INTRO TO RPI (PART 2)

BY SUTD IEEE

AGENDA

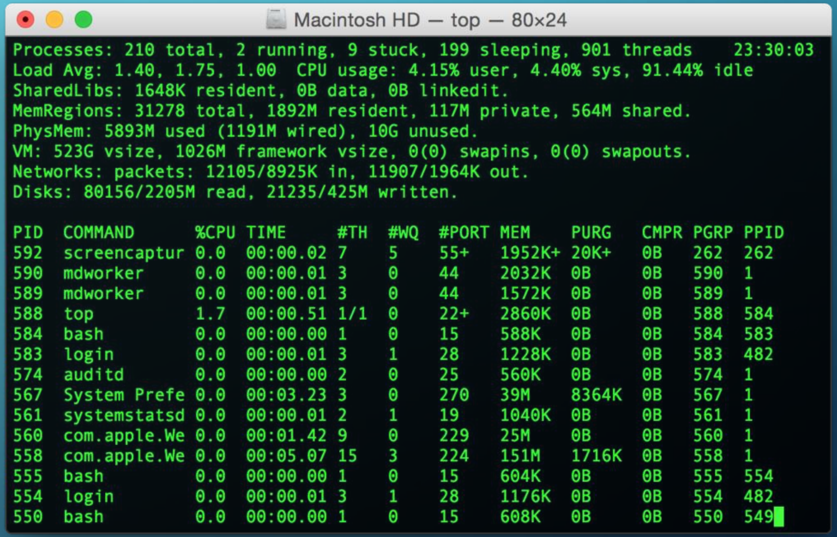
- Using the RPi through the Terminal
- Using the RPi like an Arduino
    - GP I/O Pins with Python
- RPi Serial Communication
    - Talk to an Arduino using an RPi

WHAT'S AN RPI?!

- Single Board Computer
- Runs Linux (Most of the time)
- Small
- Access to GP I/O Pins (Input and Output)
  - Like an Arduino

LINUX COMMANDS & TOOLS

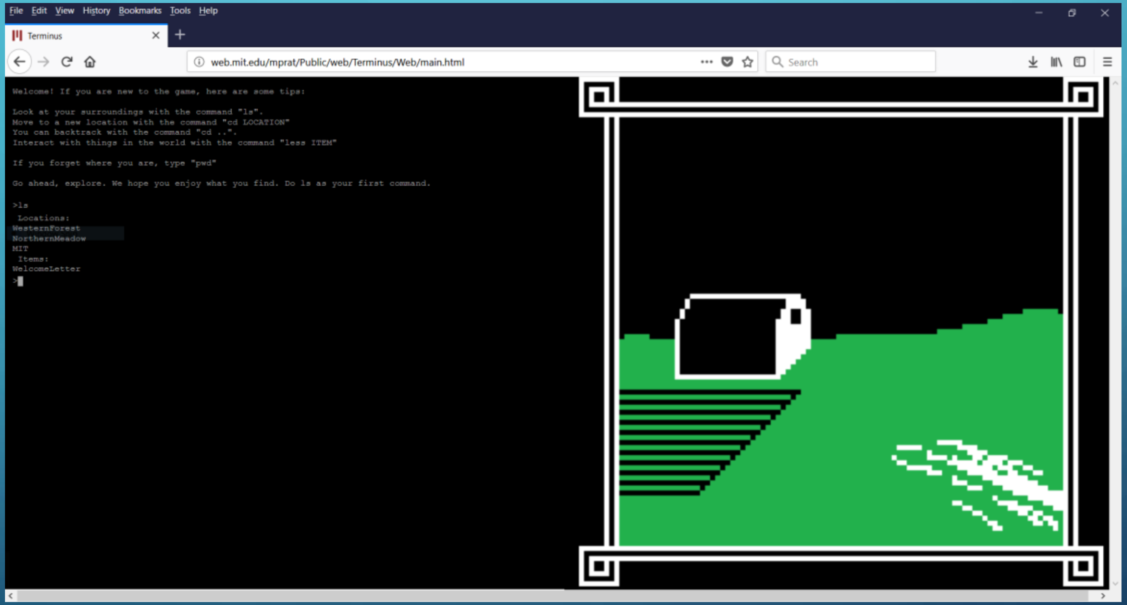
- cd
- ls
- touch
- rm
- mkdir
- rmdir
- nano
- mv
- cp
- find
- cat
- Ifconfig



```
Processes: 210 total, 2 running, 9 stuck, 199 sleeping, 901 threads    23:30:03
Load Avg: 1.40, 1.75, 1.00  CPU usage: 4.15% user, 4.40% sys, 91.44% idle
SharedLibs: 1648K resident, 0B data, 0B linkedit.
MemRegions: 31278 total, 1892M resident, 117M private, 564M shared.
PhysMem: 5893M used (1191M wired), 10G unused.
VM: 523G vsize, 1026M framework vsize, 0(0) swapins, 0(0) swapouts.
Networks: packets: 12105/8925K in, 11907/1964K out.
Disks: 80156/2205M read, 21235/425M written.

PID  COMMAND      %CPU TIME     #TH  #WQ  #PORT MEM    PURG   CMPR PGRP PPID
592  screencaptur 0.0  00:00.02 7    5    55+   1952K+ 20K+   0B   262  262
590  mdworker     0.0  00:00.01 3    0    44    2032K  0B     0B   590  1
589  mdworker     0.0  00:00.01 3    0    44    1572K  0B     0B   589  1
588  top          1.7  00:00.51 1/1  0    22+   2860K  0B     0B   588  584
584  bash         0.0  00:00.00 1    0    15    588K   0B     0B   584  583
583  login        0.0  00:00.01 3    1    28    1228K  0B     0B   583  482
574  auditd       0.0  00:00.00 2    0    25    560K   0B     0B   574  1
567  System Prefe 0.0  00:03.23 3    0    270   39M    8364K  0B   567  1
561  systemstatsd 0.0  00:00.01 2    1    19    1040K  0B     0B   561  1
560  com.apple.We 0.0  00:01.42 9    0    229   25M    0B     0B   560  1
558  com.apple.We 0.0  00:05.07 15   3    224   151M   1716K  0B   558  1
555  bash         0.0  00:00.00 1    0    15    604K   0B     0B   555  554
554  login        0.0  00:00.01 3    1    28    1176K  0B     0B   554  482
550  bash         0.0  00:00.00 1    0    15    608K   0B     0B   550  549
```

LINUX COMMANDS & TOOLS

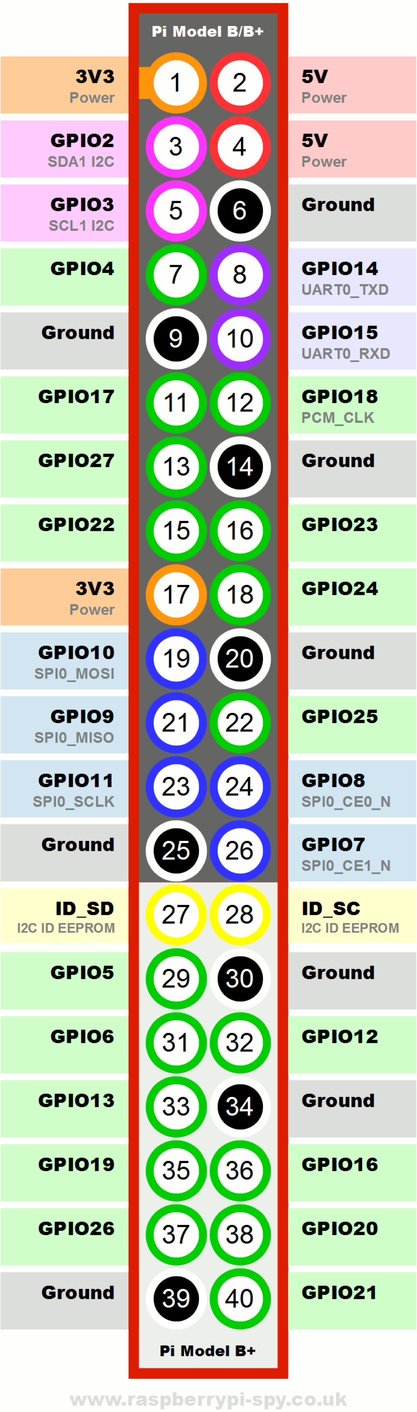
- http://web.mit.edu/mprat/Public/web/Terminus/Web/main.html


File Edit View History Bookmarks Tools Help
Terminus
web.mit.edu/mprat/Public/web/Terminus/Web/main.html
Search

```
Welcome! If you are new to the game, here are some tips:

Look at your surroundings with the command "ls".
Move to a new location with the command "cd LOCATION"
You can backtrack with the command "cd ..".
Interact with things in the world with the command "less ITEM"

If you forget where you are, type "pwd"

Go ahead, explore. We hope you enjoy what you find. Do ls as your first command.

>ls
 Locations:
WesternForest
NorthernMeadow
MIT
 Items:
WelcomeLetter
>
```

NOW FOR THE ELECTRONICS STUFF

- Program the RPi’s GP I/O Pins
  - General Purpose Input/ Output
  - https://pinout.xyz/#
- Use it like an Arduino
- Can be done using Python, C, C++, Bash, etc.



Pi Model B/B+

3V3 Power	1	2	5V Power
GPIO2 SDA1 I2C	3	4	5V Power
GPIO3 SCL1 I2C	5	6	Ground
GPIO4	7	8	GPIO14 UART0_TXD
Ground	9	10	GPIO15 UART0_RXD
GPIO17	11	12	GPIO18 PCM_CLK
GPIO27	13	14	Ground
GPIO22	15	16	GPIO23
3V3 Power	17	18	GPIO24
GPIO10 SPI0_MOSI	19	20	Ground
GPIO9 SPI0_MISO	21	22	GPIO25
GPIO11 SPI0_SCLK	23	24	GPIO8 SPI0_CE0_N
Ground	25	26	GPIO7 SPI0_CE1_N
ID_SD I2C ID EEPROM	27	28	ID_SC I2C ID EEPROM
GPIO5	29	30	Ground
GPIO6	31	32	GPIO12
GPIO13	33	34	Ground
GPIO19	35	36	GPIO16
GPIO26	37	38	GPIO20
Ground	39	40	GPIO21

Pi Model B+

www.raspberrypi-spy.co.uk

GP I/O WITH PYTHON

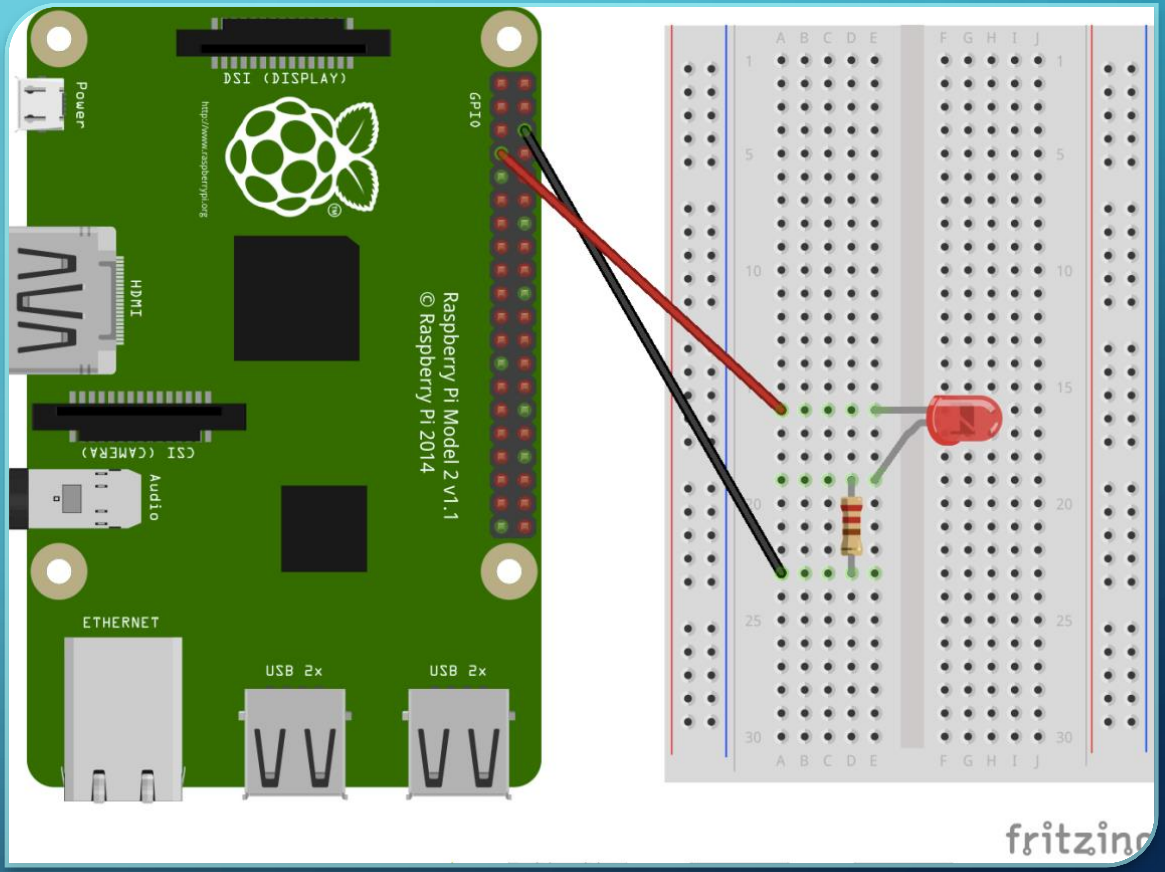
- Install RPI.GPIO (In Terminal)
  - `sudo pip3 install rpi.gpio`
- In Python File
  - `import RPi.GPIO as GPIO`

GP I/O WITH PYTHON

- **GPIO.setmode(MODE)** => MODE is GPIO.BOARD or GPIO.BCM
- GPIO.setup(channel, GPIO.HIGH) => channel can be a list of channels
- GPIO.setup(channel, GPIO.HIGH, initial=GPIO.HIGH)
- GPIO.input(channel)
- GPIO.output(channel) => channel can be a list of channels
- GPIO.PWM(channel,frequency)
- **GPIO.cleanup()**

ACTIVITY #1: BLINKING LED

- Connect +ve lead of LED (Longer leg) to BCM26
  - Refer to https://pinout.xyz/# !
- Connect a resistor from the –ve lead of the LED to an empty space
- Connect the resistor to a GND pin
  - Refer to https://pinout.xyz/# !



ACTIVITY #1: BLINKING LED

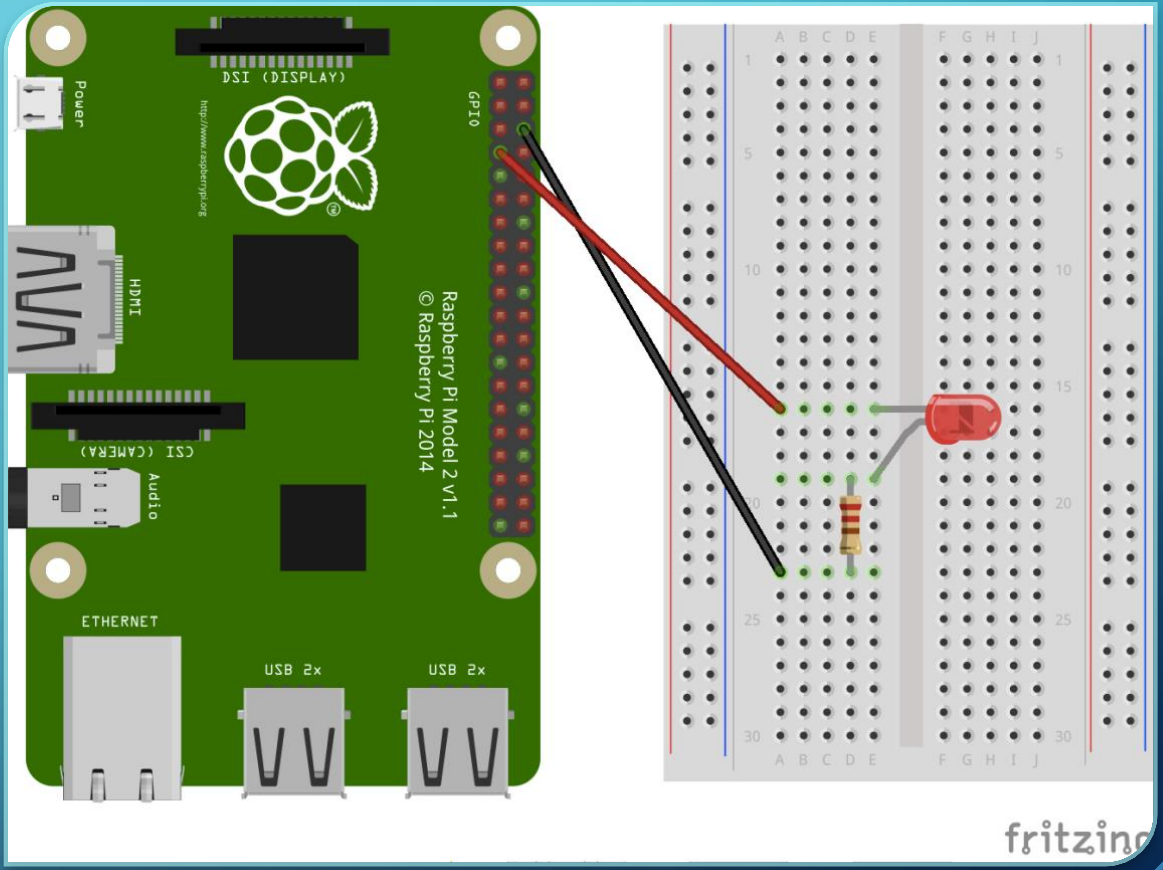
- import RPi.GPIO as GPIO
- from time import sleep
- import sys
- GPIO.setmode(GPIO.BCM)
- GPIO.setup(26,GPIO.OUT)
- GPIO.output(26,GPIO.HIGH)
- sleep(1) // Sleep for 1s

ACTIVITY #1: BLINKING LED

```
Try:
    while True:
        # Do Something
finally:
    GPIO.cleanup()
    sys.exit()
```

ACTIVITY #2: FADING LED

- Connect +ve lead of LED (Longer leg) to BCM26
  - Refer to https://pinout.xyz/# !
- Connect a resistor from the –ve lead of the LED to an empty space
- Connect the resistor to a GND pin
  - Refer to https://pinout.xyz/# !

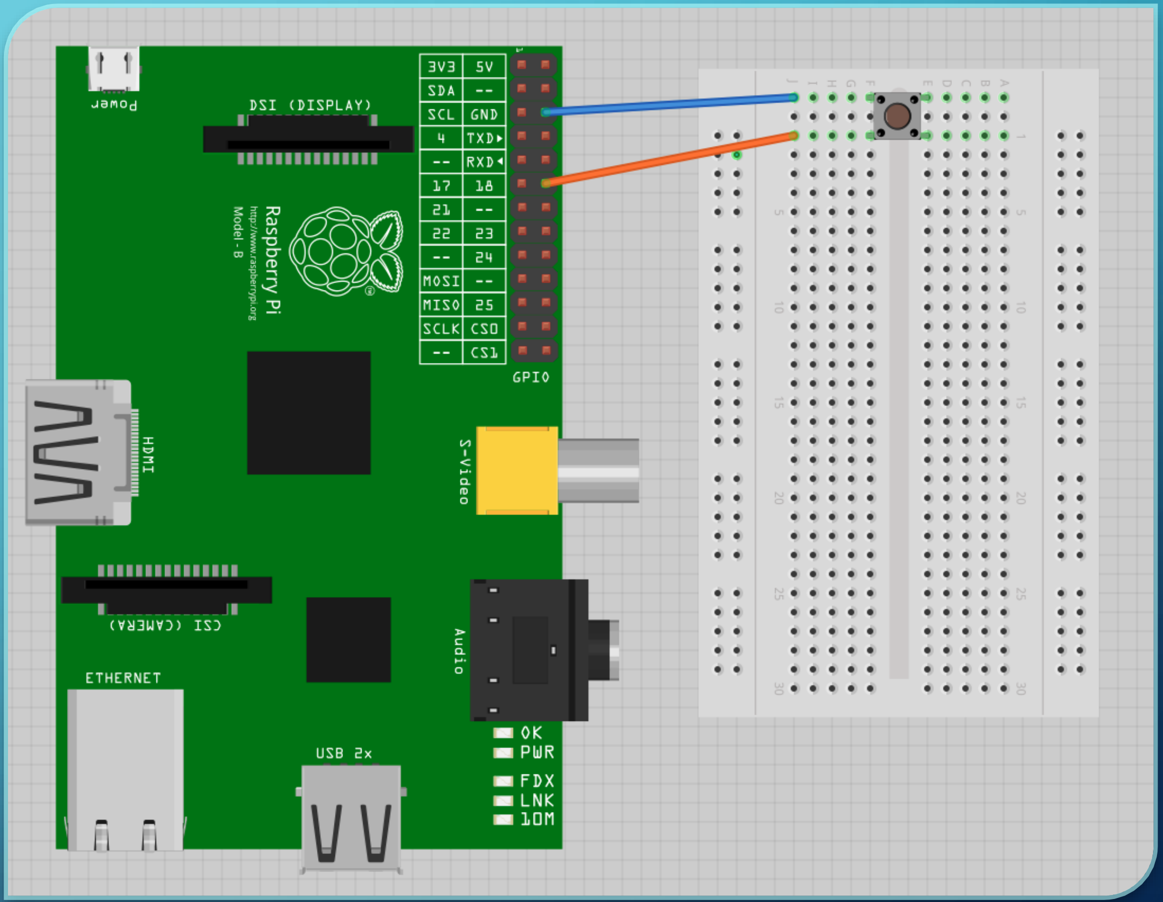


ACTIVITY #2: FADING LED

- pwm = GPIO.PWM(26,1000)
- pwm.start(0)
- pwm.ChangeDutyCycle(x) // 0 ≤ x ≤ 100
- for i in range(100):
- pwm.stop()

ACTIVITY #3: PUSH BUTTON

- Connect one end of the button to BCM26
- Connect the other end on the same side to GND



ACTIVITY #3: PUSH BUTTON

- GPIO.setup(26,GPIO.IN,pull_up_down=GPIO.PUD_UP)
- GPIO.input(26)

ACTIVITY #3: PUSH BUTTON - DEBOUNCE

- Oscillation in mechanical switch in button => Multiple button presses
- Logic:
  - Wait for x ms after button pressed and until button is released
  - Only then register it as 1 button press

ACTIVITY #4: TRY IT YOURSELF

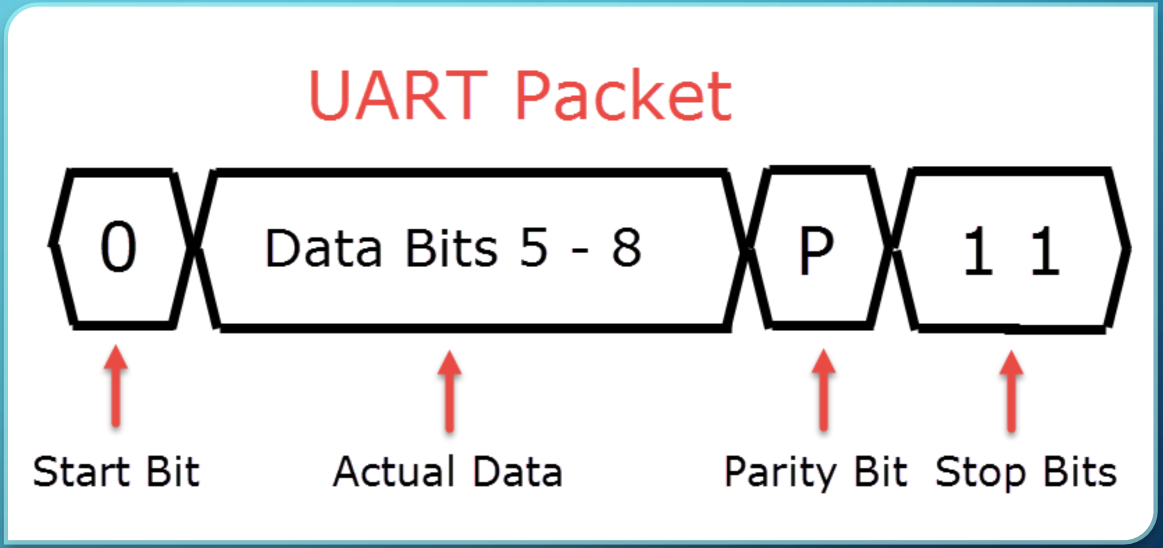
- Use a push button to toggle an LED on and off!
- TRY!

SERIAL COMMUNICATION

- Send data bit by bit, instead of all at once
- Many protocols:
  - UART / USART
  - SPI
  - I2C
  - …

SERIAL COMMUNICATION (UART)

- Universal Asynchronous Receiver-Transmitter
- Star-Bit
- Data Bits
- Parity Bit (Optional)
- Stop Bit/s

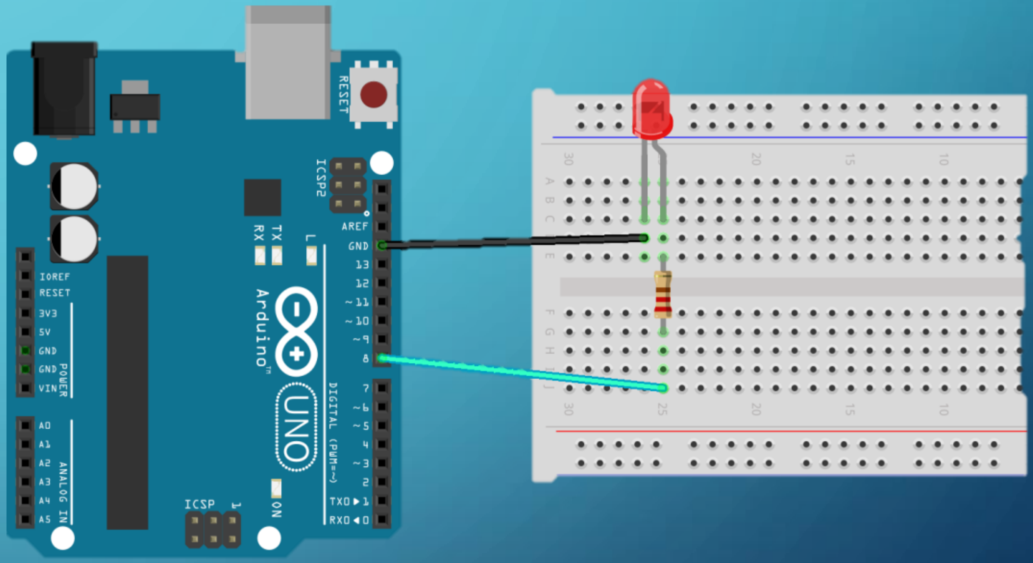


PYTHON SERIAL IN RPI (WITH ARDUINO)

- Why?
  - Offload processing and simple tasks to Arduino
  - Add more input/ output pins
  - Connect to other serial peripherals
- How?
  - Connect a USB cable from the Pi to the Arduino

ON ARDUINO

```
Sting inString = “”;
void serialEvent() {
      char c = ‘ ’;
      c = Serial.read();
      if (c == ‘\n’) {
            // Do something
            inString = “”;
      } else {
            inString += c;
      }
}
```



SPI AND I2C

- RPi has:
  - 3 SPI Bus's (Only one accessible via the headers)
  - 2 I2C Bus's accessible through the headers
  - I think

THE END