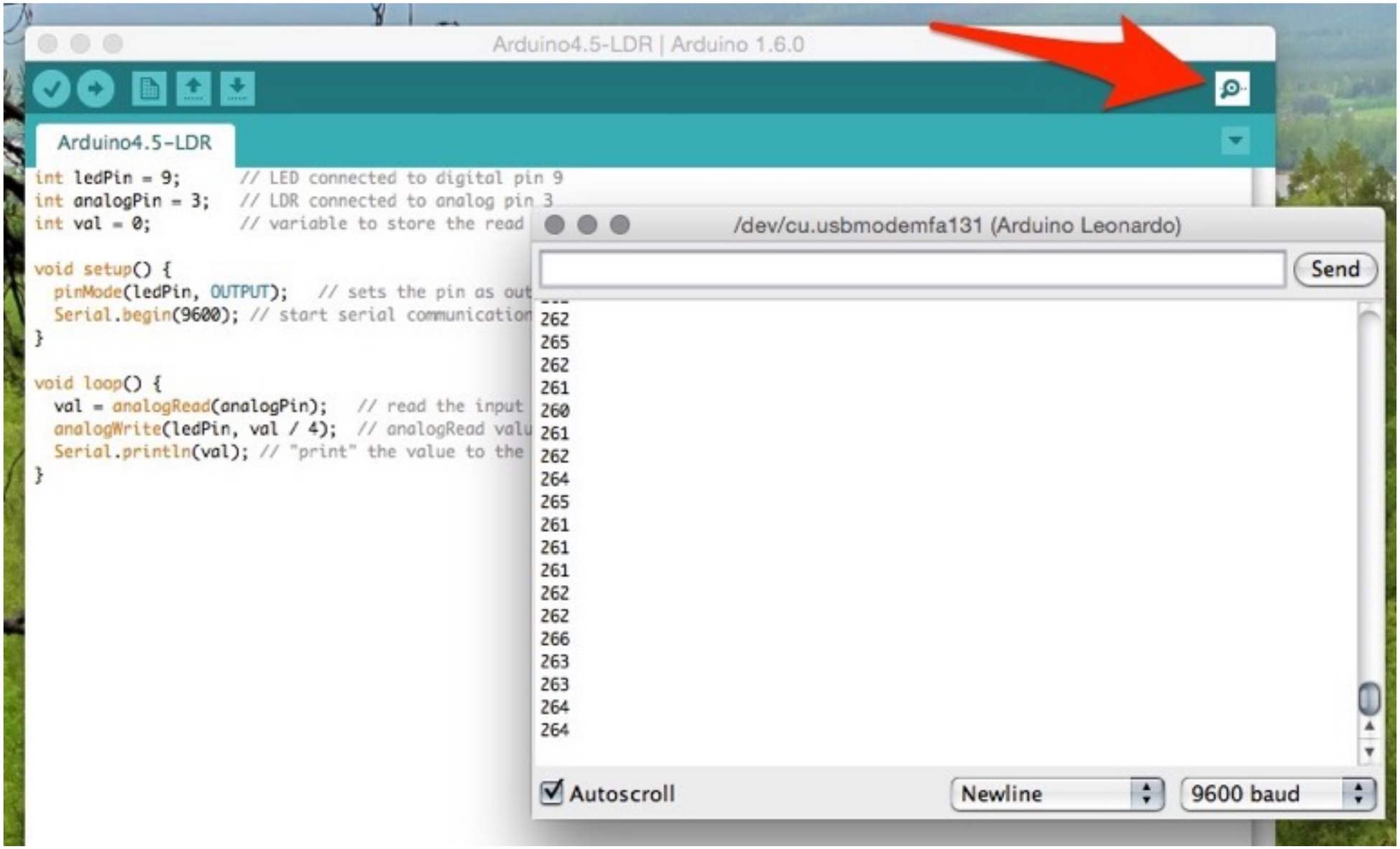
Project 3

Buttons



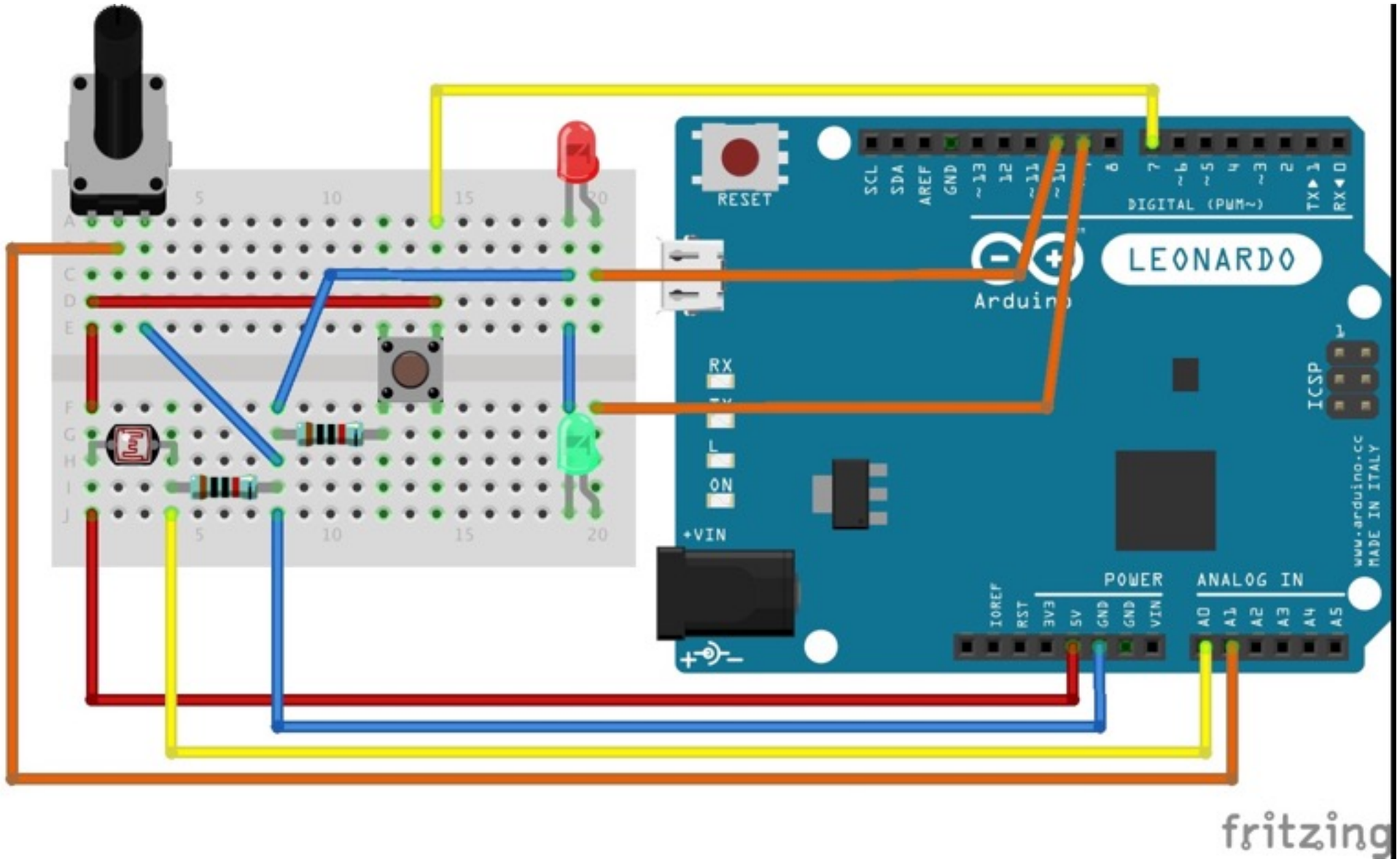
Project 4

Light Sensors



Project 4.5

Sending the LDR data to the computer!
(using the Serial Monitor)



Project 5

Make a Physical Interface for Pd.
Time to make some music!