How to communicate via a COM port using Python

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Introduction

In this presentation, I will describe:

- How to control an Arudino's pin via a COM port using Python.

Getting started

Create a new directory named "python_serial" in `C:/Users/%USER%/`.

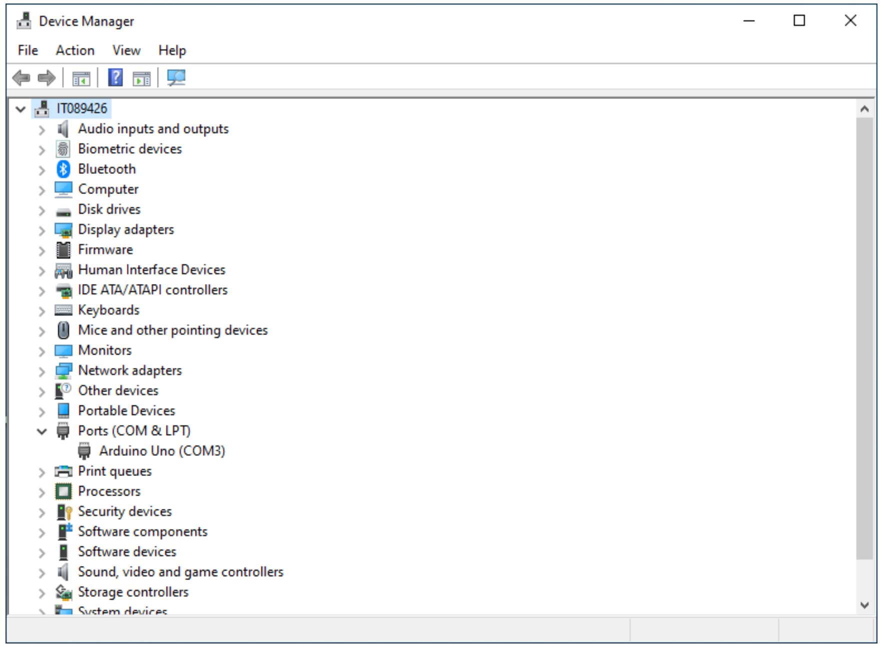
Note: Replace `%USER%` with your username.

Connect an Arduino to your computer.

Open the Start menu, type "Device Manager", and press `Enter`. This will display Windows' Device Manager.

Expand the "Ports" menu to view the Arduino's COM port.

Something similar to the following will be displayed:



```
IT089426
  Audio inputs and outputs
  Biometric devices
  Bluetooth
  Computer
  Disk drives
  Display adapters
  Firmware
  Human Interface Devices
  IDE ATA/ATAPI controllers
  Keyboards
  Mice and other pointing devices
  Monitors
  Network adapters
  Other devices
  Portable Devices
  Ports (COM & LPT)
    Arduino Uno (COM3)
  Print queues
  Processors
  Security devices
  Software components
  Software devices
  Sound, video and game controllers
  Storage controllers
  System devices
```

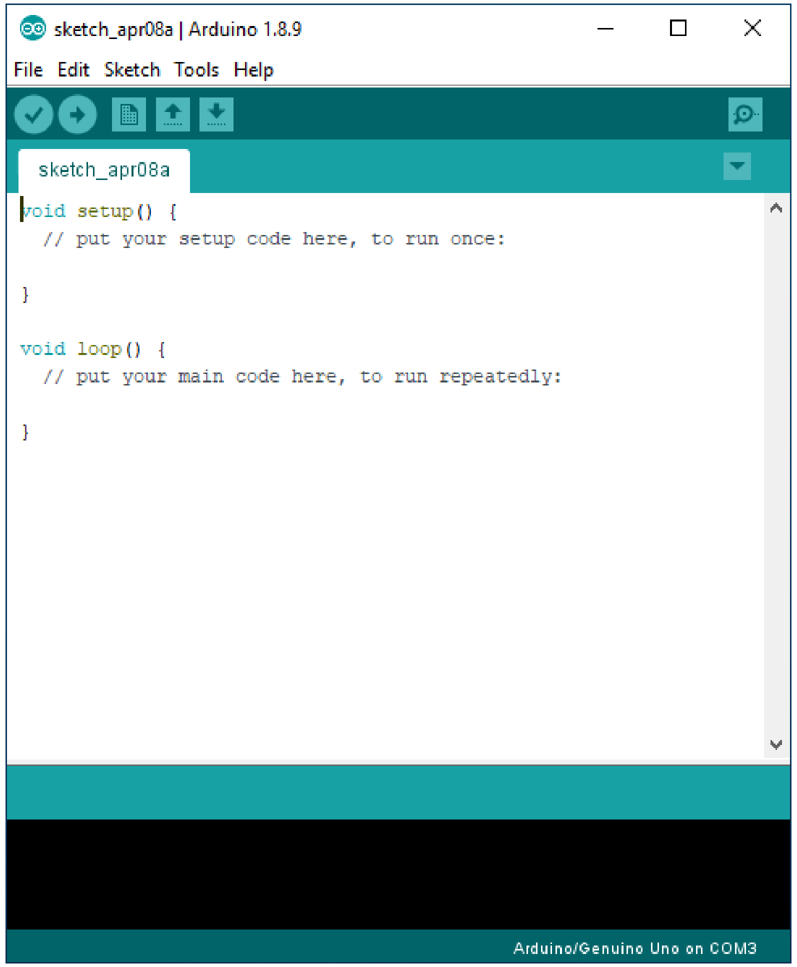
Figure: Windows' Device Manager. Here, we can see that an Arduino Uno is connected to the computer. It has enumerated as `COM3`.

Open the Arduino IDE.

Open the Start menu, type "Arduino", and press `Enter`. This will display the Arduino IDE.

Create a new sketch: Select "File > New" or press `Ctrl`+`N`.

Something similar to the following will be displayed:


sketch_apr08a | Arduino 1.8.9
File Edit Sketch Tools Help
sketch_apr08a

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

}

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

}
```

Arduino/Genuino Uno on COM3

Figure: Arduino IDE.

Type the following C++ program into the file:

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

  pinMode(13, OUTPUT);
  digitalWrite(13, HIGH);
}
```

```
void loop()
{
  if (Serial.available() >= 2)
  {
    char buffer[3] {};
    Serial.readBytes(buffer, 3);
    int pin {atoi(buffer)};

    switch(pin)
    {
      case 13:
      {
        digitalWrite(13, !digitalRead(led));
        Serial.println(digitalRead(led));
        break;
      }
    }
  }
}
```

Save the sketch in `C:\Users\%USER%\python_serial`: either:

1. Select "File > Save";

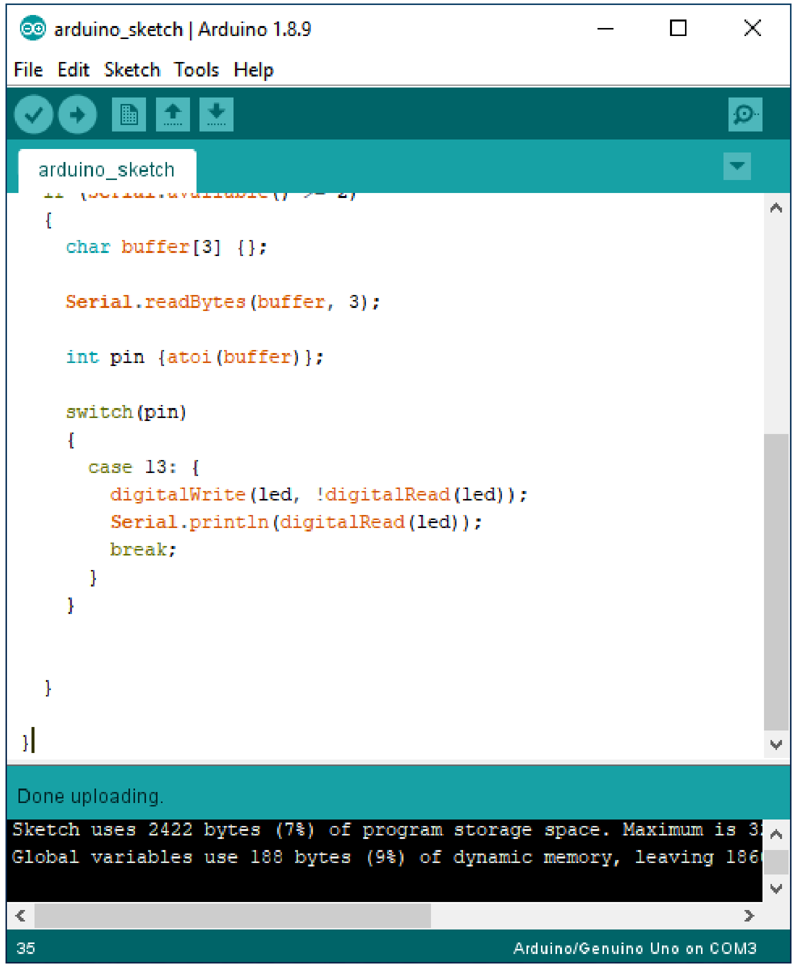
   or,
2. Press `Ctrl`+`S`, and navigate to `C:\Users\%USER%\python_serial`.

Upload the sketch to the Arduino: either:

1. Select "Sketch > Upload";

   or,
2. Press the `→` button.

Something similar to the following will be displayed:


arduino_sketch | Arduino 1.8.9
File Edit Sketch Tools Help
arduino_sketch

```
  {
    char buffer[3] {};

    Serial.readBytes(buffer, 3);

    int pin {atoi(buffer)};

    switch(pin)
    {
      case 13: {
        digitalWrite(led, !digitalRead(led));
        Serial.println(digitalRead(led));
        break;
      }
    }


  }

}
```

```
Done uploading.
Sketch uses 2422 bytes (7%) of program storage space. Maximum is 3
Global variables use 188 bytes (9%) of dynamic memory, leaving 186
```

35
Arduino/Genuino Uno on COM3

Figure: Arduino IDE.

Open Visual Studio Code in `C:/Users/%USER%/python_serial`: either:

1. Open Visual Studio Code and select "File > Open Folder..." and navigate to `C:/Users/%USER%/python_serial`;

   or,

2. Right click in `C:/Users/%USER%/python_serial` and select "Open with Code".

Open a new terminal: either:

1. press `Ctrl`+`~`;

   or

2. select "View > Terminal".

Create a new virtual environment named "venv".

Type the following command into the terminal and then press `Enter`:

```
python -m venv venv
```

This will create the `venv` virtual environment in `pyside6`.

Note: A prompt indicating Visual Studio Code "noticed a new virtual environment" and will ask "if you want to select it for the workspace folder". Press the "Yes" button.

Activate the virtual environment.

Type the following command into the terminal and then press `Enter`:

```
.\venv\Scripts\Activate.ps1
```

This will activate the `venv` virtual environment.

Note: To deactivate the `venv` virtual environment, type `deactivate` into the terminal and then press `Enter`.

Install `pyserial`.

Type the following command into the terminal and then press `Enter`:

```
python -m pip install pyserial
```

This will install the latest version of `pyserial` into the `venv` virtual environment.

Update `pip`.

Type the following command into the terminal and then press `Enter`:

```
python -m pip install --upgrade pip
```

This will update `pip` to the latest version.

`arduino_serial.py`

Create a new file named "arduino_serial.py" in `C:\Users\%USER%\python_serial`.

Open `arduino_serial.py` and type the following Python code into the file:

```python
import os
import sys

def main():

    return 0

if __name__ == "__main__":

  sys.exit(main())
```

In `arduino_serial.py`, type the following Python code:

```
import serial
from serial.tools.list_ports import comports
```

This will import the `serial` module and and the module's `comports()` function.

The documentation for the `serial` module is available at: https://pythonhosted.org/pyserial/index.html.

In `arduino_serial.py`'s `main()` function, type the following Python code:

```
ser = serial.Serial()
```

This will create an instance of the `Serial` class.

The documentation for the `Serial` class is available at: https://pythonhosted.org/pyserial/pyserial_api.html.

In `arduino_serial.py`'s `main()` function, type the following Python code:

```
    print("BAUDRATES:\n{}".format(ser.BAUDRATES))
    print("BYTESIZES:\n{}".format(ser.BYTESIZES))
    print("PARITIES:\n{}".format(ser.PARITIES))
    print("STOPBITS:\n{}".format(ser.STOPBITS))
    print("COMPORTS:\n{}".format([str(c) for c in comports()]))
```

This will display lists of all the baud rates, the data packet sizes, the parities, the number of stop bits, and the name of the devices that can be used.

Type the following command into the terminal and then press `Enter`:

```
python arduino_serial.py
```

This will run `arduino_serial.py`.

Something similar to the following will be displayed in the terminal:

```
BAUDRATES:
(50, 75, 110, 134, 150, 200, 300, 600, 1200, 1800, 2400,
    4800, 9600, 19200, 38400, 57600, 115200)
BYTESIZES:
(5, 6, 7, 8)
PARITIES:
('N', 'E', 'O', 'M', 'S')
STOPBITS:
(1, 1.5, 2)
COMPORTS:
['COM3 - Arduino Uno (COM3)']
```

Here, we can see the baud rates, the data packet sizes, the parities, the number of stop bits, and the name of the devices that can be used.

A baud rate of 9600, data packet size of 8 bits, no parity, and 1 stop bit, i.e. `9600 8N1`, is a commonly used combination of values.

In `arduino_serial.py`'s `main()` function, type the following Python code:

```
ser.baudrate = 9600
ser.bytesize = 8
ser.parity = 'N'
ser.stopbits = 1
ser.port = 'COM3'
ser.timeout = 0.5
```

This will set `ser`'s baud rate, data packet size, parity, number of stop bits, device name, and timeout to `9600`, `8`, `None`, `1`, `COM3`, and `0.5` respectively.

In `arduino_serial.py`'s `main()` function, type the following Python code:

```python
try:
    ser.open()
except Exception as e:
    print(e)
    return 1
```

This will try to open the `ser`'s port using the assigned baud rate, data packet size, parity, number of stop bits, and device name. Otherwise, an exception is displayed and the program ends.

Unplug the Arduino from the computer.

Type the following command into the terminal and then press `Enter`:

```
python arduino_serial.py
```

This will run `arduino_serial.py`.

Something similar will be displayed in the terminal:

```
BAUDRATES:
(50, 75, 110, 134, 150, 200, 300, 600, 1200, 1800, 2400,
    4800, 9600, 19200, 38400, 57600, 115200)
BYTESIZES:
(5, 6, 7, 8)
PARITIES:
('N', 'E', 'O', 'M', 'S')
STOPBITS:
(1, 1.5, 2)
COMPORTS:
[]
could not open port 'COM3': FileNotFoundError(2, 'The
    system cannot find the file specified.', None, 2)
```

Plug the Arduino back into the computer.

In `arduino_serial.py`'s `main()` function, type the following Python code:

```python
while True:
    pin = input("Enter a pin to toggle (00 - 13), Q/q to break: ")

    if pin == 'Q' or pin == 'q':
        break

    data = '{}\n'.format(pin)
    ser.write(data.encode("utf-8"))

    data = ser.readline()
    print('{}'.format(data.decode("utf-8")))

ser.close()
```

This will continuously prompt the user to type in a two-digit number, e.g. `13`, which will be encoded into an array of bytes, then written to `ser`'s port. If the user types "Q" or "q", the loop will break, and `ser`'s port will be closed.

Testing

Type the following command into the terminal and then press `Enter`:

```
python arduino_serial.py
```

This will run `arduino_serial.py`.

Something similar to the following will be displayed in the terminal:

```
BAUDRATES:
(50, 75, 110, 134, 150, 200, 300, 600, 1200, 1800, 2400,
    4800, 9600, 19200, 38400, 57600, 115200)
BYTESIZES:
(5, 6, 7, 8)
PARITIES:
('N', 'E', 'O', 'M', 'S')
STOPBITS:
(1, 1.5, 2)
COMPORTS:
['COM3 - Arduino Uno (COM3)']
Enter a pin to toggle (00 - 13), Q/q to break: 13
0
```

Type `13` into the terminal.

Press `Enter`.

Type "Q" to quit.

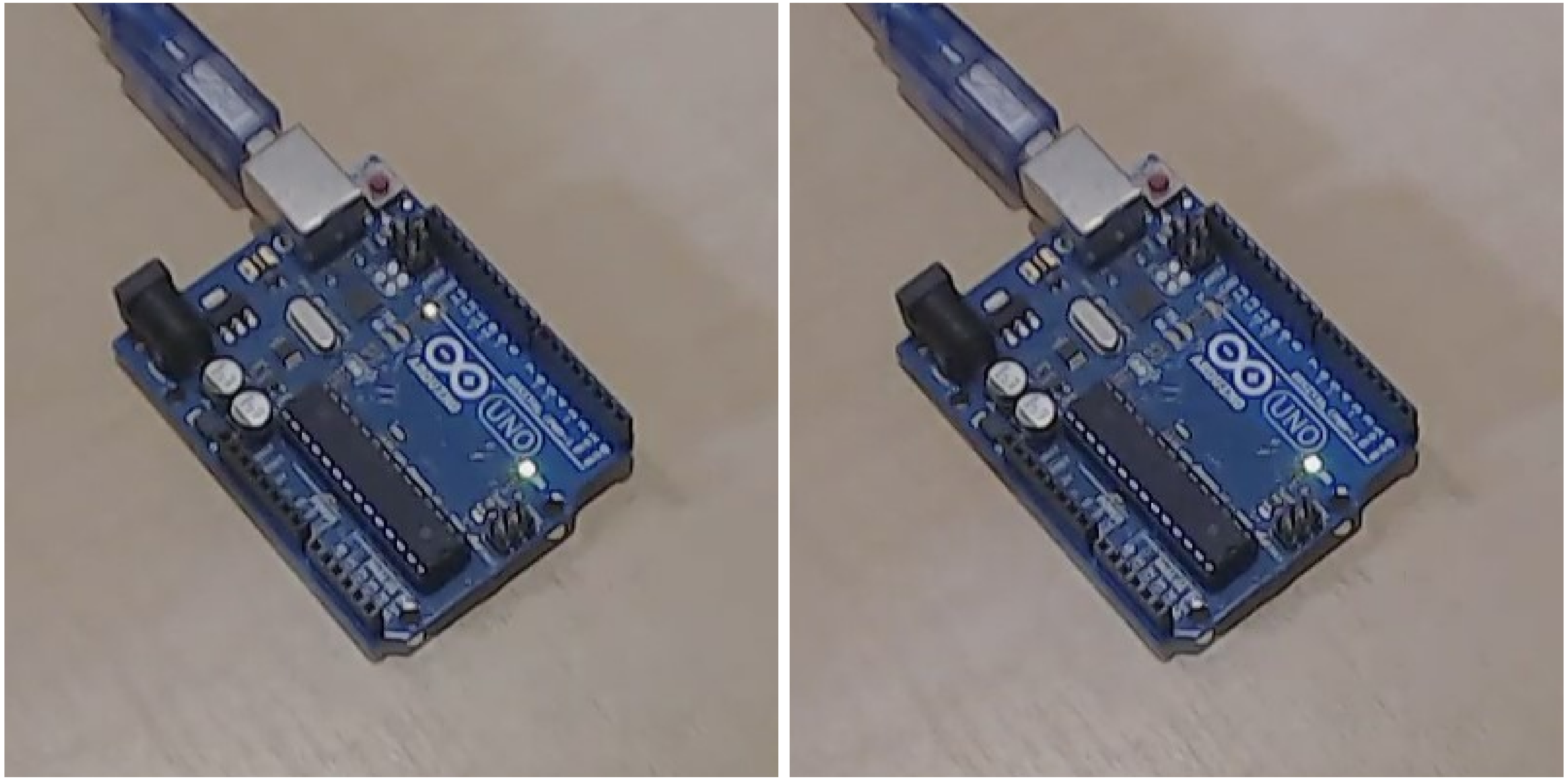


Figure: (Left) The Arduino before data was sent to it; and (Right) the Arduino after the data was received. Before, the LED connected to PIN 13 was ON; afterwards, the LED was toggled OFF.

Conclusion

In this presentation, I have described:

- How to control an Arudino's pin via a COM port using Python.

References

1. https://www.arduino.cc/
2. https://pythonhosted.org/pyserial/index.html