IoT electronic development boards
Arduino

Prof. Fouad HANNA, PhD.
fouad.hanna@heig-vd.ch

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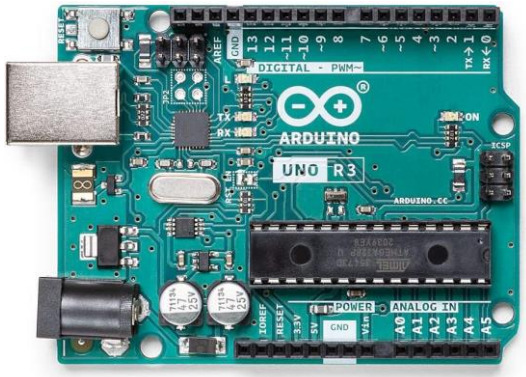
Introduction

What is Arduino

- Open-source electronics platform
- Easy-to-use hardware and software
- Microcontroller + input and output pins
- Very handy for prototyping
- Large community + lots of projects and examples and accessories



Why Arduino

- Inexpensive.

- Cross-platform - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems.

- Simple, clear programming environment - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well.

- Open source and extensible software - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries.

What can I connect to Arduino

Sensors

- Push buttons, touchpads, tilt switches
- Variable resistors (Sliders, Volume knobs)
- Photoresistors (sensing light)
- Thermistors (temperature)
- Ultrasound (proximity range finder)
- …

Actuators

- Lights, LED's
- Motors
- Speakers
- Displays (LCD's)
- ...

Arduino types

Arduino types

Arduino Board	Processor	Memory	Digital I/O	Analogue I/O
Arduino Uno	16Mhz ATmega328	flash 32 KB SRAM 2 KB EEPROM 1 KB	14	6 input, 0 output
Arduino Due	84MHz AT91SAM3X8E	flash 512 KB SRAM 96 KB	54	12 input, 2 output
Arduino Mega	16MHz ATmega2560	flash 256 KB SRAM 8 KB EEPROM 4 KB	54	16 input, 0 output
Arduino Leonardo	16MHz ATmega32u4	flash 32 KB SRAM 2.5 KB EEPROM 1 KB	20	12 input, 0 output

Memory types

- Volatile / Non volatile
- Flash
- SRAM
- EEPROM

Take 5 minutes to search the type and the usage of each, and if there are some limitations !

Memory types

- Flash

Stores the program, non volatile, limited write cycles.

- SRAM

Stores program data, volatile, no write/read limitations.

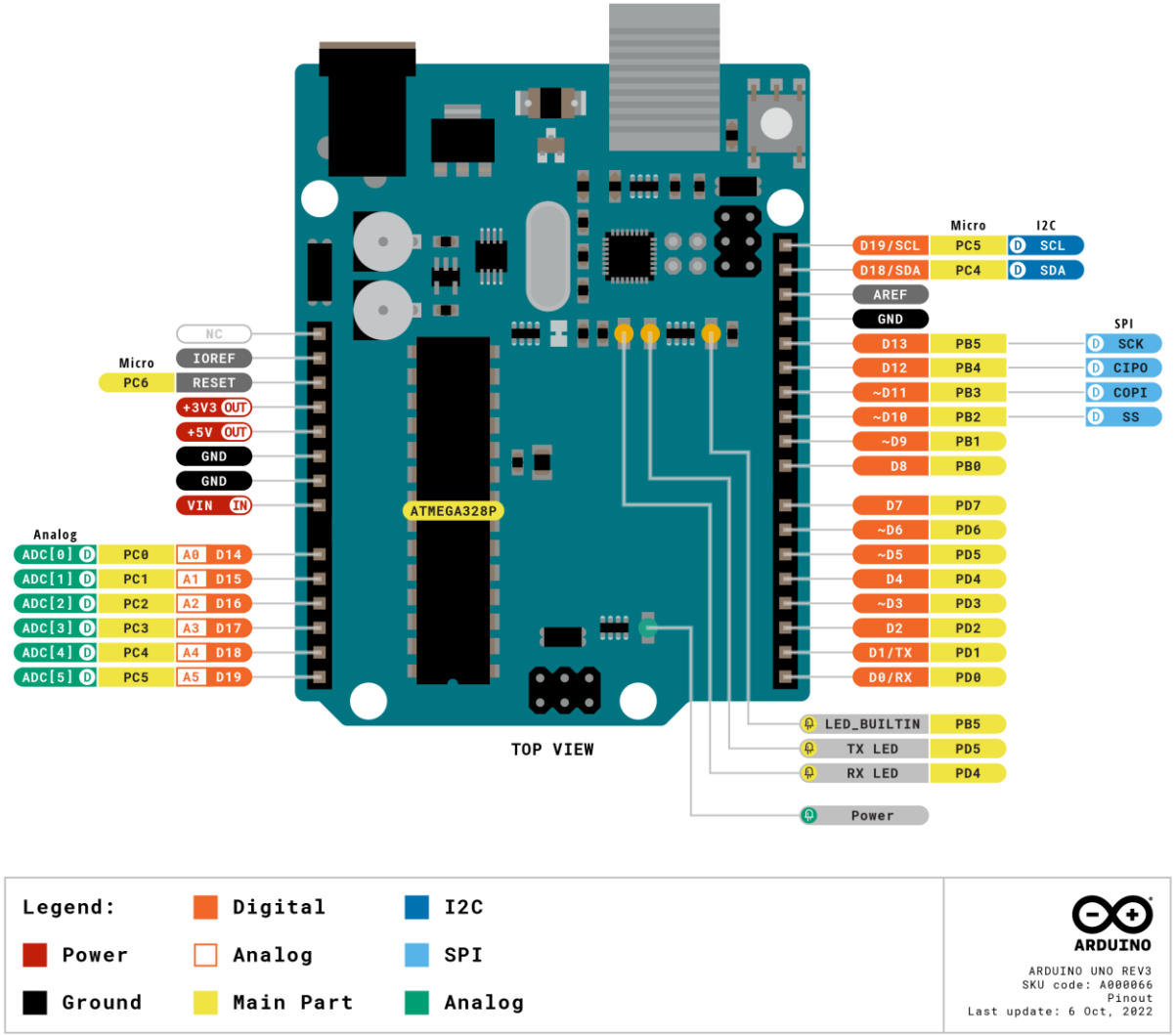
- EEPROM

Stores data from your program, non volatile, limited write cycles. Slower than SRAM

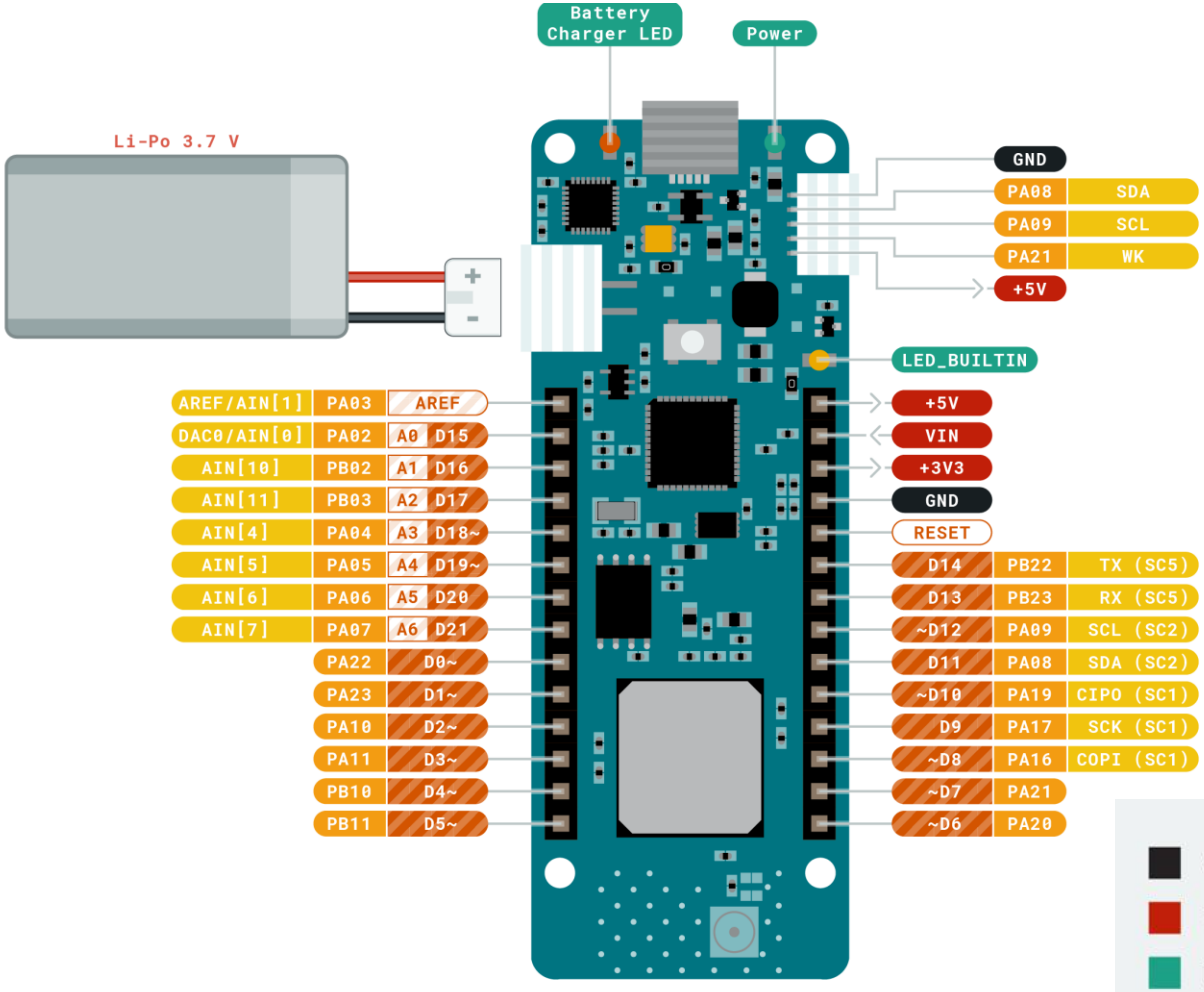
Arduino types for IoT – MKR family

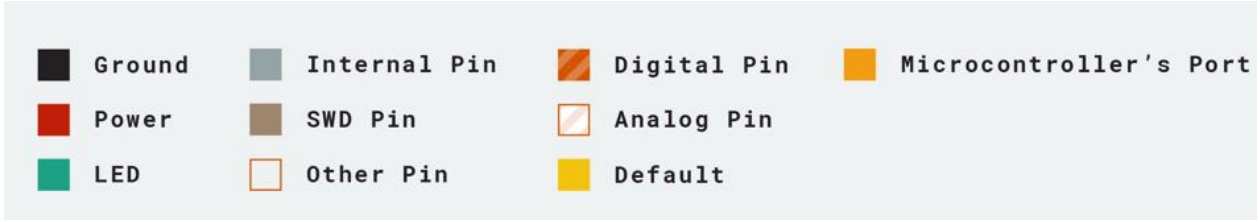
	MKR 1200	MKR 1300/1310	MKR 1400	MKR 1500	MKR 1010	MKR ETH Shield
Connectivity	Sigfox	LoRaWAN	GSM	LTE-M	Wifi	Ethernet

Arduino UNO Rev3



Arduino MKR 1310 (Lora)





Arduino SPI Protocol pin names

Master/Slave (OLD)	Controller/Peripheral (NEW)
Master In Slave Out (MISO)	Controller In, Peripheral Out (CIPO)
Master Out Slave In (MOSI)	Controller Out Peripheral In (COPI)
Slave Select pin (SS)	Chip Select Pin (CS)

Programming Arduino

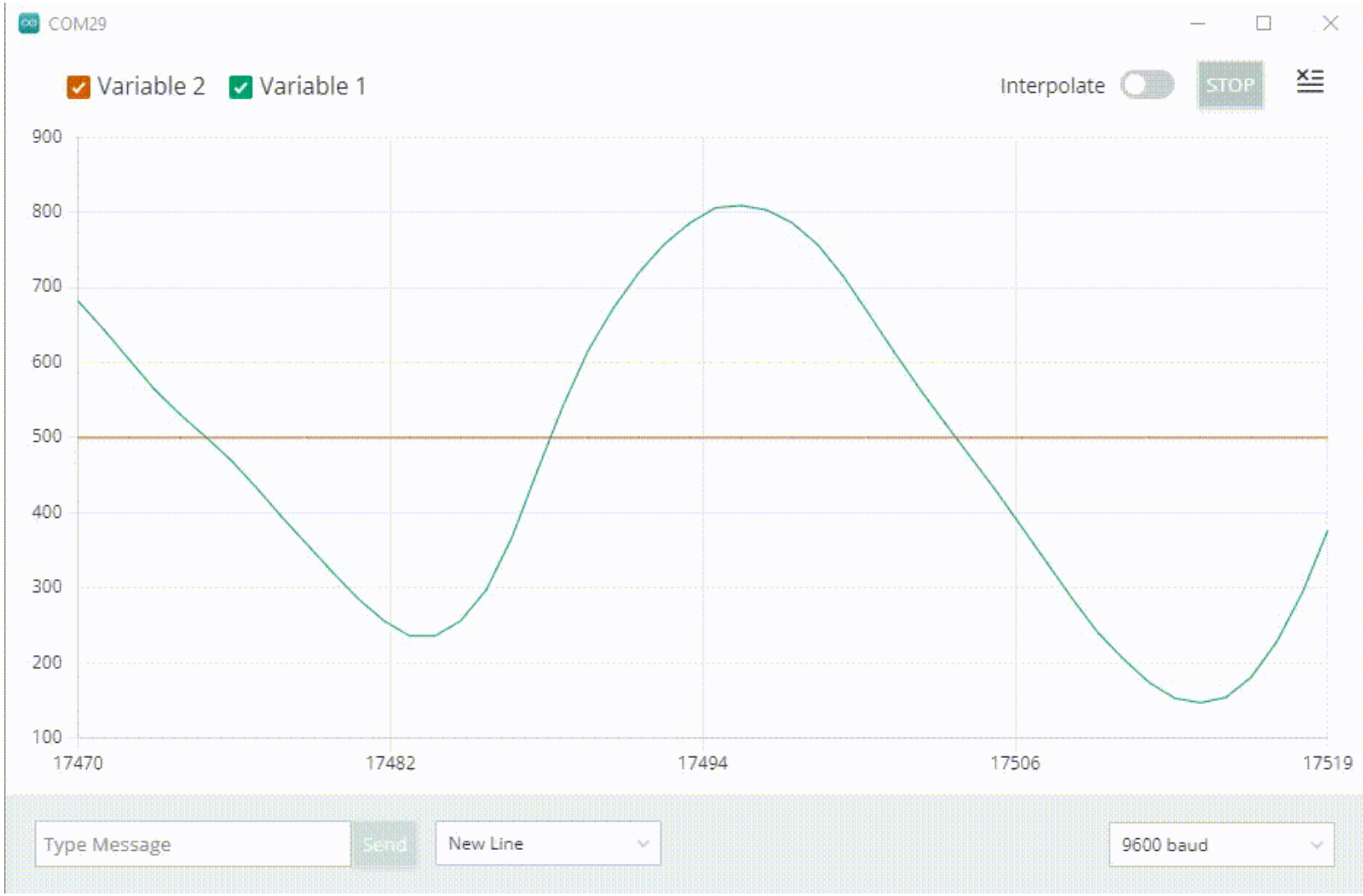
Arduino IDE 2.x.x (2021)

Arduino IDE 2.x.x (2021)

- **Verify / Upload** - compile and upload your code to your Arduino Board.
- **Select Board & Port** - detected Arduino boards automatically show up here, along with the port number.
- **Sketchbook** - here you will find all of your sketches locally stored on your computer.
- **Boards Manager** - browse through Arduino & third party packages that can be installed. For example, using a MKR WiFi 1010 board requires the Arduino SAMD Boards package installed.
- **Library Manager** - browse through thousands of Arduino libraries, made by Arduino & its community.
- **Debugger** - test and debug programs in real time.
- **Search** - search for keywords in your code.
- **Open Serial Monitor** - opens the Serial Monitor tool, as a new tab in the console.

Arduino IDE 2.x.x (2021)

Serial Plotter



Arduino language

- Simplified C/C++

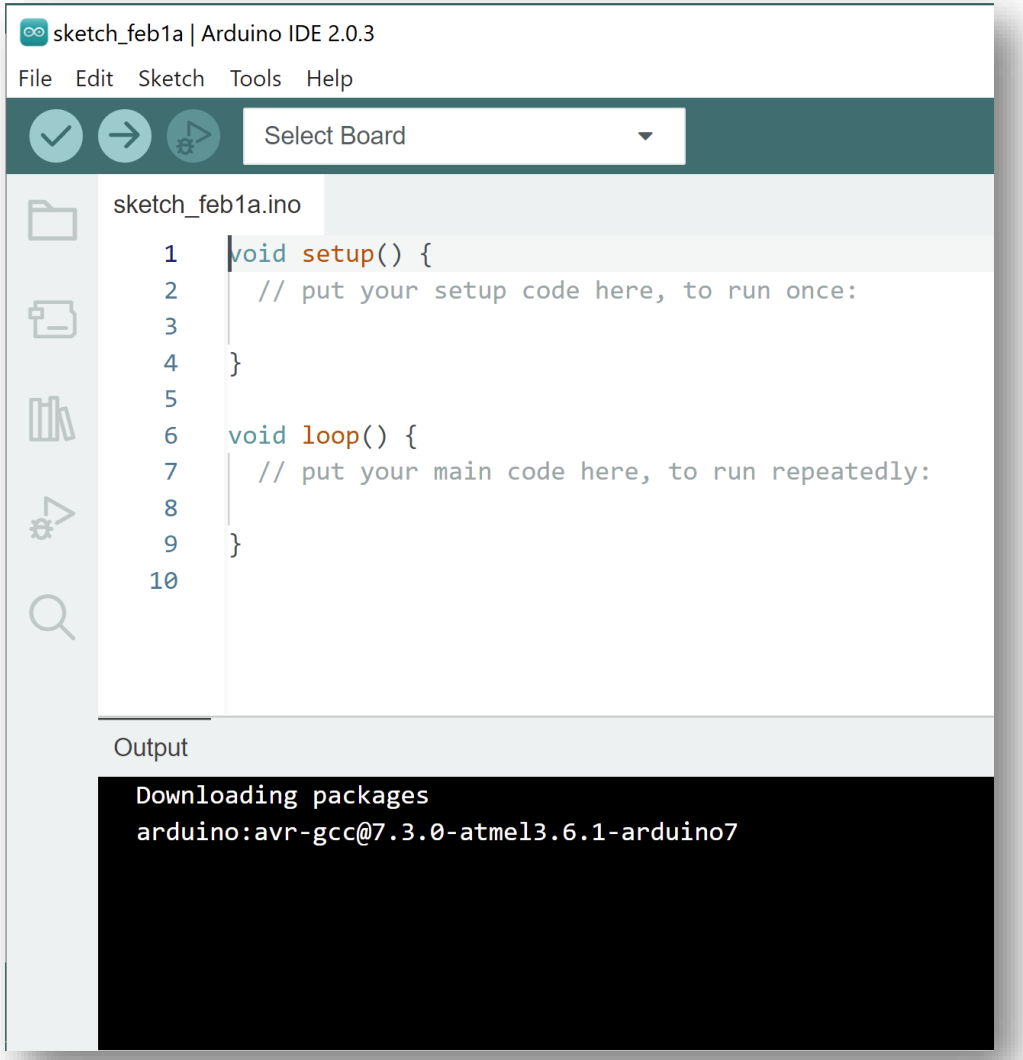
- Based on the wiring project

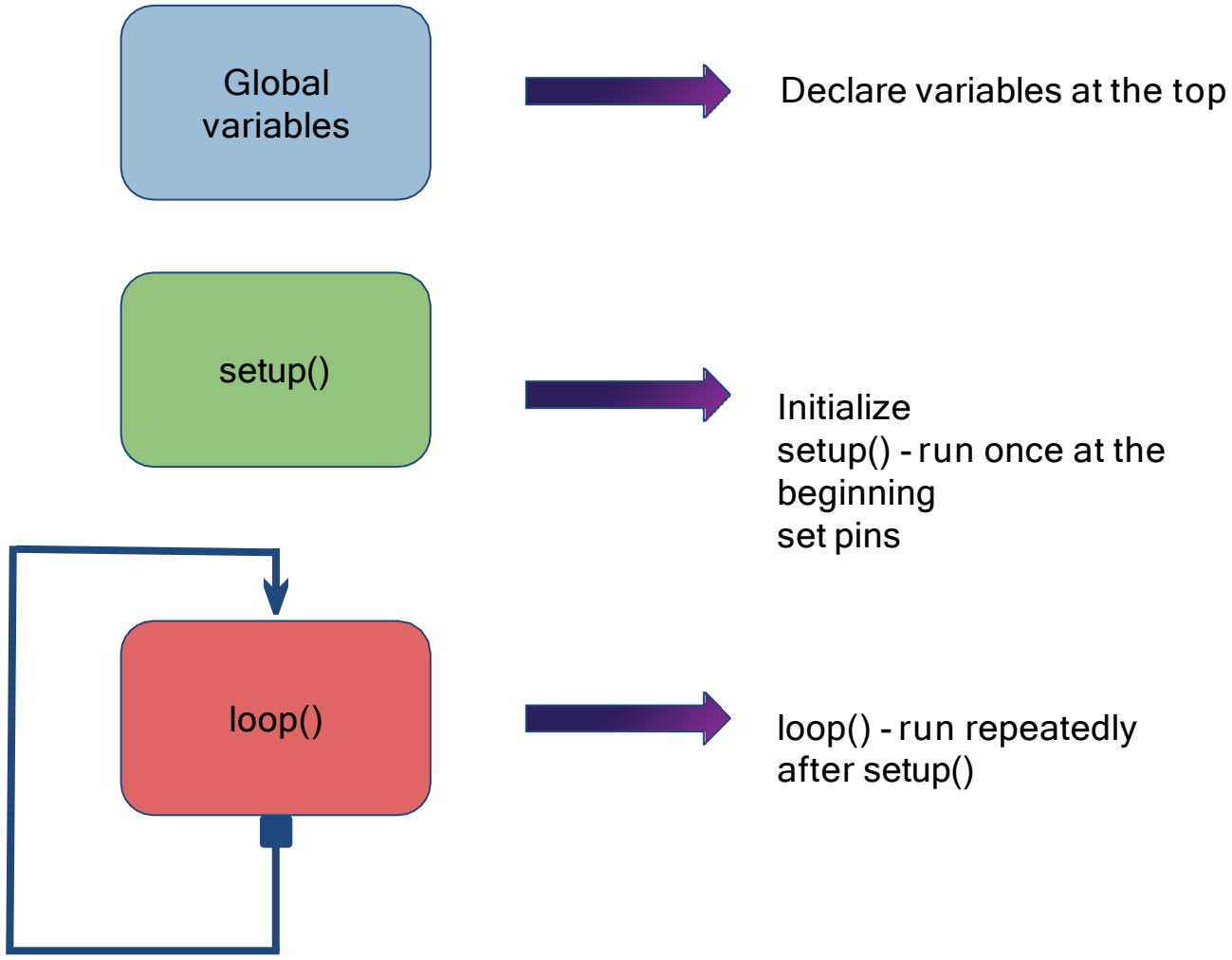
http://wiring.org.co

- Peripheral libraries

LCD, sensors, I2C, etc.

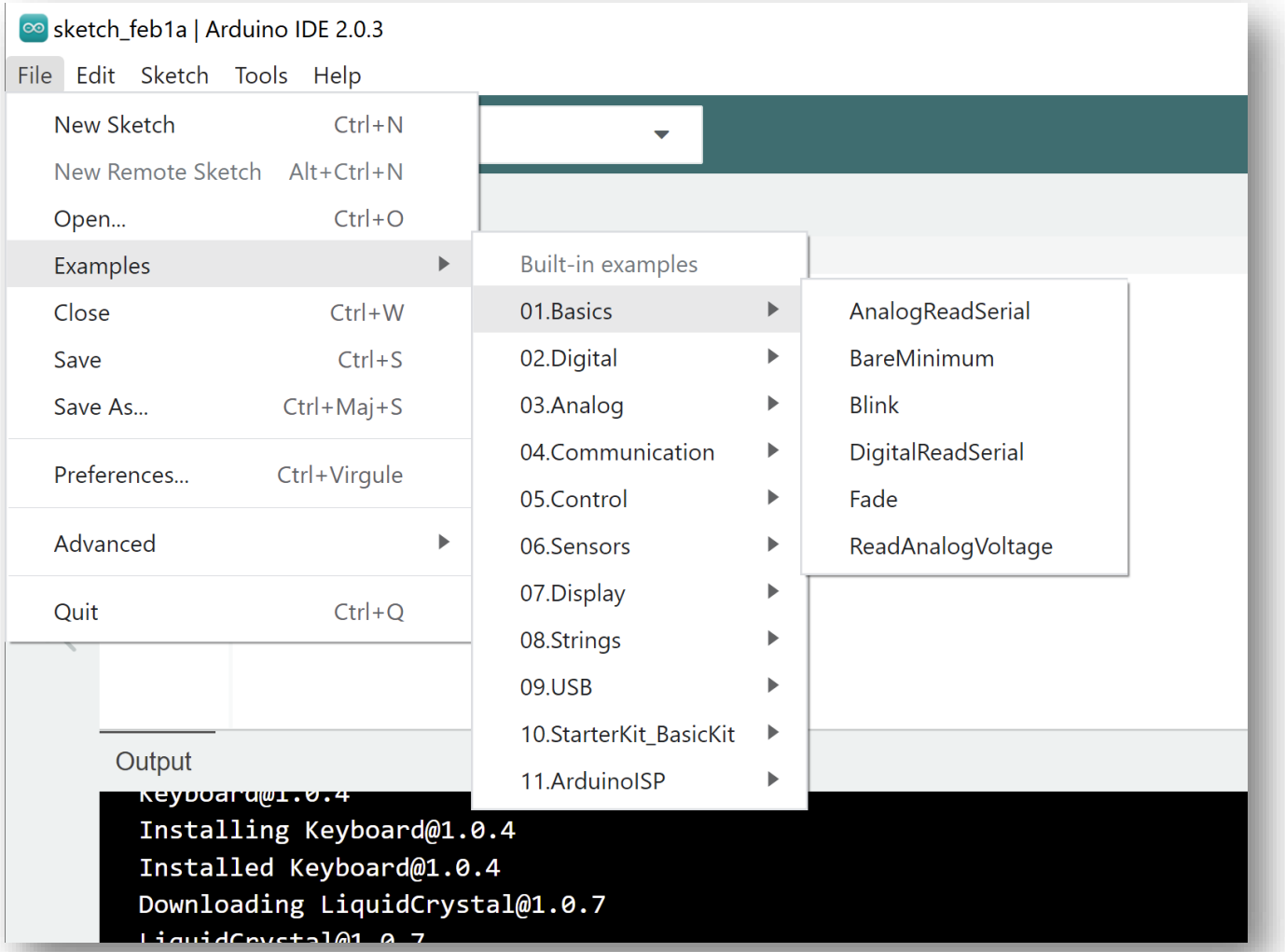
Arduino sketch





Arduino sketch

- A lot of examples accessible form the IDE



Blink led example

Blink | Arduino IDE 2.0.3

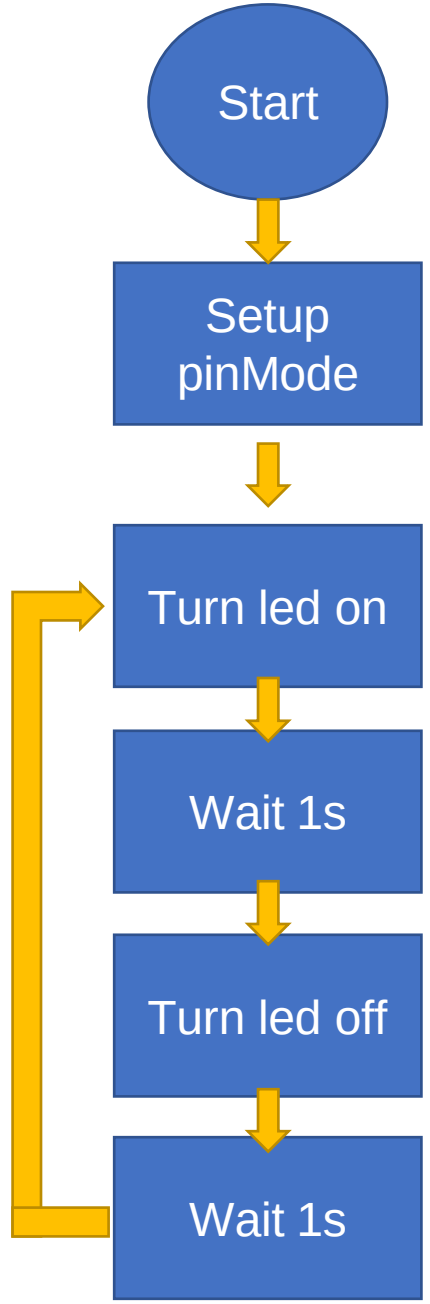
File Edit Sketch Tools Help

Select Board

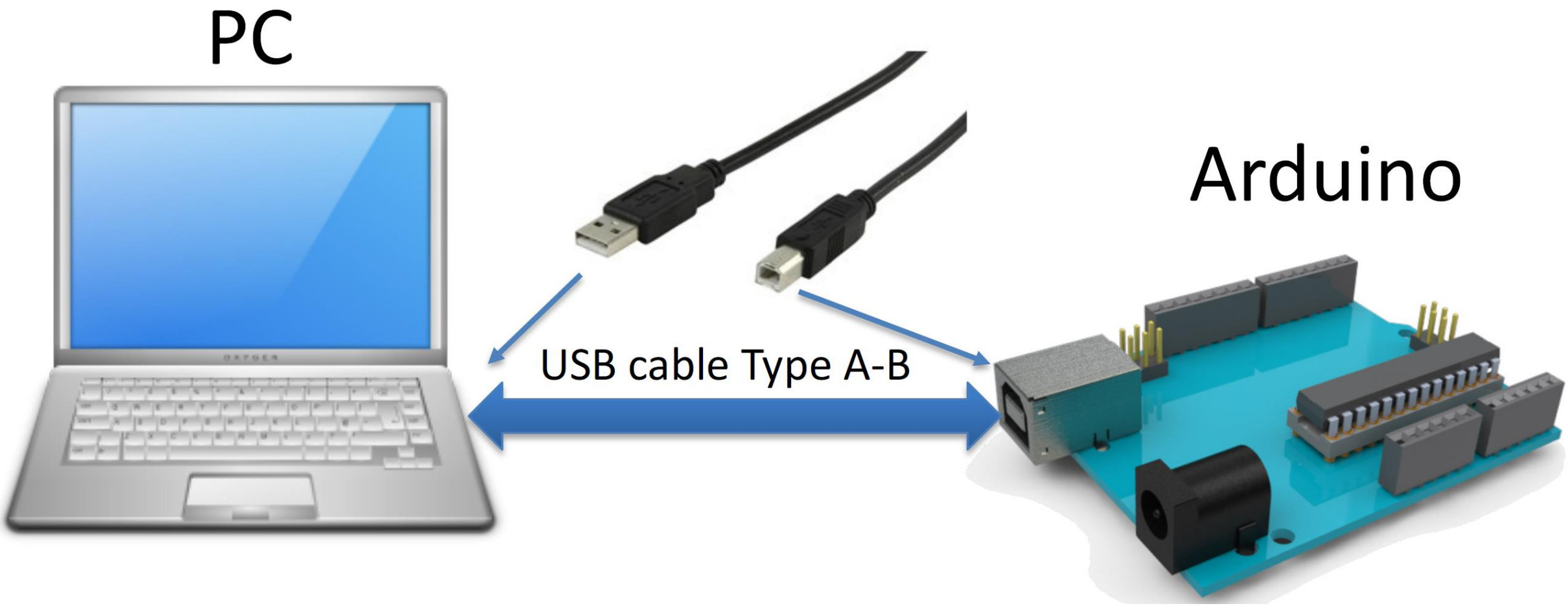
Blink.ino

```
  by Arturo Guadalupi
  modified 8 Sep 2016
  by Colby Newman

  This example code is in the public domain.

  https://www.arduino.cc/en/Tutorial/BuiltInExamples/Blink
*/

// the setup function runs once when you press reset or power the board
void setup() {
  // initialize digital pin LED_BUILTIN as an output.
  pinMode(LED_BUILTIN, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(LED_BUILTIN, HIGH);  // turn the LED on (HIGH is the voltage level)
  delay(1000);                      // wait for a second
  digitalWrite(LED_BUILTIN, LOW);   // turn the LED off by making the voltage LOW
  delay(1000);                      // wait for a second
}
```

Ln 1, Col 1



And then download the sketch to the arduino



Some useful fonctions

pinMode()	set pin as input or output
digitalWrite()	set a digital pin high/low
digitalRead()	read a digital pin’s state
analogRead()	read an analog pin
analogWrite()	write an “analog” PWM value
delay()	wait an amount of time
millis()	get the current time

Analog Read – convert to volt

```
void setup() {
  Serial.begin(9600);
}

void loop() {
  // read the input on analog pin 0:
  int sensorValue = analogRead(A0);
  // Convert the analog reading (which goes from 0 - 1023) to a voltage (0 - 5V):
  float voltage = sensorValue * (3.3 / 1023.0);
  Serial.println(voltage);
}
```

MKR family boards
- Operating voltage 3.3v
- Default resolution 10 bits → 1024

Millis

```
int ledPin = 13;

void setup() {

  pinMode(ledPin, OUTPUT);

}

void loop() {

  digitalWrite(ledPin, HIGH);

  delay(1000);

  digitalWrite(ledPin, LOW);

  delay(1000);

}
```

```
unsigned long previousMillis = 0;

const long interval = 1000;

...

void loop() {

  unsigned long currentMillis = millis();

  if (currentMillis - previousMillis >= interval) {

    previousMillis = currentMillis;

    if (digitalRead(ledPin) == LOW) {

      digitalWrite(ledPin, HIGH);

    } else {

      digitalWrite(ledPin, LOW);

    }

 }

}
```

Arduino online simulator

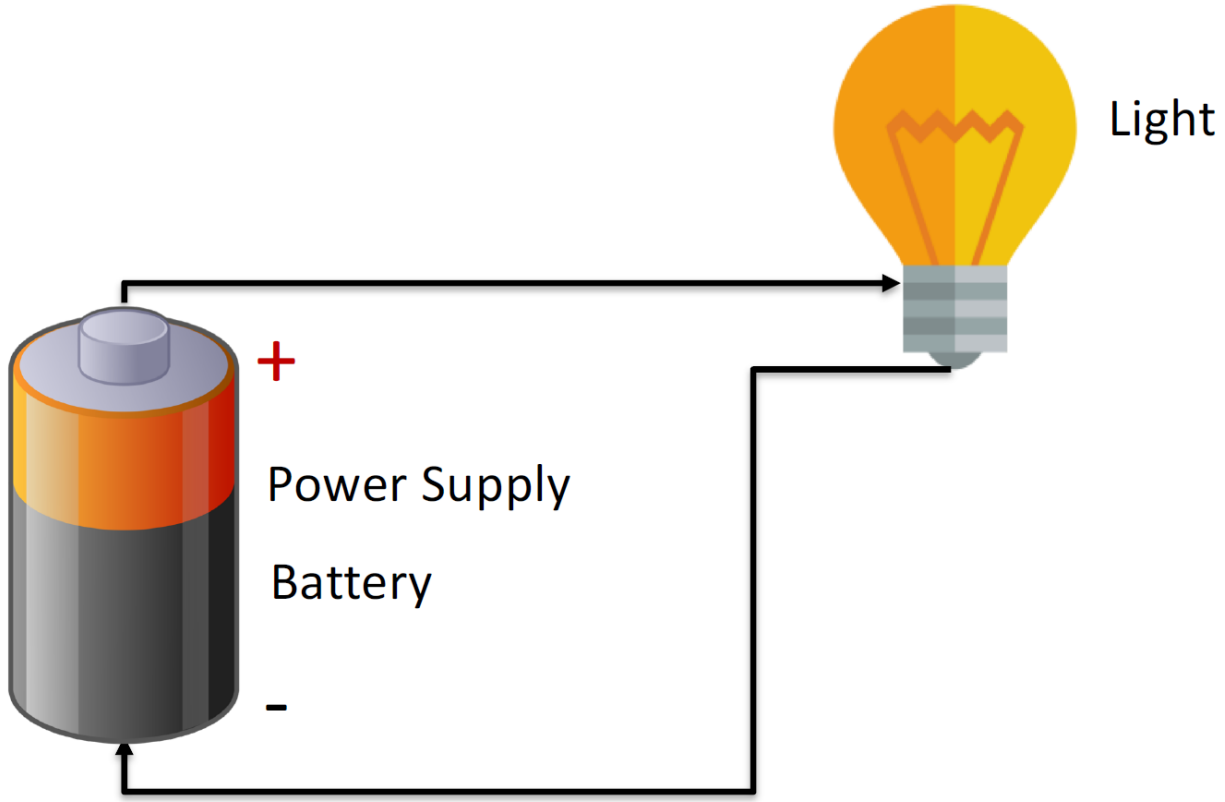
- If you don’t have the materials you can use an online simulator.

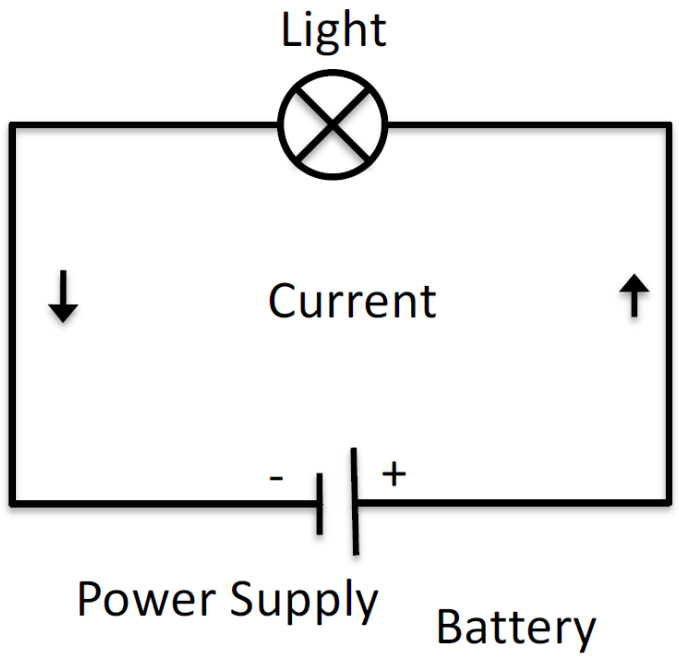
- Tinkercad is a free, online 3D modeling program that runs in a web browser, known for its simplicity and ease of use. Since it became available in 2011 it has become a popular platform for creating models for 3D printing as well as an entry-level introduction to constructive solid geometry in schools.

AUTODESK®
TINKERCAD®

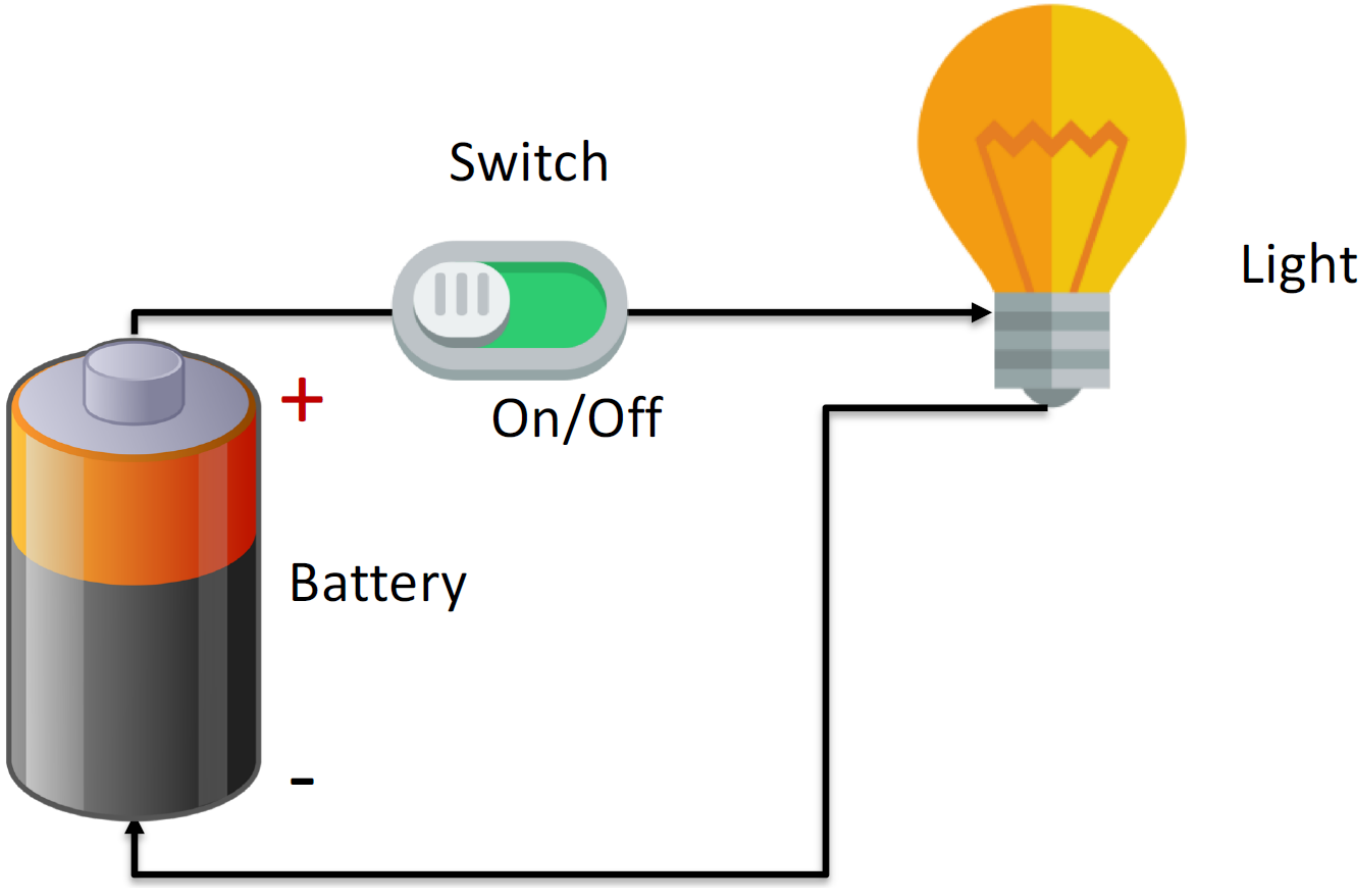
Some electronics

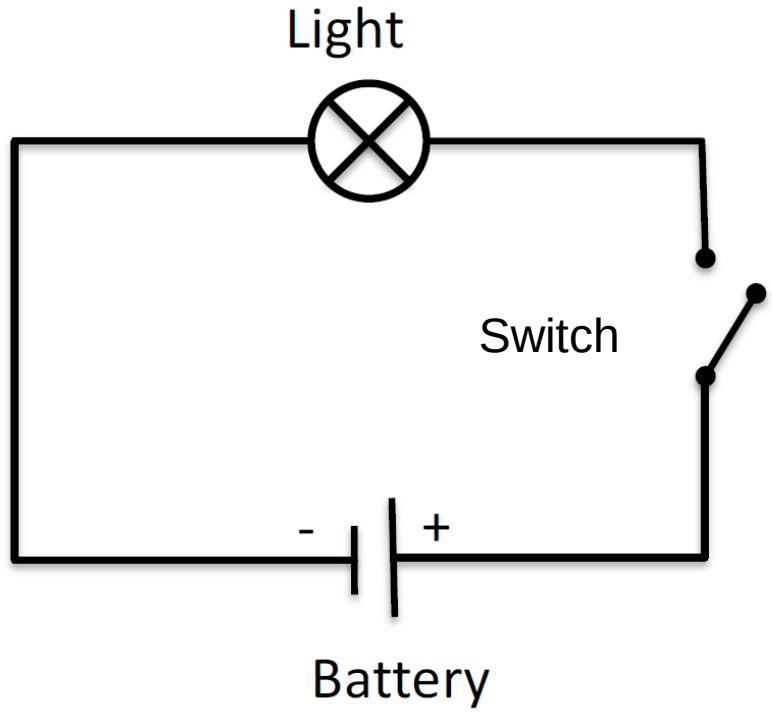
Electrical Circuit





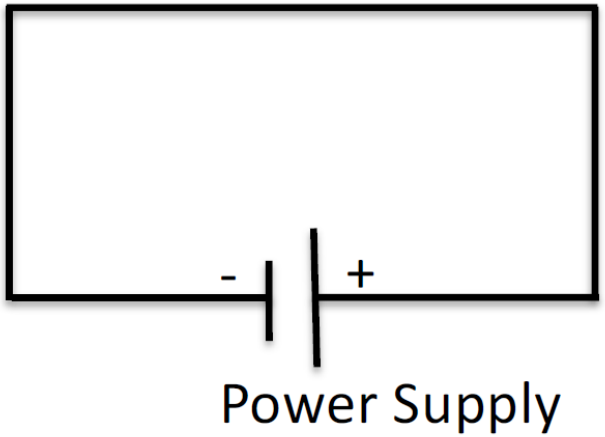
Electrical Circuit with a Switch





Short Circuit

- We must never connect positive and negative side to a power source without having an electrical component in between.
- If you do, it is called a short circuit.
- For example, if you short circuit a battery, the battery will get very hot and the battery will run out very quickly.



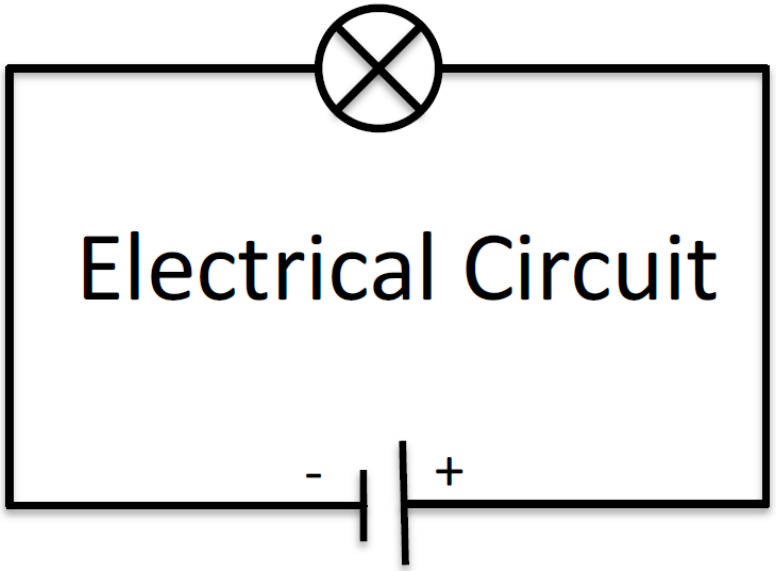
Ohms Law

$$U = R * I$$

U – Voltage $[V]$

R – Resistance $[\Omega]$

I – Current [A]



Multimeter

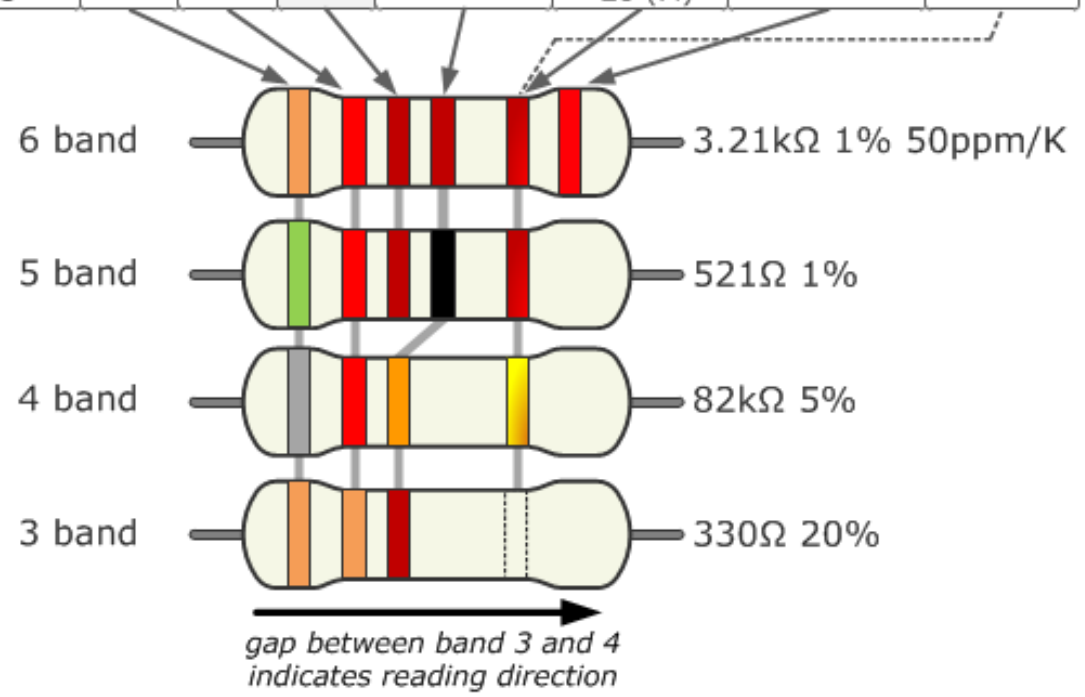
- You can use a Multimeter to measure current, voltage, resistance, etc. in an electric circuit.

Resistance color code reading

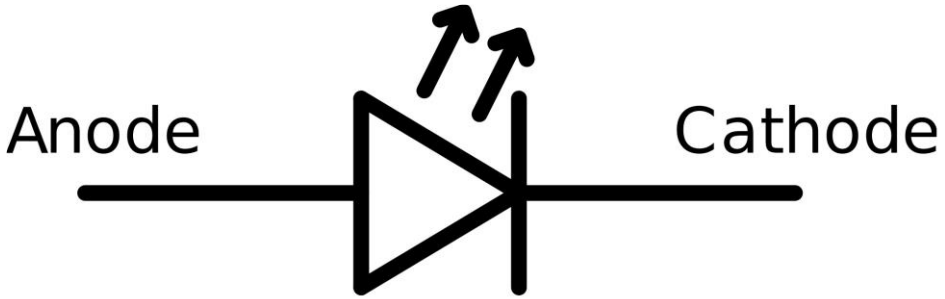
- Online calculators exist, try them !
- Otherwise, use a multimeter to measure the value.

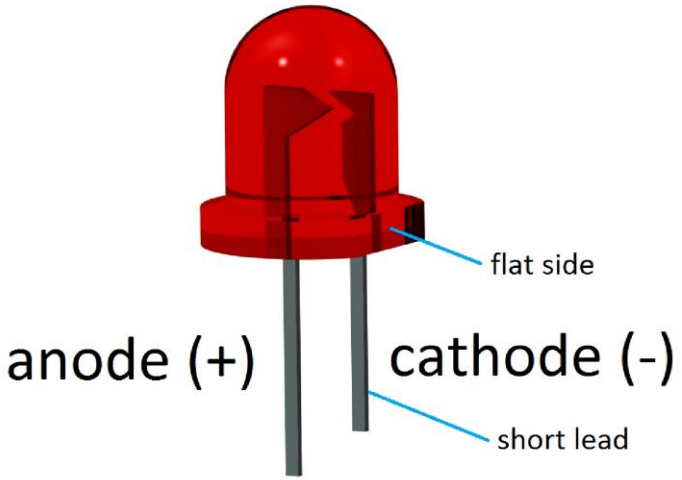
www.resistorguide.com

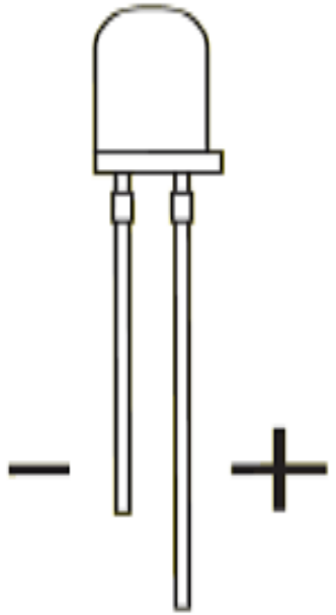
Color	Signficant figures			Multiply	Tolerance (%)	Temp. Coeff. (ppm/K)	Fail Rate (%)
black	0	0	0	x 1		250 (U)	
brown	1	1	1	x 10	1 (F)	100 (S)	1
red	2	2	2	x 100	2 (G)	50 (R)	0.1
orange	3	3	3	x 1K		15 (P)	0.01
yellow	4	4	4	x 10K		25 (Q)	0.001
green	5	5	5	x 100K	0.5 (D)	20 (Z)	
blue	6	6	6	x 1M	0.25 (C)	10 (Z)	
violet	7	7	7	x 10M	0.1 (B)	5 (M)	
grey	8	8	8	x 100M	0.05 (A)	1(K)	
white	9	9	9	x 1G			
gold			3th digit only for 5 and 6 bands	x 0.1	5 (J)		
silver				x 0.01	10 (K)		
none					20 (M)		



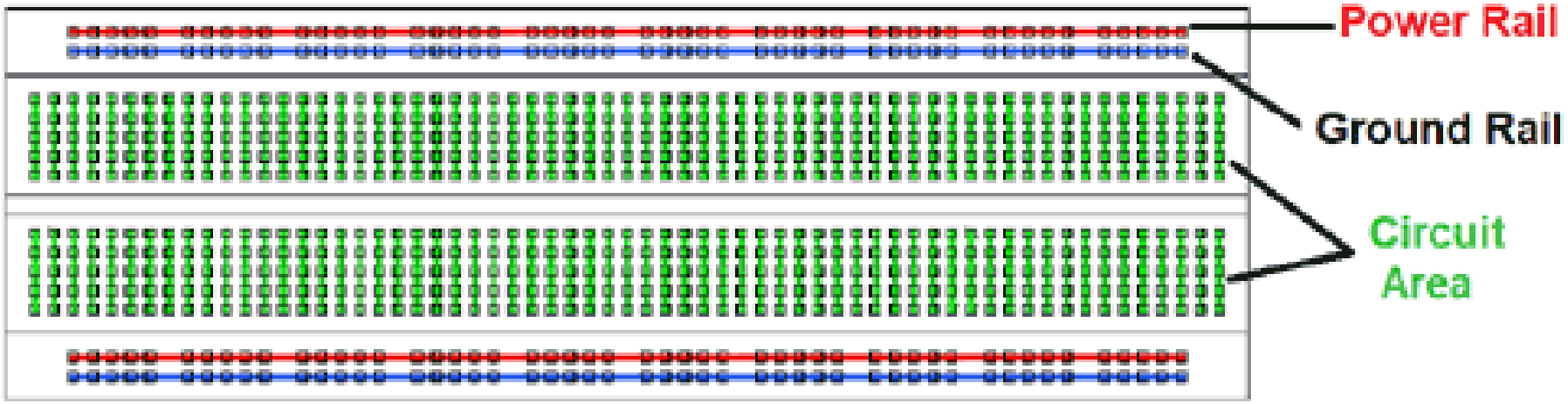
Light-Emitting Diode - LED



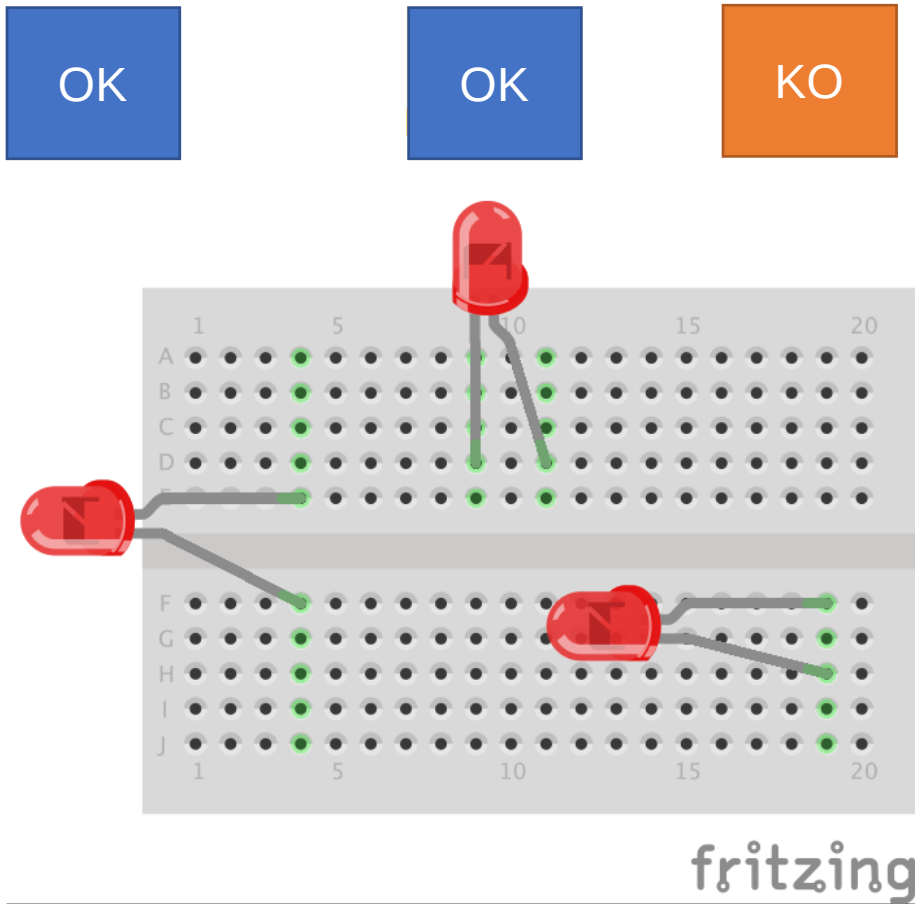




Breadboard



Breadboard



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Prof. Fouad HANNA, PhD.

fouad.hanna@heig-vd.ch

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