

# Python 的串口通信

## 引言

Python 是一种面向对象、解释型计算机程序设计语言，它的设计哲学是优雅、明确、简单。因为其开源免费的精神与简单易学的特点，自 1989 年问世以来，Python 的使用率呈线性增长。并且近年来作为少儿编程的入门级语言，也受到了越来越多的教育从业者的关注。

Arduino 是一款便捷灵活、方便上手的开源电子原型平台，它包含可以用来做电路连接的 Arduino 电路板和配套的程序开发环境（Arduino IDE）。基于 Arduino 的项目，可以只包含 Arduino，也可以包含 Arduino 和其他一些在 PC 上运行的软件，如 Processing、VB、Python 等。

串行接口简称串口，也称串行通信接口或串行通讯接口（通常指 COM 接口），是采用串行通信方式的扩展接口。串行接口（Serial Interface）是指数据一位一位地顺序传送，其特点是通信线路简单，只要一对传输线就可以实现双向通信（可以直接利用电话线作为传输线），从而大大降低了成本，特别适用于远距离通信，但传送速度较慢。

当我们使用 Python 语言通过串口控制 Arduino 读取设备状况并实施控制的时候，就构成了上位机下位机系统。安装有 Python 之类软件实施控制的计算机为上位机，能够控制设备并获取设备状况的 Arduino 为下位机，它们相互之间可以通过串行口或无线的方式进行通讯，进而实现控制与被控制。

代码，看不见摸不着；而智能设备，具有良好的展示效果。通过 Python 编程，以串口通信对智能硬件进行控制，完成二次开发，甚至将普通设备赋予人工智能，对于少儿编程具有重要意义。

## 编程基础

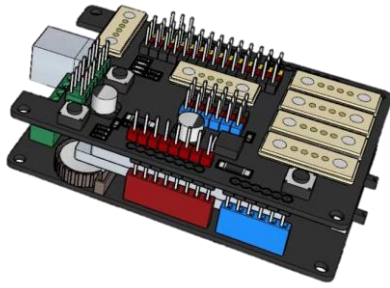
本文在 WIN10 环境下编程，LINUX 和 MAC 环境下只需要注意串口名称即可。

### （1）安装 Python 开发环境

本文中使用的案例及程序，基于 Python3.7 进行编写，关于 Python3 的安装，请各位老师及同学到官网进行下载及安装。另外，各位老师及同学可以自行使用 Python2 进行代码重新编辑。

### （2）安装 Arduino 开发环境

Arduino 主控板部分可在淘宝网上通过关键词“arduino uno”“arduino mini”“arduino mega”搜索购买。Arduino 集成开发环境（Arduino IDE）可访问“<https://www.arduino.cc/en/Main/Software>”，根据需要下载安装。本例硬件使用了星原力智能主板（X-TACO），该主板基于 Arduino Uno，软件我们使用了 Mixly，配套星原力 xforce，同时也可以使用 Arduino1.8.4 版本。（注意主板串口安装）



### (3) 安装 pyserial

采用 pip 安装。

In(1): pip3 install pyserial

```
管理员: C:\Windows\system32\cmd.exe
Microsoft Windows [版本 6.1.7601]
版权所有 (c) 2009 Microsoft Corporation。保留所有权利。

C:\Users\Administrator>pip3 install pyserial
Collecting pyserial
  Using cached https://files.pythonhosted.org/packages/0d/e4/2a744dd9e3be04a0c09
07414e2a01a7c88bb3915cbe3c8cc06e209f59c30/pyserial-3.4-py2.py3-none-any.whl
Installing collected packages: pyserial
Successfully installed pyserial-3.4

C:\Users\Administrator>
```

Pyserial 基本指令：

import serial 导入模块

ser = serial.Serial(0) 是打开第一个串口

ser.write(“hello”) 就是往串口里面写数据

ser.close() 就是关闭 ser 表示的串口

ser.open() 会打开这个串口

ser = serial.Serial('COM1', 115200) 设置波特率，当然还有专门的函数

data = ser.read() 可以读一个字符

data = ser.read(20) 是读 20 个字符

data = ser.readline() 是读一行，以/n 结束，要没有/n 就一直读，阻塞

data = ser.readlines() 和 ser.xreadlines() 都需要设置超时时间

ser 来查看当前串口的状态

ser.isOpen() 看看这个串口是否已经被打开

### (4) 其他代码编辑器

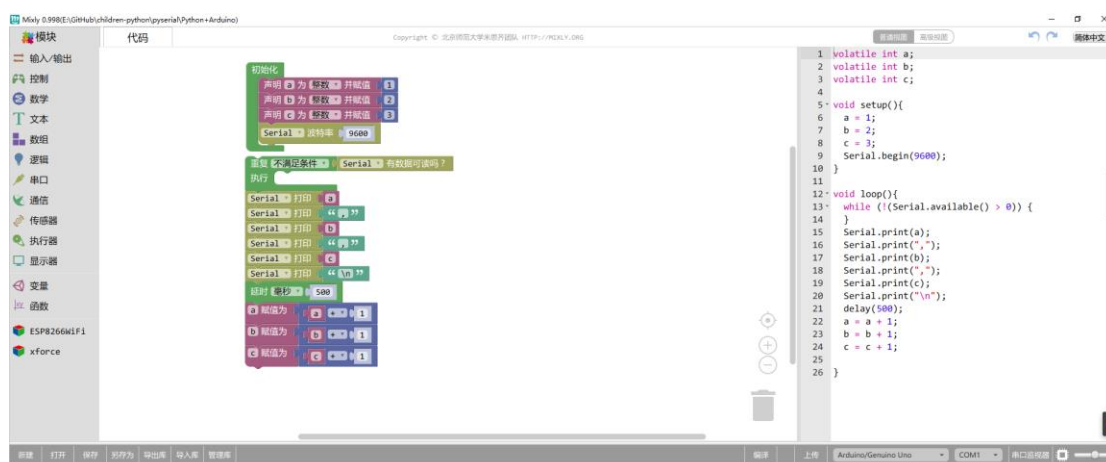
除了已安装好的 Python IDE 及 Arduino IDE，我们同样推荐使用其他代码编辑器，比如 PyCharm、Sublime Text、VS Code 等。

## 项目实践

如果环境已经搭建好，那么我们可以开始实践几个简单的案例。

案例 1: Arduino 向 Python 发送数据

首先，在 Mixly / Arduino IDE 中编写 Arduino 代码，以 Mixly 为例：



程序解析如下：1) 设置串口波特率为 9600；2) 如果串口连接不成功，Arduino 不进行任何操作；3) 串口连接成功后，打印 a、b、c，并以“,” 隔开；4) 打印成功后，将 a、b、c 数值进行增加。

将编写好的 Arduino 代码上传到 X-TACO 中，成功显示如下：



打开串口监视器，可以发现，在没有任何操作的情况下，监视器中没有任何数据，而随机发送一个值后，串口开始打印数据，说明以上操作成功。

下面开始编写 Python 代码（具体参看附录）。第一步，导入 pyserial 模块，建立串口连接：

```
import serial
ser = serial.Serial('COM7', 9600, timeout=1)
print(ser.name)
```

第二步，读取串口数据，并解析成标准字符串，并且将以“,” 分隔的字符串转换成一个列表，并打印出来：

```
val = ser.readline().decode('utf-8')
parsed = val.split(',')
print(parsed)
```

第三步，使用列表生成式去掉最后一个元素的换行符，判读读取的元素是否是 3 个，打印列表：

```

parsed = [x.rstrip() for x in parsed]
if len(parsed) > 2:
    print(parsed)

```

第四步，对列表中的三个元素进行进一步读取，将获得的字符串转换为整数，因此采用字符串+0，整数除以 10，获得 a、b、c 三个元素，并打印：

```

a = int(int(parsed[0] + '0') / 10)
b = int(int(parsed[1] + '0') / 10)
c = int(int(parsed[2] + '0') / 10)
print(a)
print(b)
print(c)
print(a + b + c)

```

运行程序，结果如下：

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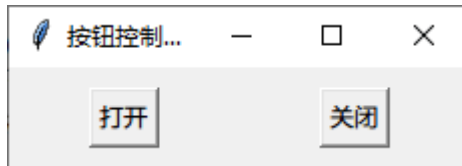


下面开始编写 Python 代码，第一步，导入 pyserial 模块，建立串口连接；导入 tkinter，完成 LED 亮灭指令设置：

```
import serial
import tkinter as tk
ser = serial.Serial('COM7', 9600, timeout=1)
LED_ON = '1'
LED_OFF = '0'
```

第二步，完成 GUI 参数设计，目标效果：

```
class ButtonsApp(tk.Tk):
    def __init__(self):
        super().__init__()
        self.btn_on = tk.Button(
            self, text="打开",
            relief=tk.RAISED, command=self.on)
        self.btn_off = tk.Button(
            self, text="关闭",
            relief=tk.RAISED, command=self.off)
        self.btn_on.pack(padx=40, pady=10, side=tk.LEFT)
        self.btn_off.pack(padx=40, pady=10, side=tk.LEFT)
```



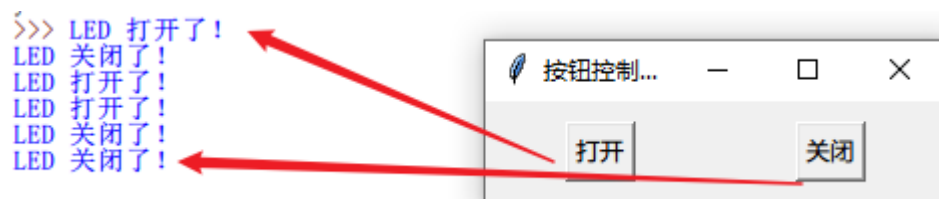
第三步，编写开关指令，即发送“1”或“0”给 Arduino，并打印“LED 打开了！”和“LED 关闭了！”提示用户：

```
def on(self):  
    ser.write(LED_ON.encode('utf-8')) # 串口发送数据，编码成比特字符串  
  
    print("LED 打开了!")  
  
def off(self):  
    ser.write(LED_OFF.encode('utf-8')) # 串口发送数据，编码成比特字符串  
  
    print("LED 关闭了!")
```

第四步，运行程序，命名为“按钮控制 arduino LED 灯”

```
if __name__ == "__main__":  
    app = ButtonsApp()  
    app.title("按钮控制 arduino LED 灯")  
    app.mainloop()
```

运行程序，结果如下：



通过以上几个案例，我们简单的了解了 Python 与 Arduino 的通信与控制过程。那么大家还有没有什么案例，快动手试试吧！

## 结语

近年来，人工智能、大数据处理、物联网等方面有了长足的进步，这里面离不开软件与硬件的结合，Python 编程语言作为一个黏贴式语言，可以将软件、算法、硬件连接在一起，真正的连接万物。基于 Arduino，你可以轻易的完成各类科技创作，那么通过 Python 与 Arduino，将丰富你的世界。

附录:

案例 1 的代码:

Arduino 代码:

```
int a=1;
int b=2;
int c=3;
void setup() {
    // put your setup code here, to run once:
    Serial.begin(9600);
}

void loop() {
    // put your main code here, to run repeatedly:
    while(!Serial){}
    Serial.print(a);
    Serial.print(",");
    Serial.print(b);
    Serial.print(",");
    Serial.print(c);
    Serial.print("\n");
    delay(500);
    a++;
    b++;
    c++;
}
```

Python 代码:

```
import serial
ser = serial.Serial('COM7', 9600, timeout=1)
print(ser.name)
while 1:
    val = ser.readline().decode('utf-8')
    parsed = val.split(',')
    print(parsed)
    parsed = [x.rstrip() for x in parsed]
```

```

if len(parsed) > 2:
    print(parsed)
    a = int(int(parsed[0] + '0') / 10)
    b = int(int(parsed[1] + '0') / 10)
    c = int(int(parsed[2] + '0') / 10)
    print(a)
    print(b)
    print(c)
    print(a + b + c)

```

案例 2 的代码：

案例 3 的代码：

Arduino 代码：

```

#define LED 13
int state;
void setup() {
    // put your setup code here, to run once:
    Serial.begin(9600);
    pinMode(LED, OUTPUT);
}

void loop() {
    // put your main code here, to run repeatedly:
    while(!Serial){}
    if(Serial.available()>0)
    {
        state=Serial.parseInt();
        digitalWrite(LED,state);
    }
}

```

Python 代码：

```

import serial

```



```
import tkinter as tk
ser = serial.Serial('COM7', 9600, timeout=1)
LED_ON = '1'
LED_OFF = '0'

class ButtonsApp(tk.Tk):
    def __init__(self):
        super().__init__()
        self.btn_on = tk.Button(
            self, text="打开
", relief=tk.RAISED, command=self.on)
        self.btn_off = tk.Button(
            self, text="关闭
", relief=tk.RAISED, command=self.off)
        self.btn_on.pack(padx=40, pady=10, side=tk.
LEFT)
        self.btn_off.pack(padx=40, pady=10, side=tk
.LEFT)

    def on(self):
        ser.write(LED_ON.encode('utf-8')) # 串口发
送数据，编码成比特字符串

        print("LED 打开了！")

    def off(self):
        ser.write(LED_OFF.encode('utf-8')) # 串口发
送数据，编码成比特字符串

        print("LED 关闭了！")
```

```
if __name__ == "__main__":  
    app = ButtonsApp()  
    app.title("按钮控制 arduino LED 灯")  
    app.mainloop  
  
# 按钮控制 arduino LED 灯  
  
# 板载 LED Pin 13
```