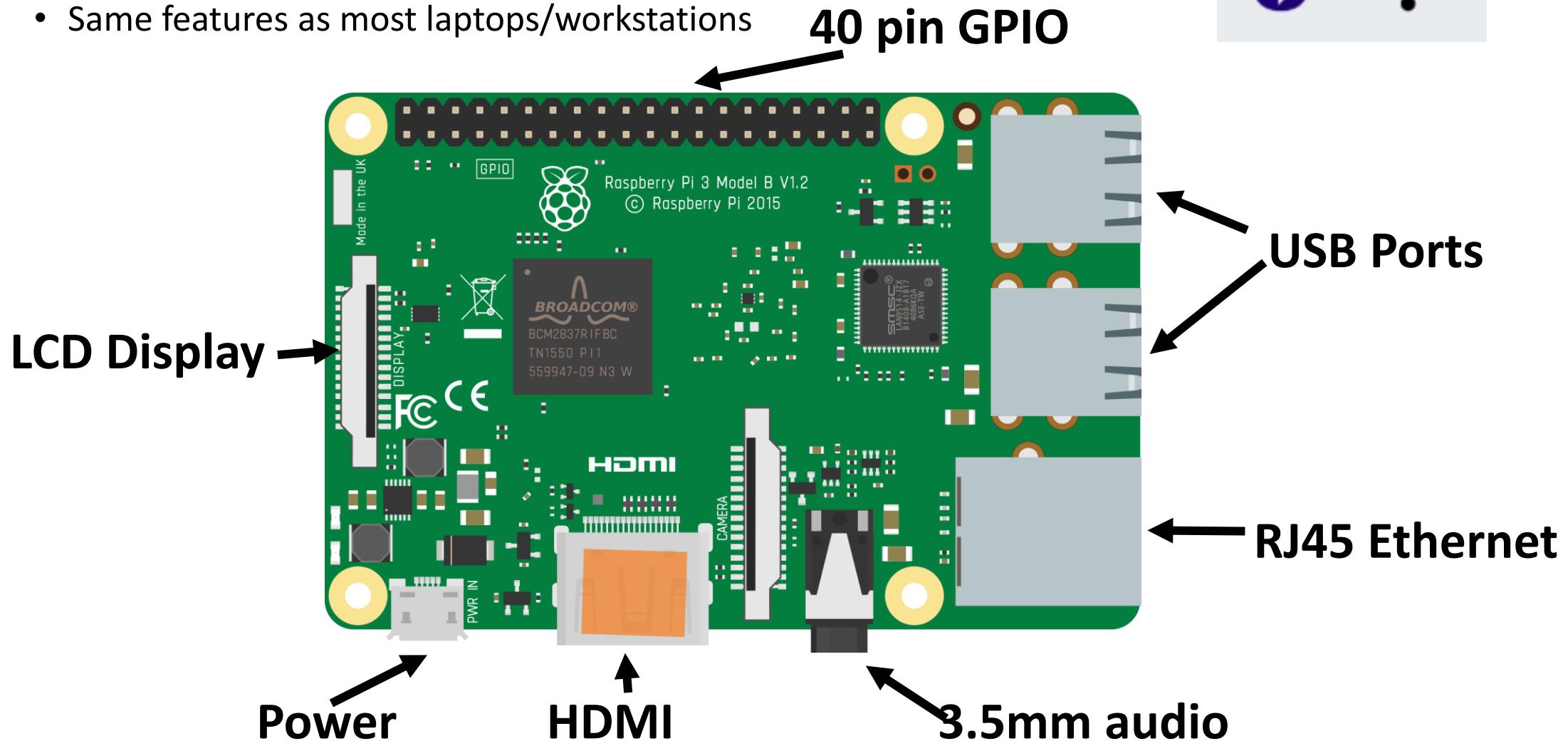
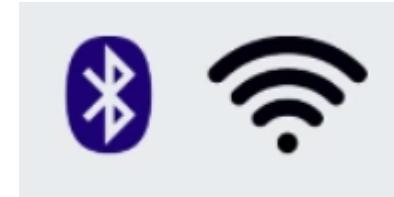


# Raspberry Pi/SenseHAT Introduction

Frank Walsh

# What is a Raspberry Pi?

- Low cost, single board computer
- Same features as most laptops/workstations



# Raspberry Pi - Storage



# History

- Launched in 2012
- Inspired by Acorn's BBC Micro from 1981
- Original concept to inspire/educate kids
- Used a lot in 3rd level/home

1981

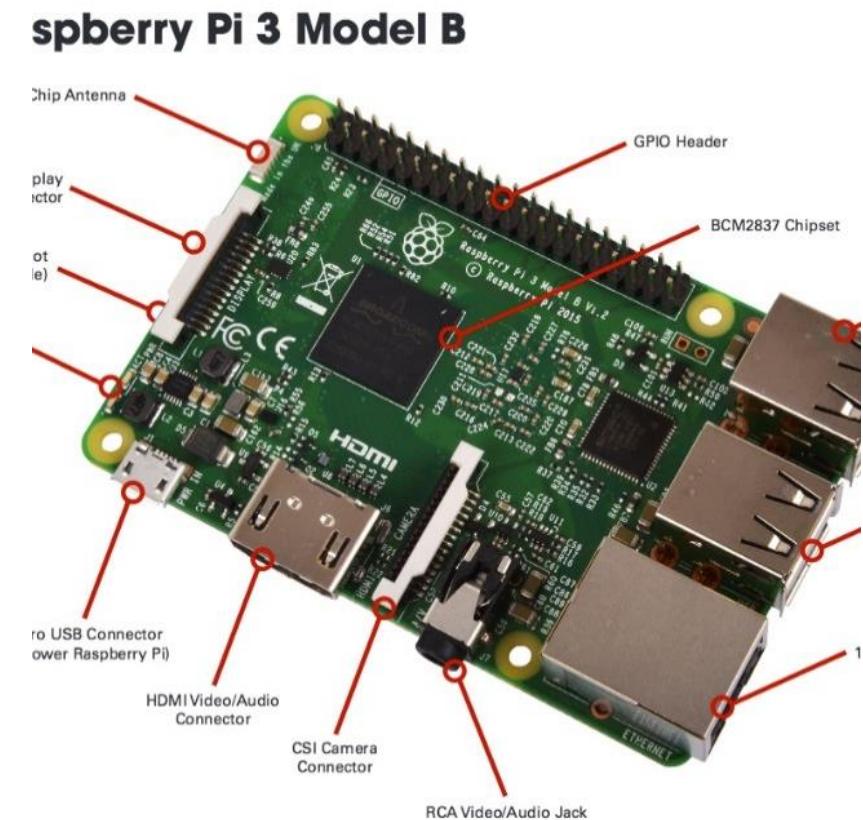


2016



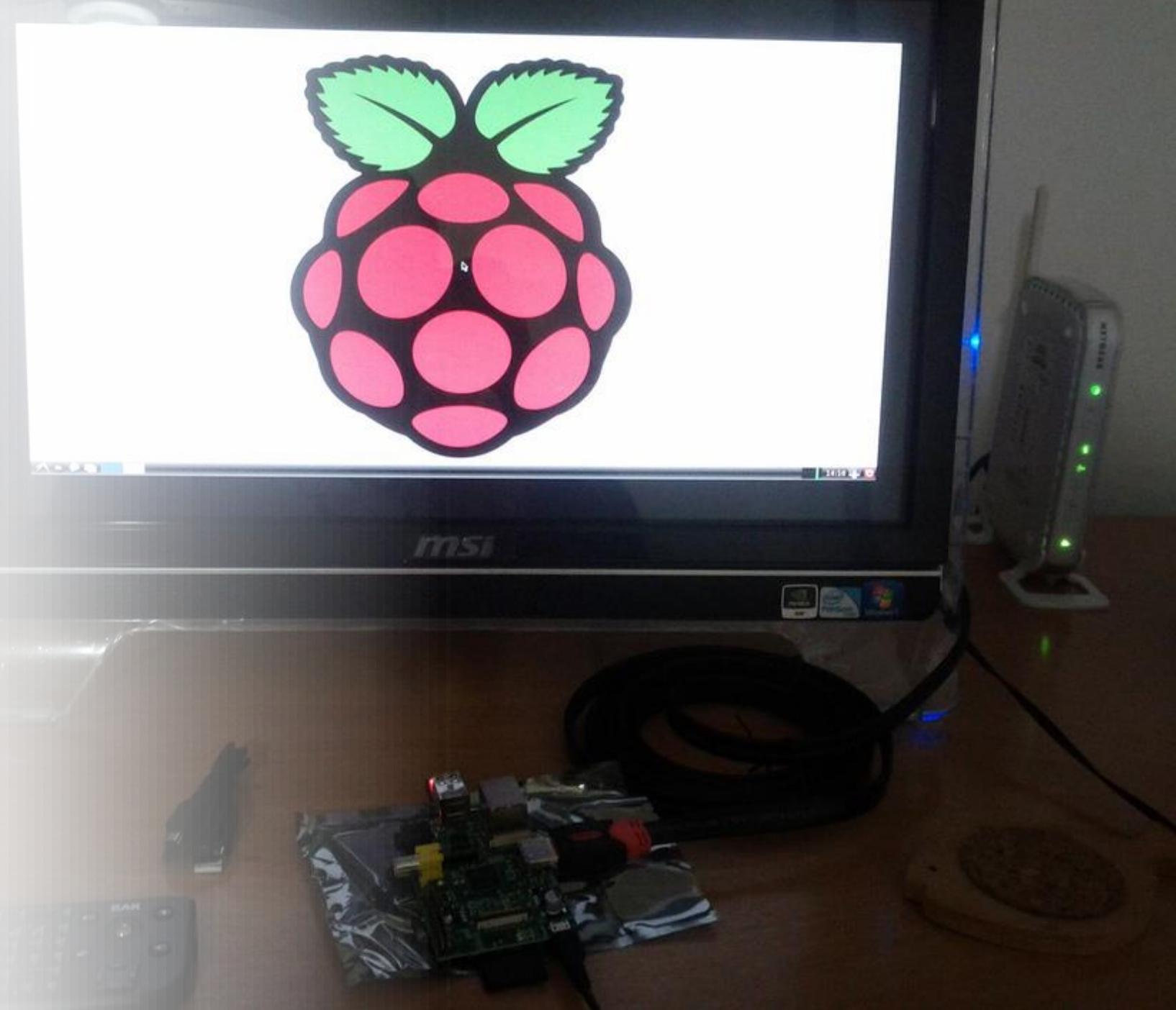
# Raspberry Pi - Hardware

- Processor and Memory (for pi 3 B+)
  - Broadcom 2836 System On Chip
    - 64 bit ARM RISC CPU core (not x86 compatible)
    - Videocore IV GPU
  - Default clock is 1200Mhz. Overclocking not permitted in Rpi-3
  - GPU is basically as powerful as what was on the original Xbox
- Mass Storage: micro SD card
  - Any SD card
  - Kernel boots from SD card
  - Easy to access root FS on other device



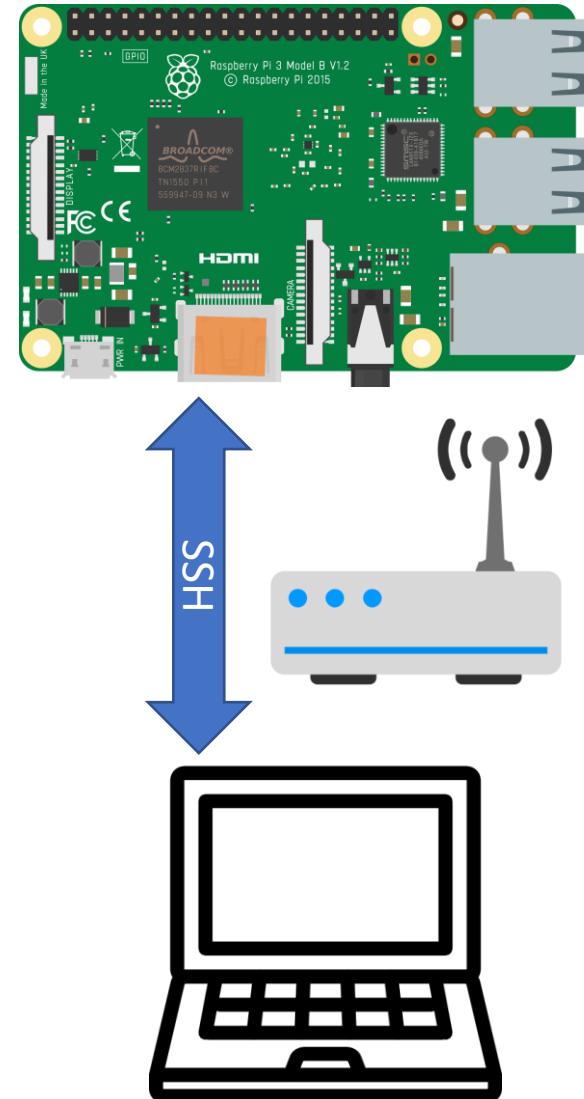
# Getting Started - Conventional

- Raspberry Pi 3 B
- Keyboard and mouse
- HDMI display monitor
- SD Card (8 GB+ recommended)
- SD Card Reader (usually a laptop)



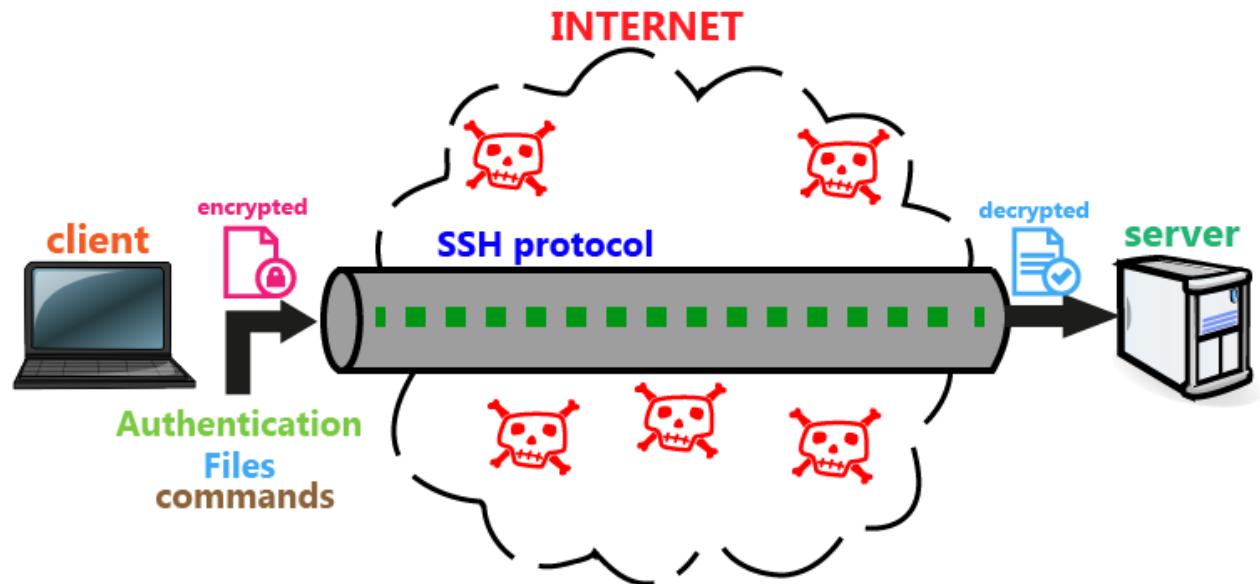
# Getting Started – Headless

- Raspberry Pi 3 B or higher
- ~~Keyboard and mouse~~
- ~~HDMI display monitor~~
- SD Card (8 GB+ recommended)
- SD Card Reader (usually a laptop)
- Accessible WiFi network



# Secure Shell (SSH)

- Cryptographic Network Protocol for operating over an unsecured network.
- Typically used for remote command-line, login, and remote command execution.
  - Can use with Rpi to remotely log in/open remote terminal
  - Can also set up Routers/Switches with SSH to remotely configure them.
- Replaces unsecure Telnet
- In our mode of operation, use automatically generated public-private key pairs to simply encrypt a network connection.
  - list of authorized public keys is typically stored in the home directory of the user that is allowed to log in remotely.



# SSH:

---

- SSH is present on most Operating Systems
  - MAC, Linux, Windows 10+
- SSH widely used in Cloud Computing
  - Access remote VMs in the cloud using SSH
  - You will see it again in Dev Ops
- [https://www.youtube.com/watch?v=Atbl7D\\_yPg](https://www.youtube.com/watch?v=Atbl7D_yPg)

www.brianlinkletter.com

**Control an Amazon  
EC2 server from an  
Apple iPad using  
SSH and VNC |  
Open-Source  
Routing and Netw...**



# Using Secure Shell

At command line, connect to remote server using ssh command with user name and address(either IP or Domain Address) of remote server:

```
ssh UserName@SSHserver.com  
ssh pi@10.1.1.234
```

If it's the first connection between the host and the server, you will be prompted with the remote host's public key fingerprint and prompted to connect, despite there having been no prior connection:

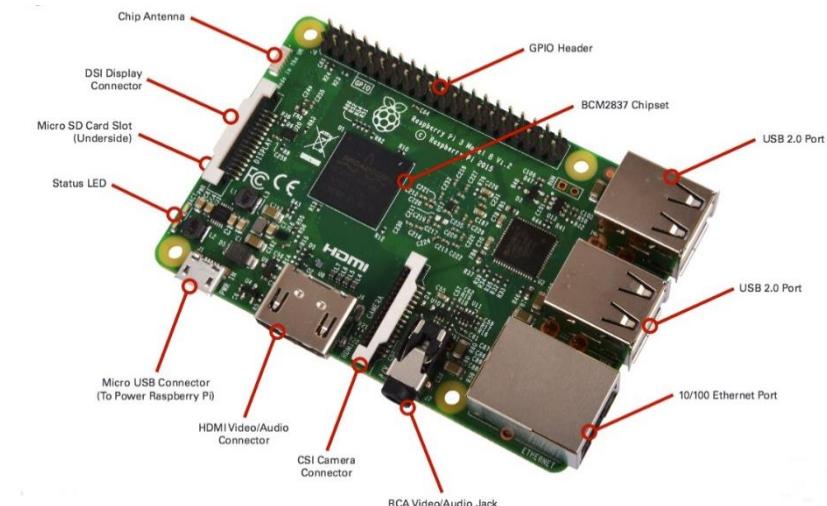
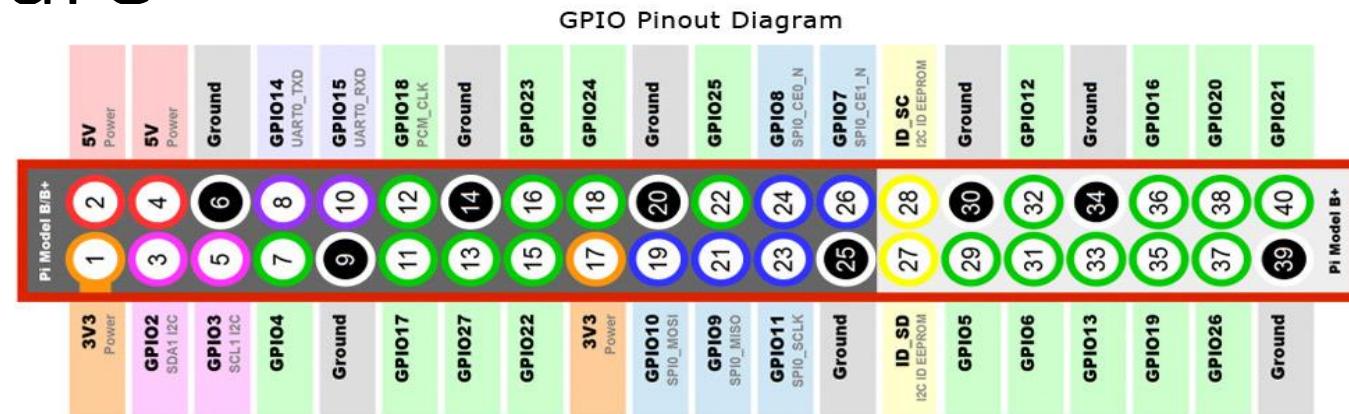
```
compsys@compsys-virtualbox:~$ ssh pi@192.168.1.153  
The authenticity of host '192.168.1.153 (192.168.1.153)' can't be established.  
ECDSA key fingerprint is SHA256:0BDXaffVubs342AfeSSMwCn8tUJpvfWWLlbCcDluewc.  
Are you sure you want to continue connecting (yes/no/[fingerprint])? y  
Please type 'yes', 'no' or the fingerprint: yes  
Warning: Permanently added '192.168.1.153' (ECDSA) to the list of known hosts.  
pi@192.168.1.153's password:  
Linux sensePi 5.10.63-v7+ #1457 SMP Tue Sep 28 11:25:31 BST 2021 armv7l
```

The programs included with the Debian GNU/Linux system are free software; the exact distribution terms for each program are described in the individual files in /usr/share/doc/\*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent permitted by applicable law.  
Last login: Tue Oct 12 16:09:30 2021 from 192.168.1.104  
pi@sensePi:~ \$ █

# Raspberry Pi - Hardware

- General Purpose I/O (GPIO)
  - 3.3 volt logic via 40 pin header
    - NOT 5 volt or short tolerant
  - Parallel I/O pins
  - UART (Linux console support)
  - I2C, SPI for peripherals
  - No Analog to Digital/D, so no analog input
  - Can do software-based PWM
  - Libraries exist for interacting with the GPIO through several programming languages
- More I/O
  - Display Serial Interface (DSI) LCD panel support
  - Camera Serial Interface (CSI) camera support



# Warning - Don't fry your RPi

- RPis are fairly robust but...
- If using with keyboard/screen
  - Connect the USB keyboard and USB first
  - Connect the HDMI connector
  - Turn on the monitor
- Plug in the power cable
  - Do not plug in the SenseHat when the RPi is plugged in and booted into Raspian.
  - ALWAYS plug in the HAT before plugging in the power cable.

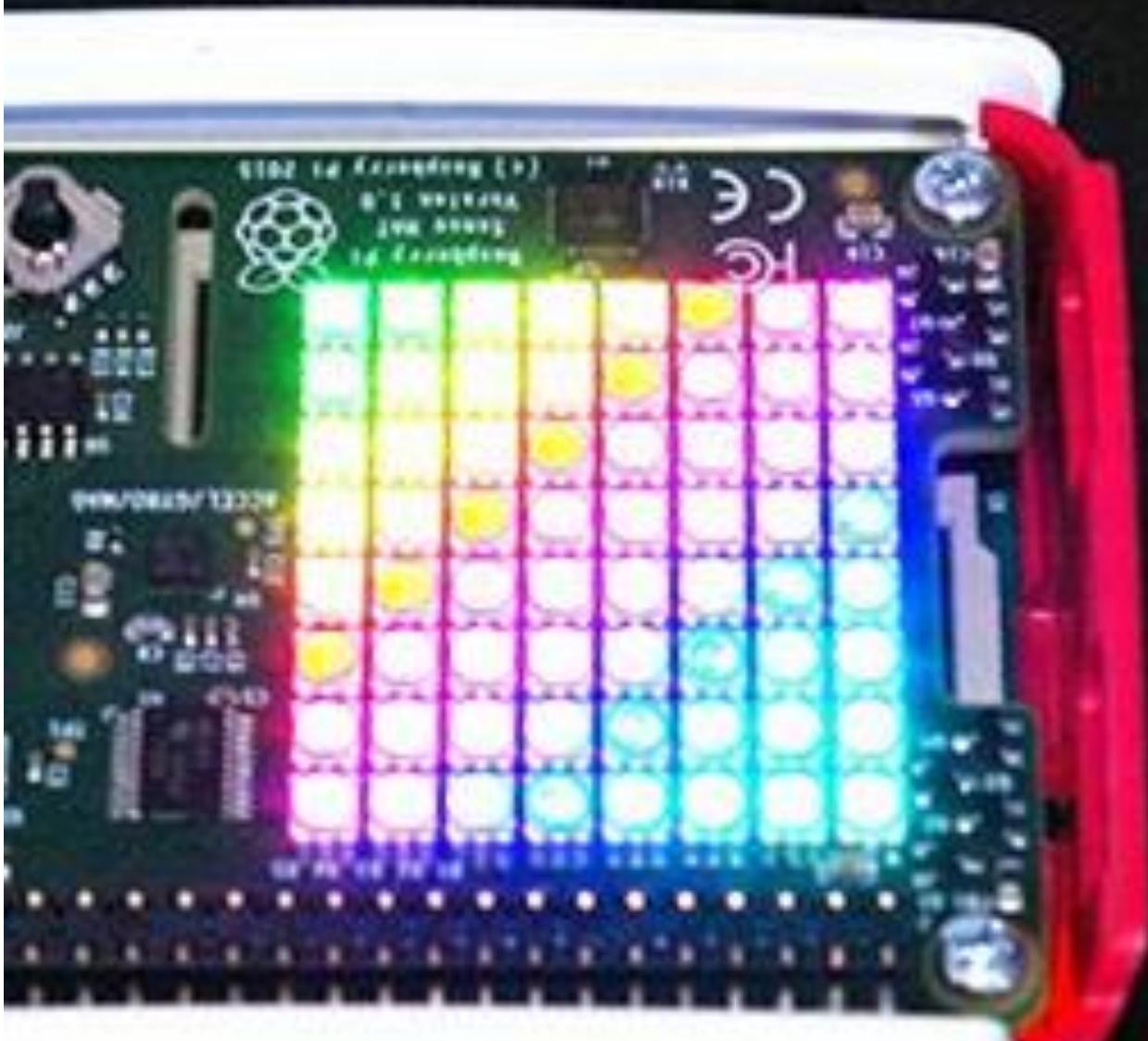


# Warning - Don't fry your Rpi Physical Stuff....

- If you're doing some "physical computing"
  - Input no more than 3.3V to a GPIO
  - Use GPIO.cleanup() to set the GPIO pins back to a safe state; input only
- Current load should be less than 16mA on any one GPIO pin
- Current load should be less than 100mA for all GPIO pins
- Do not connect a motor directly to the Pi's GPIO, the back EMF(Electromotive Force) will fry the Pi;
  - Use a transistor

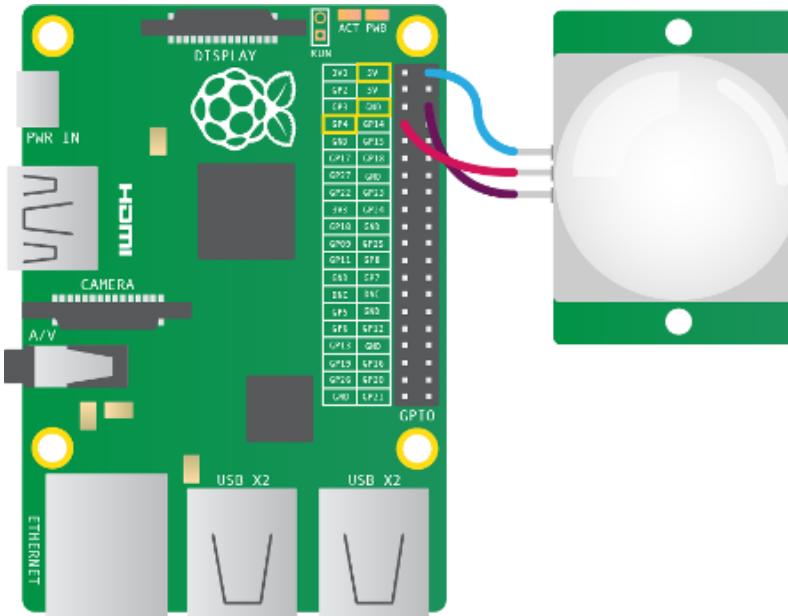
# SenseHAT

- HAT stands for Hardware Attached on Top.
- Several HATs available for RPi.
  - These are external boards you can purchase that plug right into the GPIOs.
- We're using SenseHAT
  - 8×8 RGB LED matrix
  - five-button joystick and includes the following sensors:
    - Gyroscope
    - Accelerometer
    - Magnetometer
    - Temperature
    - Barometric pressure
    - Humidity
- Also a [Python library](#) provides an easy programmatic interface to everything on the board.



# Other things you can do with RPi – Physical Computing

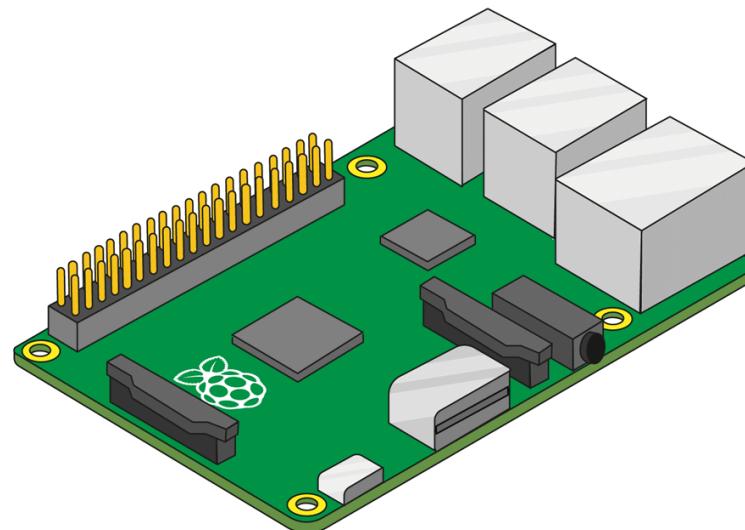
- Can interface with many different devices/components
- Use the GPIO pins on your Raspberry Pi to interface with electronic components, such as LEDs and PIRs.
- Write programs that interact/control attached components



# Setting Up Your Pi - Attaching the SenseHAT

- Follow the instructions here:

<https://projects.raspberrypi.org/en/projects/getting-started-with-the-sense-hat/3>



# Setting up your RPi – Installing an OS

- If you bought your RPi with a pre-installed SD card you're good to go.
- If you have a blank SD card, do this weeks lab!
- Supported OS
  - Raspbian (Debian optimized for Rpi)
  - Debian (non-optimized)
  - Arch Linux
  - RISC OS
  - NetBSD
  - OpenELEC – an XBMC media center
  - Pidora – Fedora remix

