CS 1010



Deep dive into Raspberry Pi with Python

Prof. Kartik Bulusu, MAE Dept.

From LED Madness to Ultrasound Cacophony

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Fall 2022

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Photo: Kartik Bulusu

Raspberry Pi Hardware and Connections

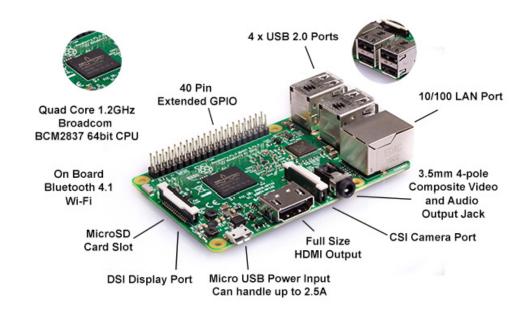


Source: https://www.raspberrypi.org/help/

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Source: https://opensensorhub.org/2019/05/19/kinect-support-on-raspberrypi-3b/

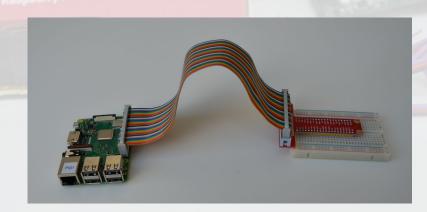
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Connect the Raspberry Pi Model 3 B+ (RPi) to a bread board









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Access to the RPi in the laboratory

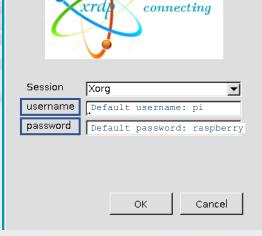
Just



Login to DEBIAN

Each RPi is assigned a unique

- IP address <161.253.30.xxx>
- OR DNS name
 <kartik###.seas.gwu.edu>
- username & password



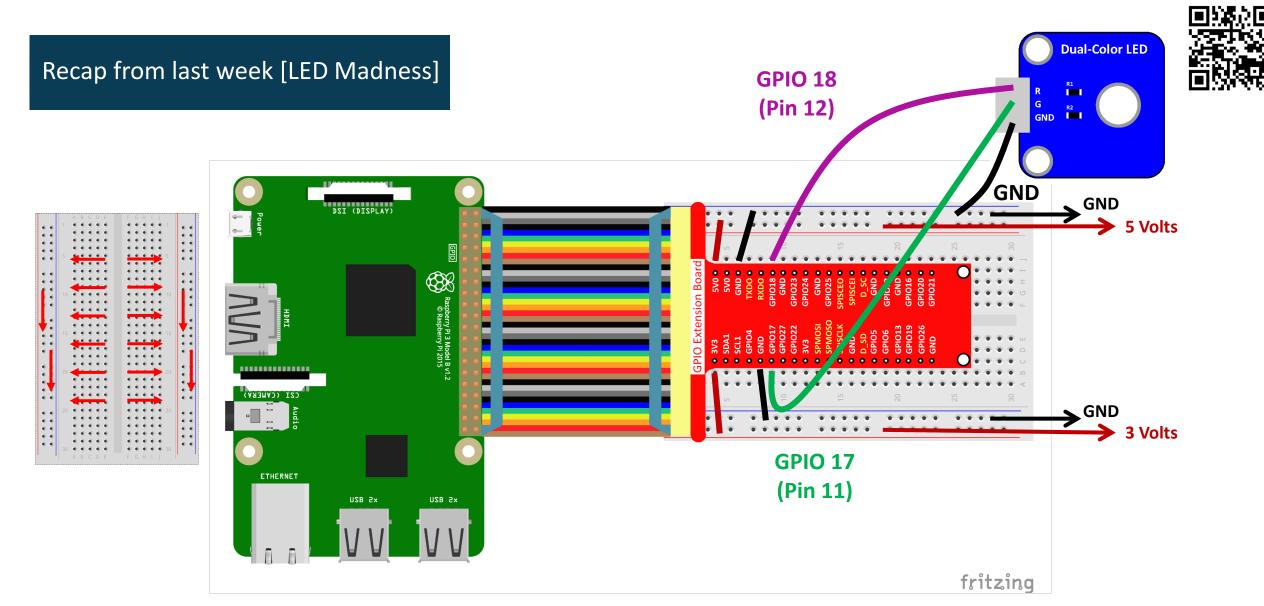
Source: https://upload.wikimedia.org/wikipedia/commons/f/f1/XRDP Screenshot.png

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Fall 2021

APSC 1001 CS 1010

Introduction to Engineering for Undeclared Majors Computer Science Orientation

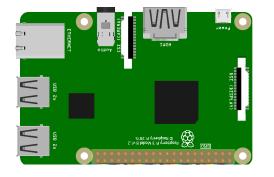




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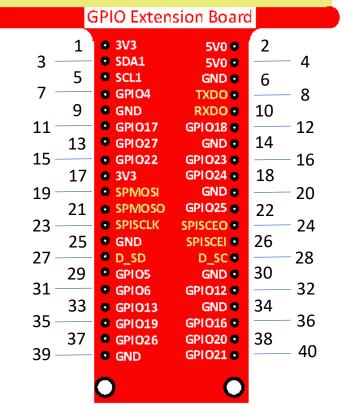


How a python code lit up your LED with Raspberry Pi Model 3 B+ (RPi)





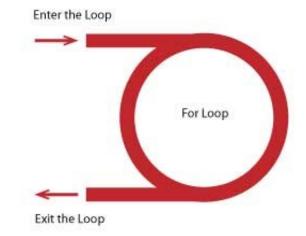
GPIO.setmode(GPIO.BOARD)

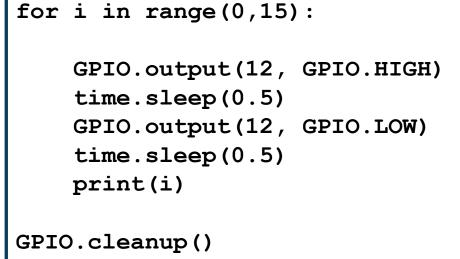






(For) How many times do you want to execute a piece of code?





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Ultrasound Signals and its Applications





Source: https://youtu.be/Rr9RaisO11E

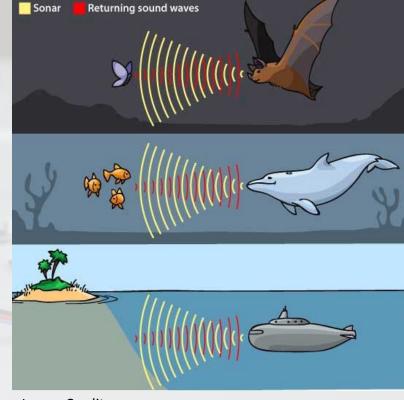


Image Credit: http://www.robaid.com/bionics/bat-biosonar-biomimicryfor-improved-sonar-technology.htm

 $Distance\ traversed = (Speed\ of\ sound) \times (Time\ elapsed/2)$

Photo: Kartik Bulusu

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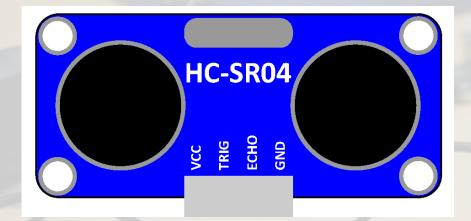
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Know your Ultrasonic Sensor







The Ultrasonic sensor sends out ultrasonic waves to detect objects and measure distances.

Connectors:

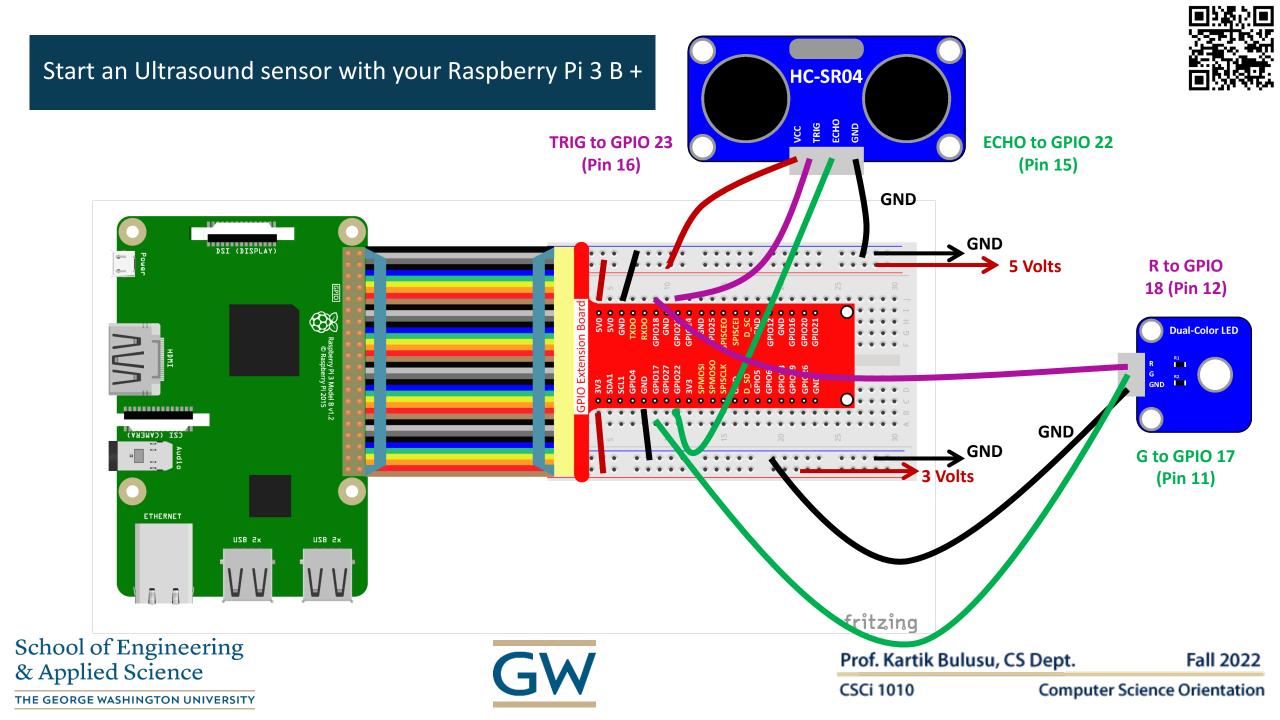
4-pin jumper cables

Goal of the lab segment:

- Co-work
 - Observe, ask and try in groups
- Make
 - Build-a-hack
 - Ultrasound sensors and Raspberry Pi 3B + boards
- Analyze data using Python

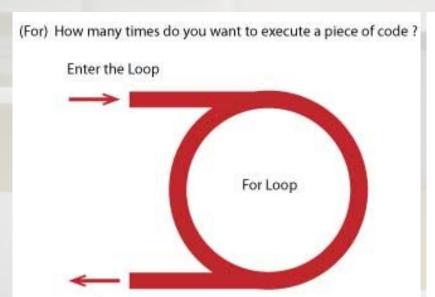
Photo: Kartik Bulusu School of Engineering & Applied Science

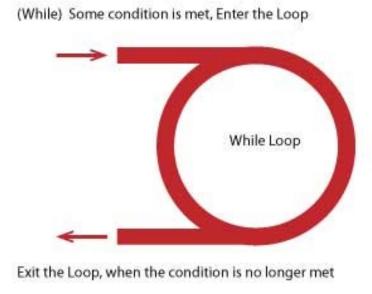


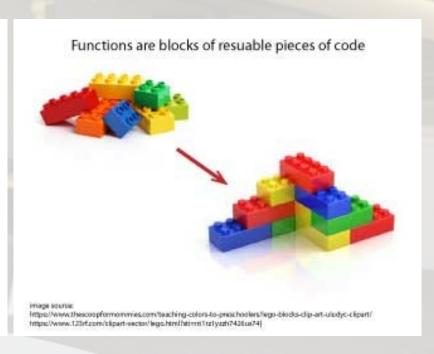


Know some programming paradigms











Loops

Functions

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Exit the Loop



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Pseudo-code to kick start your Raspberry Pi Model 3 B+ (RPi)

GPIO Extension Board 3V3 5V0 • SDA1 5V0 • SCL1 GND • GPIO4 TXDO • GND RXDO • 12 GPIO17 GPI 018 • 14 GPIO27 GND • GP1023 • 16 GPIO22 3V3 GPI 024 • SPMOSI GND • 20 GP1025 • SPMOSO SPISCEO . 24 SPISCLK GND SPISCEI • 28 D SD D_SC • 30 GND • GPI 05 32 GPI06 **GPI 012** • **GND** 34 33 • GPI013 GPI 016 • GPIO19 GPIO26 GP1020 • 40 GND GPI 021 •

import LIBRARY as NAME
import ANOTHER_LIBRARY



```
INITIALIZE GPIO CHANNELS
```

DEFINE SETUP FUNCTION

GPIO.setmode(GPIO.BOARD)

GPIO.setup(CHANNEL-1, GPIO.OUT)

GPIO.setup(CHANNEL-2, GPIO.IN))

DEFINE DISTANCE FUNCTION
return (TIME ELAPSED / 2) * 340 * 100

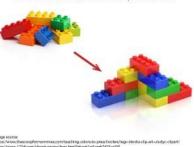
DEFINE LOOP FUNCTION while True:

DEFINE DESTROY FUNCTION
CLEAN UP GPIO CHANNELS

```
if __name__ == "__main__":
    setup():
    try:
       loop()
    except KeyboardInterrupt:
       destroy()
```

User defined functions

Functions are blocks of resuable pieces of code



Entry point into the program –

pulls in all user

defined functions



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A simple python code to kick start your Raspberry Pi Model 3 B+ (RPi)

GPIO Extension Board

```
2

    3V3

                      5V0 •
         SDA1
                      5V0 •
        SCL1
                      GND •

    GPIO4

                                  8
                     TXDO •
                     RXDO •
        GND
        GPI017
                                 12
                    GPI 018 •
    13 • GPI027
                      GND • 14

    GPIO22

                    GP1023 •
                                 16
                    GP1024 •
        3V3
        SPMOSI
                      GND •
                                  20
    21 • SPMOSO
                    GPI 025 •

    SPISCLK

                   SPISCEO .
                    SPISCEI • 26
    25 • GND
        D SD
                                  28
                     D_SC •
                     GND • 30
        GPIO5
                                  32
        GPI06
                    GPI 012 •
                      GND ● 34
    33 • GPI013
        GPIO19
                    GPI 016 •
                    GPI020 • 38
    37 • GPI026
                                  40
39 ——
        GND
                    GPI 021 •
```

```
import RPi.GPIO as GPIO
import time
```

```
TRIG = 16
ECHO = 15
def setup():
    GPIO.setmode(GPIO.BOARD)
    GPIO.setup(TRIG, GPIO.OUT)
    GPIO.setup(ECHO, GPIO.IN))
```

```
def distance():
    GPIO.output(TRIG, 0)
    time.sleep(0.000002)
    GPIO.output(TRIG, 1)
    time.sleep(0.00001)
    GPIO.output(TRIG, 0)
    while GPIO.input(ECHO) == 0:
        time1 = time.time()
    while GPIO.input(ECHO) == 1:
        time2 = time.time()
    during = time2 - time1
    return (during / 2) * 340 * 100
```



```
def loop():
    while True:
        dist = distance()
        print(dist, 'cm')
        print('')
        time.sleep(0.1)
```

```
def destroy():
    GPIO.cleanup()
```

```
if
    name
                  main ":
    setup():
    try:
        loop()
    except KeyboardInterrupt:
        destroy()
```

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