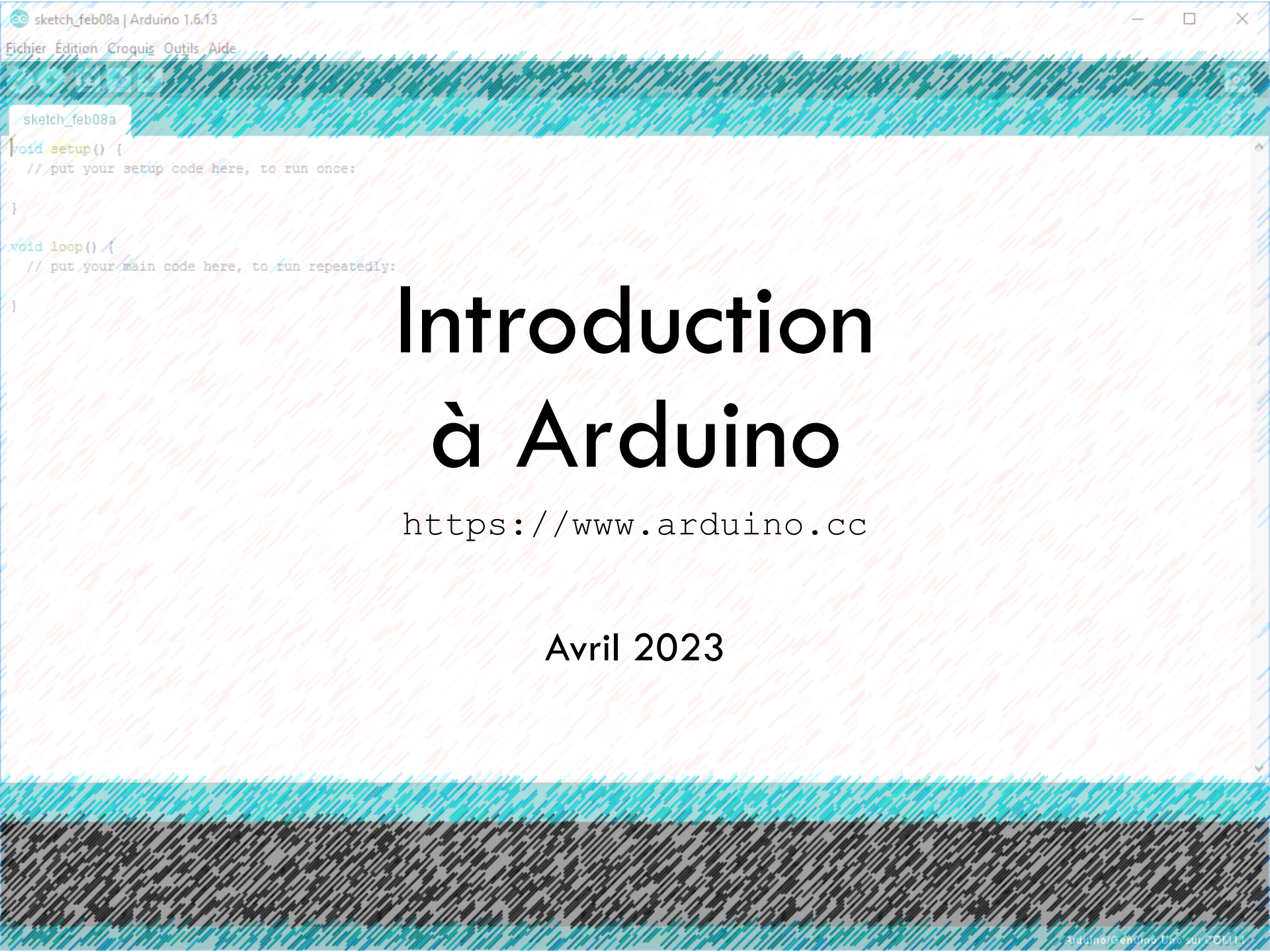


Introduction à Arduino

https://www.arduino.cc

Avril 2023

sketch_feb08a | Arduino 1.6.13

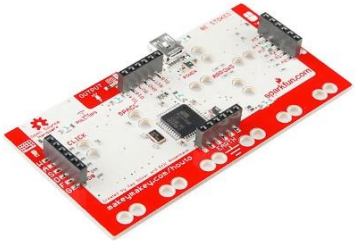
Fichier Édition Croquis Outils Aide

Qu'est ce qu'Arduino ?

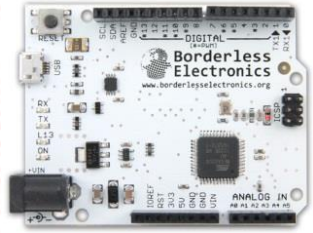
sketch_feb08a

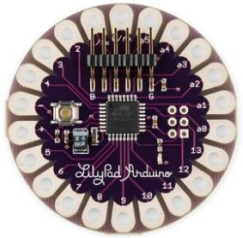
```
void setup() {
  // put your setup code here, to run once:

}

void loop() {
  // put your main code here, to run repeatedly:

}
```

D'abord du matériel !









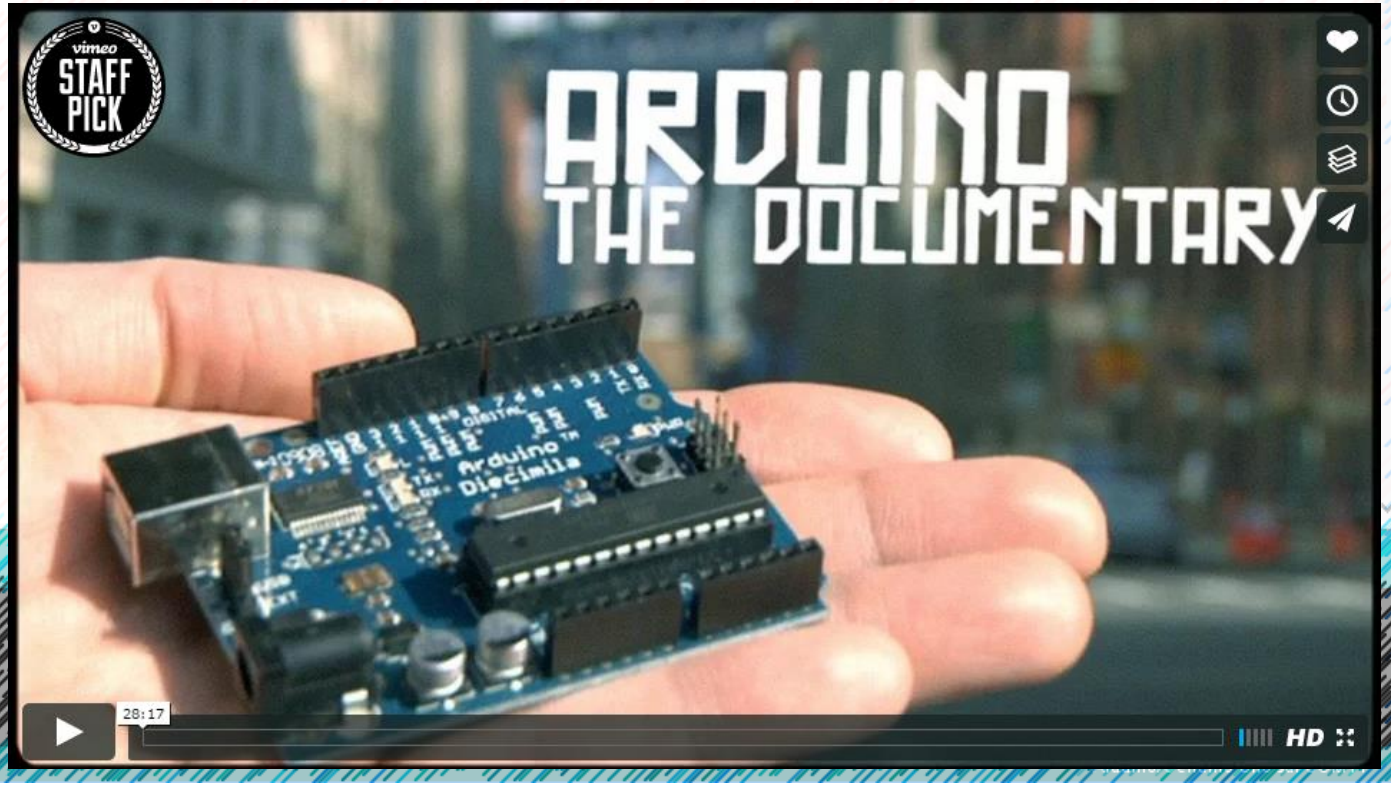

avec plein de versions différentes !

Arduino/Genuino Uno sur COM14

Une histoire d'Arduino ...

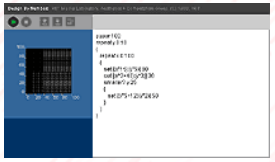
https://youtu.be/D4D1WhA_mi8

https://arduinohistory.github.io

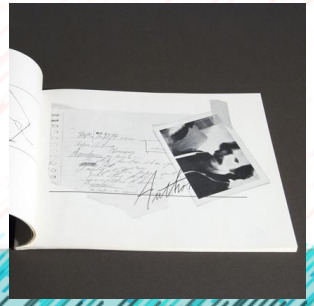


Historique

Design by Numbers
http://dbn.media.mit.edu
Date : 1999-2001
Lieu : MIT Media Lab
John Maeda



Visible Language Workshop
http://museum.mit.edu/150/115
Date : 1975
Lieu : MIT
Muriel Cooper



Processing
https://www.processing.org
Date : Printemps 2001
Lieu : MIT Media Lab
Ben Fry / Casey Reas

Processing 4

p5.js

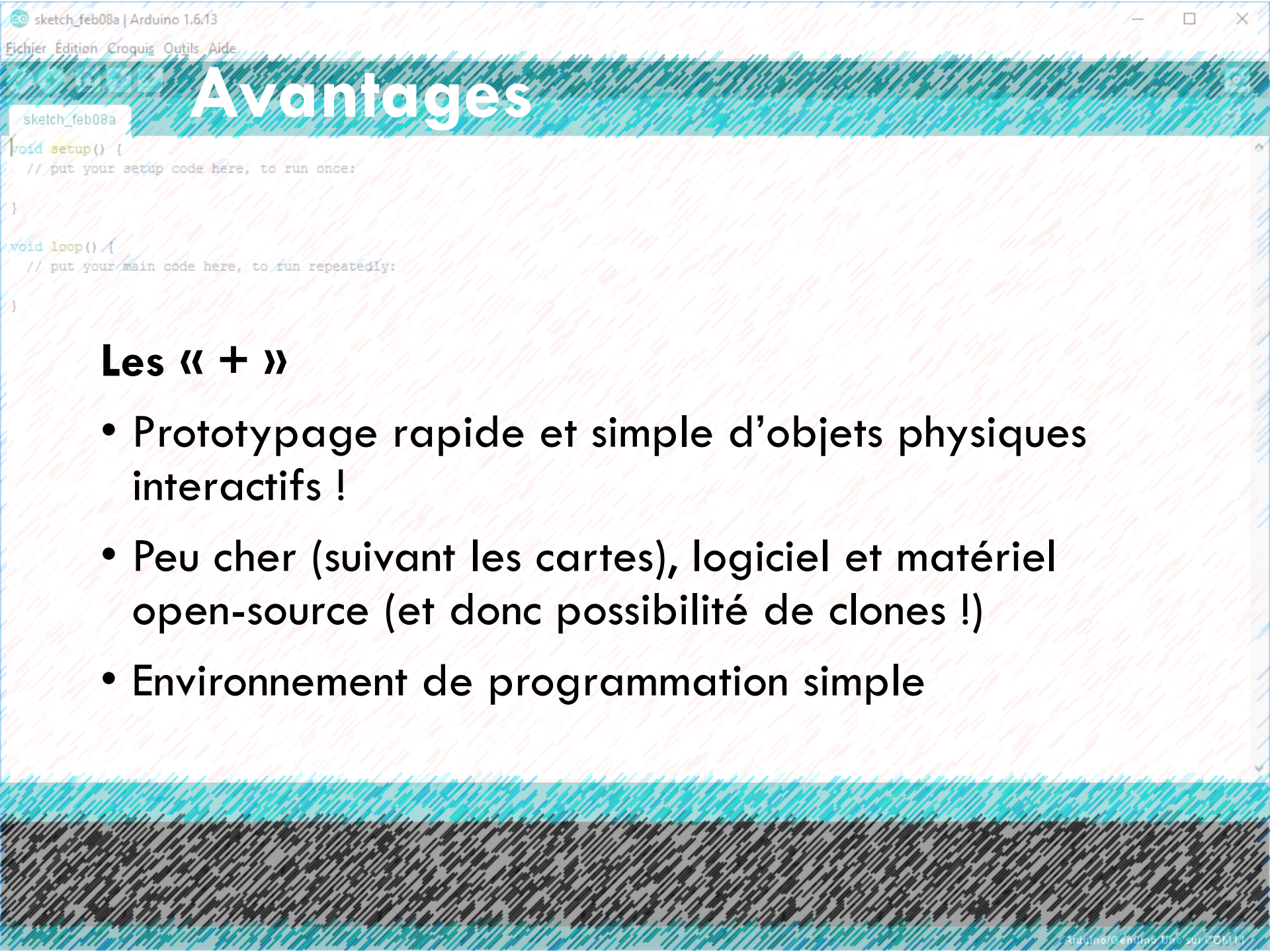
Wiring
http://wiring.org.co
Date : 2003
Lieu : IDII
Hernando Barragán

Arduino
https://www.arduino.cc
Date : 2005
Lieu : IDII
Massimo Banzi

Genuino

ARDUINO

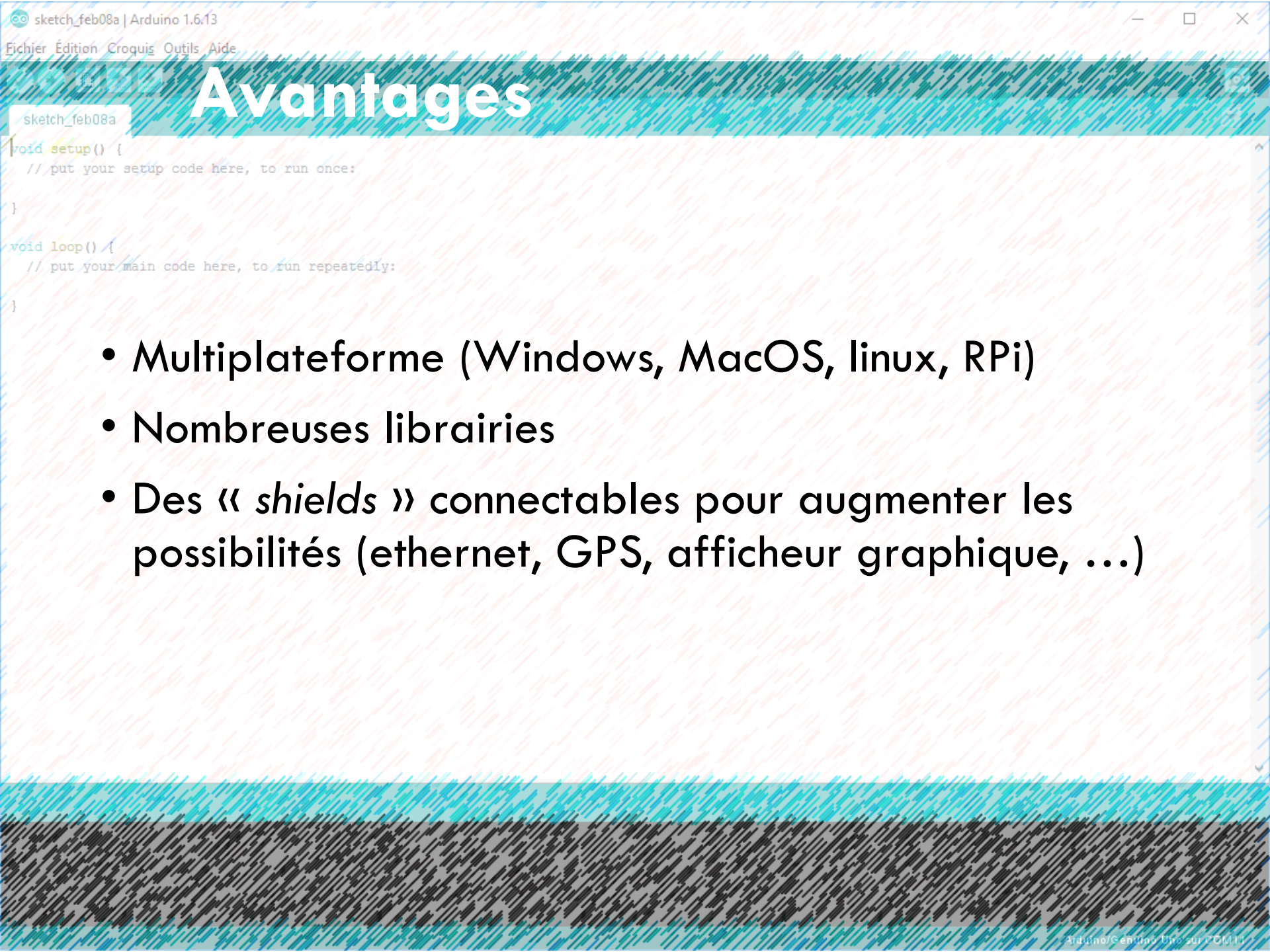
IDE – Environnement de dév.



Avantages

Les « + »

- Prototypage rapide et simple d'objets physiques interactifs !
- Peu cher (suivant les cartes), logiciel et matériel open-source (et donc possibilité de clones !)
- Environnement de programmation simple

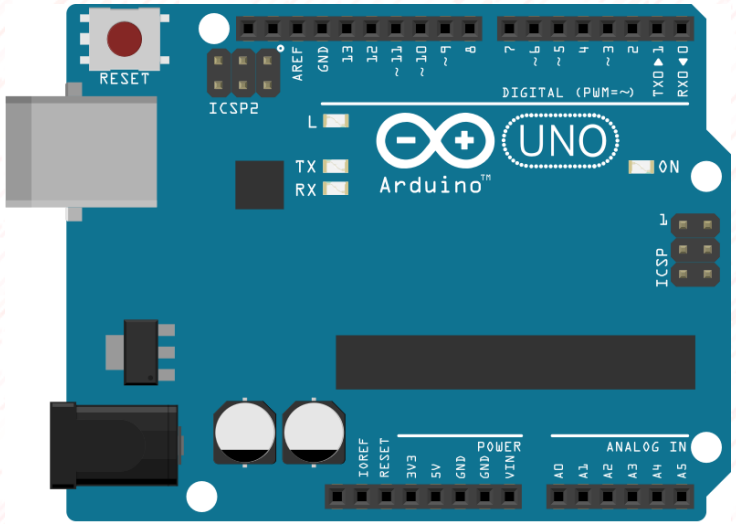


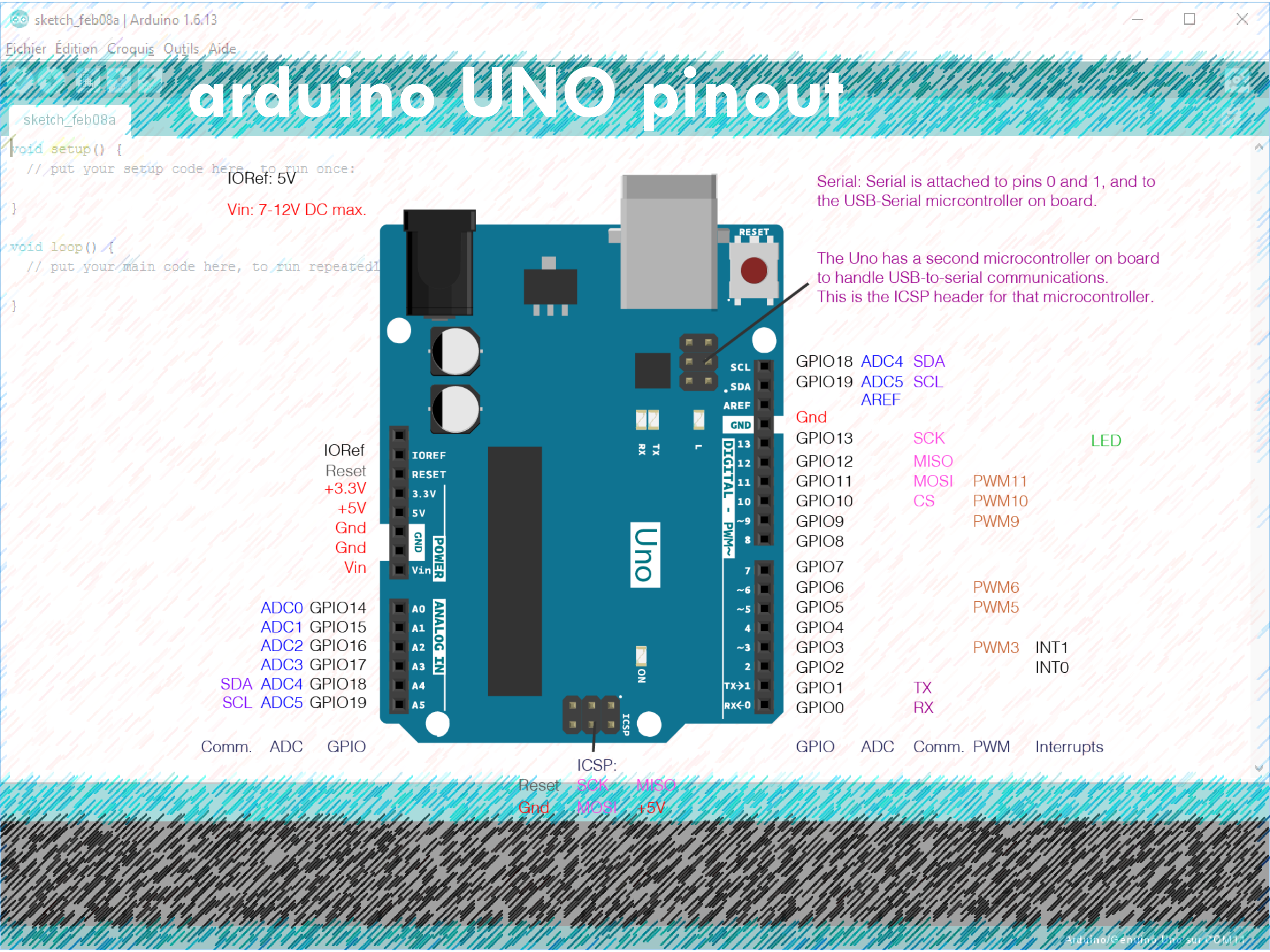
Avantages

- Multiplateforme (Windows, MacOS, linux, RPi)
- Nombreuses librairies
- Des « *shields* » connectables pour augmenter les possibilités (ethernet, GPS, afficheur graphique, …)

La carte arduino UNO …

- Des entrées/sorties numériques
- Des entrées analogiques (**A**)
- …





sketch_feb08a | Arduino 1.6.13
Fichier Édition Croquis Outils Aide
arduino UNO pinout
sketch_feb08a
void setup() {
// put your setup code here, to run once:
}
void loop() {
// put your main code here, to run repeatedly:
}
IORef: 5V
Vin: 7-12V DC max.
Serial: Serial is attached to pins 0 and 1, and to the USB-Serial micrcontroller on board.
The Uno has a second microcontroller on board to handle USB-to-serial communications. This is the ICSP header for that microcontroller.
RESET
GPIO18 ADC4 SDA
GPIO19 ADC5 SCL
AREF
Gnd
GPIO13 SCK LED
GPIO12 MISO
GPIO11 MOSI PWM11
GPIO10 CS PWM10
GPIO9 PWM9
GPIO8
GPIO7
GPIO6 PWM6
GPIO5 PWM5
GPIO4
GPIO3 PWM3 INT1
GPIO2 INT0
GPIO1 TX
GPIO0 RX
GPIO ADC Comm. PWM Interrupts
IORef
Reset
+3.3V
+5V
Gnd
Gnd
Vin
ADC0 GPIO14
ADC1 GPIO15
ADC2 GPIO16
ADC3 GPIO17
SDA ADC4 GPIO18
SCL ADC5 GPIO19
Comm. ADC GPIO
IOREF
RESET
3.3V
5V
GND
Vin
POWER
A0
A1
A2
A3
A4
A5
ANALOG IN
SCL
SDA
AREF
GND
13
12
11
10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL - PWM~
TX
RX
L
Uno
ON
ICSP
ICSP:
Reset SCK MISO
Gnd MOSI +5V
Arduino/Genuino Uno sur COM11

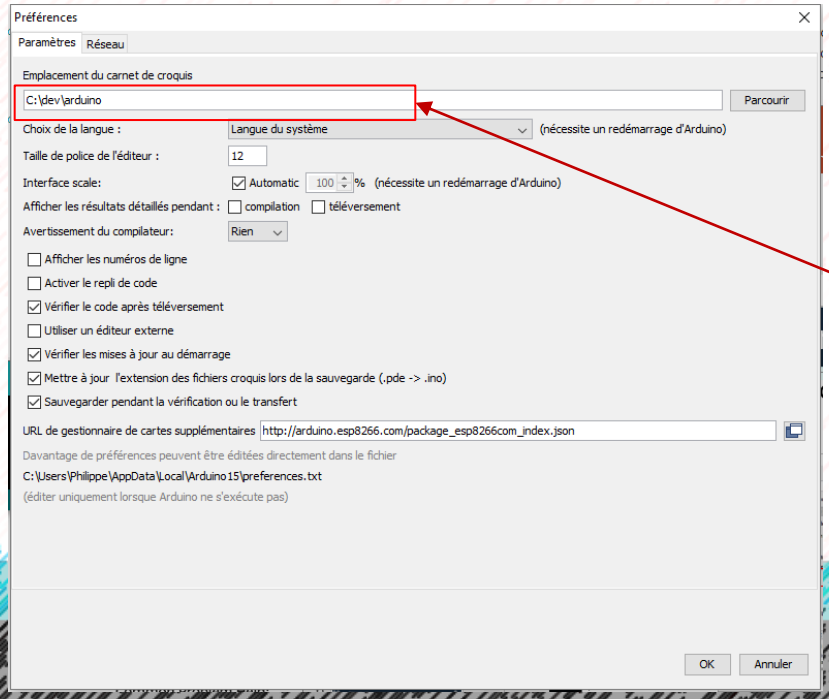
Programmation arduino

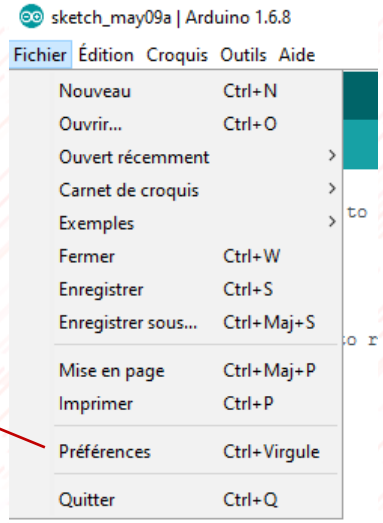
Arduino est « ***un langage commun*** » (syntaxe C++) indépendant des langages bas-niveau permettant de prototyper rapidement des applications physiques.

La base du programme arduino est le « *sketch* » (programme, prototype)
L'extension est le « **.ino** »

Structure

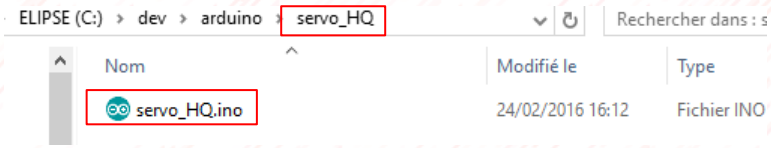
- Les « sketchs » (programmes) sont localisés dans le répertoire « préférences »





Structure

- un sketch est composé de :
  - Au moins un fichier « **.ino** » (cela peut être plus – un par classe objet).
    Le fichier principal doit avoir le même nom que le répertoire du sketch



Deux fonctions basiques

sketch_feb08a | Arduino 1.6.13

Fichier Édition Croquis Outils Aide

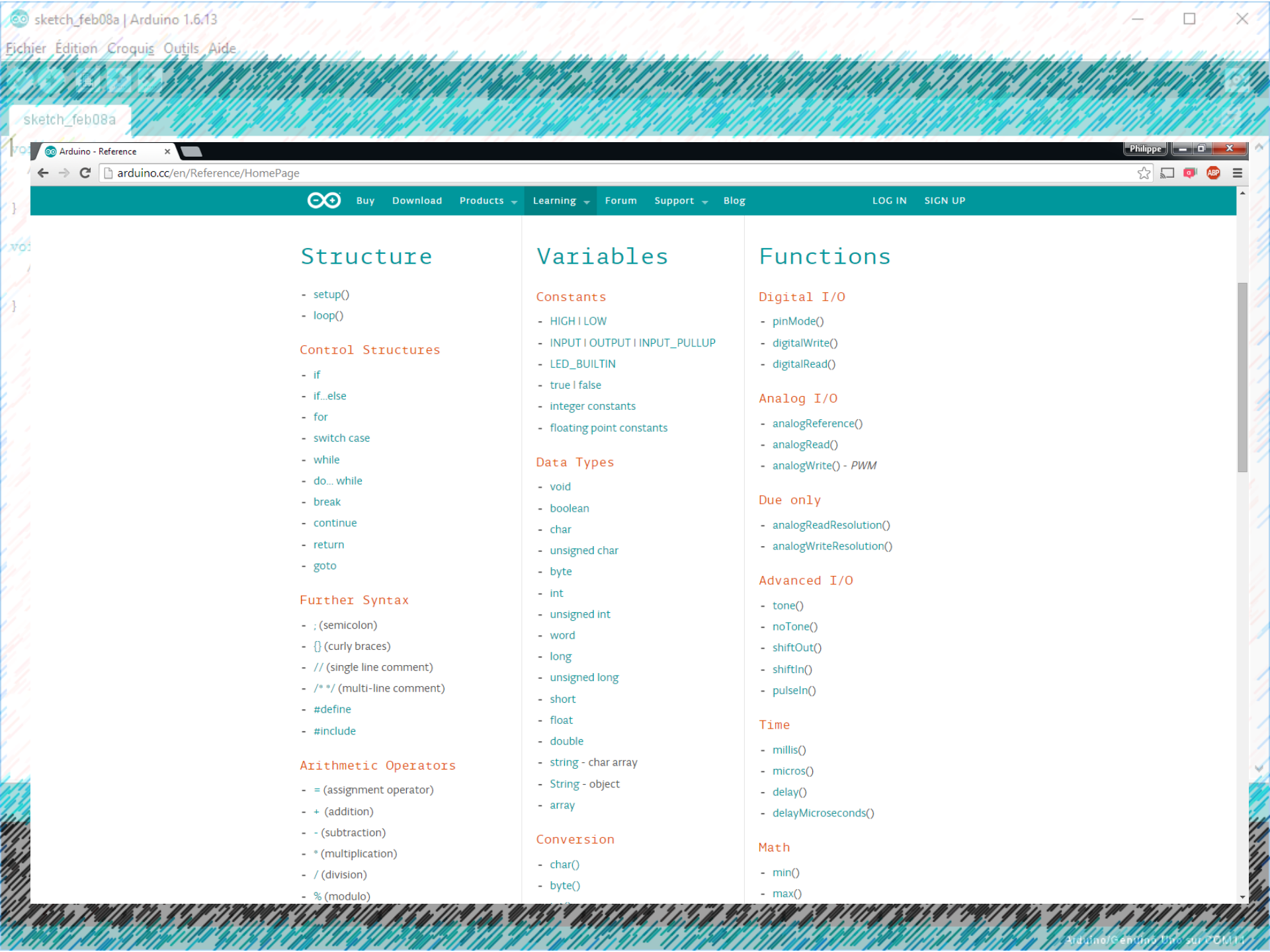
sketch_feb08a

```
void setup() {
  // put your setup code here, to run once:

}

void loop() {
  // put your main code here, to run repeatedly:

}
```

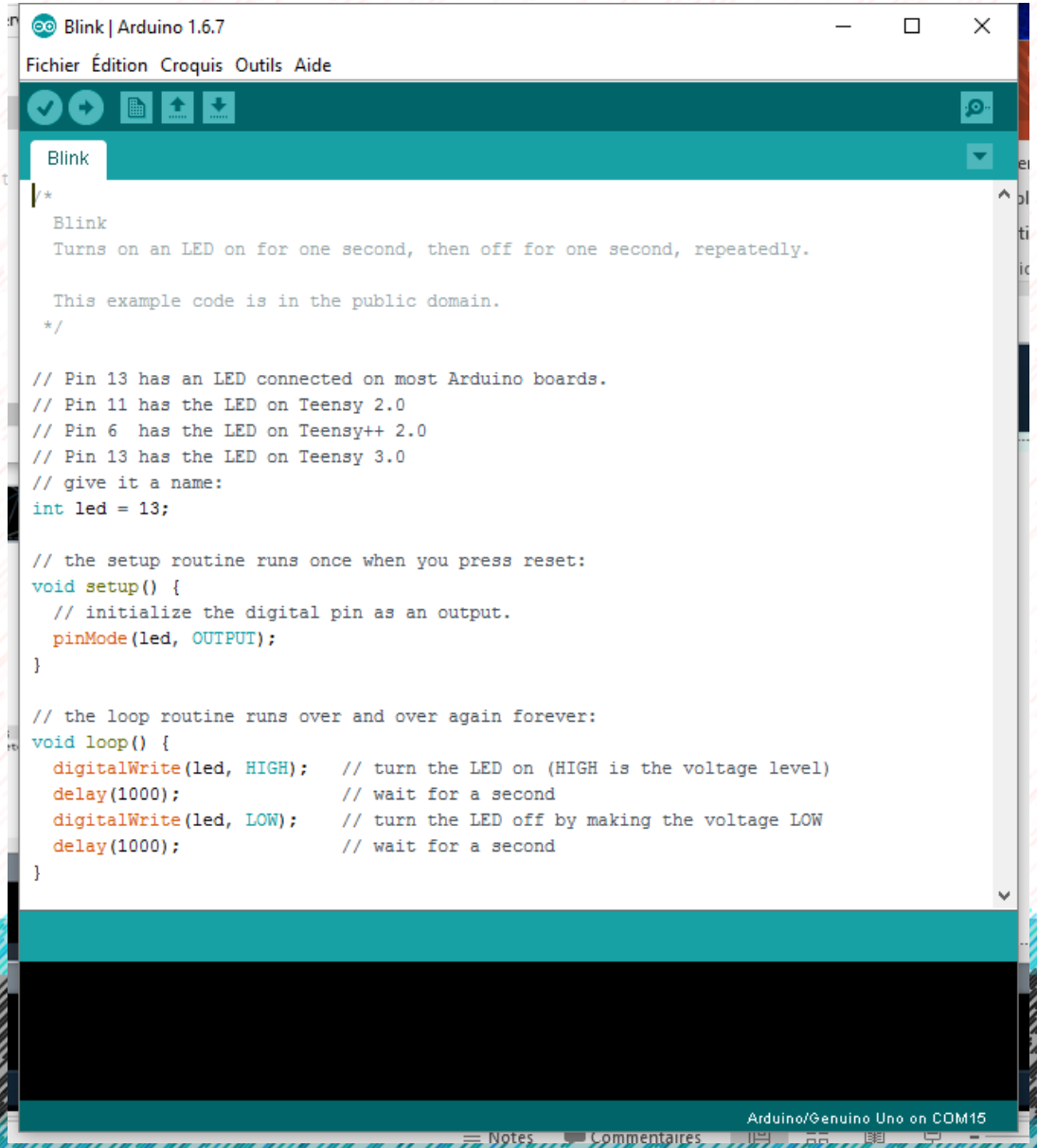
- **setup** : exécuté une seule fois au démarrage – permet d'initialiser les variables du programme

```
void setup() {
  Serial.begin(9600);
  Serial.println("16 channel Servo test!");

  pwm.begin();
  pwm.setPWMFreq(60);  // Analog servos run at ~60 Hz updates
  yield();
}
```

- **loop** : c'est la boucle de traitement des capteurs exécutée « *à l'infini* » (*mainloop*)

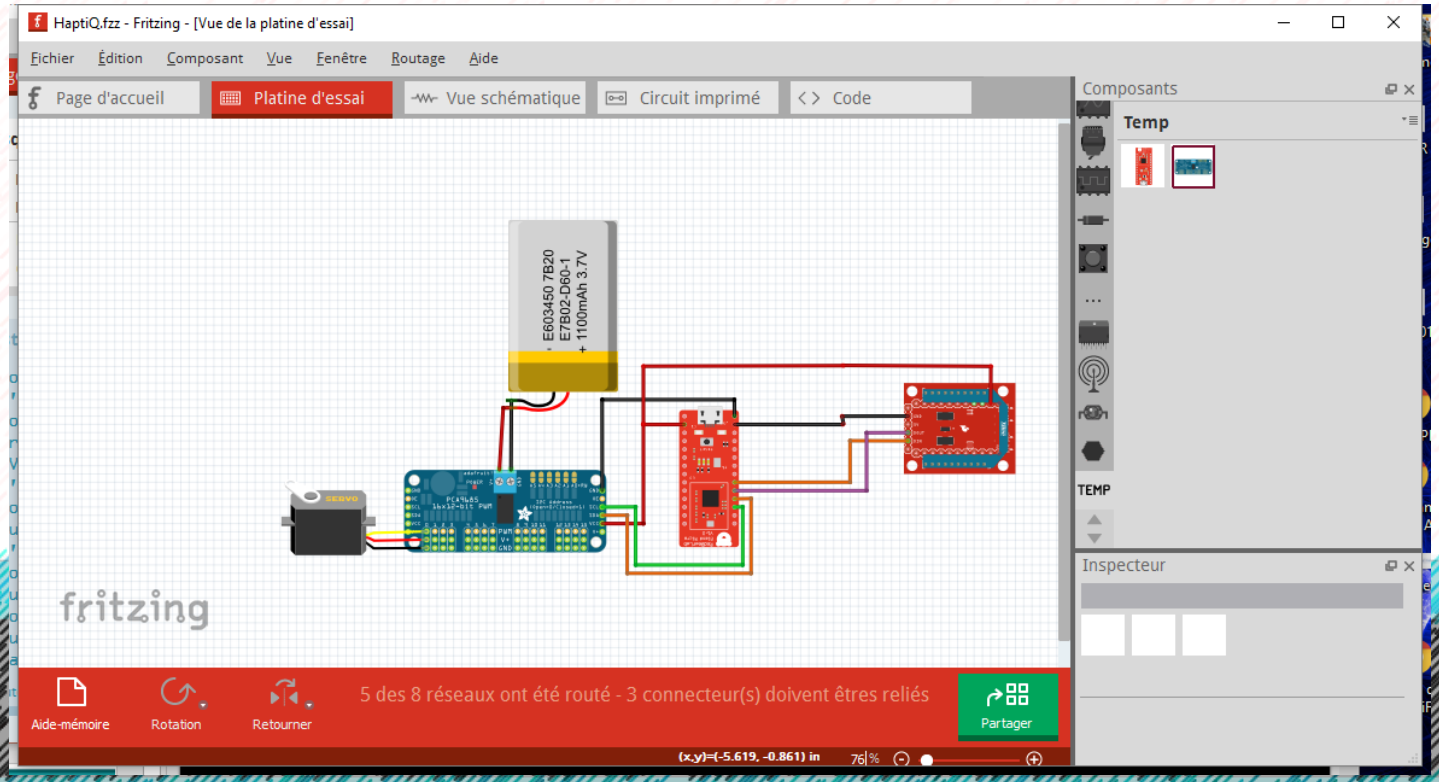

sketch_feb08a | Arduino 1.6.13
Fichier Édition Croquis Outils Aide
sketch_feb08a
Arduino - Reference
Philippe
arduino.cc/en/Reference/HomePage
Buy Download Products Learning Forum Support Blog LOG IN SIGN UP
Structure
setup()
loop()
Control Structures
if
if...else
for
switch case
while
do... while
break
continue
return
goto
Further Syntax
; (semicolon)
{} (curly braces)
// (single line comment)
/* */ (multi-line comment)
#define
#include
Arithmetic Operators
= (assignment operator)
+ (addition)
- (subtraction)
* (multiplication)
/ (division)
% (modulo)
Variables
Constants
HIGH | LOW
INPUT | OUTPUT | INPUT_PULLUP
LED_BUILTIN
true | false
integer constants
floating point constants
Data Types
void
boolean
char
unsigned char
byte
int
unsigned int
word
long
unsigned long
short
float
double
string - char array
String - object
array
Conversion
char()
byte()
Functions
Digital I/O
pinMode()
digitalWrite()
digitalRead()
Analog I/O
analogReference()
analogRead()
analogWrite() - PWM
Due only
analogReadResolution()
analogWriteResolution()
Advanced I/O
tone()
noTone()
shiftOut()
shiftIn()
pulseIn()
Time
millis()
micros()
delay()
delayMicroseconds()
Math
min()
max()

Un premier exemple



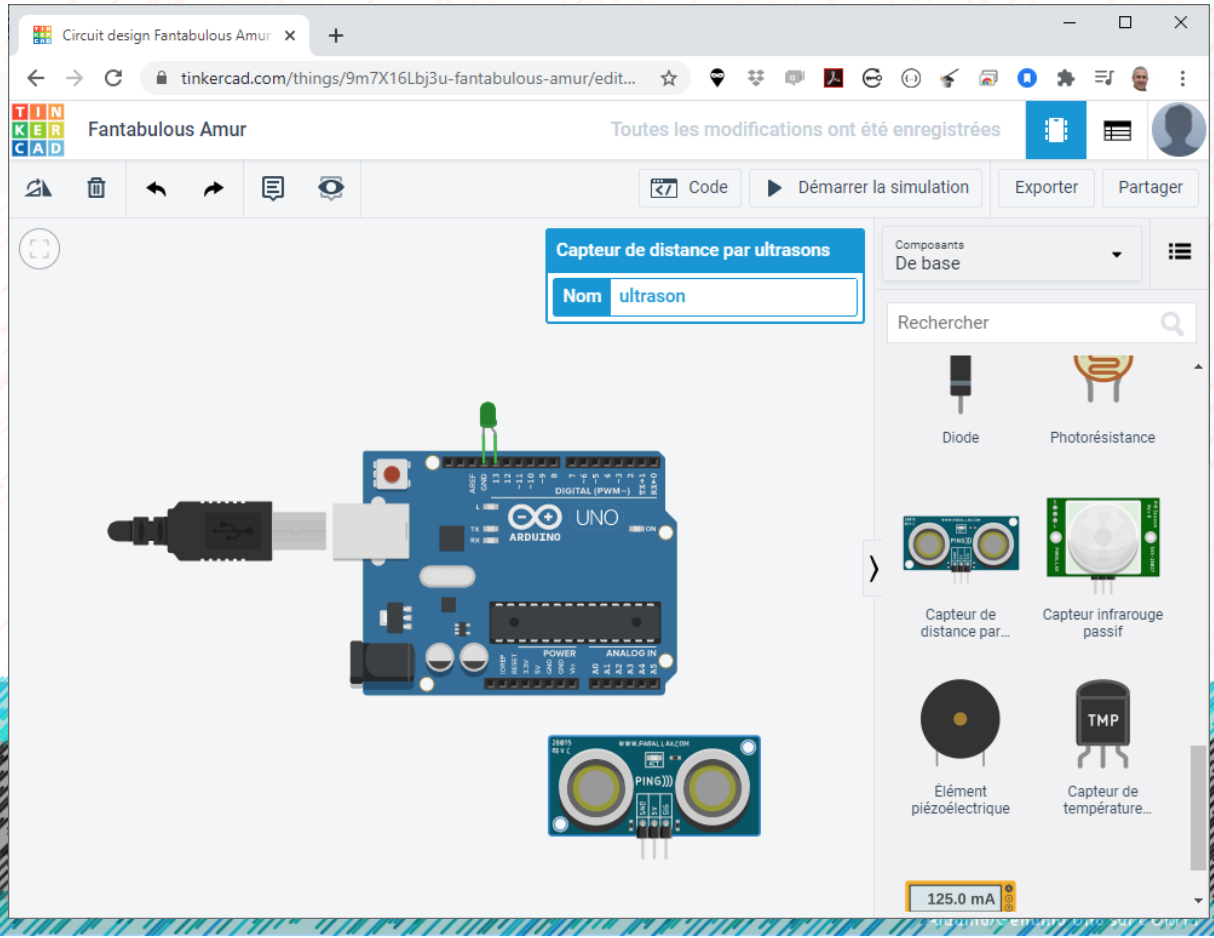
Un outil d'aide au montage

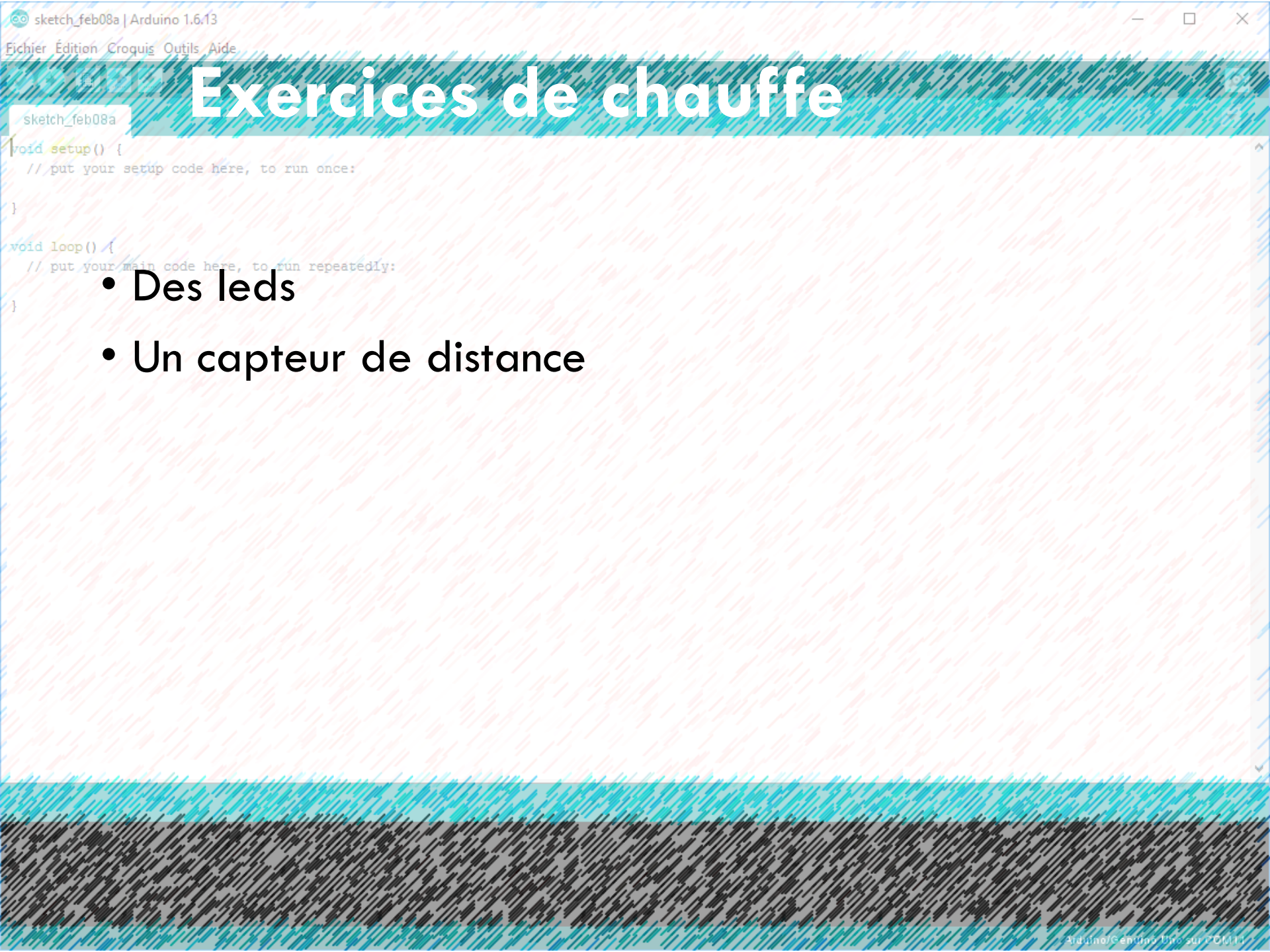
- **Fritzing** - https://fritzing.org (payant depuis 2019)
  https://www.softpedia.com/get/Science-CAD/Fritzing.shtml#download



Un simulateur en ligne

- https://www.tinkercad.com/dashboard
- Choisir Circuits





Exercices de chauffe

- Des leds
- Un capteur de distance

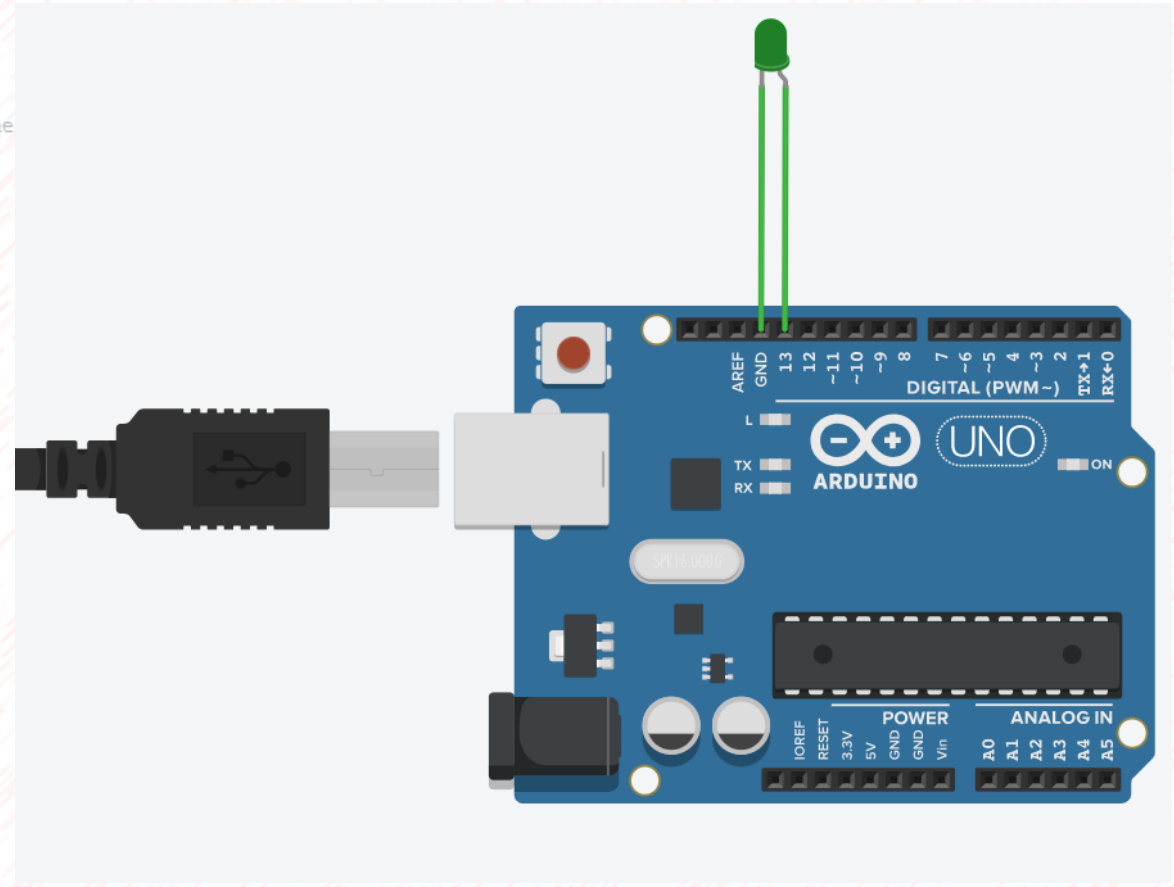
sketch_feb08a | Arduino 1.6.13

Fichier Édition Croquis Outils Aide

Led

sketch_feb08a

```
void setup() {
  // put your setup code here, to run once:

}

void loop() {
  // put your main code he
  // put your main code here, to run repeatedly:

}
```



Arduino/Genuino Uno sur COM14

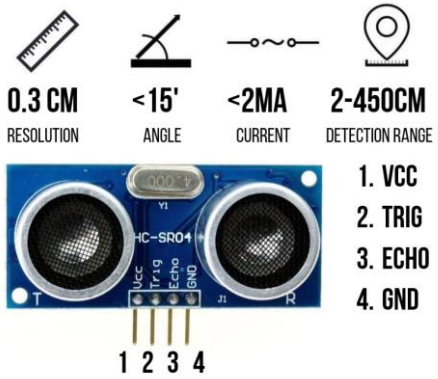
sketch_feb08a | Arduino 1.6.13

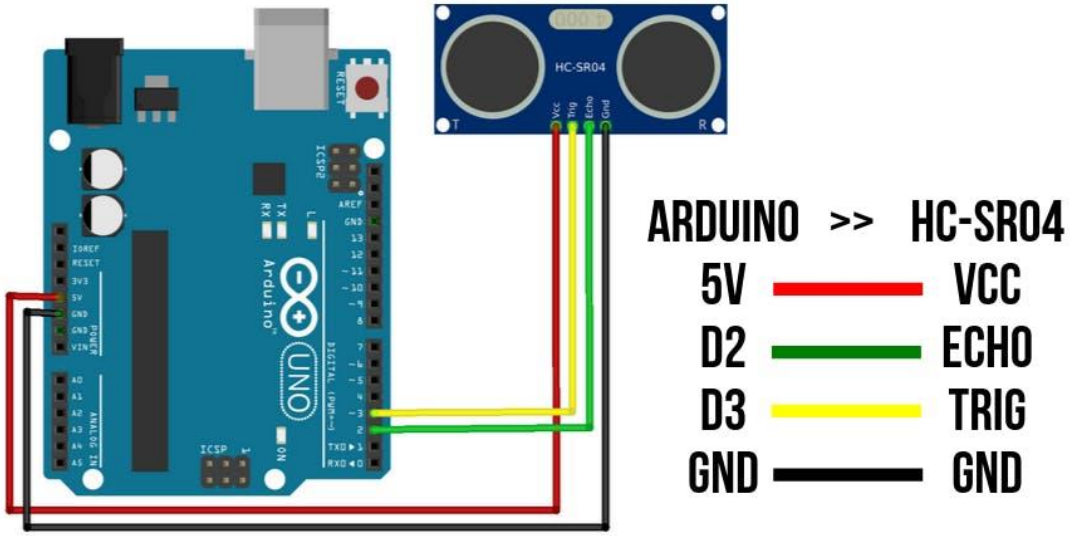
Fichier Édition Croquis Outils Aide

Capteur de distance

sketch_feb08a

```
void setup() {
  // put your setup code here, to run once:

}

void loop() {
  // put your main code here, to run repeatedly:

}
```





ARDUINO	>>	HC-SR04
5V		VCC
D2		ECHO
D3		TRIG
GND		GND

Liaison série

- interruption

```
void serialEvent(){// instructions}
```

/!\ Ne fonctionne pas pour tous les arduino

Machine à états

```
typedef enum {ETEINT=LOW, ALLUME=HIGH} MAE; //
l'énumération est définie sous le type MAE

MAE mae;


…

void loop(){
  switch(mae) {
    case ALLUME: …
```

Exercices de démarrage

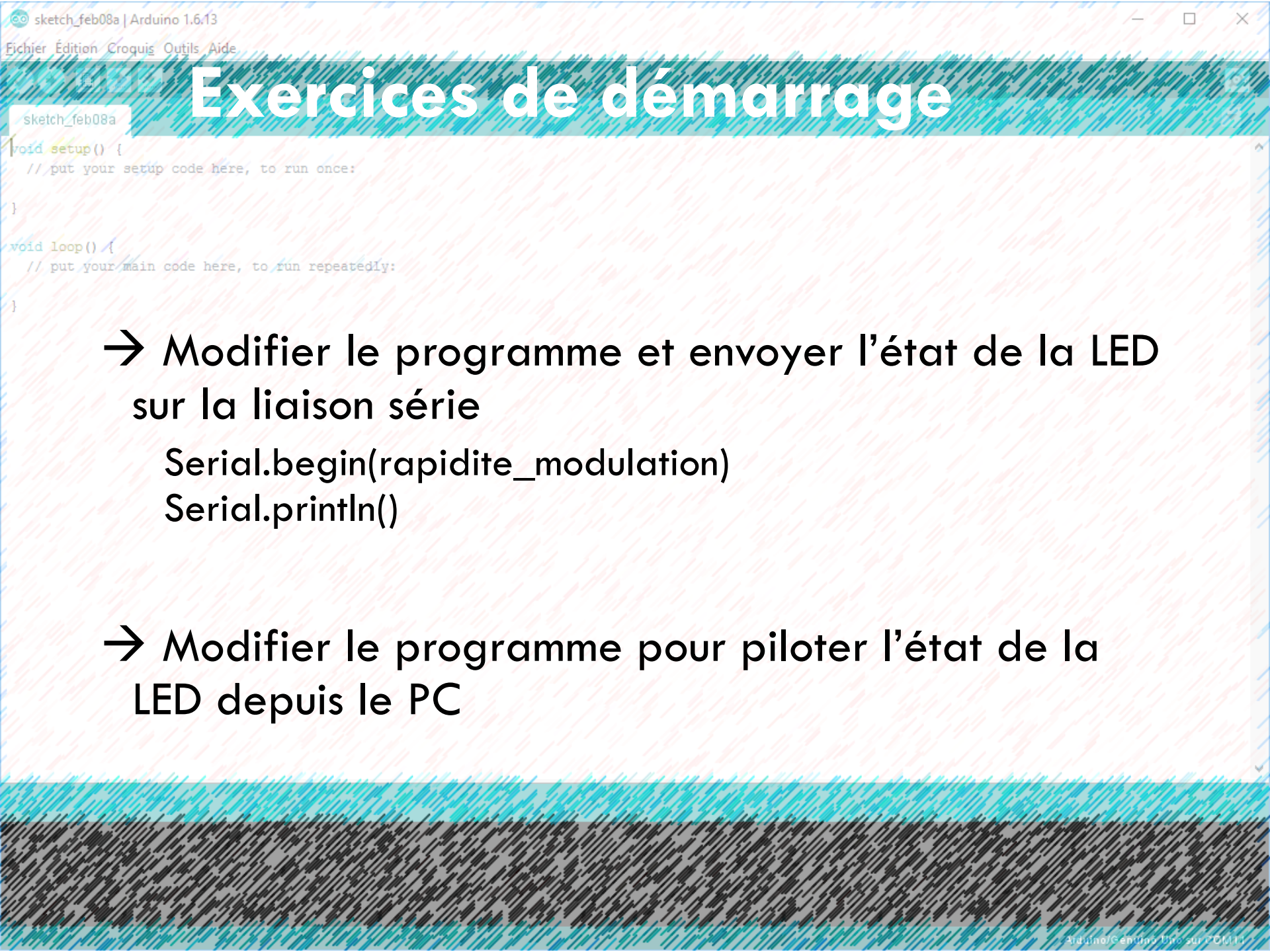
- ***Allumer/Eteindre une led***

Ouvrir **Fichier | Exemples | 01.Basics | Blink**

LED_BUILTIN → Pin 13 sur l'Arduino UNO

→ Modifier la durée du clignotement

Exercices de démarrage



→ Modifier le programme et envoyer l'état de la LED sur la liaison série

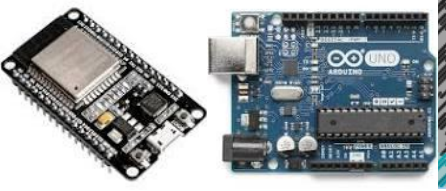
Serial.begin(rapidite_modulation)
Serial.println()

→ Modifier le programme pour piloter l'état de la LED depuis le PC

Exercices de démarrage

- Utiliser une librairie externe → capteur ultrason HC-SR04
  - https://bitbucket.org/teckel12/arduino-new-ping/downloads/NewPing_v1.9.7.zip (ou via la bibliothèque)

Pour être utilisable sur ESP32, il faut le modèle HC-SR04P ou modifier le capteur (https://www.instructables.com/Modify-Ultrasonic-Sensors-for-3-Volts-Logic-prepar/)

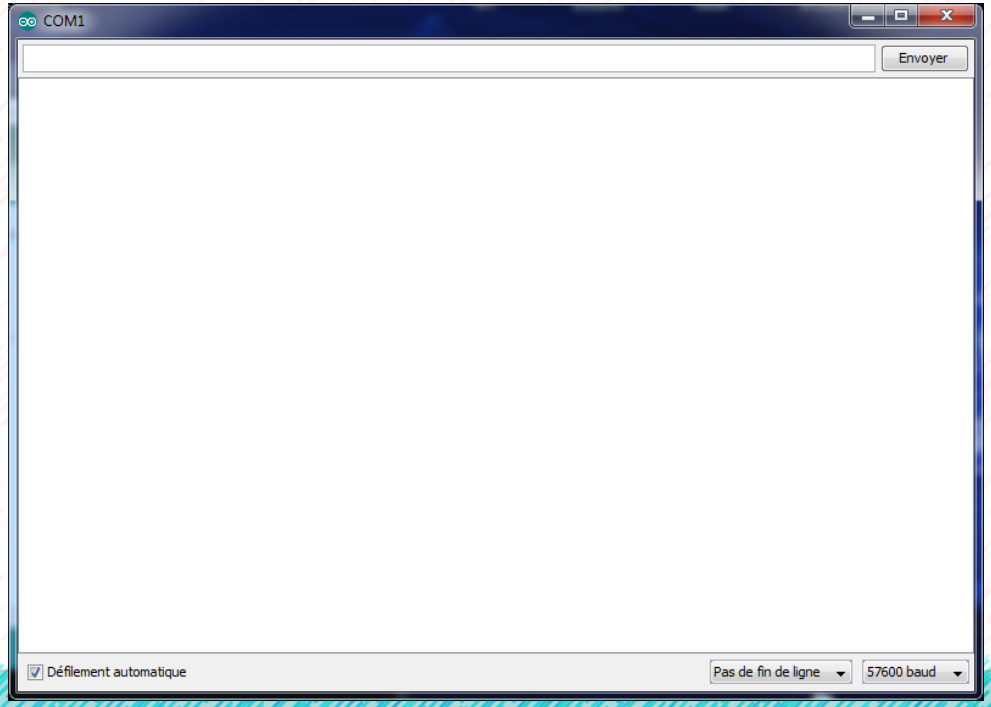


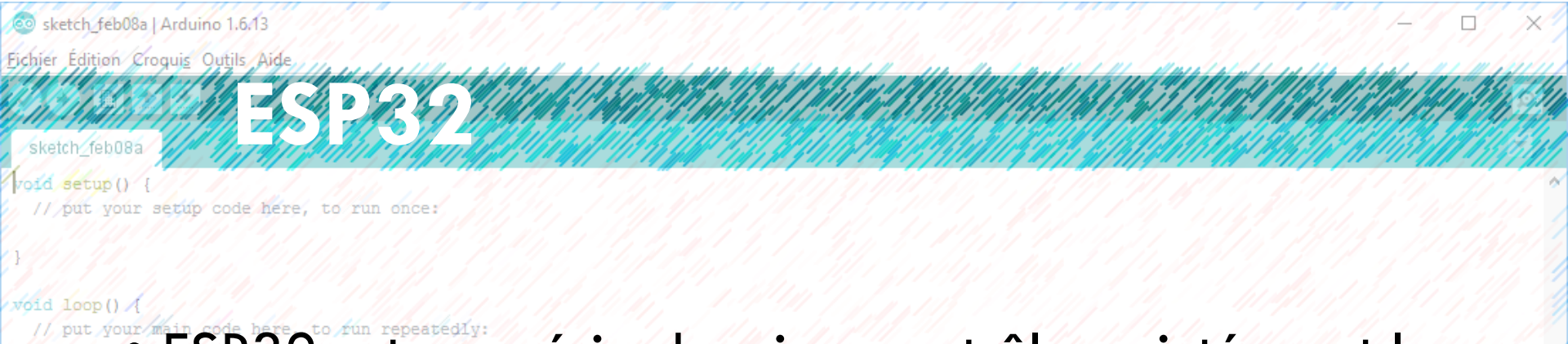
Exercices de démarrage

→ Écrire un programme qui envoie sur le port série la distance perçue par l'arduino avec le plus proche objet et allume la led **LED_BUILTIN** si la distance est inférieure à 20 cm

« Astuces »

- Outils | Moniteur série



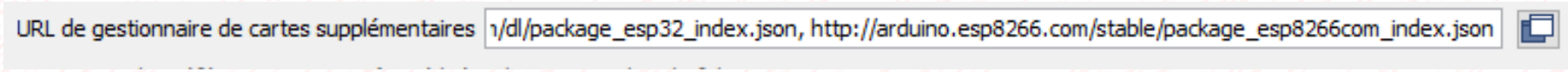


ESP32

- ESP32 est une série de micro-contrôleurs intégrant la gestion du wifi et du bluetooth (jusqu'à BLE)
- Il est peu cher et très apprécié dans le domaine de l'IoT !

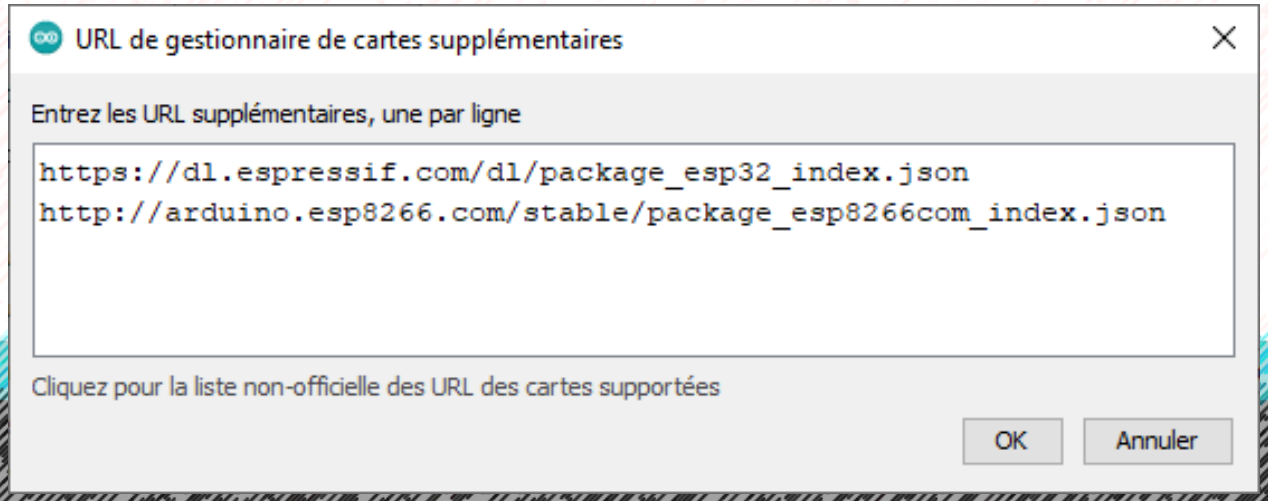
Installer ESP8266 et ESP32

- Dans `Fichier|Préférences`



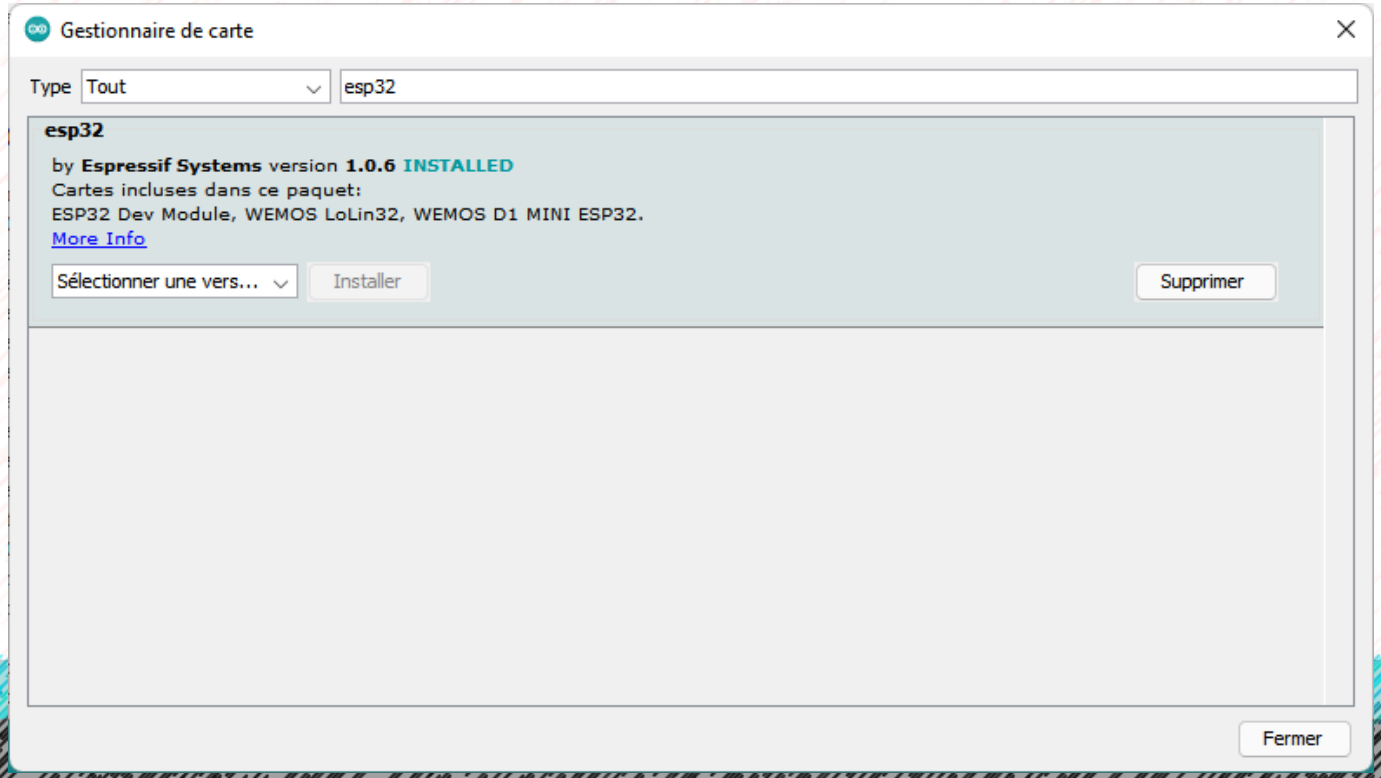
`https://dl.espressif.com/dl/package_esp32_index.json`

`http://arduino.esp8266.com/stable/package_esp8266com_index.json`



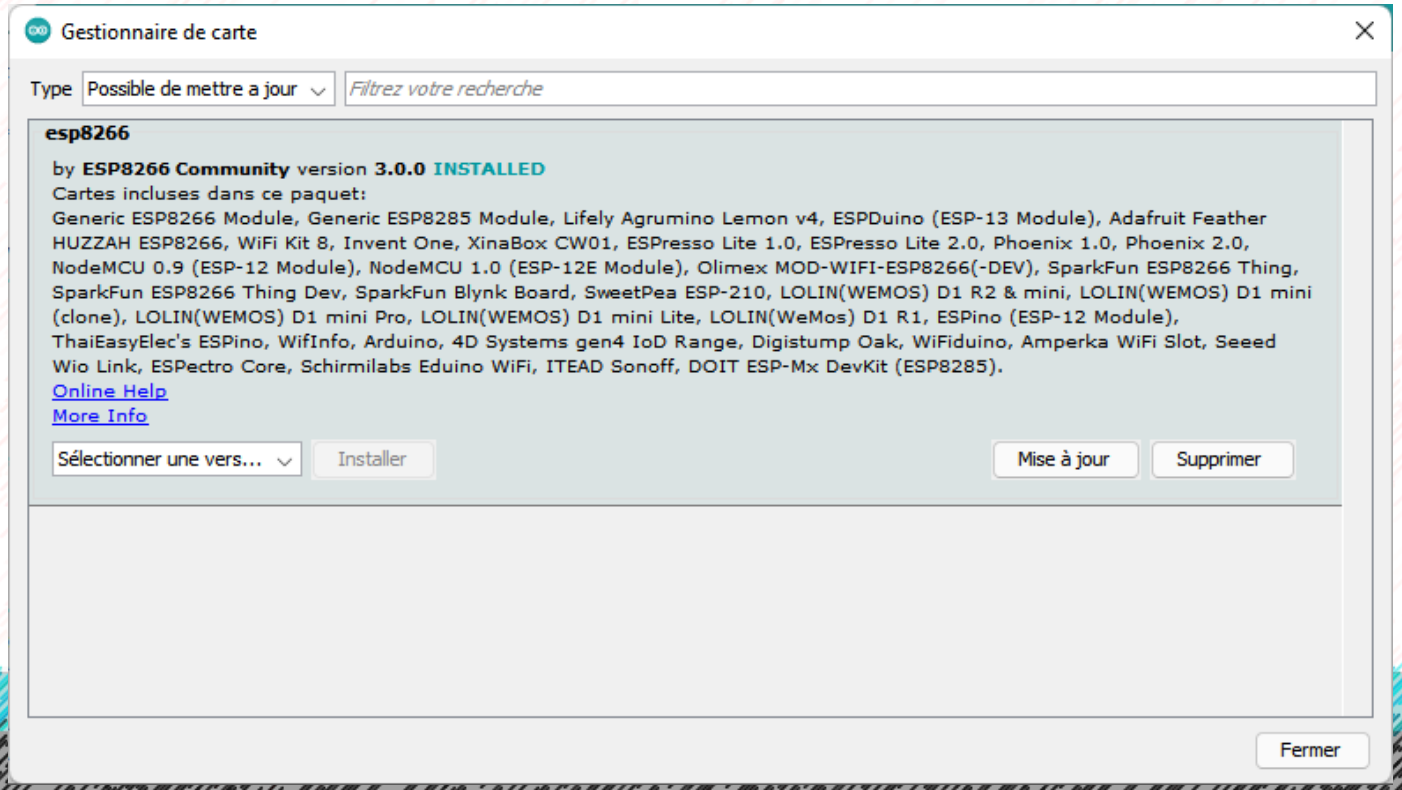
Installer ESP8266 et ESP32

- Dans `Outils |Type de carte |Gestionnaire de carte`

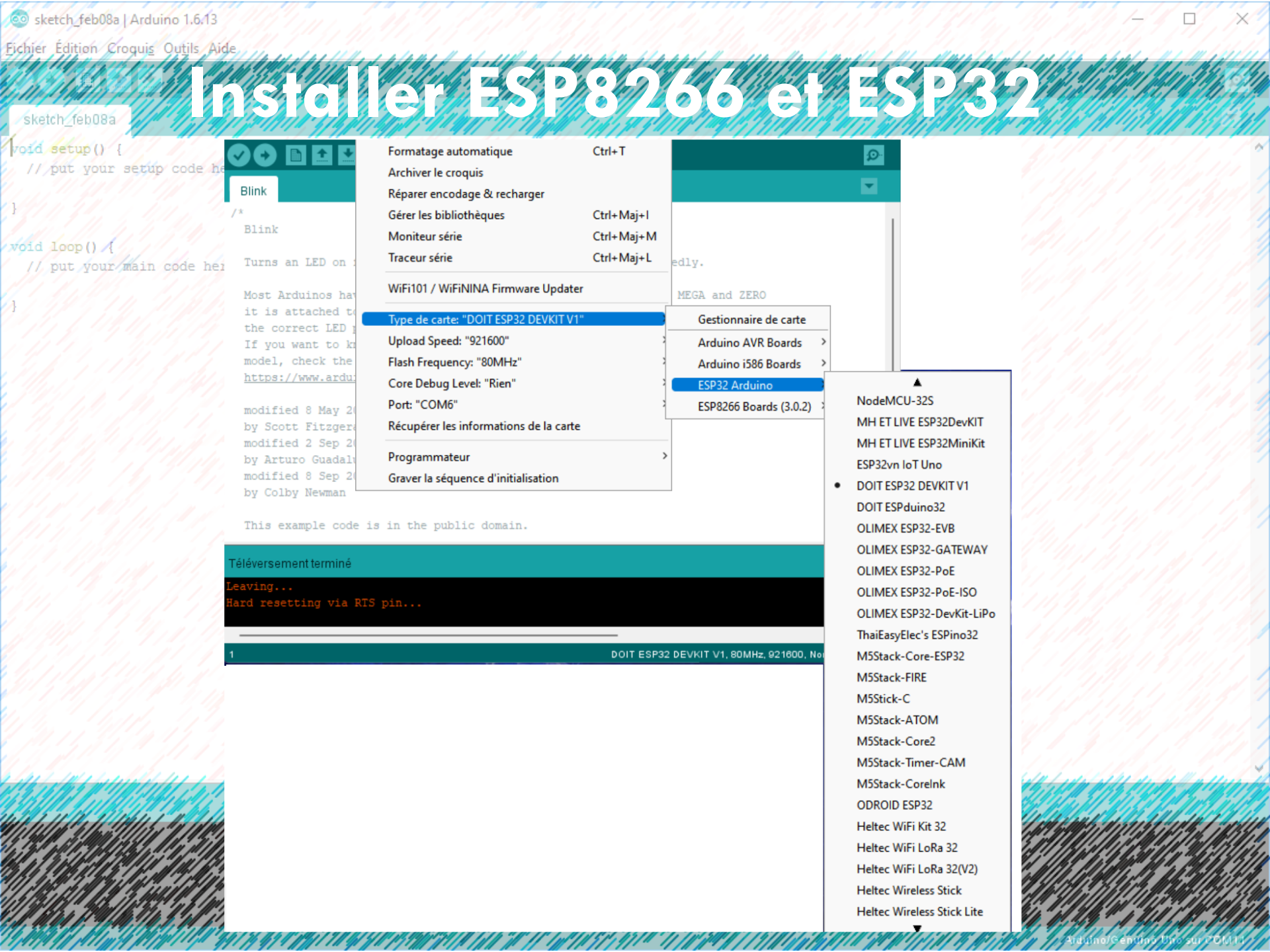


Installer ESP8266 et ESP32

- Dans `Outils |Type de carte |Gestionnaire de carte`



Installer ESP8266 et ESP32



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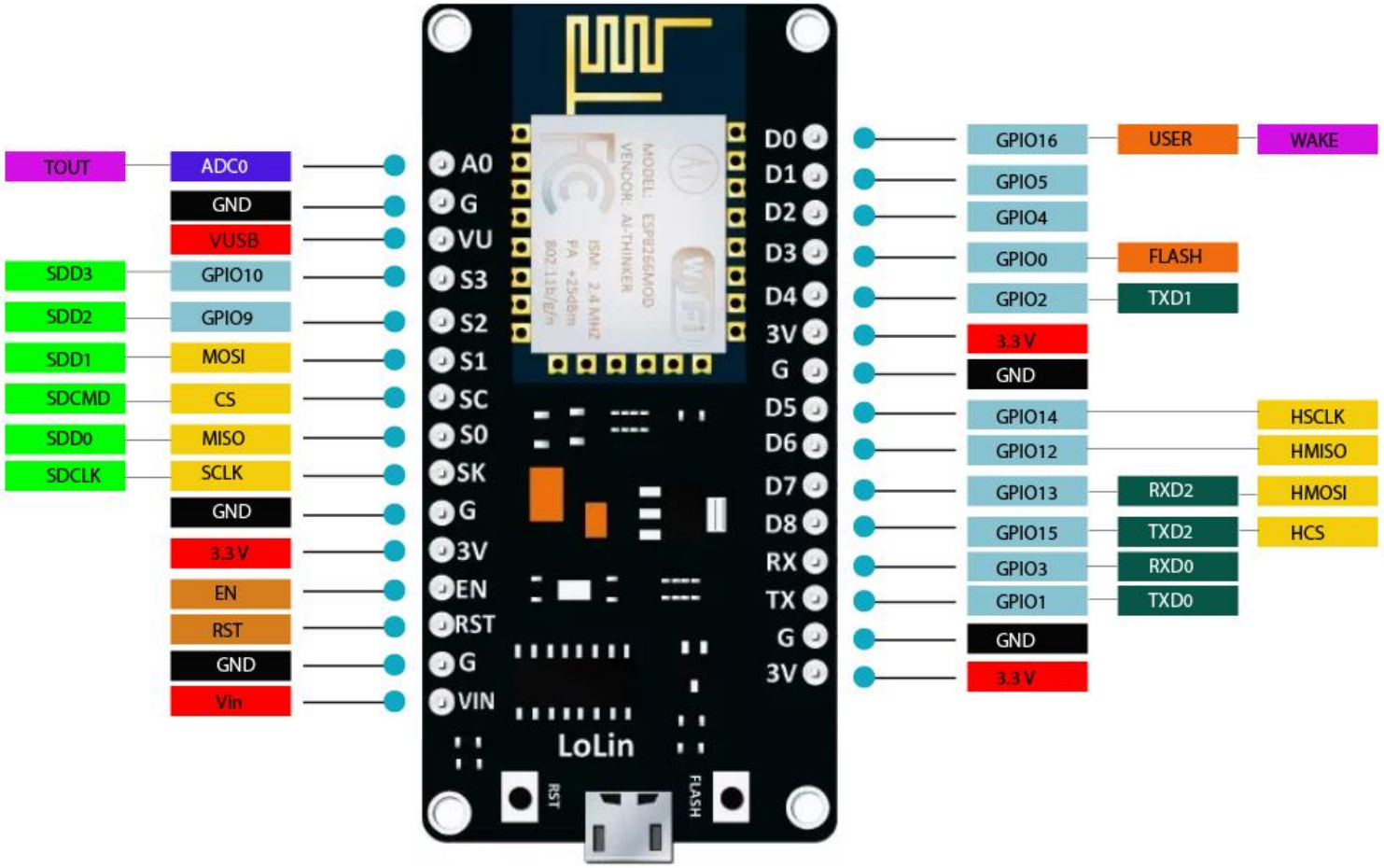
sketch_feb08a

ESP8266 pinout



NodeMCU V3 Pinout

www.TheEngineeringProjects.com

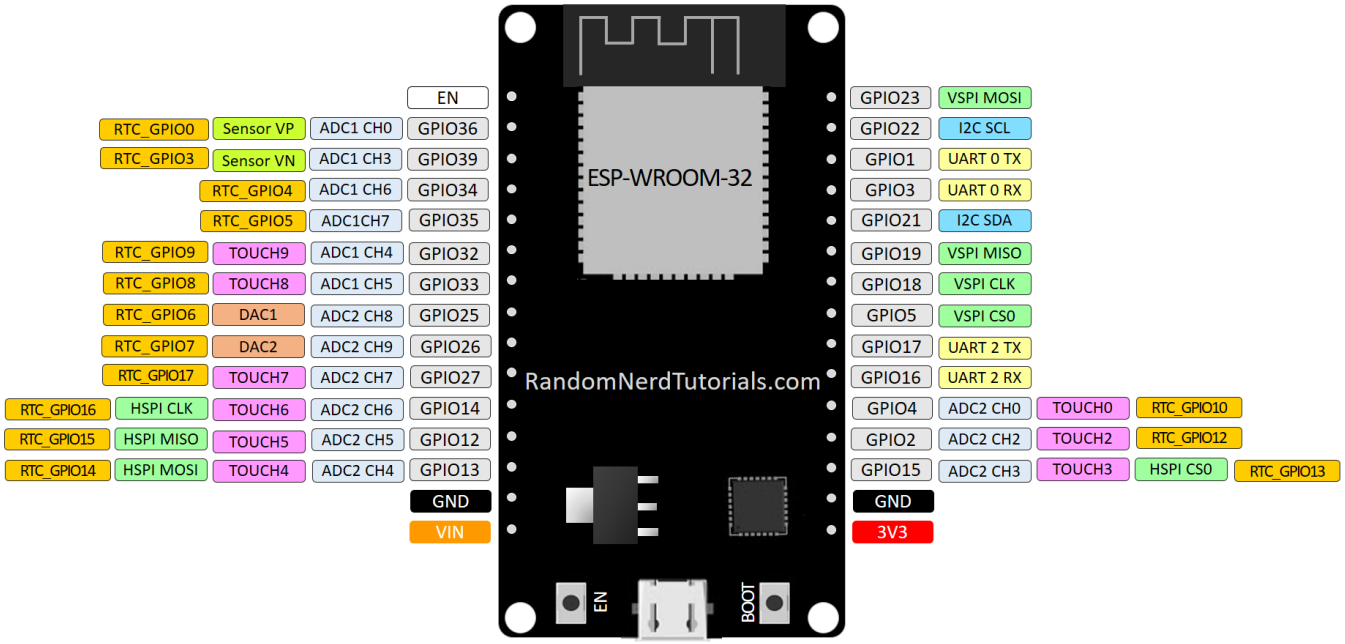
D0	GPIO16
D1	GPIO05
D2	GPIO04
D3	GPIO00
D4	GPIO02
D5	GPIO14
D6	GPIO12
D7	GPIO13
D8	GPIO15
D9	GPIO03
D10	GPIO01

Arduino/Genuino Uno sur COM14

ESP32 pinout

ESP32 DEVKIT V1 – DOIT

version with 30 GPIOs



ESP32 pinout