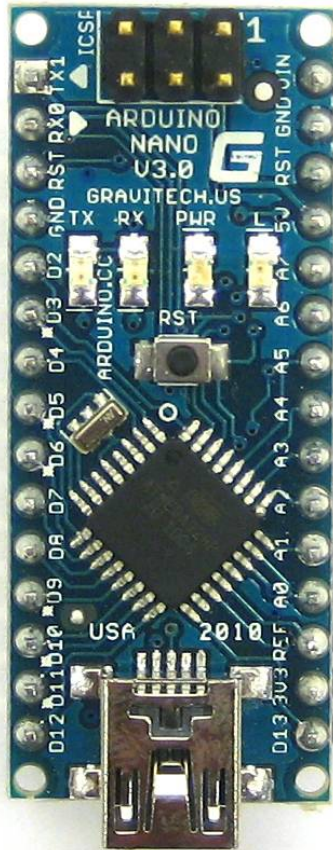


# Arduino

# Carte électronique



- 'nano v3.0'
- ATmega328p
- (FTDI/CH340/...)
- Pins (ana, digit)
- USB (ou non)

# IDE



The screenshot shows the Arduino IDE interface. The main window displays the 'Blink' sketch code. The code is as follows:

```
/*
 * Blink
 *
 * The basic Arduino example. Turns on an LED on for one second,
 * then off for one second, and so on... We use pin 13 because,
 * depending on your Arduino board, it has either a built-in LED
 * or a built-in resistor so that you need only an LED.
 *
 * http://www.arduino.cc/en/Tutorial/Blink
 */

int ledPin = 13;           // LED connected to digital pin 13

void setup()              // run once, when the sketch starts
{
  pinMode(ledPin, OUTPUT); // sets the digital pin as output
}

void loop()              // run over and over again
{
  digitalWrite(ledPin, HIGH); // sets the LED on
  delay(1000);                // waits for a second
  digitalWrite(ledPin, LOW);  // sets the LED off
  delay(1000);                // waits for a second
}
```

Below the code editor, the status bar shows 'Done compiling.' and 'Binary sketch size: 1098 bytes (of a 14336 byte maximum)'. The page number '22' is visible in the bottom left corner of the IDE window.

- Configurer
- Écrire le programme
- Compiler
- Téléverser
- Communiquer

# Historique



Arduino d'Ivrea  
(Civica raccolta stampe - Milano)

- Interaction Design Institute Ivrea
- Bar di Re Arduino
- Arduin d'Ivrea
- Ivrea (40 km N Turin; 100 km W Milan ; Val d'Aoste)

# Motivations

Éducatif

Bon marché

Facile

(existant jugé trop cher/pas assez puissant)

# Choix du microcontrôleur

- AVR de Atmel
- (pas PIC de Microchip ou autre)
- Programmable à partir d'un PC
  - Lien série → USB
  - Eeprom
  - Bootloader (Avrdude)
  - Compilateur gcc

# Exemple ATmega328p

- 8 bits AVR ('Risc', Harvard modifié)
- 32 KB flash (programme) + 2KB ram (+1KB)
- 20 MHz (20 MIPS)
- 131 instructions (multiplication)
- 32 registres
- ADC 10 bits, timers, counters, I<sup>2</sup>C, SPI, USART
- ... (>600 pages de doc ; 2 euros chez Farnell)

# Autres : ATtiny13/ATtiny85

- 1 KB/8 KB de flash
- Bus série
- ...



# Langage

- 'Processing'
- ~ C/C++ & librairie
- Structure & API simple

# Structure d'une application

- Void setup()

```
{  
}
```

- Void loop()

```
{  
}
```

# API

- `pinmode(digital/analogique)`
- `Digital/analogique read/write()`
- `Delay()`
- Interrupts
- Serial
- ...
- <https://www.arduino.cc> -> Learning -> Reference

# Ecosystème

- Succès
- → bouquins, 'breakouts', librairies, clones

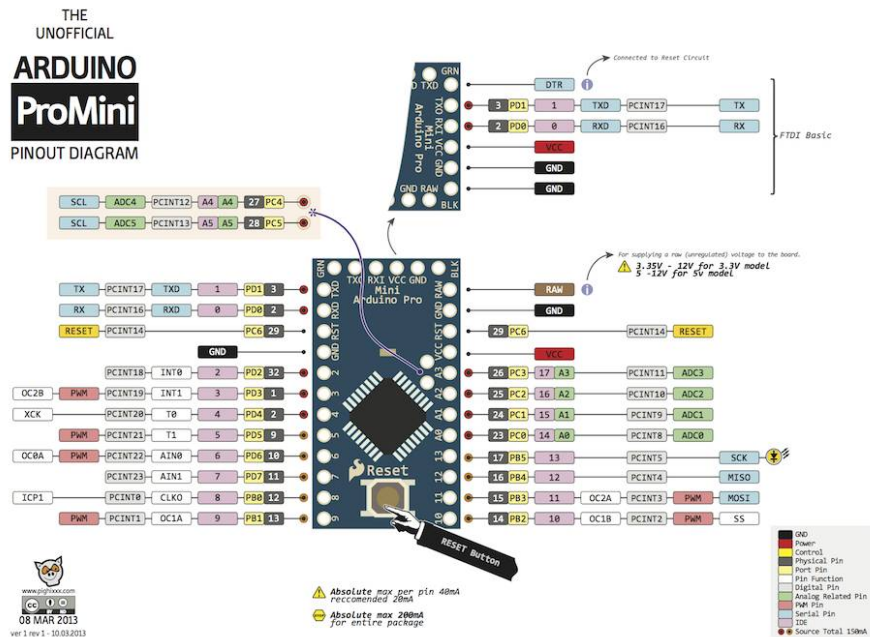
# Démo

# Oui mais...

- Portabilité discutable
- Un peu brolesque
- Pas très transparent

# Pins multifonctions

- VDD, GND, osc.
- I/O digital/analog
- Bus
- (interruptions)



# 'Détails'

- Consommation
- Timing serré
- Bus I<sup>2</sup>C, SPI
- UART



# Sans IDE (sans Arduino)

- Gcc (+libc)

- C vs C++ (ex : String...)

- `Avr-gcc -mmcu=atmega328 -Os -o x.elf x.c`

- Avrdude (bootloader – SPI)

- `avrdude -c arduino -p atmega328P -P /dev/ttyUSB0 -b 57600 -U flash:w:x.elf`

- 

- 

- RTOS (?)

# Documentation abondante

Datasheet  
Architecture (instructions)  
Application notes  
Bouquins  
Internet