UNIVERSITY OF TWENTE.

ARDUINO & ELECTRONICS PRACTICAL

PRACTICAL SESSION 1

Part of SmartProducts

ARDUINO & ELECTRONICS PRACTICAL

PRACTICAL SESSION 1

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- Goal: *Become familiar with* ***Electronics & Arduino***
- 2 afternoon sessions: Apr. 24th, 28th

- Introduction to Arduino powered electric circuits
- Practical assignment

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Lauren Schreurs
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Mariya Popnikolova
Kilian Buitenhuis

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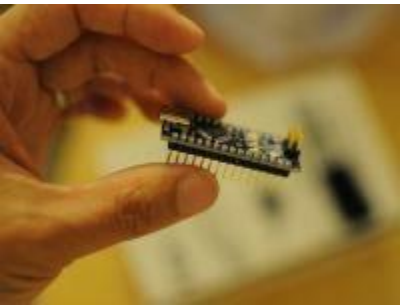
slides @ vanslooten.com/appdev

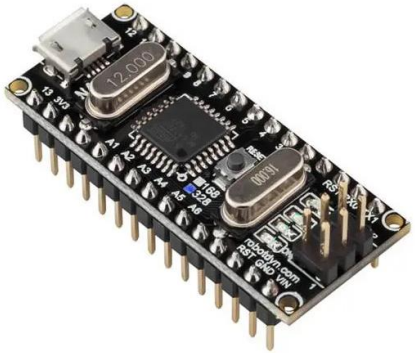
ARDUINO NANO

PROGRAMMABLE CIRCUIT BOARD (AKA MICROCONTROLLER)



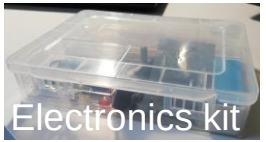
Uno

Nano BLE
with Bluetooth



Nano

What is in the Electronics kit? Check it here



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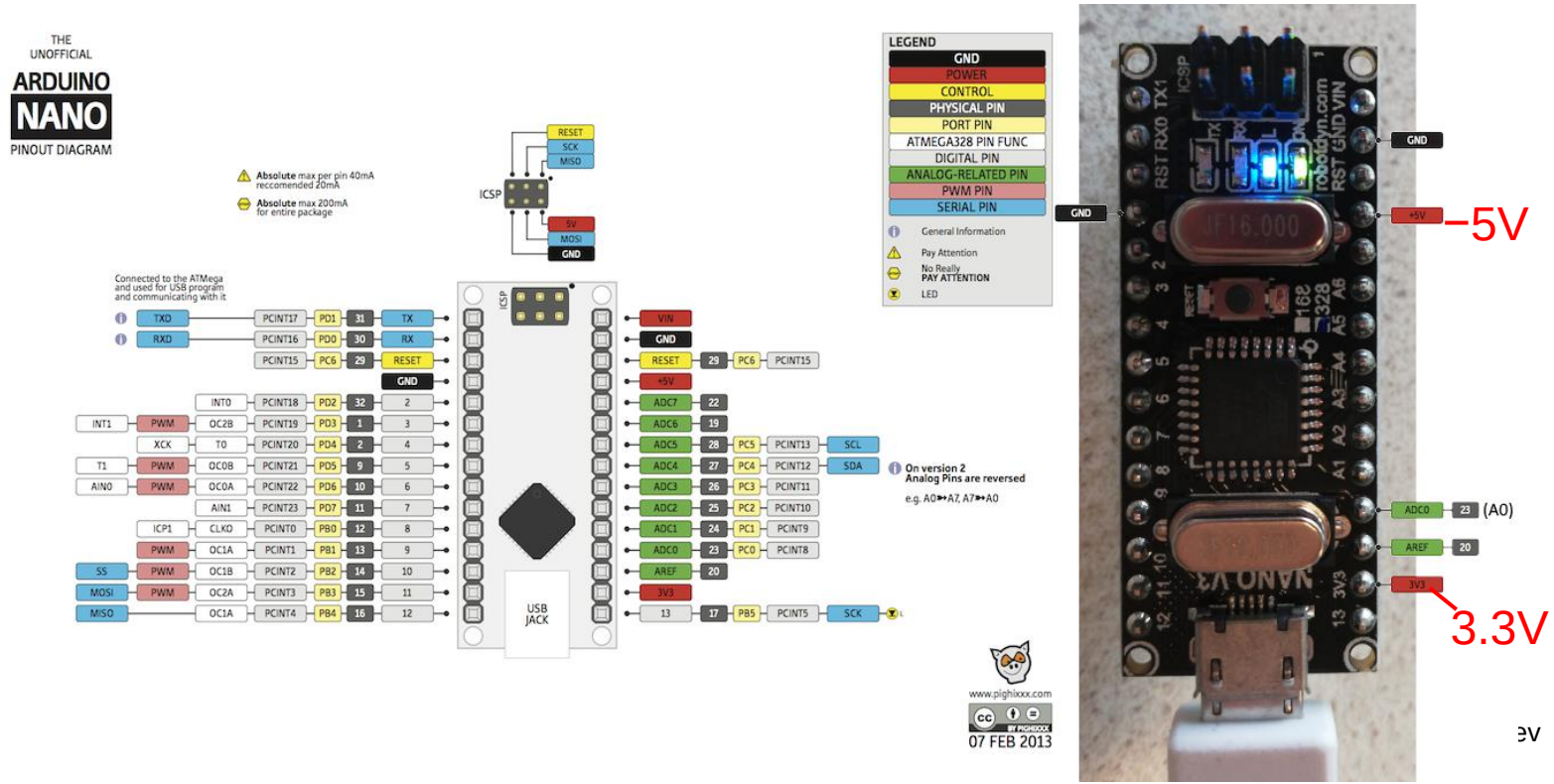
learn.sparkfun.com/tutorials/what-is-an-arduino

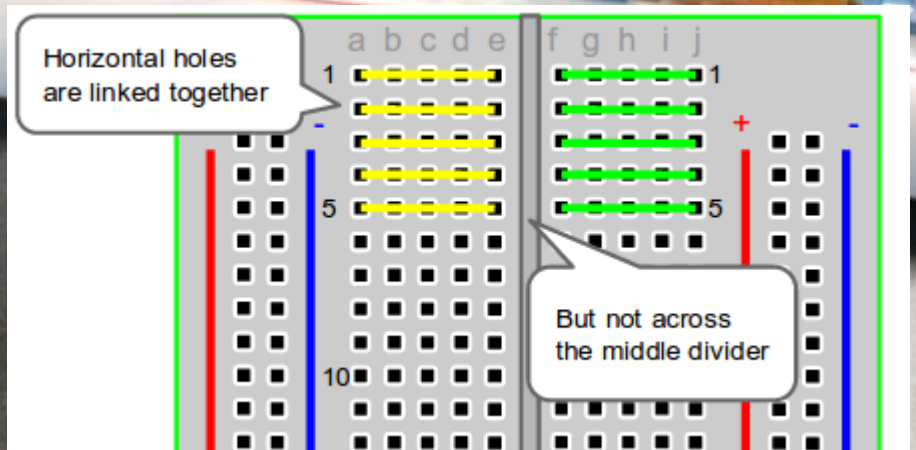
PINOUT


THE UNOFFICIAL
ARDUINO NANO
PINOUT DIAGRAM
Absolute max per pin 40mA reccomended 20mA
Absolute max 200mA for entire package
ICSP
RESET
SCK
MISO
5V
MOSI
GND
Connected to the ATMega and used for USB program and communicating with it
TXD
RXD
USB JACK
LEGEND
GND
POWER
CONTROL
PHYSICAL PIN
PORT PIN
ATMEGA328 PIN FUNC
DIGITAL PIN
ANALOG-RELATED PIN
PWM PIN
SERIAL PIN
General Information
Pay Attention
No Really PAY ATTENTION
LED
On version 2 Analog Pins are reversed
e.g. A0↦A7, A7↦A0
www.pighixxx.com
07 FEB 2013
GND
+5V
ADC0
AREF
3V3
(A0)
5V
3.3V

BREADBOARD: PLUGIN ELECTRONIC COMPONENTS

+ track for VCC (power 5 or 3.3V)

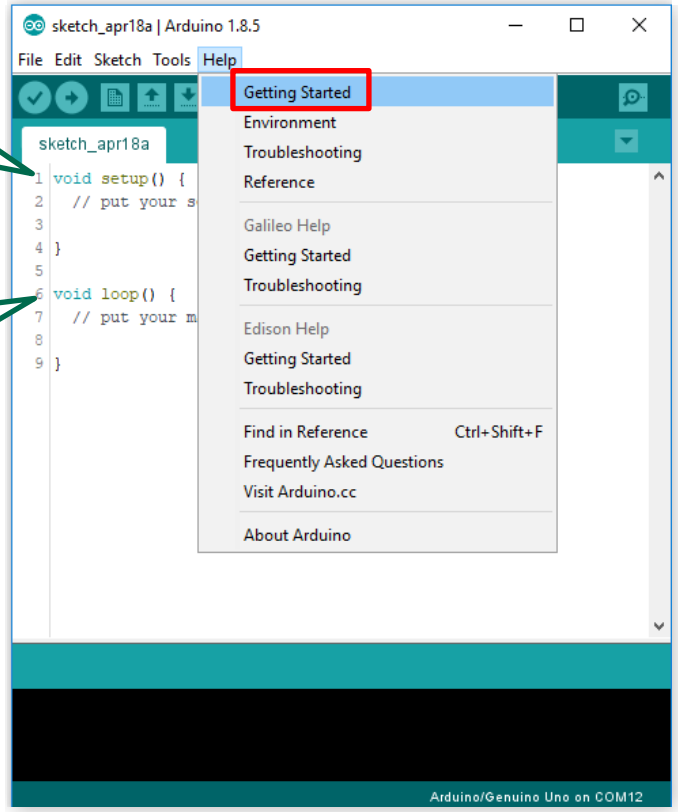
- track for GND (ground)



ARDUINO PROGRAMMING

`setup()`: start of program, runs once

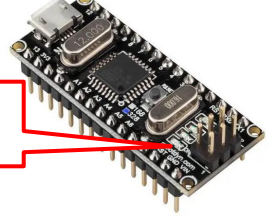
`loop()`: runs continuously after setup()



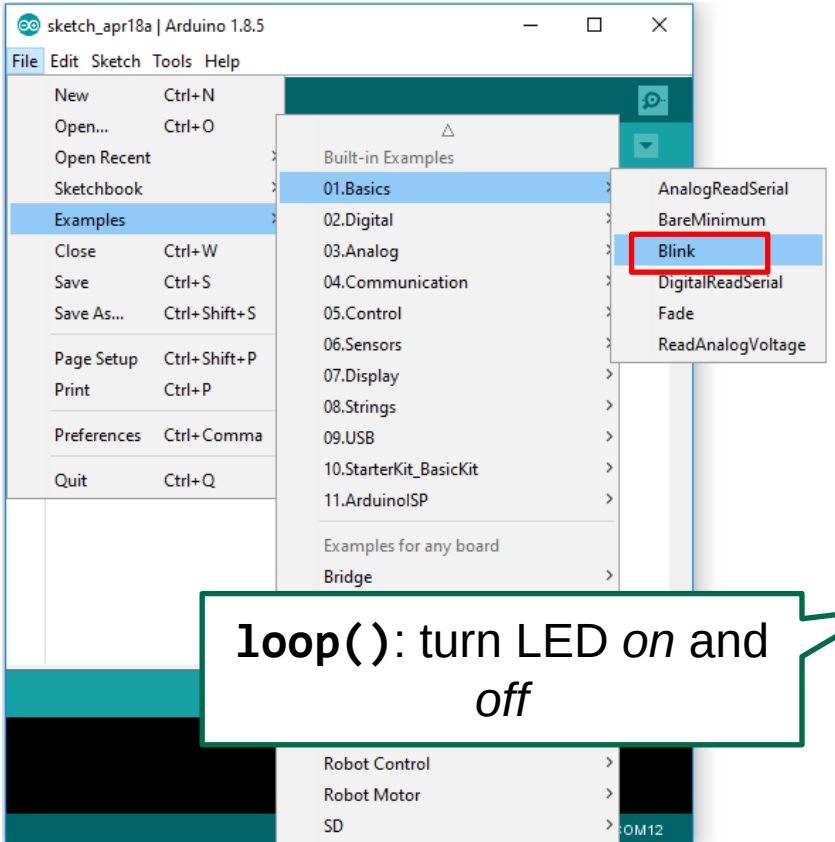
- Arduino program also called: ***sketch***
- Language: C++ (similar to Java)

ARDUINO PROGRAMMING

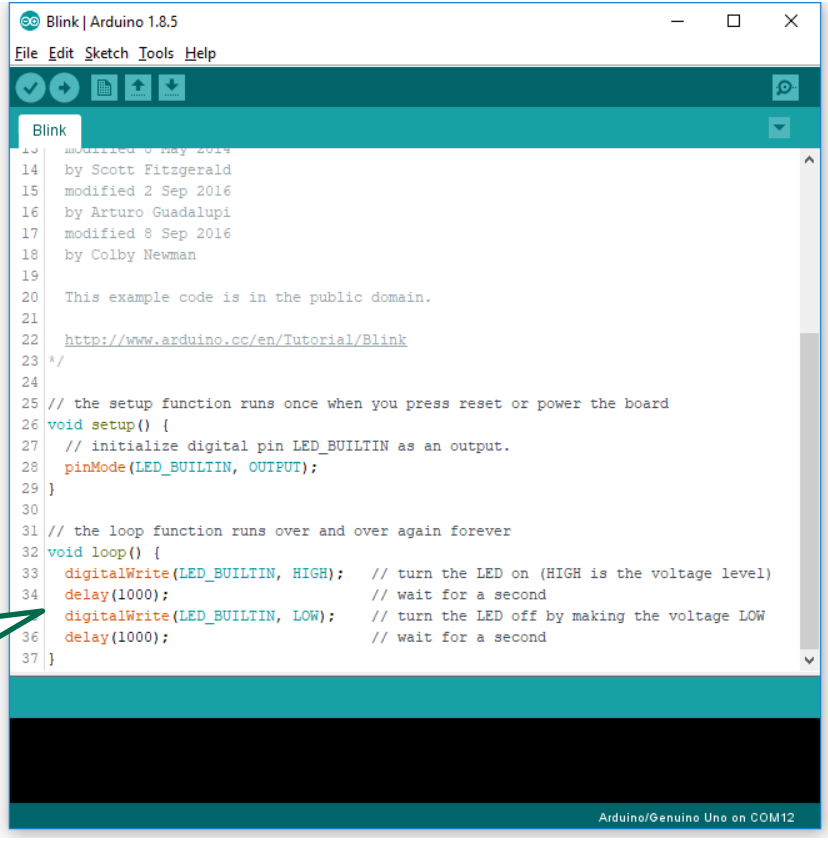
LEARN BY EXAMPLES



`LED_BUILTIN` is the LED on the board



`loop()`: turn LED *on* and *off*



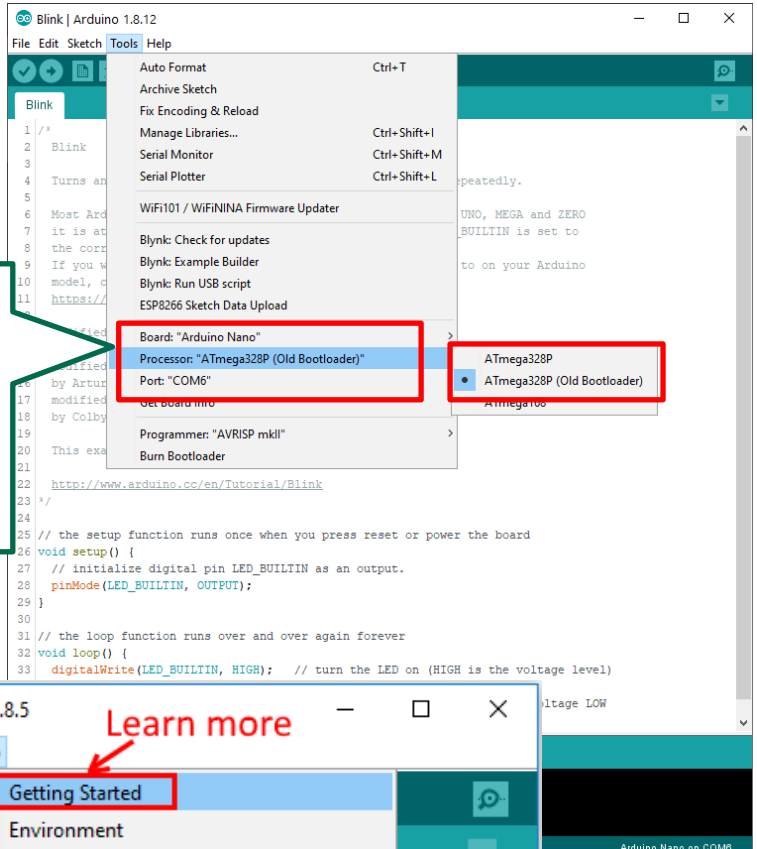
RUN A PROGRAM

UPLOAD SKETCH TO ARDUINO

Connect USB cable first

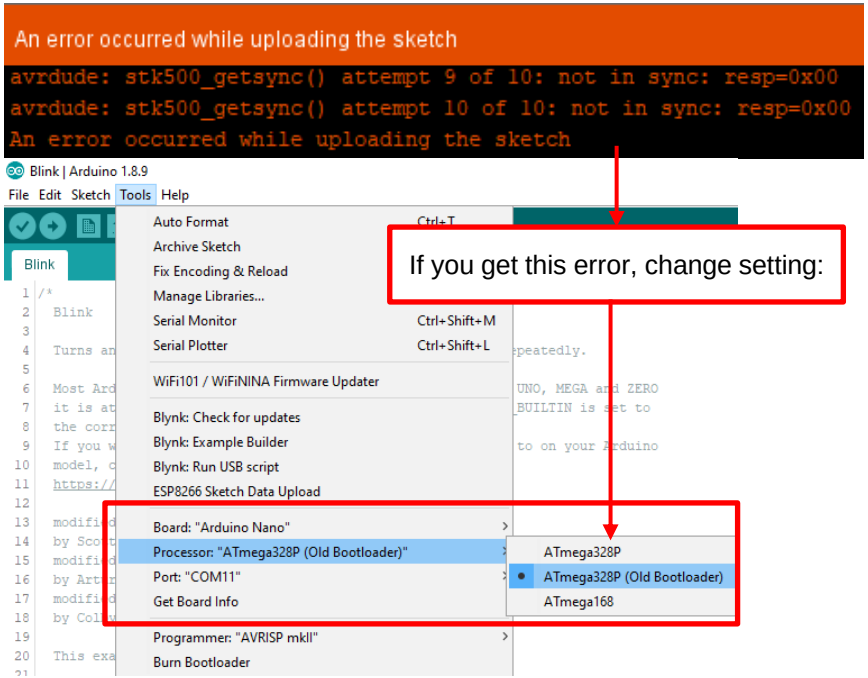
Select Board, Processor and Port.

For Nano V3 we have, select Old Bootloader version. For Nano BLE, use the other (ATmega328P)



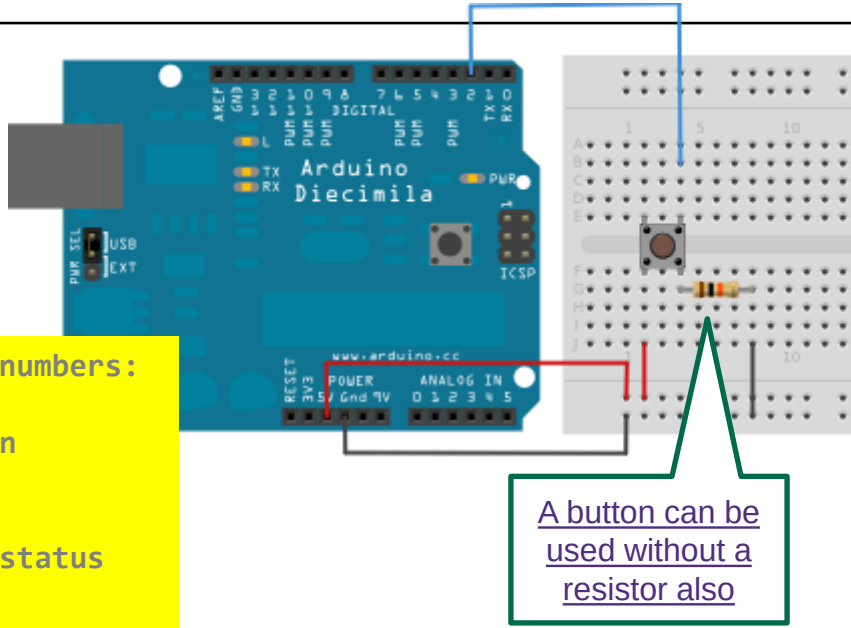
TIP: SELECT PROPER PROCESSOR

TOOLS > *PROCESSOR* CHOICE FOR ARDUINO NANO



ARDUINO PROGRAMMING BASICS

File > Examples > 02.Digital > Button



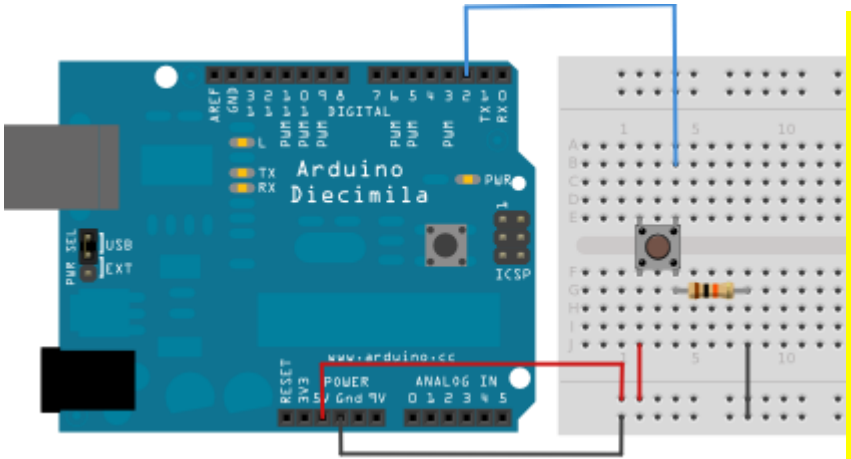

```
// constants won't change. They're used here to set pin numbers:
const int buttonPin = 2;     // number of pushbutton pin
const int ledPin =  13;      // number of onboard LED pin

// variables will change:
int buttonState = 0; // variable for reading pushbutton status

void setup() {
  // initialize the LED pin as an output:
  pinMode(ledPin, OUTPUT);
  // initialize the pushbutton pin as an input:
  pinMode(buttonPin, INPUT);
}
```

arduino.cc/en/Tutorial/Button

ARDUINO PROGRAMMING BASICS




```
void loop() {
  // read the state of the pushbutton value:
  buttonState = digitalRead(buttonPin);

  // check if the pushbutton is pressed.
  // If it is, the buttonState is HIGH:
  if (buttonState == HIGH) {
    // turn LED on:
    digitalWrite(ledPin, HIGH);
  } else {
    // turn LED off:
    digitalWrite(ledPin, LOW);
  }
}
```

Does not work as expected...?
Check out next example: 'debounce'

arduino.cc/en/Tutorial/Button

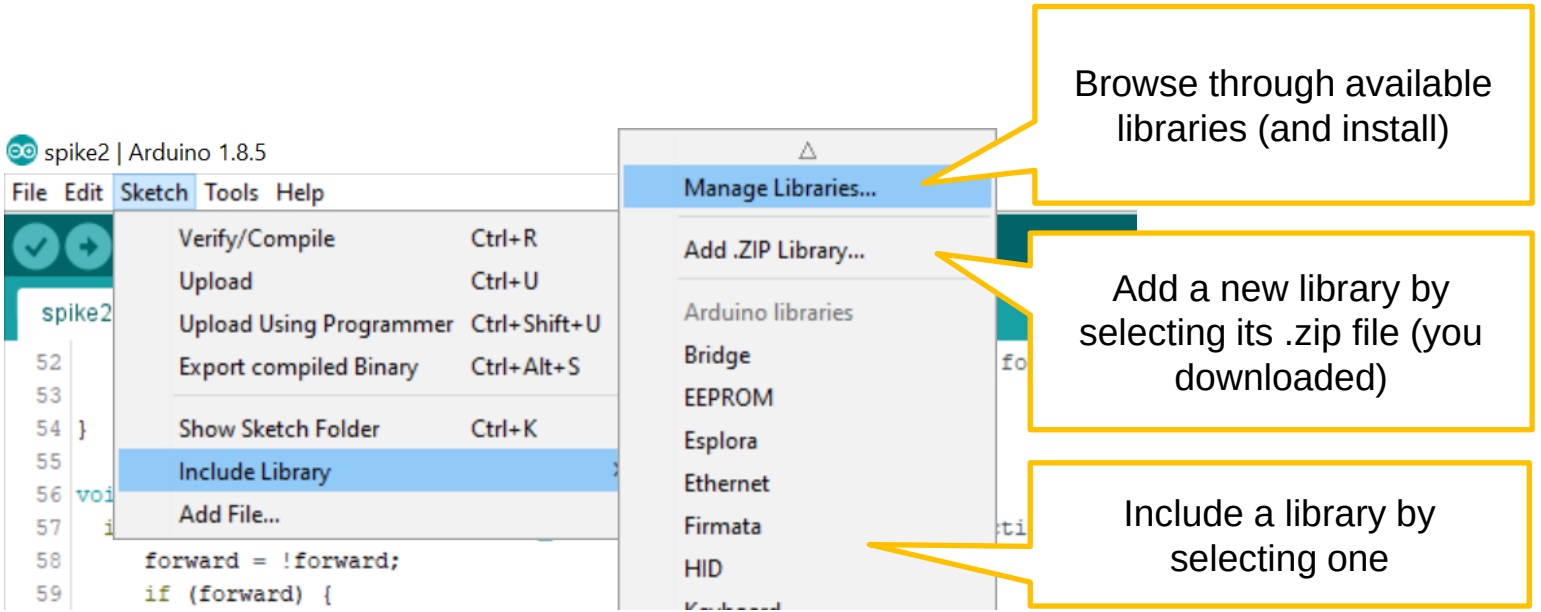
arduino.cc/en/Tutorial/Debounce

USING LIBRARIES

MAKE PROGRAMMING EASIER

arduino.cc/en/Main/Libraries

- Libraries extend functionality
- `Documents\Arduino\libraries` contains folders with libraries



ELECTRONICS KIT: CONTENTS

→ to be returned July 4th

- Check out what is in the kit here
- One part missing: Vibration Motor

Link to more info & tutorials about part

Link to shop, in case you need to buy more/spare

Hover over part so see image!

1 electronics kit, containing:		a transparent box, with the content below.
Arduino Nano	☐	Arduino Nano, can be black or blue board.
Arduino Nano BLE	☐	Arduino Nano with onboard Bluetooth module.
Breadboard	☐	Board with lots of holes in which you can stick components.
Breadboard wires	☐	Small box of breadboard wires.
Various basic components	☐	Resistors, capacitors, LEDs in various colors, at least 6 push buttons etc.
Potmeter	☐	Potentiometer.
Buzzer	☐	Buzzer. Shopping link is to starter kit which contains this.
7-segment display	☐	Small 7-segment LED display (displays a single character).
2 RGB Leds	☐	RGB Led
Ultrasonic sensor module	☐	Ultrasonic distance sensor
OLED Display	☐	0.96 inch OLED Display 128*64 pixels blue - I2C
Temperature sensor	☐	DHT11 temperature sensor, blue.
MPU-6050 Accelerometer & Gyroscope 3-Axis Module	☐	MPU-6050 Accelerometer and Gyroscope sensor. Warning: version in shop has no headers (you have to solder these yourself, so you need a soldering iron with a fine point and good eyes or a magnifying glass).
Vibration motor module	☐	Vibration motor, like the vibration element in your phone. **Unfortunatly, due to supply-problems, most of the kits have been sent without this module!**

GENERAL TIPS

Chat service on most pages on website
to use, please login to the site, so we can see who you are

- Always disconnect power (USB cable) if modifying circuit!
- Resistor color codes: resistorcolorcodecalc.com (or use multimeter)

Resistance	Minimum	Maximum
220 Ω ±5%	209 Ω	231 Ω

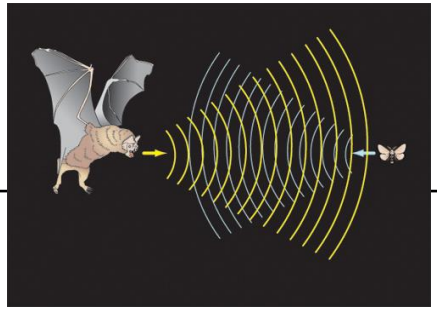
	Band 1	Band 2	Band 3	Band 4
Color	1st	2nd	Multiplier	Tolerance
Black		0	x10^0	
Brown	1	1	x10^1	±1%
Red	2	2	x10^2	±2%
Orange	3	3	x10^3	±0.05%
Yellow	4	4	x10^4	±0.02%
Green	5	5	x10^5	±0.5%
Blue	6	6	x10^6	±0.25%
Violet	7	7	x10^7	±0.1%
Grey	8	8	x10^8	±0.01%
White	9	9	x10^9	
Gold			x10^-1	±5%

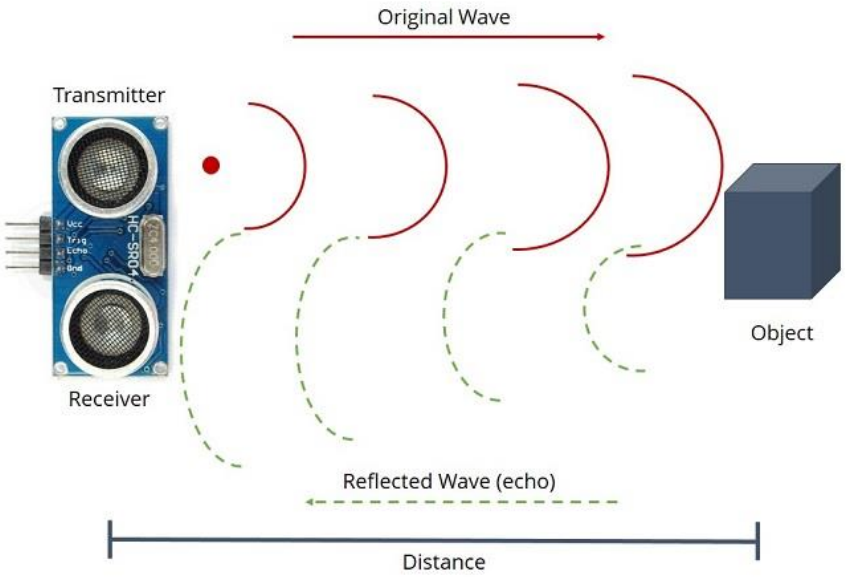
Troubleshooting:

- Use Stackoverflow forum or the chat on the site
- Arduino general troubleshooting guide

USE A DISTANCE SENSOR

ULTRASONIC SENSOR

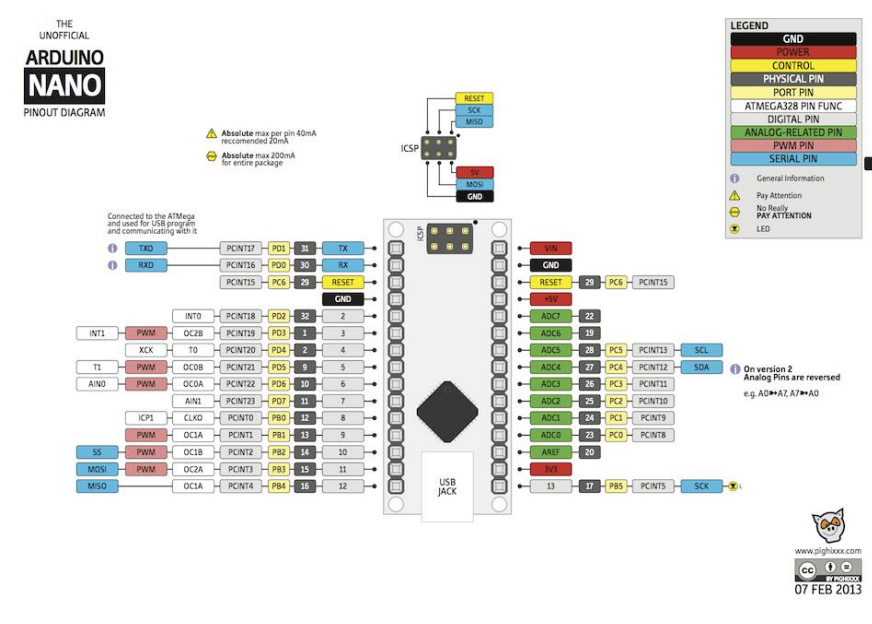


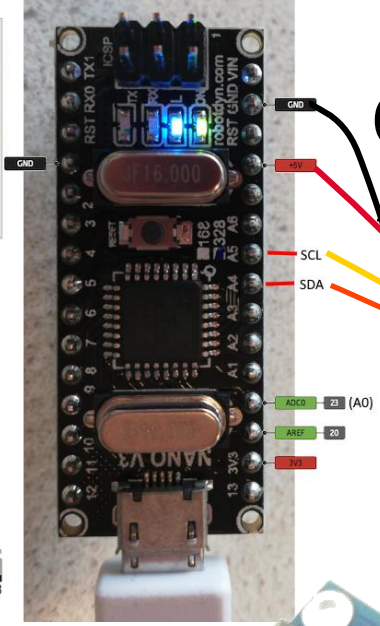


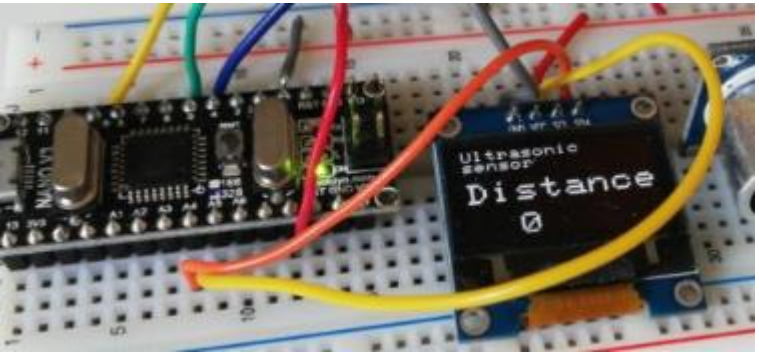
- Uses ultrasonic sound waves to determine range of object (echo-location)
- Range 5-250cm… or more
- Send a ‘ping’… wait for return, measure time to get distance

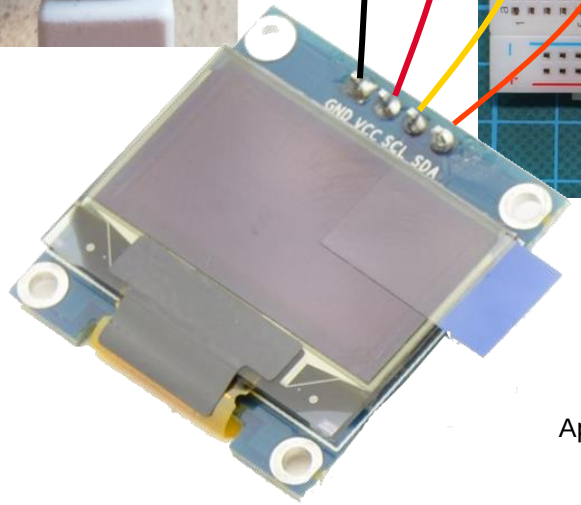
OLED DISPLAY

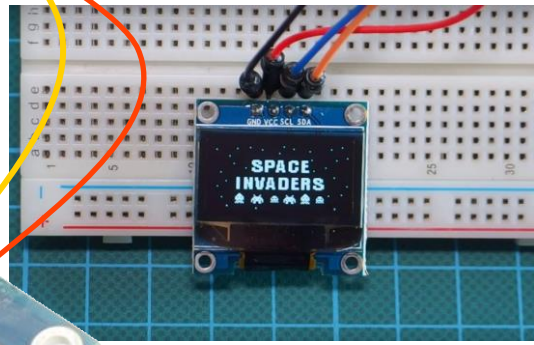
- Display text (8 lines, 16 characters).
- Or double font size
- Graphics:











WRITING YOUR FIRST LINES OF CODE

- If.. Some condition is *true*
- Do something

```
if ( condition ) { // something nearby?
  // sound alarm
}
```

- Example condition:

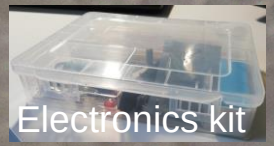
```
distance < 150
```

PRACTICAL ASSIGNMENT

DISTANCE SENSOR WITH ALARM

- Do assignment today or next week: deadline Friday May 1st (next week)
- Hand-in Arduino project on Canvas with demonstration video
- In the video, demonstrate the circuit you built, and the code!
- Tutorial for this assignment: "Build a distance sensor with an alarm"

Practical count towards the grade just like any other assignment.
More on grading in de FAQ.



Electronics kit

Check out what is in the kit here