COMMUNICATION BETWEEN PROCESSING & ARDUINO
Processing& Arduino通讯

Day04_2

COMMUNICATION BETWEEN PROCESSING & ARDUINO

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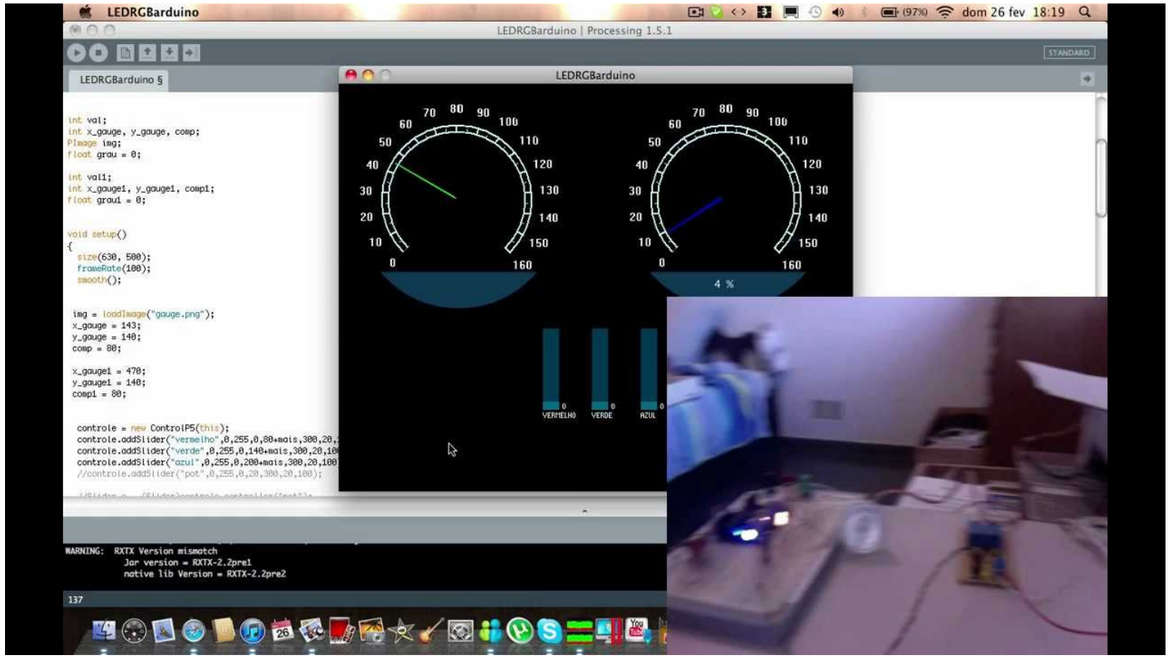
Communication between Processing and Arduino can happen in the following ways:

- Firmata
- Mouse & Keyboard Emulation
  键盘鼠标事件模拟
- Serial Communication

  串口通信



COMMUNICATION BETWEEN PROCESSING & ARDUINO

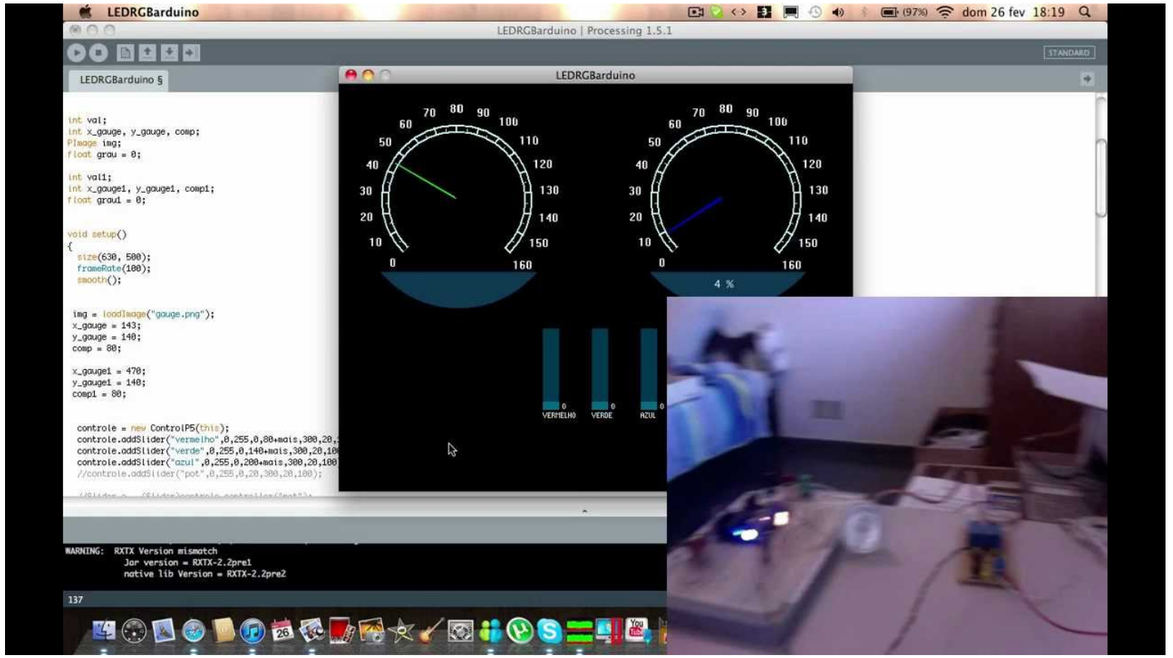
- Firmata
  - Great for simple inputs (buttons) and outputs (LEDs)

    方便实现简单输入（按钮）输出（LED）
  - Can’t do libraries and complex sensors / complex outputs!

    无法使用libraries和复杂的输出
- Leonardo / Due (Red Arduinos) 特殊型号Arduino板
  - Great for input to replace mouse/ keyboard

    方便替换鼠标和键盘
- Serial Communication 串口通信
  - Great for Sensors and complex outputs (motors)

    方便使用传感器和复杂输出（如电机）



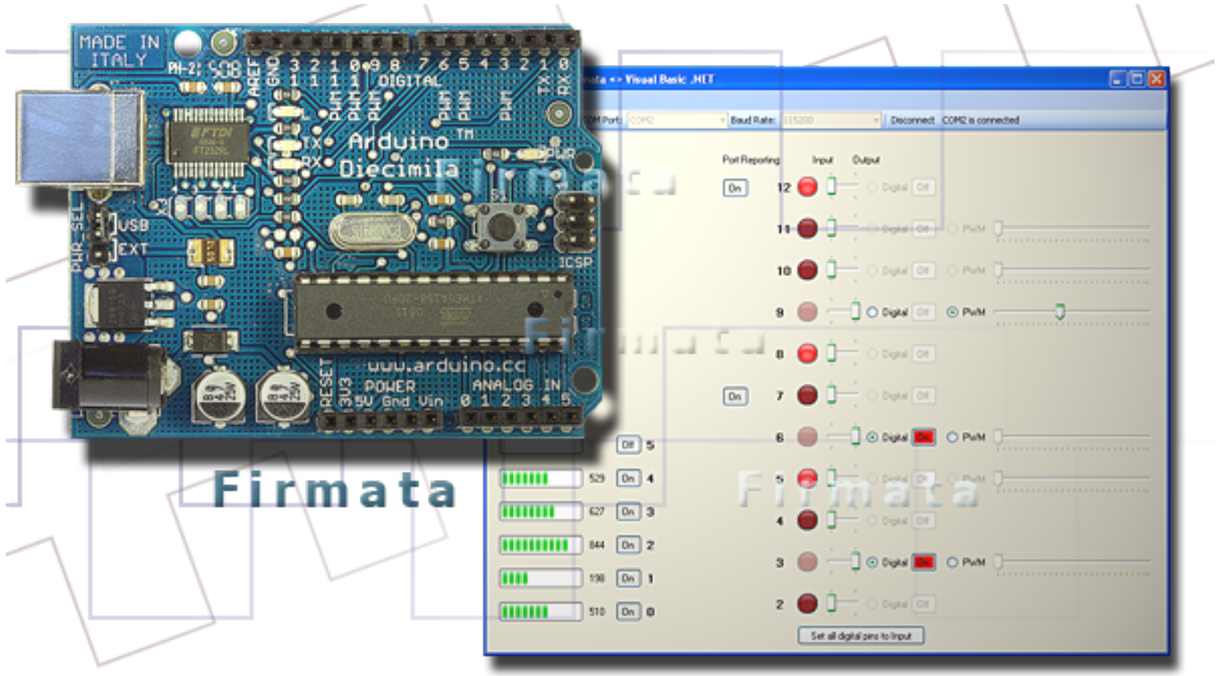
FIRMATA

FIRMATA

Firmata is a protocol for communicating between microcontrollers and computers.

To use Firmata, first install the libraries in both Processing and Arduino.

Firmata是一种微控制器和电脑之间通信的协议，使用Firmata需要先分别给Processing和Arduino加载library文件



ARDUINO FIRMATA LIBRARY

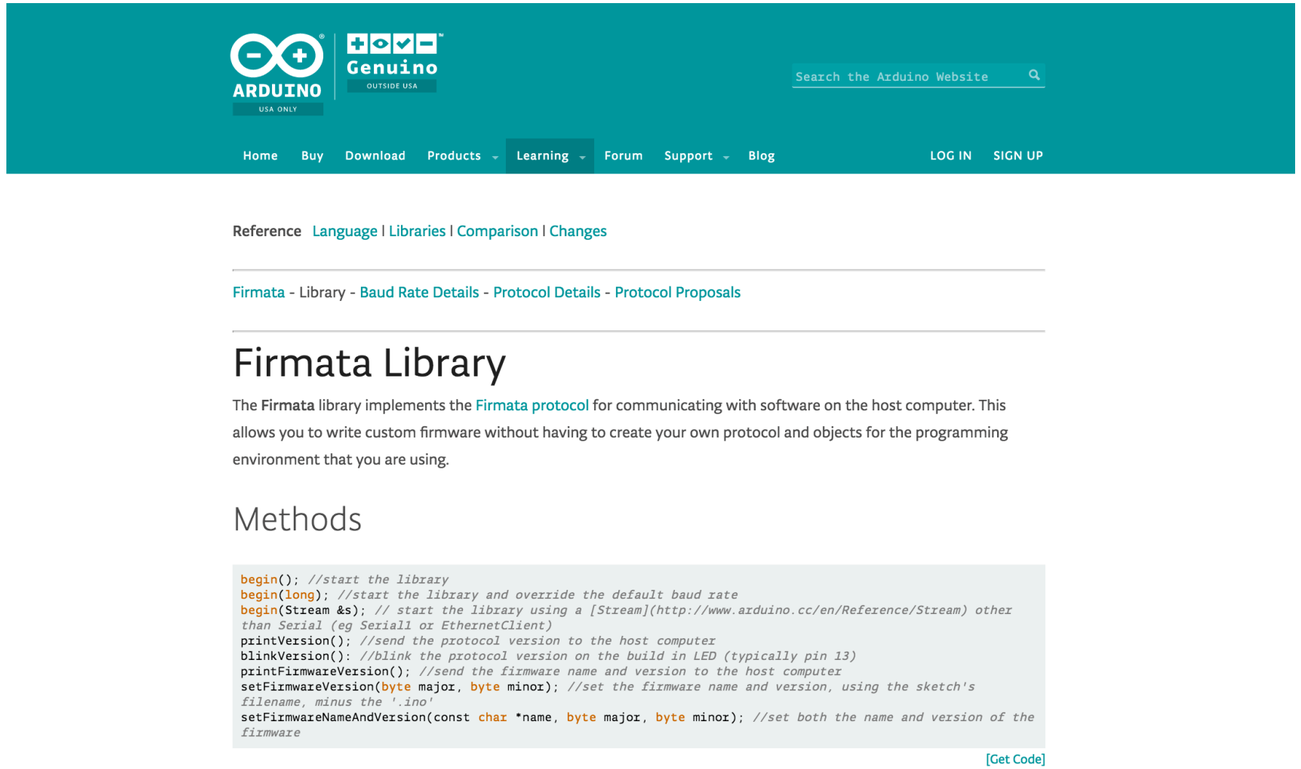
Step 1:

Download / Update Firmata on the Arduino IDE.

You can get to the library window by going to

Sketch > Include Library > Manage Libraries

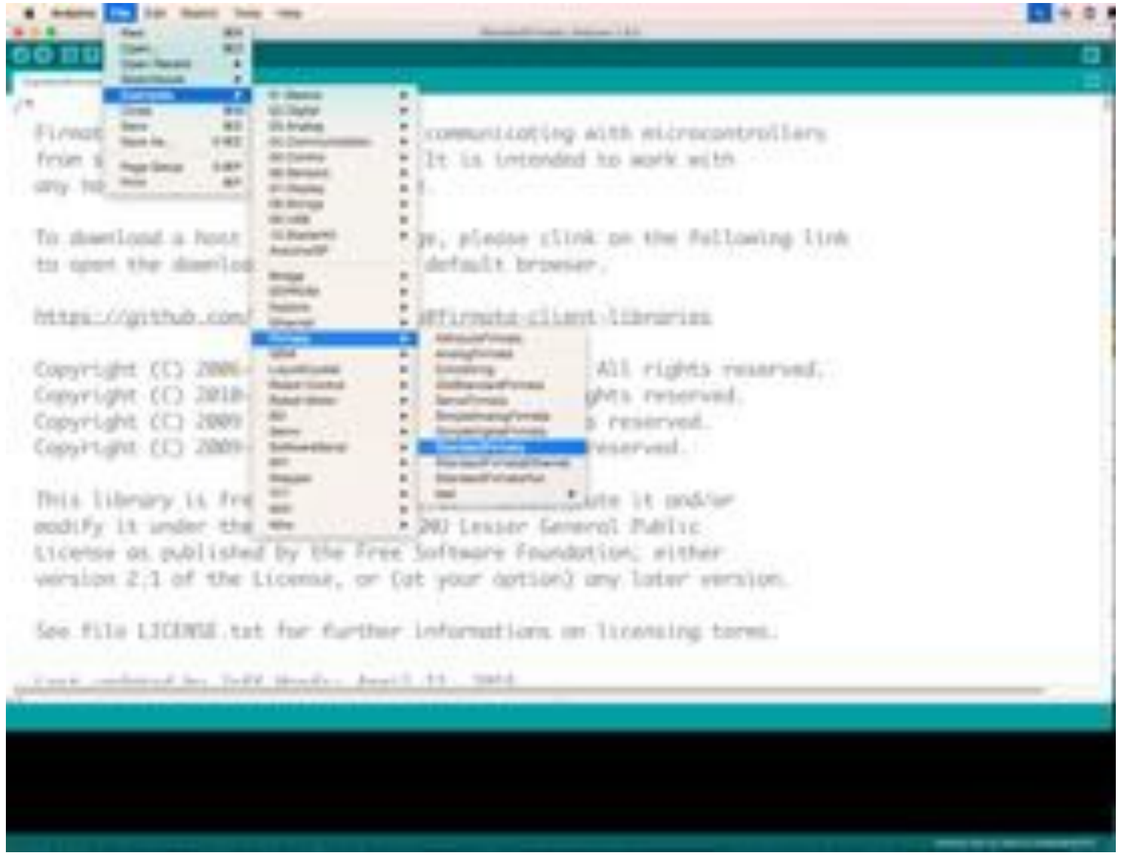
And search for Firmata.



STANDARD FIRMATA EXAMPLE

Step 2:

Once the Firmata libraries are installed, upload the Standard Firmata sketch to your Arduino.



SCREENSHOT

PROCESSING FIRMATA LIBRARIY

Step 3:

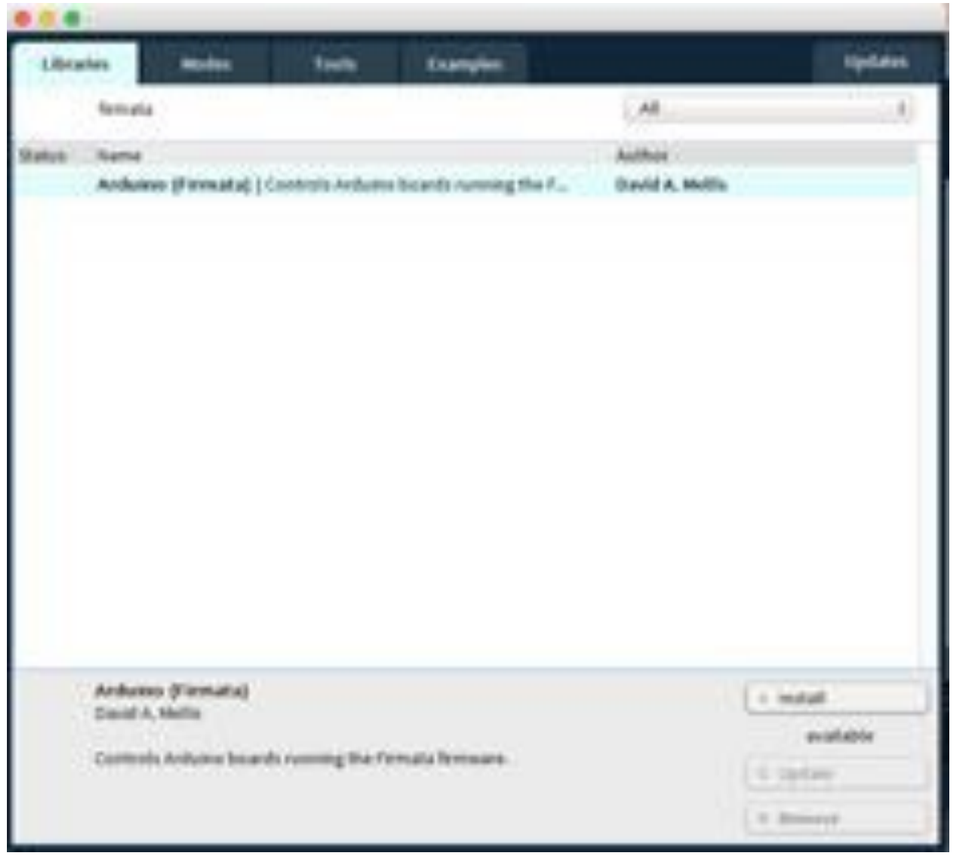
Download / Update Firmata on the

Processing IDE.

You can get to the library window by going to

Sketch > Import Library > Add Library And search

for Firmata.



SCREENSHOT

PROCESSING FIRMATA EXAMPLE

Step 4:

Run the Firmata “arduino_input” example on

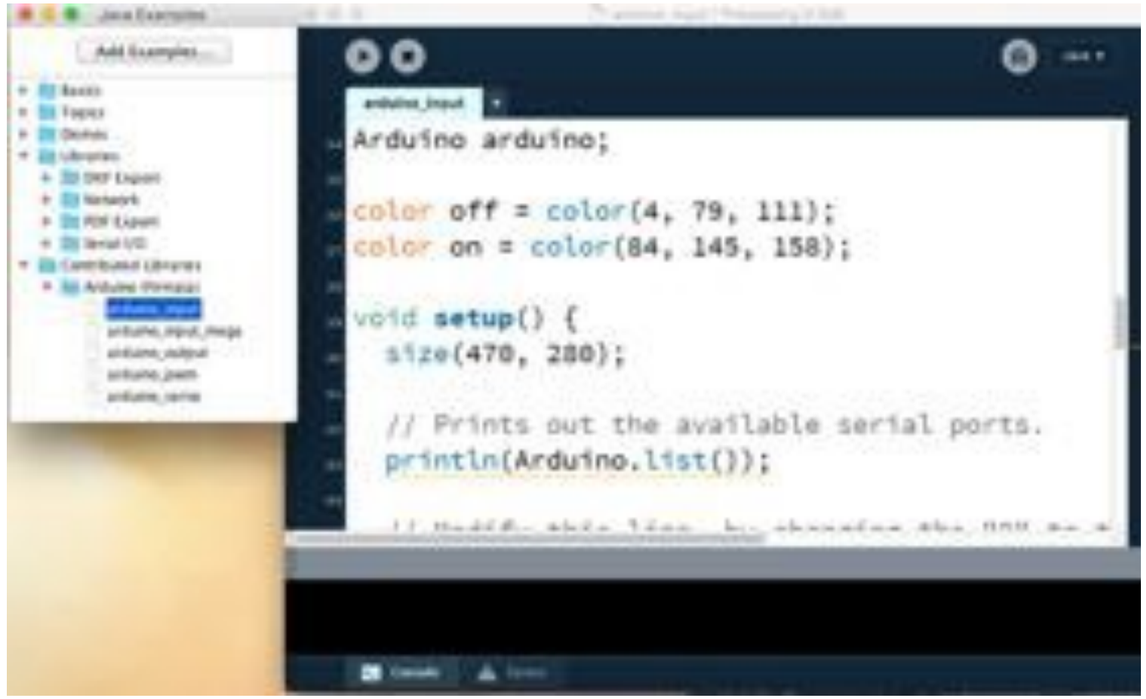
Processing.

You may need to modify the following line: arduino = new

Arduino(this, “…“, 57600); with the name of the serial

port

such as "/dev/tty.usbmodem621"

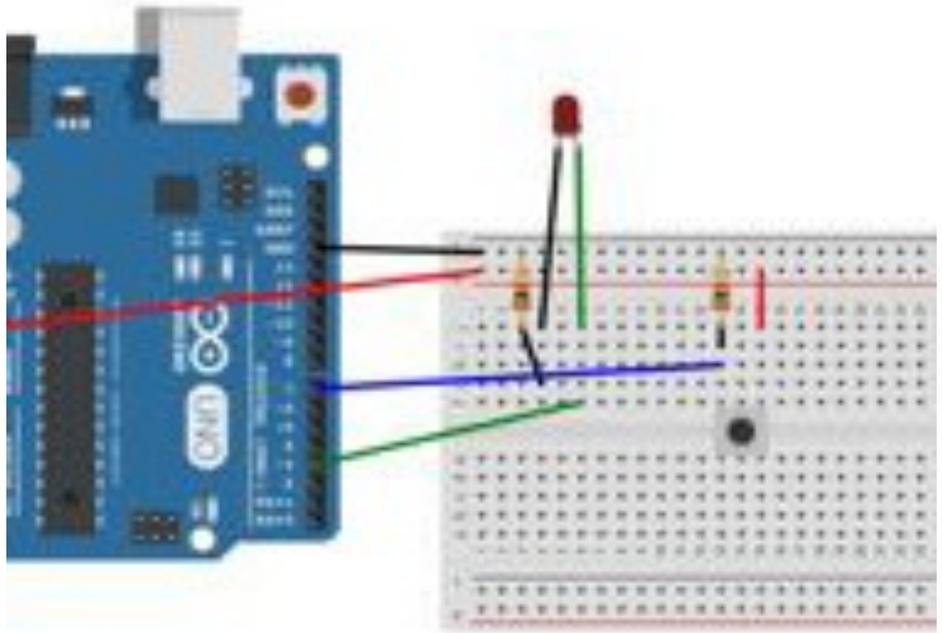


SIMPLE CIRCUIT

Connect an LED and a button to test out the Firmata library.

You can also try a simple sensor like the Vibration sensor into the analog inputs.

But complex sensors and outputs like the Accelerometer and the Servo motor are not good to control with Firmata.



PROCESSING FIRMATA EXAMPLE

```
// Receives Digital Data from Arduino
// Into Processing

import processing.serial.*;
import cc.arduino.*;
Arduino arduino;

void setup() {
size(470, 280);
arduino = new Arduino(this,Arduino.list()[3],57600);
println(Arduino.list()[3]);
arduino.pinMode(7, Arduino.INPUT);
}

 void draw()
   { background(0);
   if (arduino.digitalRead(7) == Arduino.HIGH)
       { rect(10, 10, 200, 200);
   }
 }
```

PROCESSING FIRMATA EXAMPLE

```
// Sends Digital Data out of Processing
// Into Arduino

import processing.serial.*;
import cc.arduino.*;
Arduino arduino;

void setup(
{ size(470,280);
  arduino = new Arduino(this, Arduino.list()[3], 57600);
  println(Arduino.list()[3]);
  arduino.pinMode(3, Arduino.OUTPUT);
}

void draw() { background(0);
  if(mousePressed){
    arduino.digitalWrite(3,Arduino.HIGH);
  } else { arduino.digitalWrite(3,Arduino.LOW);
  }
}
```

MOUSE & KEYBOARD EMULATION｜键盘鼠标事件模拟

MOUSE & KEYBOARD EMULATION｜键盘鼠标事件模拟

Certain Arduino boards are capable of emulating a USB Human Interface Device (HID), for example a mouse or keyboard.

This allows an Arduino to control any piece of software running on a computer, including your Processing sketches.

某些Arduino具有模拟USB交互设备（HID）的能力，比如键盘和鼠标，通过模拟键鼠交互，你可以使用arduino控制任何软件包括processing程序

PHOTO BY POCKAFWYE

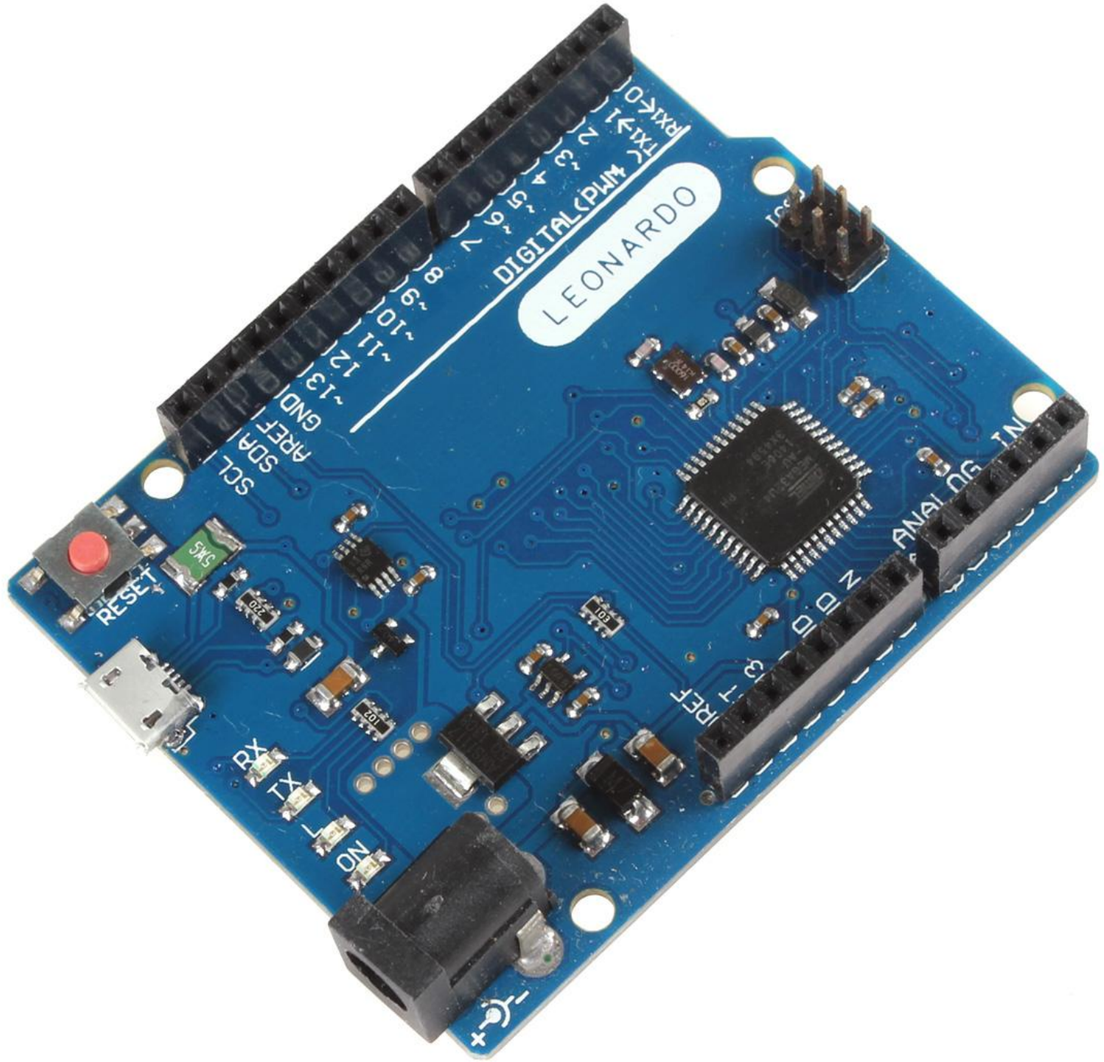
LEONARDO, MICRO & DUE

The 3 Arduinos that are designed with USB HID capability are the Leonardo, Micro, and Due.

可以实现模拟键盘鼠标的arduino板型号为：

Leonardo, Micro, and Due

我们有的设备中有5块Arduino leonardo

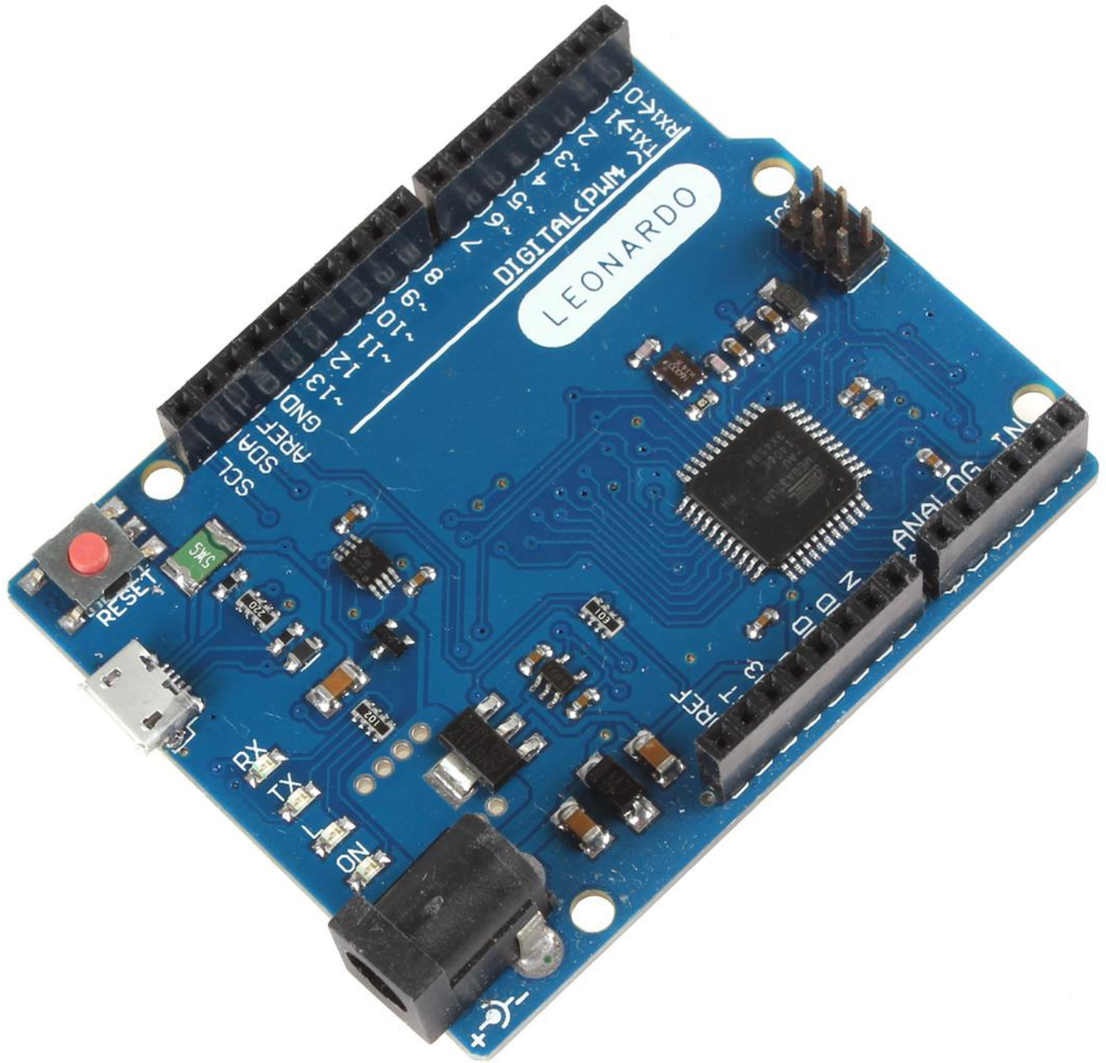


ARDUINO LEONARDO

These Arduinos need a USB Micro connection.

In-class: experiment with mouse and keyboard emulation.

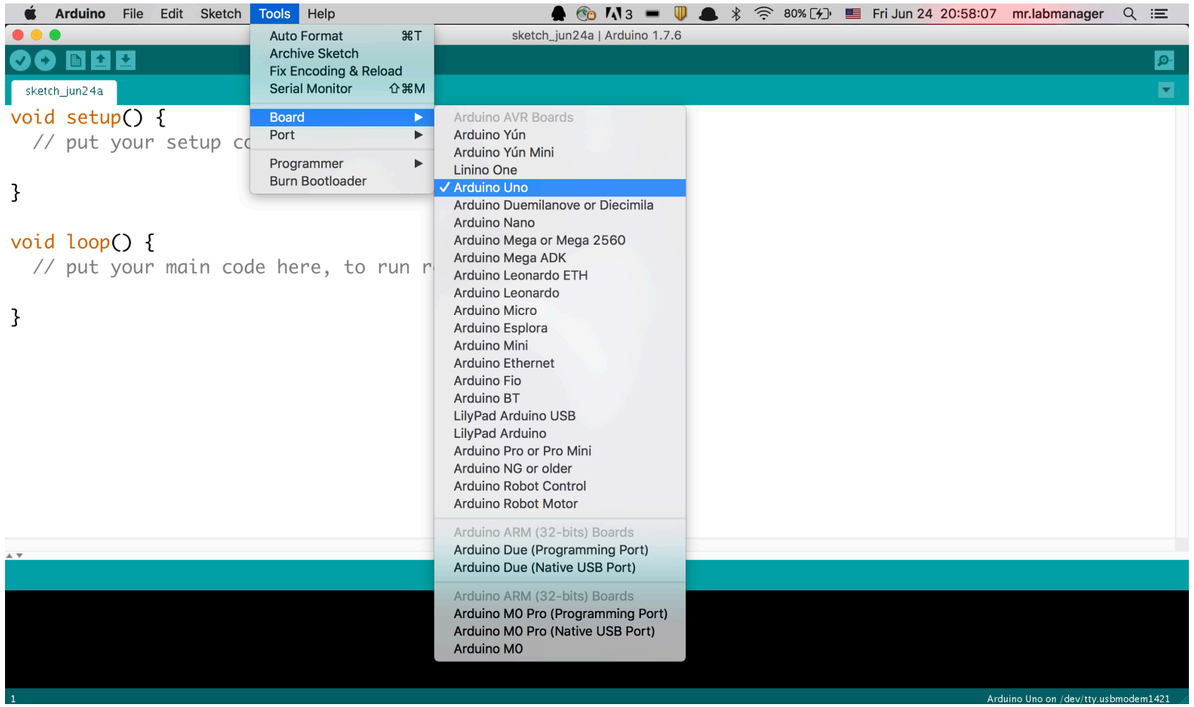
LEONARDO 使用micro USB线连接电脑，也是采购的设备



ARDUINO LEONARDO

Don’t forget to select the correct board under Tools > Board > Arduino Leonardo

使用LEONARDO时注意更改Tools> Board下的型号为Arduino Leonardo



ARDUINO MOUSE LIBRARY

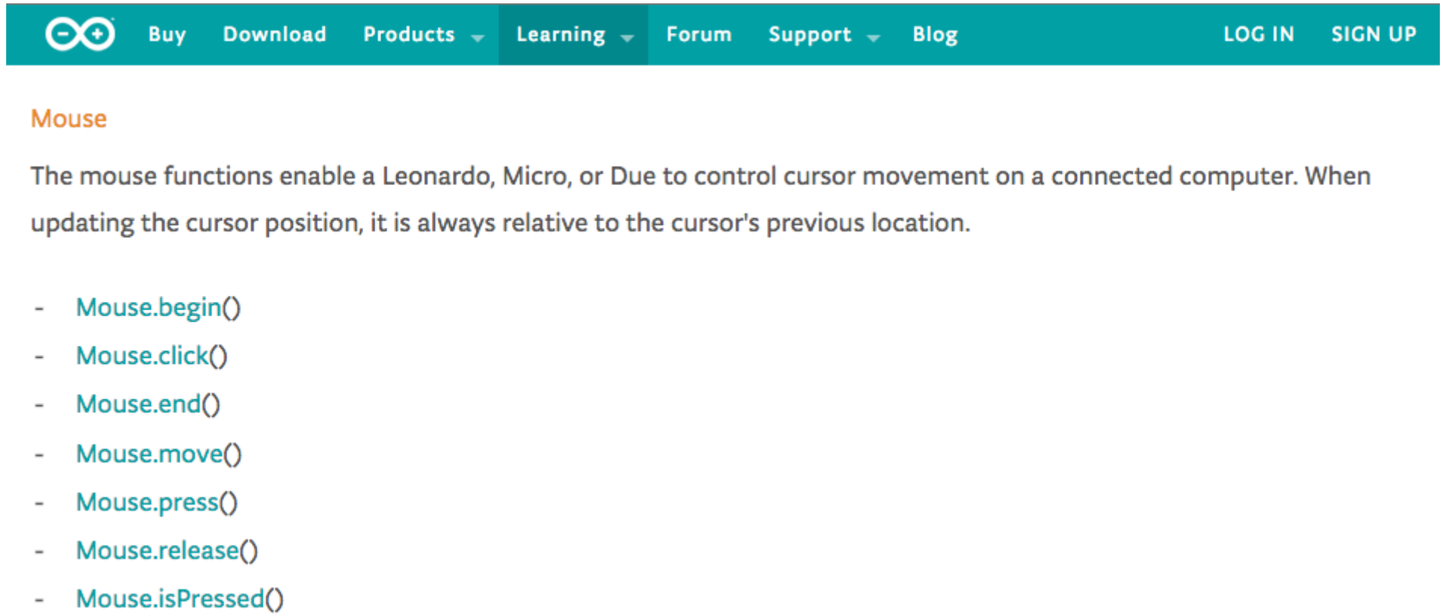
Mouse.h

The Arduino Mouse Library allows an Arduino to act like a mouse by initiating clicks and even moving the cursor around.

Library，用以实现Arduino模拟鼠标功能，可以触发鼠标点击甚至移动光标

PHOTO BY YUM9ME

ARDUINO MOUSE LIBRARY



Mouse.begin();

Mouse.click();

Mouse.click(button);

//MOUSE_LEFT (default)

//MOUSE_RIGHT

//MOUSE_MIDDLE

Mouse.move(x,y,wheel);

//x, int, amount to move along the x axis

//y, int, amount to move along the y axis

//wheel, int, amount to move scroll wheel

PHOTO BY YUM9ME

MOUSE LIBRARY EXAMPLE

```
#include "Mouse.h"

void setup(){
pinMode(7,INPUT);
Mouse.begin();
}
Void loop() {
if(digitalRead(7) == HIGH){
     Mouse.click();
   }
}
```

ARDUINO KEYBOARD LIBRARY

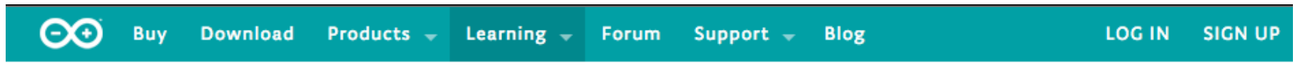
Keyboard.h:

The Arduino Keyboard Library allows an Arduino to act like a keyboard by initiating key presses.

Library，用以实现Arduino模拟键盘功能，可以触发键盘按键点击

PHOTOPEDIA

ARDUINO KEYBOARD LIBRARY



Keyboard

The keyboard functions enable a Leonardo, Micro, or Due to send keystrokes to an attached computer.

Note: Not every possible ASCII character, particularly the non-printing ones, can be sent with the Keyboard library. The library supports the use of modifier keys. Modifier keys change the behavior of another key when pressed simultaneously. See here for additional information on supported keys and their use.

- Keyboard.begin()
- Keyboard.end()
- Keyboard.press()
- Keyboard.print()
- Keyboard.println()
- Keyboard.release()
- Keyboard.releaseAll()
- Keyboard.write()

```
Keyboard.begin();
Keyboard.press(‘a’); //char
Keyboard.print(“hello”); //string
```

KEYBOARD LIBRARY EXAMPLE

```
#include "Keyboard.h"
void setup(){
pinMode(7,INPUT);
Keyboard.begin();
}
void loop(){
if(digitalRead(7) == HIGH){
     Keyboard.press('n');
     delay(100);
     Keyboard.release('n');
   }
}
```

SERIAL COMMUNICATION|串口通信

Serial is a form of digital communication that involves sending a sequence of bits,one at a time, between electronic devices.

串口指设备之间同时发送比特序列的通信方式

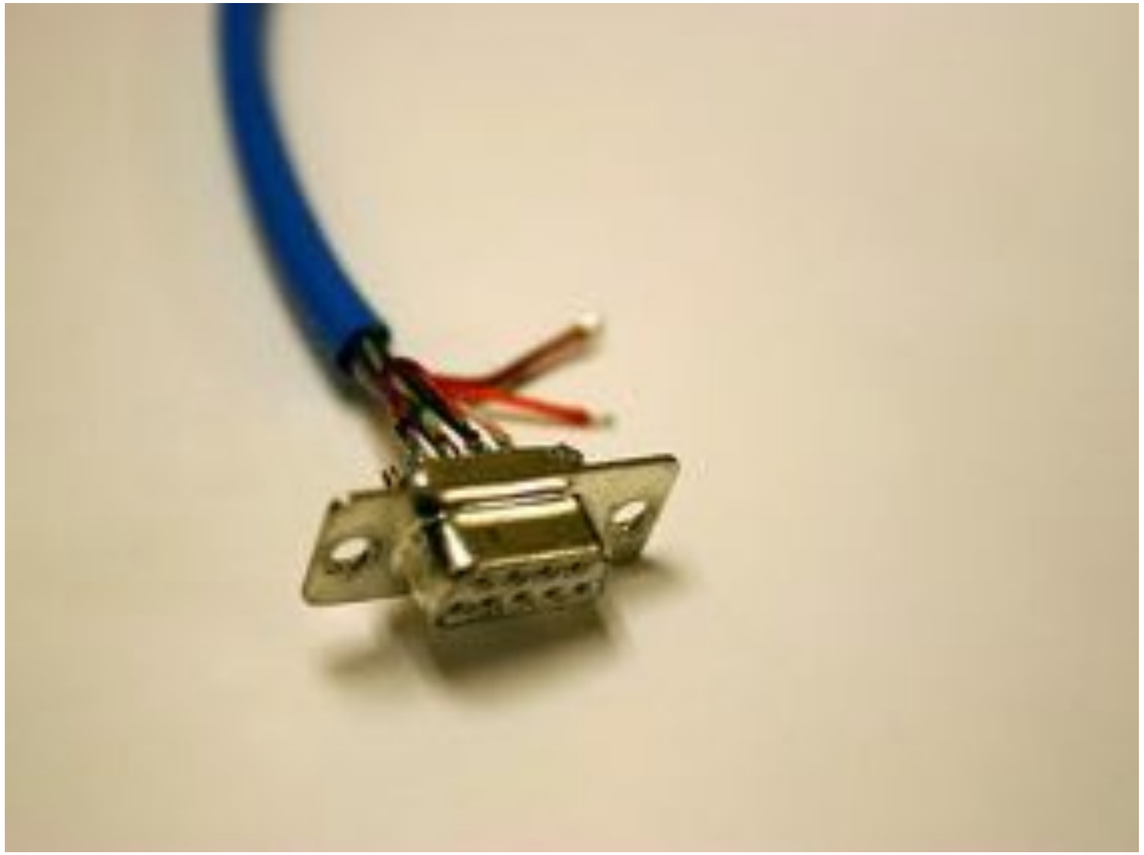


PHOTO BY MARTIN CATHRAE

BITS & BYTES｜比特&字节

A bit is the smallest unit of digital information, representing a single binary value, either 0 or 1.
A Byte is a slightly larger unit of digital information, representing eight bits, between 0 and 255.
Bytes are also a Variable data type in processing and Arduino.

比特：二进制一位数值如0，1
字节：和比特大一级的单位，8比特，可以表达00000000～11111111，转化为十进制为0～255

PHOTO BY MARK ROUND

UART

In serial communication, a Universal Asynchronous Receiver Transmitter (UART) is a device that converts a byte of data into individual bits and sends it out by modulating the voltage either high or low to represent a 1 or 0.

Typically, another UART on the receiving end converts the bits back into bytes.

PHOTO BY MARK DEMERS

USB|通用串行总线

Universal Serial Bus (USB) is a modern communications protocol that can support multiple devices attached to a single port at very high data rates. USB can also support older serial devices through a converter.
Different Arduino boards have varying converters like this.

连接计算机系统与外部设备的一种串口总线标准，也是一种输入输出接口的技术规范，被广泛地应用于个人电脑和移动设备等信息通讯产品，并扩展至摄影器材、数字电视（机顶盒）、游戏机等其它相关领域.
USB也可以通过转接头支持其他类型的串口设备，不同的arduino使用不同的转接头

PHOTO BY MARCELO ALVES

DATA RATE

A data rate is the speed at which communication occurs. In order for serial communication to be successful the transmitting and receiving sides must both be set to communicate at the same speed.
With a speed of 9600 bits per second (baud) the voltage is interpreted every 1/9600th of a second.

指数据传输速率，串口通信需要发送和接收端速率保持同步

9600比特 / 秒

PHOTO BY CROSS DUCK

PORT |端口

A port is the physical interface though which serial communication occurs.

When you plug in your Arduino it appears as an available serial port on your computer.

A port can only be connected to one device at a time.

端口是串口通信发生的物理界面，连接arduino和电脑后可以找到可用端口，一个端口不能同时被两个或以上设备使用

PHOTO BY BERT VAN DIJK

BUFFER | 缓冲

A buffer is a place in the memory of an electronic device where bytes are temporarily stored as they arrive from another device.

缓冲器为暂时置放输出或输入数据的内存。缓冲器内数据自存储设备（如硬盘），放置在缓冲器中，须待机送至CPU或其他运算设备

PHOTO BY KJELL ESON

PROTOCOLS | 通讯协议

A protocol defines the rules that govern the interpretation of whatever communication is taking place. Although we have little control over serial communication itself, what we can control is what is being sent and what it means.

Protocol specification should be determined based on the complexity of the data being transmitted.

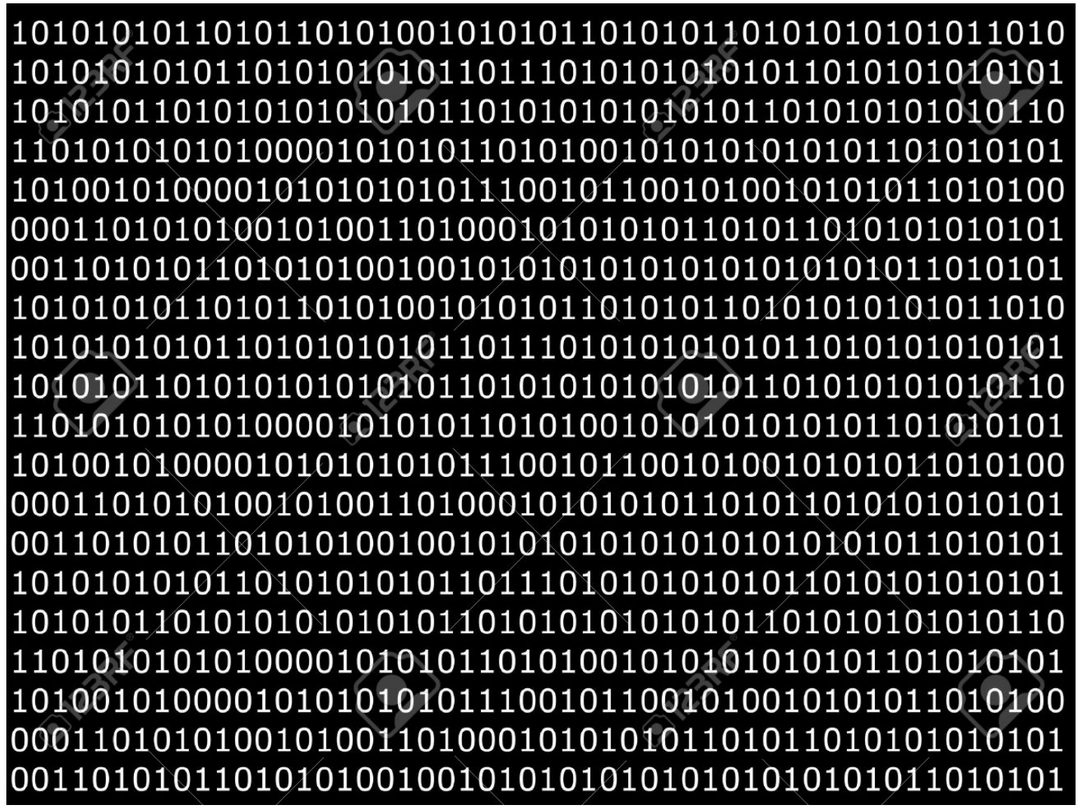
网络传输协议或简称为传送协议，是指计算机通信或网络设备的共同语言。传送协议也存在于计算机的其他形式通信，例如：面向对象编程里面对象之间的通信；操作系统内不同程序之间的消息，都需要有一个传送协议，以确保传信双方能够沟通无间。

PHOTO BY GORDON TARPLEY

BINARY PROTOCOLS

A binary Protocol is a protocol in which every value being transmitted fits within a single byte and does not need to be interpreted.

指所有的数值使用单字节传输，并且不用被interprete



BINARY PROTOCOLS

00000000 / 11111111

ARDUINO SERIAL PORTS｜串口通信端口

The Arduino Uno has a single hardware serial port which uses digital pins 0 (receive) and 1 (transmit).
Other Arduinos may have multiple serial ports.
You can also configure software based serial ports if you need to communicate with multiple devices simultaneously.

UNO只有一个端口用于串口通信，使用0，1号引脚通信，其他可能型号的arduino有更多的端口,可以同时和多个设备通信

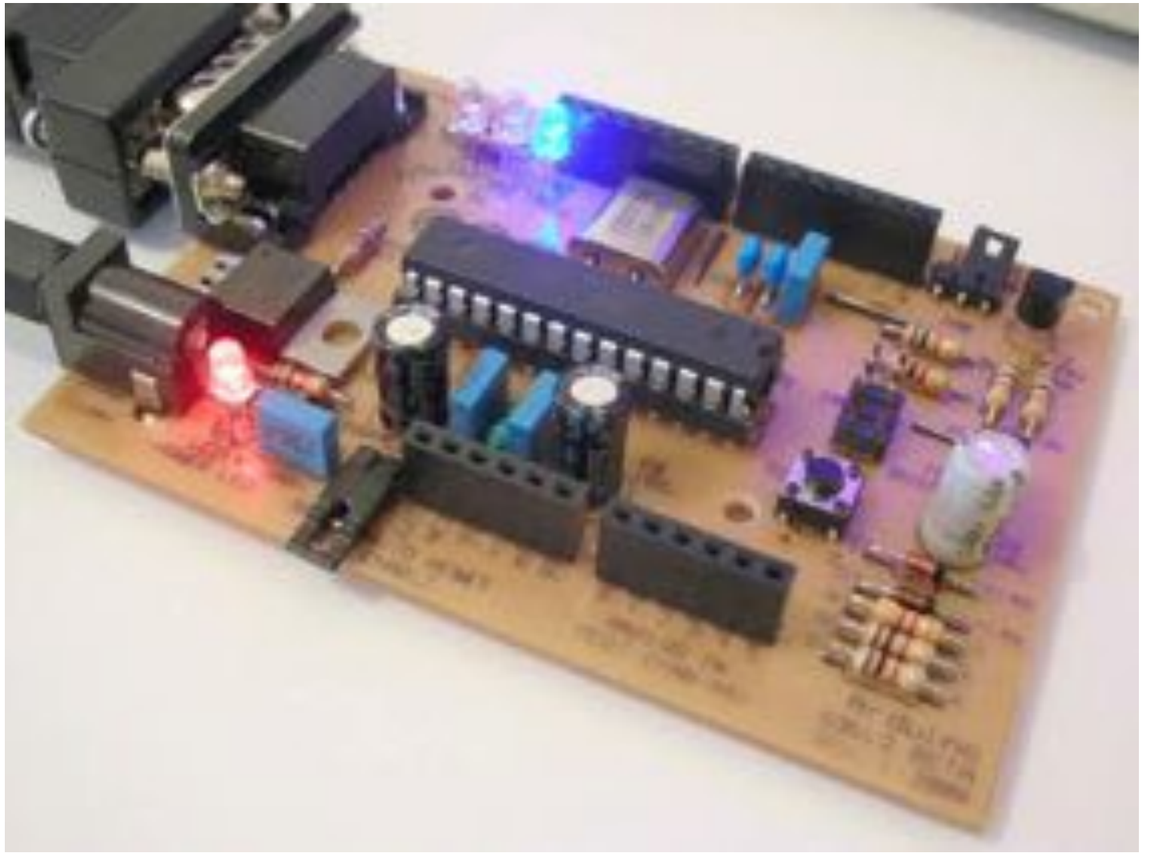


PHOTO BY ADILSON AKASHI

SERIAL FUNCTIONS｜串口function

Arduino has many built-in Serial Functions that facilitate data transmission and receipt.

Before using serial, you must first call Serial.begin() and define a data rate.

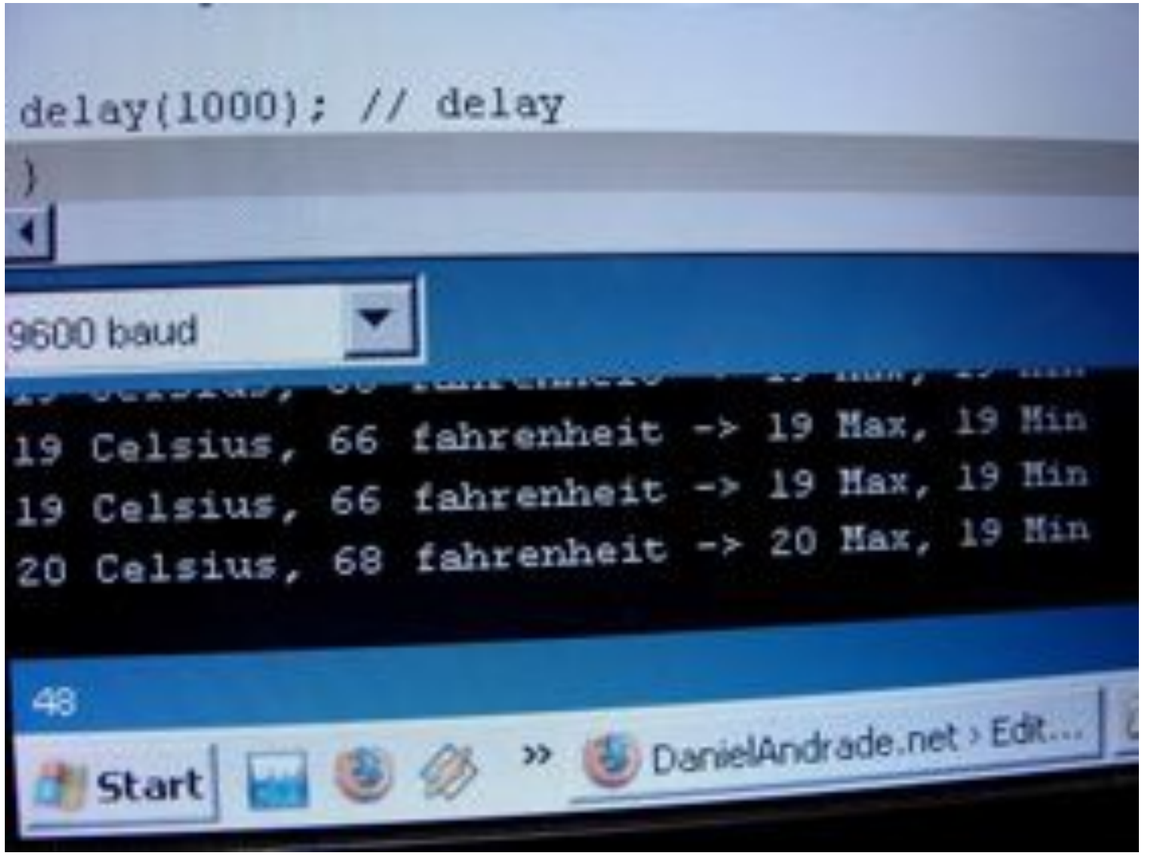


PHOTO BY DANIEL SPILLERE ANDRADE

ARDUINO SERIAL EXAMPLE

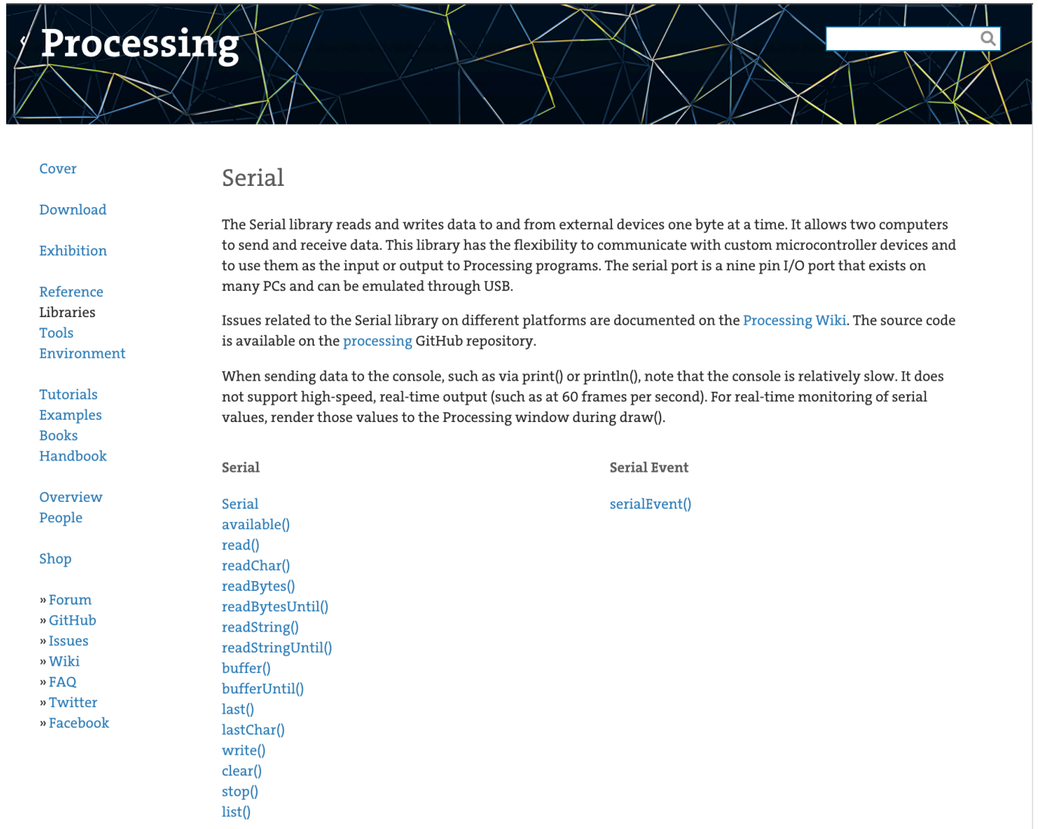
```
void setup()
   { Serial.begin(9600);
}

void loop() {
   int sensorValue = analogRead(A0);
   sensorValue = sensorValue/4;
   Serial.write(sensorValue);
}
```

PROCESSING SERIAL LIBRARY

Processing has a Serial Library, also with many built-in functions.

Before using the Serial function in Processing you must first import the Serial library, create a serial variable, and define the port and data rate.



PROCESSING SERIAL EXAMPLE

```
import processing.serial.*;
Serial myPort;
void setup() {
  myPort = new Serial(this, Serial.list()[0], 9600);
}
void draw() {
  while (myPort.available() > 0)
    { int inByte = myPort.read();
    println(inByte);
  }
}
```