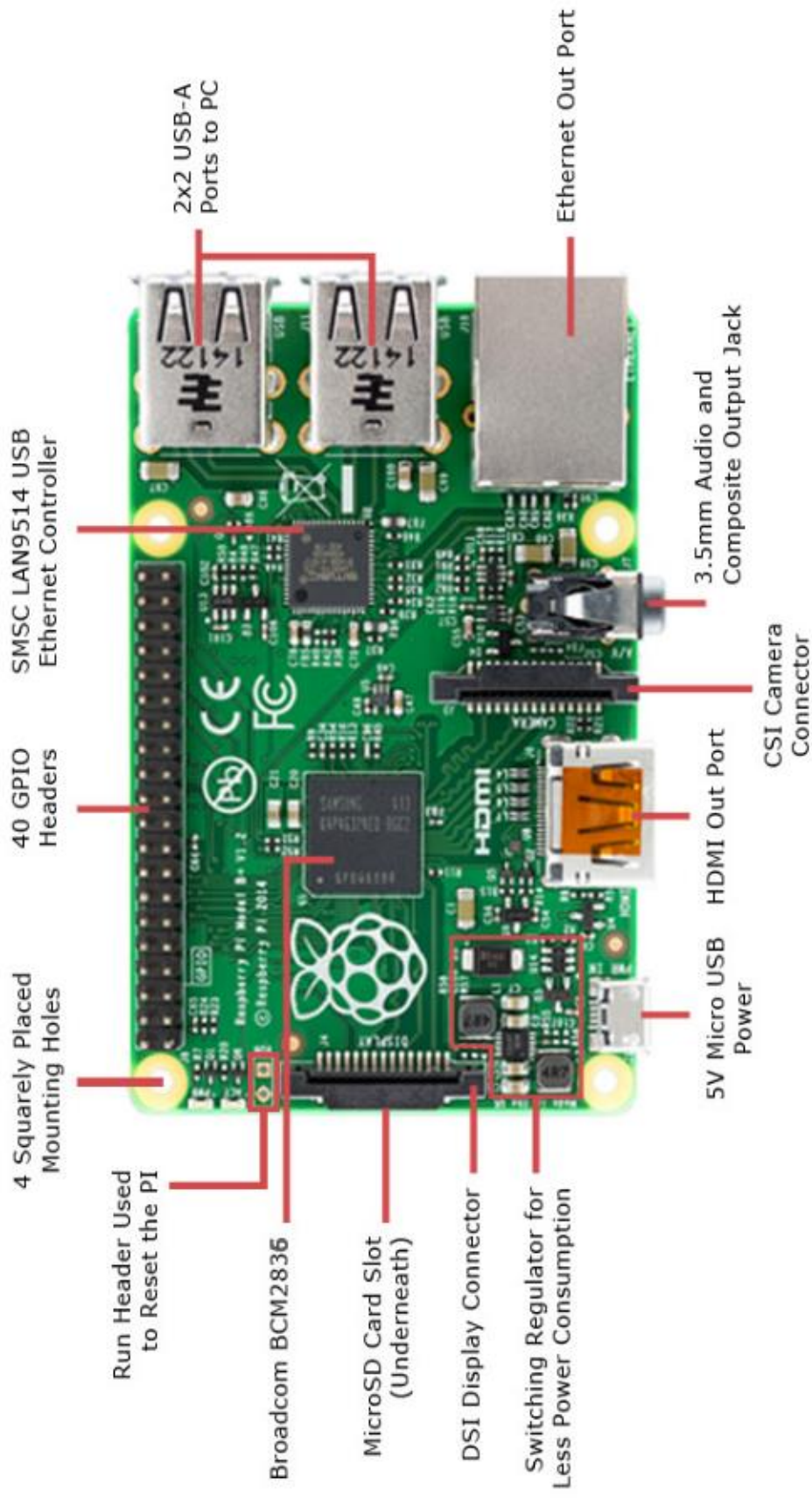
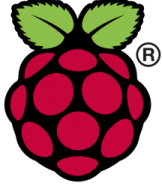



# Raspberry Pi and Basic Linux

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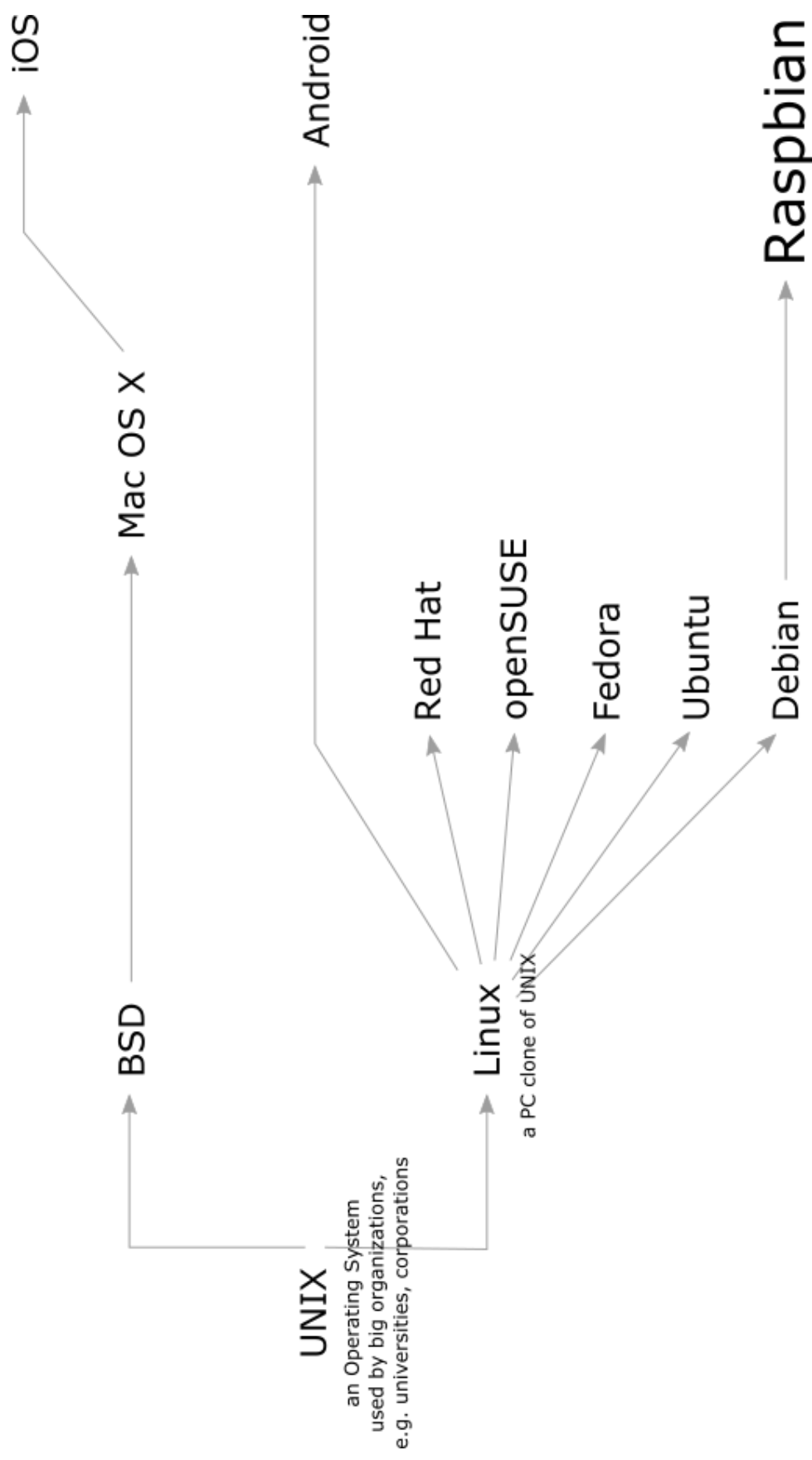
# Raspberry Pi 3 Model B+ vs Arduino

		
	Micro-computer	Micro-controller
	Has OS  Run your program along with many others	No OS  Run your program ONLY
	Python, NodeJS, Ruby, Java, C, C++, etc.	C++
	Knowledge of Linux required	Program and debug on Windows
GPIO pins	Digital only	Analog and digital
Processor	BCM2837 (Broadcom)	ATmega (Atmel)
Speed	1.4 GHz, quad-core	8-16 MHz
RAM	1 GB	32-256 KB

From official documentations:

[Pi 3] can still be run from a 5V micro-USB power adapter ... we're recommending a 2.5A adapter if you want to connect power-hungry USB devices to the Raspberry Pi.

# A Simplified UNIX Family Tree



# Prepare an SD card

1. Download **Raspbian**, a Linux flavor commonly used for Raspberry Pi.
  - Go to the **Downloads** section on **raspberrypi.org**
  - Find **Raspbian**. Download its zip file.
  - Unzip it. The resulting file is called a **disk image**.
2. Download and install an image burner program.
  - On **Windows**, search for **Win32DiskImager**
  - On **Mac**, search for **Pi Filler**
  - Cross-platform: **Etcher**
3. With the program you have just installed, burn the Raspbian image onto an SD card.

**To enable SSH on first startup, manually insert a file named "ssh" (without the quotes, contents don't matter) into the boot partition.** For more details, refer to:

<https://www.raspberrypi.org/blog/a-security-update-for-raspbian-pixel/>

4. Insert the SD card to a Raspberry Pi.

# Initial Configuration

```
$ sudo raspi-config
```

- **Change User Password:** Doesn't really matter, but good practice.

Notice that, as you type the password, the cursor NEVER moves. This is normal. Linux does not reveal the length of password as you type. If you type wrong, **[backspace]** all the way to start anew, or just **[enter]** to give yourself another chance.

If you do not change password, the default is:

User: **pi**

Password: **raspberry**

- **Network Options → Hostname:** Change the computer's name, so it is more easily recognized on the network.
- **Interfacing Options → SSH → Yes:** Enable SSH server, so you can login remotely.
- **Interfacing Options → VNC → Yes:** Enable VNC server, so you can use the graphical desktop remotely.
- **Finish and Reboot.**

After reboot, update the system:

```
$ sudo apt-get update
```

```
$ sudo apt-get upgrade
```

# Install LCD driver

```
$ wget https://github.com/waveshare/LCD-show/archive/master.zip  
$ unzip master.zip  
$ cd LCD-show-master  
$ sudo ./LCD5-show
```

It should reboot, and you should see system messages printing on LCD as it is starting up.

# Calibrate touchscreen

The mouse pointer is not entirely accurate. The touchscreen needs calibration.

```
$ sudo dpkg -i -B xinput-calibrator_0.7.5-1_armhf.deb
$ DISPLAY=:0.0 xinput_calibrator
```

**DISPLAY=:0.0** to force graphical display to LCD screen.

There will be a prompt for **four-point calibration** on the LCD screen. Click the points one by one to finish the process.

The new calibration data should be displayed in the terminal, like this:

```
Section "InputClass"
    Identifier      "calibration"
    MatchProduct    "ADS7846 Touchscreen"
    Option "Calibration"    "162 3988 195 3862"
EndSection
```

Put them in the file `/etc/X11/xorg.conf.d/99-calibration.conf` to make the calibration permanent.

Reboot and check the touchscreen again.

**The LCD may turn dark after a period of inactivity.** Don't panic. Touch it to turn it back on.



# VNC

On a PC within the same network:

1. Download **RealVNC viewer**
2. Connect to Pi's IP address

You may find the desktop resolution very small. To make it bigger, you may create a new desktop:

```
$ vncserver -geometry 1000x800
```

Take note of the **IP address:display number** printed out, e.g.  
192.168.0.103:1

Connect to that <IP address:display number>.

For more tips on using Raspberry Pi:

**<https://www.raspberrypi.org/documentation>**

# 如何找出 IP 地址？

1. LCD 螢光幕：將滑鼠箭咀移至右上角網路 **icon** 上
2. Router：登入**路由器**管理介面（通常是 192.168.?.1），查看 **DHCP 使用者列表**之類。
3. *hostname.local*：電腦需要支援 **multicast DNS**
4. Network scan：下載一個**網絡掃描軟件**，掃吓內聯網有什麼電腦、什麼 IP。

掃描軟件可試吓 Advanced Port Scanner 或 Angry IP Scanner，或 Fing 手機應用程式。

5. Plug n Pi：下載 **Plug n Pi** 手機應用程式，以 **USB 線**連接手機及樹莓批，手機就可查看樹莓批的 IP 地址。

手機必須是 Android。樹莓批必須裝有 Plug n Pi Server 軟件。

熟習 **Linux** ，  
事半功倍。

# ls

list

**ls**

What things are there?

**ls -l**

Give me more details.

**ls -a**

Show me the hidden stuff (those starting with a dot).

**ls -l -a**

Chain two options together to double the benefits.

**ls -la**

You may also chain them like this.

**ls -tl**

Sort by date.

**ls *directory***

What is in that directory?

**man ls**

Explain this command.

**ls --help**

Another way to explain this command.

But the output overflows the page, what can I do?

# cd

change directory

**cd** *directory*

Go to a directory.

**cd** ..

Go up a level.  
Double-dot means the parent directory.

**cd** .

Stay in the same directory.  
Single-dot means the current directory.

In practice, you never do this. It is here for educational purposes only.

**cd** ~

Go back to home directory.  
The tilde (~) means home directory.

**cd**

Go back to home directory. Equivalent to **cd** ~.

# pwd

print working directory

**pwd**

Where am I?

## cp

copy

**cp** *oldfile newfile*

Make a copy of *oldfile*, and name it *newfile*.

**cp -r** *olddir newdir*

Copy an entire directory.

“-r” means “recursive”. That is, copy sub-directories, and their sub-directories, and their sub-directories, and so on.

Type **cp --help** or **man cp** to review the options.

## mv

move or rename

**mv** *oldfile newfile*

*oldfile* now becomes *newfile*.

**mv** *file dir*

Move file to directory.

## **rm**

remove

**rm** *filename*

Delete a file.

**rm -r** *directory*

Delete a directory.

“-r” means “recursive”. That is, delete sub-directories, and their sub-directories, and their sub-directories, and so on.

## **mkdir**

make directory

**mkdir** *directory*

Create a new directory.

## **rmdir**

remove directory

**rmdir** *directory*

You can only remove an empty directory. Delete everything inside first, or use **rm -r**.

# nano

a text editor

**nano**

When you want to write something,  
bring up a text editor.

**nano** *filename*

Edit an existing file.

Two shortcuts you need to know, for  
now:

Ctrl-O to save

Ctrl-X to exit



# more or less

show text content, or show output page-by-page

**less** *filename*

Display file content.

If content is longer than one page:

- Use ← ↑ ↓ → **[Page Up/Down]** to navigate
- Type **q** to quit.

**ls --help | less**

Display the preceding command's output in a page-by-page manner.

"|" is called a "pipe". We will see more of it later.

If you have trouble typing the "|":

1. Enter **sudo raspi-config**
2. Select **Internationalisation options**
3. Select **Change Keyboard Layout**, this may take a while.
4. Linux should have detected the keyboard for you. Press **[enter]**.
5. Then, it asks for Keyboard Layout. Default is English (UK). DO NOT trust that. You should select **Other**, then **English (US)**, then **English (US)** again.
6. Finally, it asks a few more questions. Press **[enter]** to skip all of them.
7. **Finish** and **reboot**.

# sudo reboot, sudo halt -h

Reboot and shutdown

`sudo reboot`

“sudo” means “superuser do”.  
You cannot reboot the machine as an ordinary user. You must turn yourself into a *superuser* first.

`sudo halt -h`

To shutdown the machine, you also have to be a superuser.

Type **halt --help** or **man halt** to review the options.

DO NOT unplug the power until Raspberry Pi is completely shut down. The SD card may be corrupted if power is pulled prematurely.

Pay attention to the **blinking lights** on Raspberry Pi. Wait until only **one steady red light** is left and all other lights are dead. That’s when you can unplug the power safely.

How do you turn it on again? Just re-plug the power.

# find

look for files with certain properties

```
find . -name *.wav
```

Any .wav files in current directory?

```
find python_games -name *.py
```

Any .py files in python\_games directory?

```
find . -type d
```

Any directories in current directory?  
“-type d” tells it to show directories only.

```
find directory -type f
```

Any files in that *directory*?  
“-type f” tells it to show files only.

Type **man find** or **find --help** to learn more.

# grep

look for lines with certain words

```
grep -lr import  
python_games
```

Which files in `python_games` contain the word “import”?

```
grep -Hr word  
directory_or_file
```

Try the command with the `-H` option. What are the differences?

You may look for any *word* in any *directory or file* with this command.

```
ps aux
```

It tells you what processes are running on the Raspberry Pi. The output is usually very long. What can you do?

```
ps aux | less
```

You may “pipe” it to a **less** command to read the information page-by-page.

```
ps aux | grep ssh
```

Sometimes, you want to look for a process to see if it is running, or how many of it are running.

For example, if you want to list all ssh-related processes, you may “pipe” the output to a **grep** command that looks for “ssh” and only shows those lines.

# Other useful commands

`ps` - report a snapshot of current processes

`top` - report current processes in an interactive manner

`kill` - send a signal to a process. As the name implies, it is often used to kill a process.

`dd` - convert and copy a file, often used to create backups.

`df` - report disk space usage

`ifconfig` - network interface information

`wget` - download files from the internet

`tar` - archive and (de)compress files

`unzip` - decompress zip files

# How to find something to kill

Use **ps** or **pgrep** to find the PID (Process ID).

```
$ ps
$ ps aux
$ ps aux | grep ssh
$ ps aux | grep python
$ pgrep ssh
```

Use **kill** (with **-9** option if necessary) to kill.

```
$ kill 1234
$ kill -9 1234
```

Always remember that you are logged in as the user **pi**. To kill a process belonging to the user **root**, you have to **sudo**.

Think twice before you **sudo kill** something.