

Linux Administration

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2016/11/19 @CYCU

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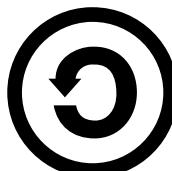
姓名標示 — 非商業性 — 相同方式分享



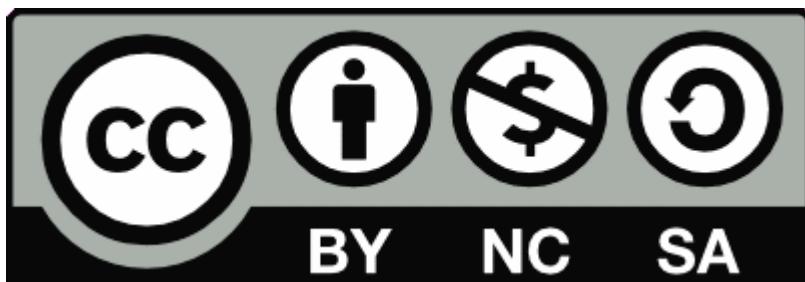
姓名標示 — 你必須給予 適當表彰、提供指向本授權條款的連結，以及 指出（本作品的原始版本）是否已被變更。你可以任何合理方式為前述表彰，但不得以任何方式暗示授權人為你或你的使用方式背書。



非商業性 — 你不得將本素材進行商業目的之使用。



相同方式分享 — 若你重混、轉換本素材，或依本素材建立新素材，你必須依本素材的授權條款來散布你的貢獻物。



今日主題

- 環境設定 : Serial + WiFi
- 基礎設定
 - 使用者帳號管理，檔案權限，檔案系統結構，壓縮與打包
- 網路與服務設定
 - 常用網路指令，程序管理，系統服務，軟體安裝與管理
- 伺服器架設
- 開機流程介紹

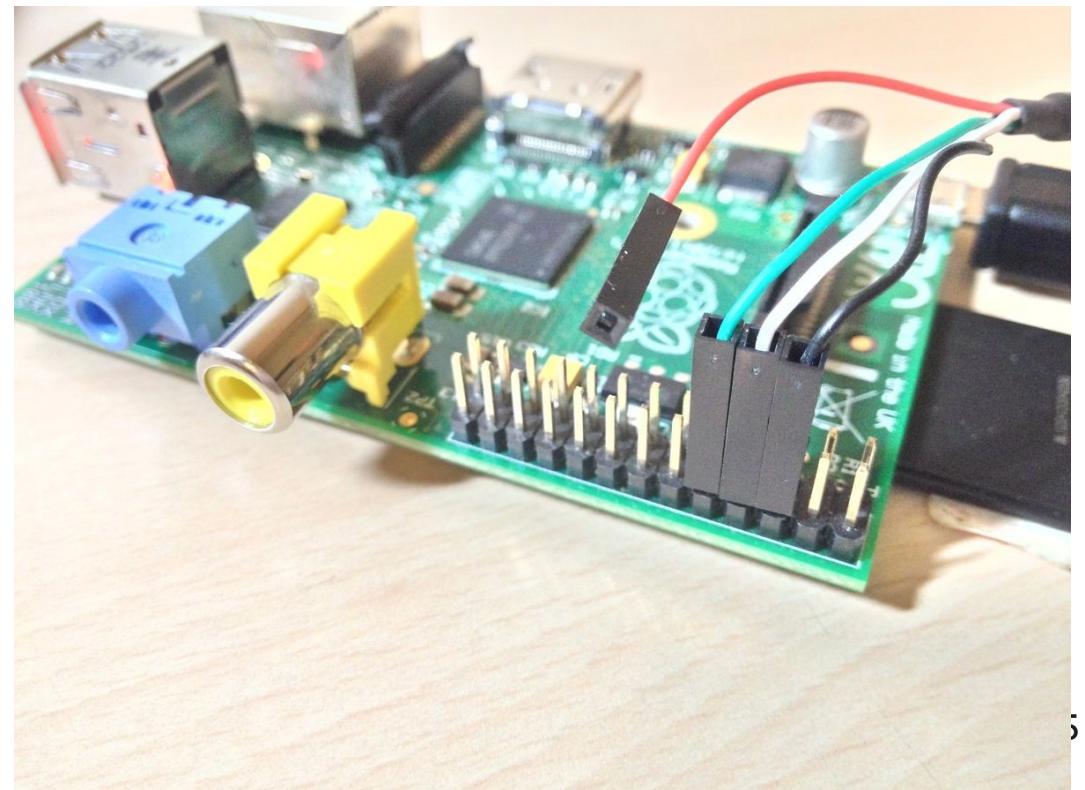
環境設定: Serial + WiFi

用 Serial 來設定 WiFi



Serial 連線方式

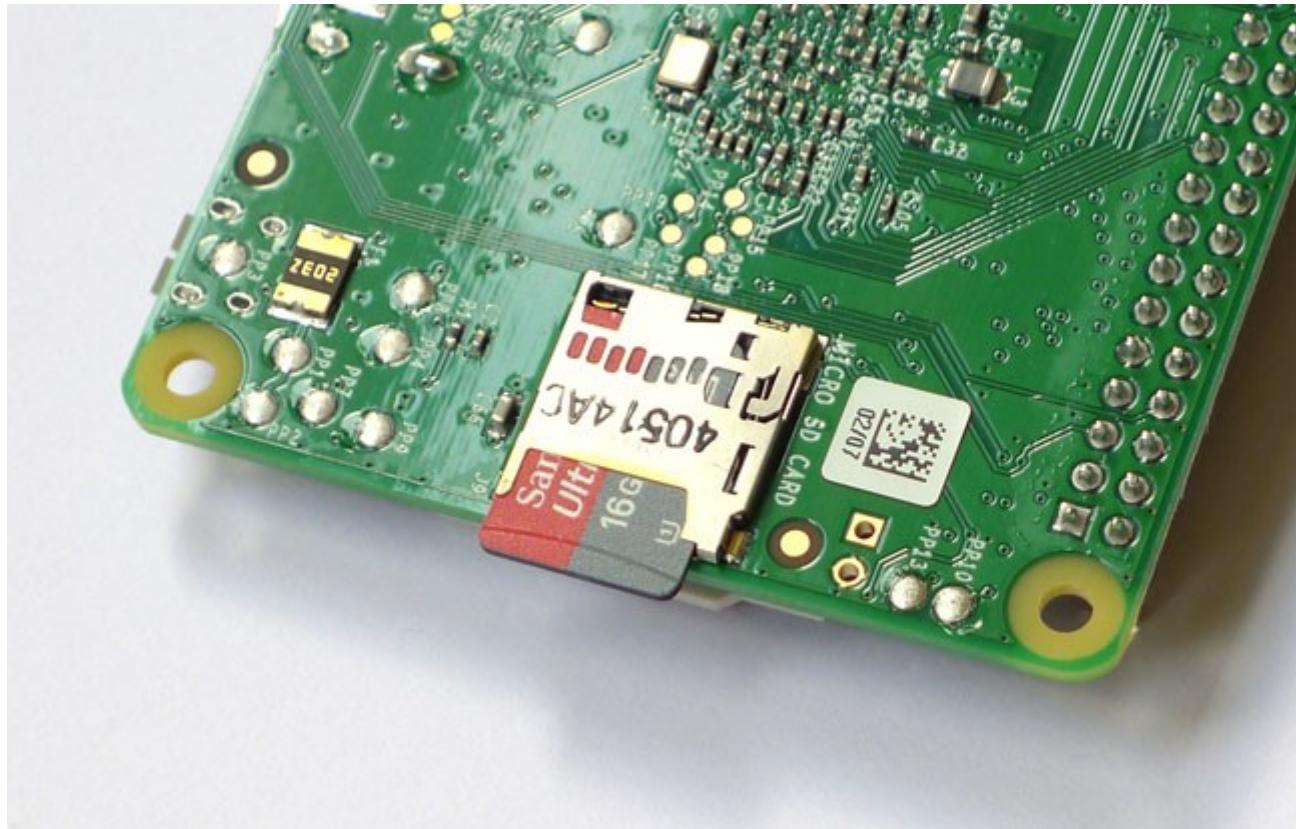
- 以 USB 轉 TTL 傳輸線和 Pi 相連
- 接線方式
 - 黑色 / 白色 / 綠色照圖接
 - 紅色不接



放大圖



將 microSD 卡插到 Pi 上

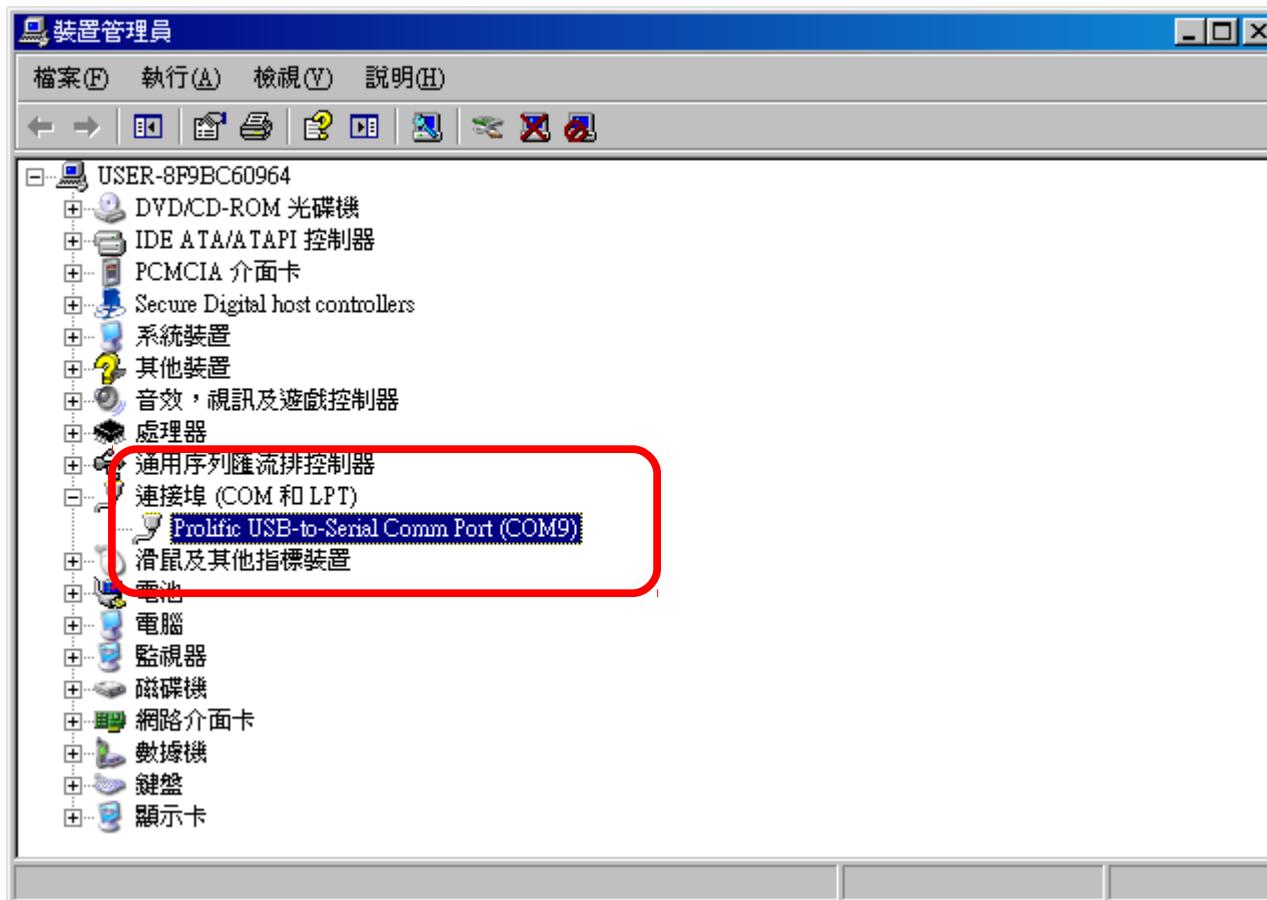


PL2303 接好後上電



Serial Port in Windows

- 安裝驅動程式 , <http://goo.gl/QC5Q30>
- 從裝置管理員找到 COM 的埠號 (本例為 COM9)



Serial Port in Windows - 2

- 下載 putty , <http://goo.gl/zdD9G9>

Binaries

The latest release version (beta 0.67)

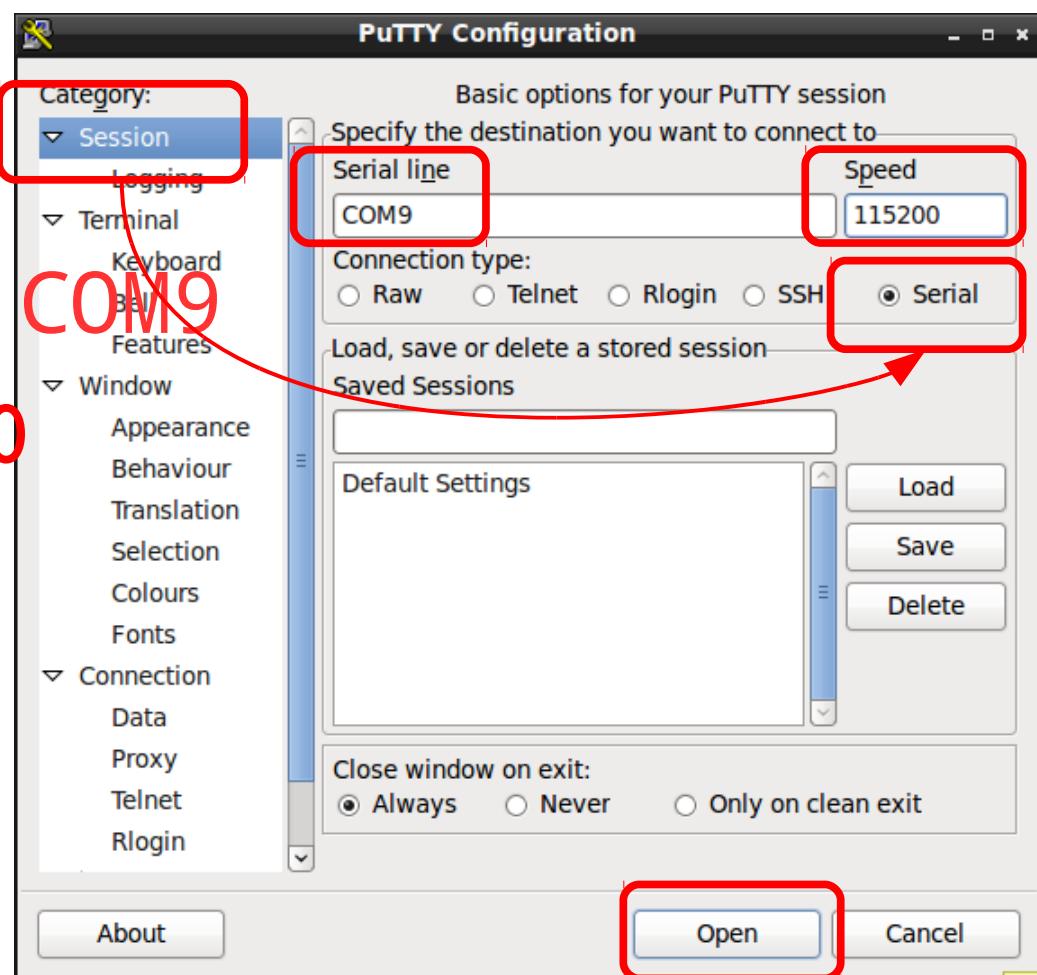
This will generally be a version we think is reasonably likely to work well. If you have a problem already fixed the bug, before reporting it.

For Windows on Intel x86

PuTTY:	putty.exe	(or by FTP)	(signature)
PuTTYtel:	puttytel.exe	(or by FTP)	(signature)
PSCP:	pscp.exe	(or by FTP)	(signature)
PSFTP:	psftp.exe	(or by FTP)	(signature)
Plink:	plink.exe	(or by FTP)	(signature)
Pageant:	pageant.exe	(or by FTP)	(signature)
PuTTYgen:	puttygen.exe	(or by FTP)	(signature)

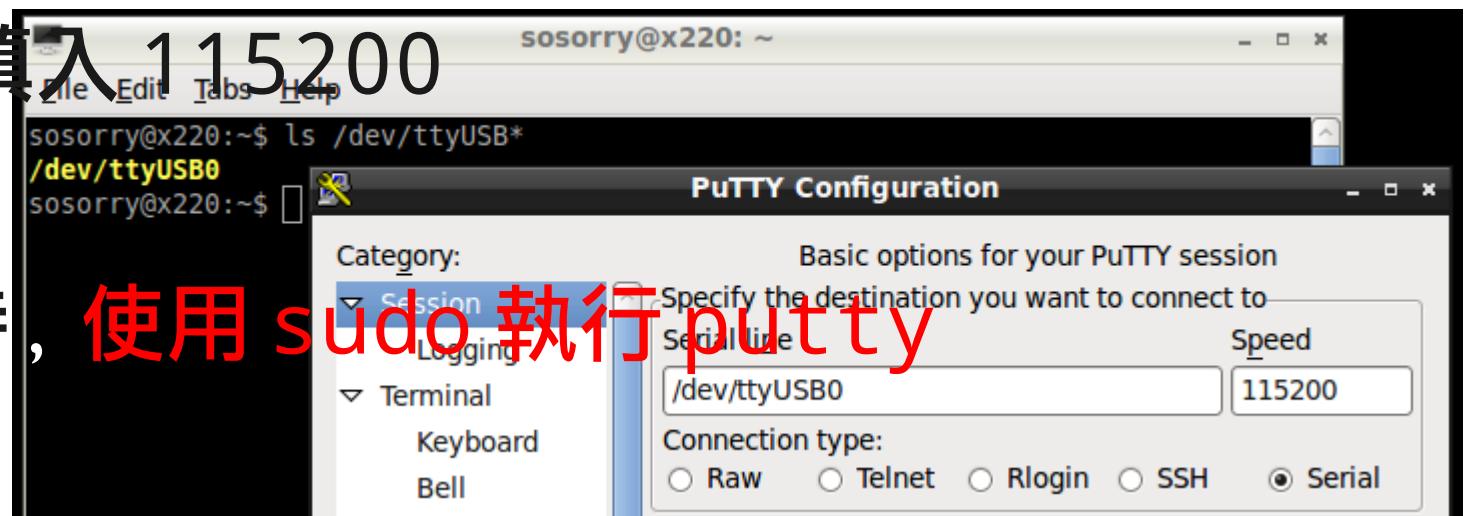
Serial Port in Windows - 3

- 執行 putty
 - 1. 選擇 Session
 - 2. 選擇 Serial
 - 3. Serial line 填 COM9
 - 4. Speed 填入 115200
 - 5. Open !
- 沒畫面，先按 ENTER
- 再不行，重插拔電源



Serial Port in Linux

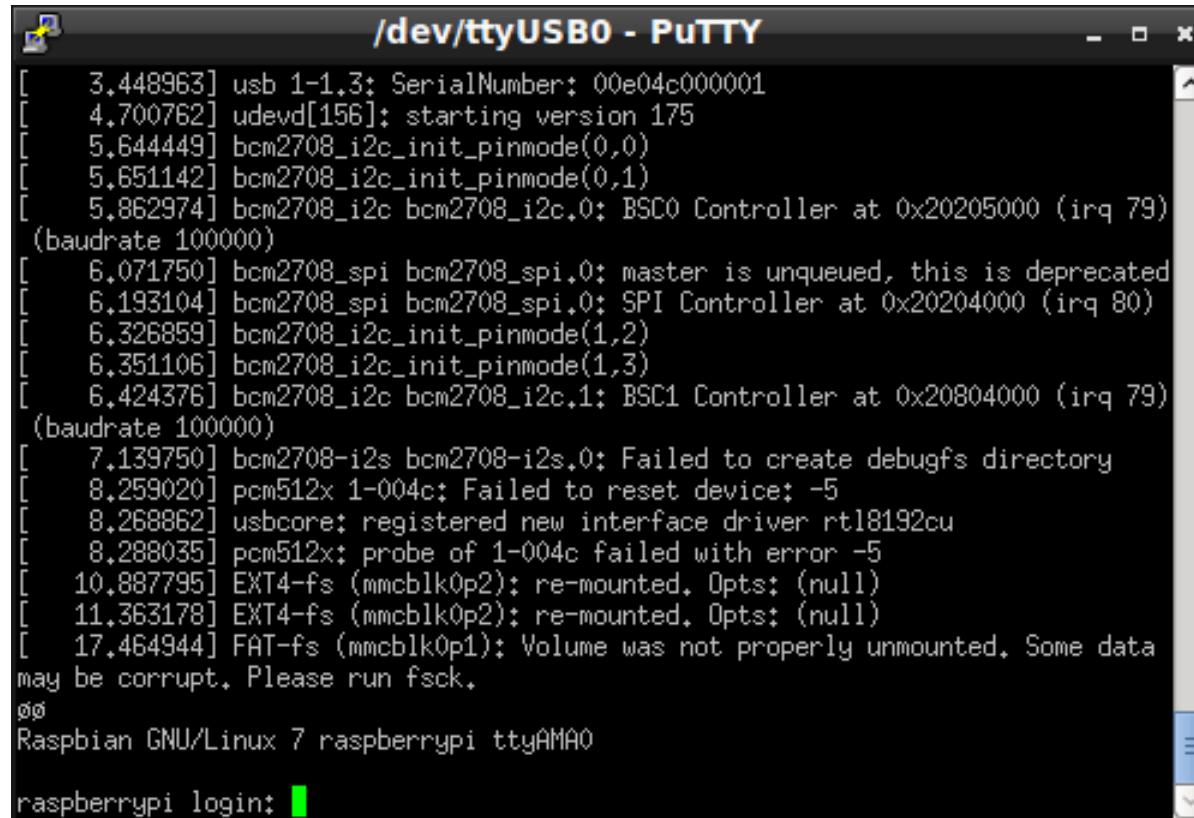
- \$ ls /dev/ttyUSB*
- 開啟 putty
 - 選擇 Session
 - 在 Serial line 填入 /dev/ttyUSB0 (本例為 ttyUSB0)
 - Speed 填入 115200
 - Open !
- 無法連線時，使用 sudo 執行 putty



Serial Port in Mac

- 安裝驅動程式 , <http://goo.gl/ht1t3F>
- 重開機生效
- \$ ls /dev/cu*
- 如果有 /dev/cu.usbserial
- \$ screen /dev/cu.usbserial 115200
 - 如果沒畫面 , 先按 ENTER
 - 再不行 , 重新插拔電源 (PL2303 不要拔)

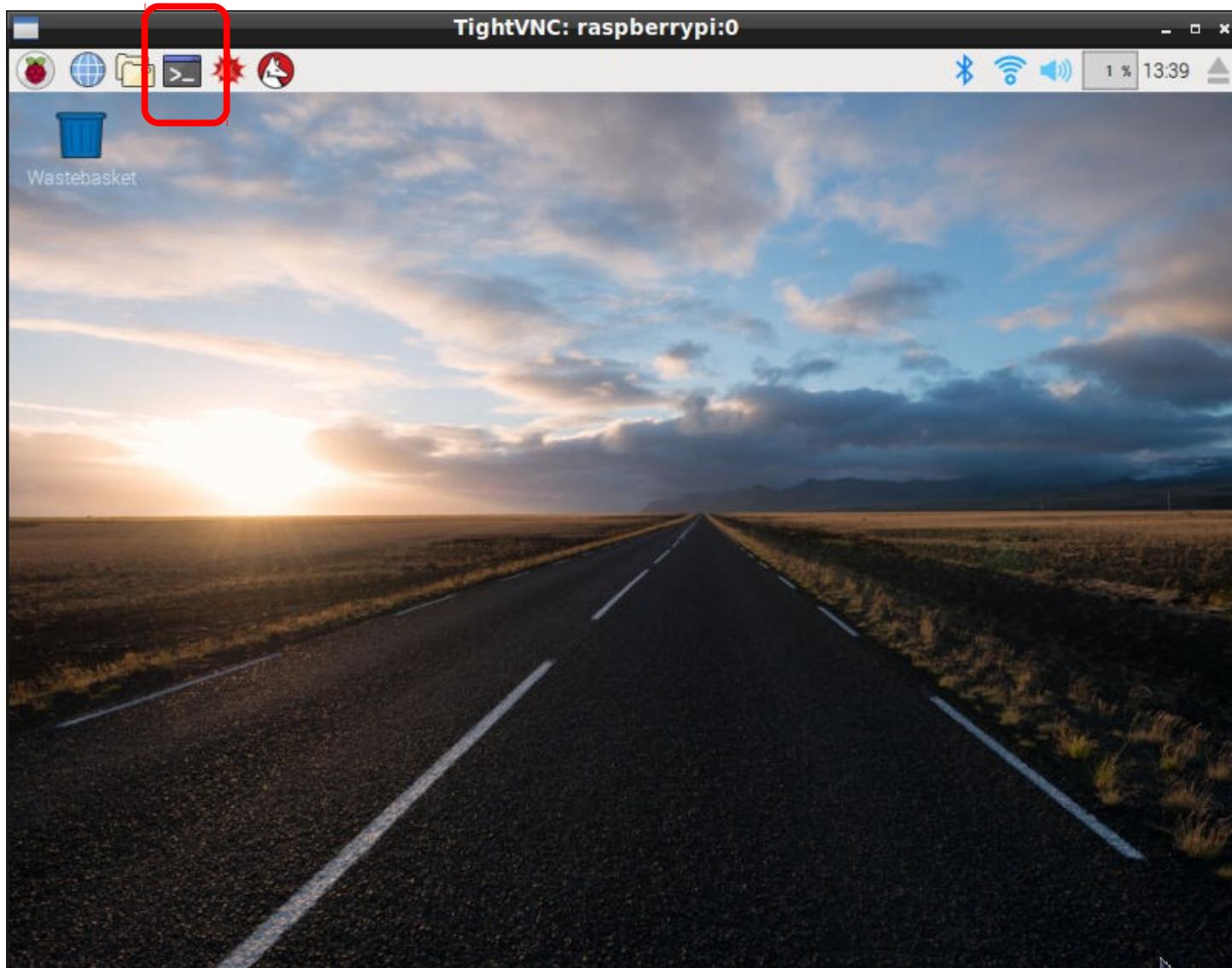
連線成功



```
[ 3.448963] usb 1-1.3: SerialNumber: 00e04c000001
[ 4.700762] udevd[156]: starting version 175
[ 5.644449] bcm2708_i2c_init_pinmode(0,0)
[ 5.651142] bcm2708_i2c_init_pinmode(0,1)
[ 5.862974] bcm2708_i2c bcm2708_i2c.0: BSC0 Controller at 0x20205000 (irq 79)
(baudrate 100000)
[ 6.071750] bcm2708_spi bcm2708_spi.0: master is unqueued, this is deprecated
[ 6.193104] bcm2708_spi bcm2708_spi.0: SPI Controller at 0x20204000 (irq 80)
[ 6.326859] bcm2708_i2c_init_pinmode(1,2)
[ 6.351106] bcm2708_i2c_init_pinmode(1,3)
[ 6.424376] bcm2708_i2c bcm2708_i2c.1: BSC1 Controller at 0x20804000 (irq 79)
(baudrate 100000)
[ 7.139750] bcm2708-i2s bcm2708-i2s.0: Failed to create debugfs directory
[ 8.259020] pcm512x 1-004c: Failed to reset device: -5
[ 8.268862] usbcore: registered new interface driver rt18192cu
[ 8.288035] pcm512x: probe of 1-004c failed with error -5
[ 10.887795] EXT4-fs (mmcblk0p2): re-mounted. Opts: (null)
[ 11.363178] EXT4-fs (mmcblk0p2): re-mounted. Opts: (null)
[ 17.464944] FAT-fs (mmcblk0p1): Volume was not properly unmounted. Some data
may be corrupt. Please run fsck.
@Raspbian GNU/Linux 7 raspberrypi ttyAMA0
raspberrypi login: [REDACTED]
```

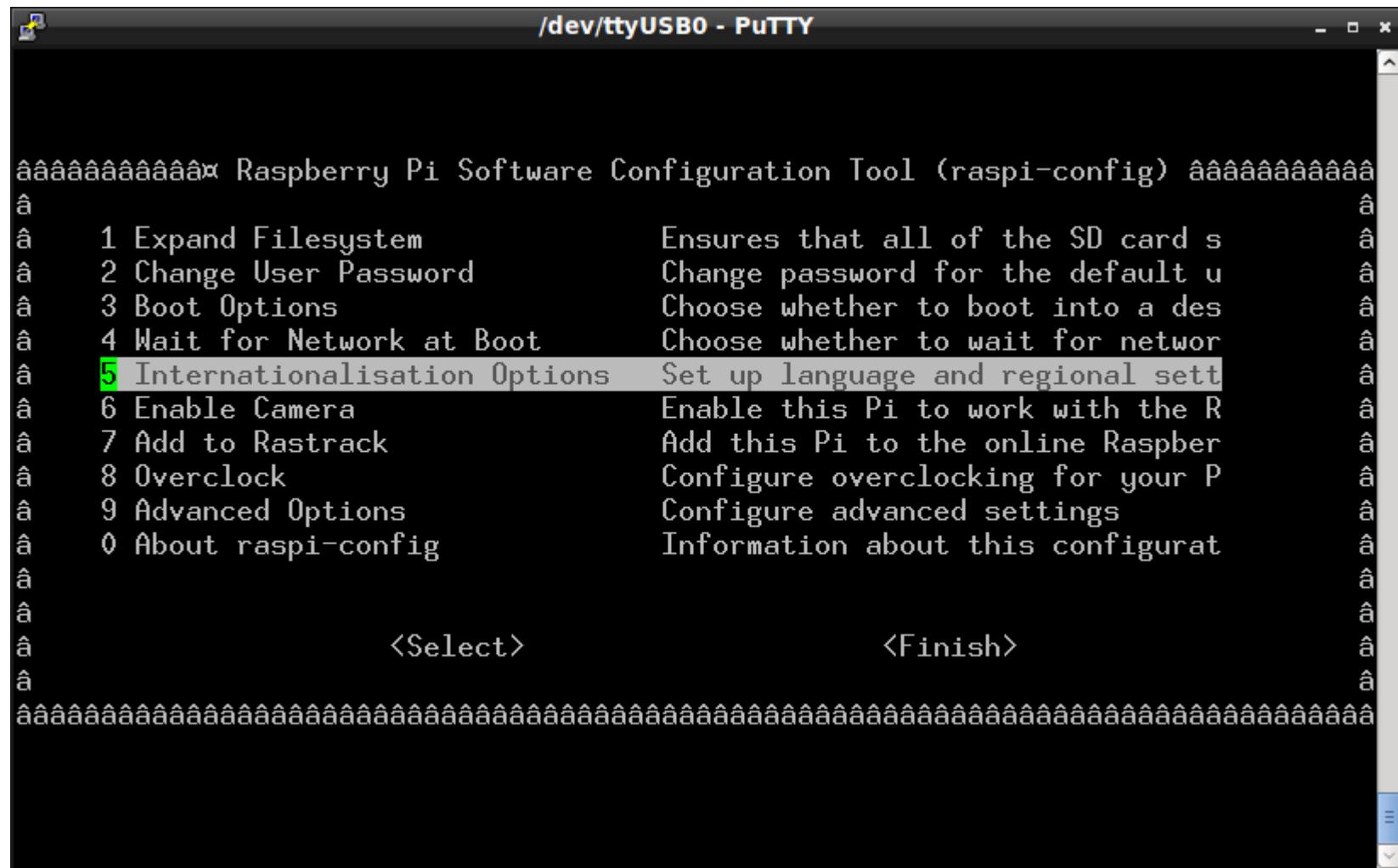
- 預設帳號 / 密碼：pi / raspberry
- 如果沒有畫面，先按 ENTER
- 如果出現亂碼，確定 baud rate 為 115200

接螢幕的同學請修改鍵盤設定

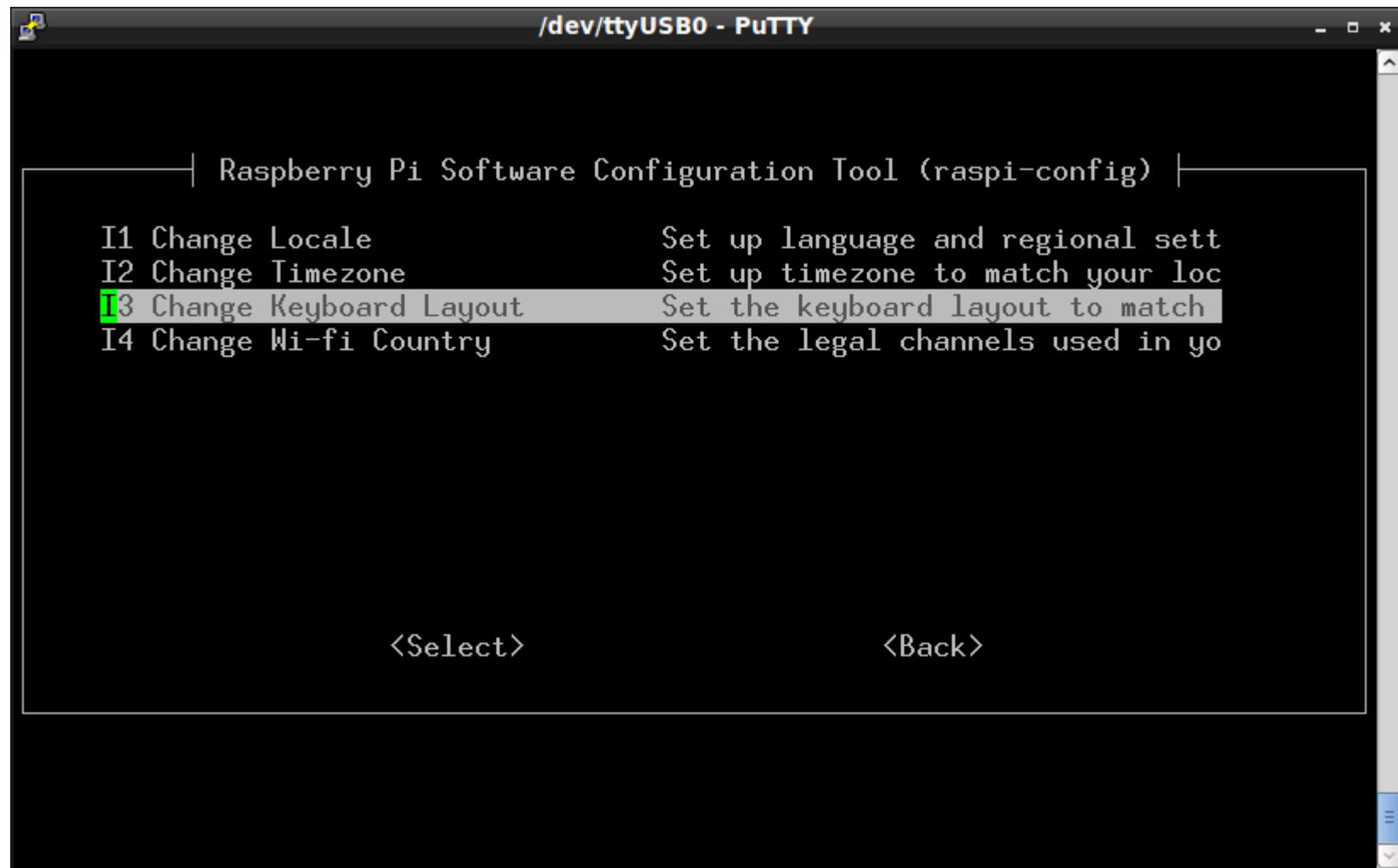


```
$ sudo raspi-config
```

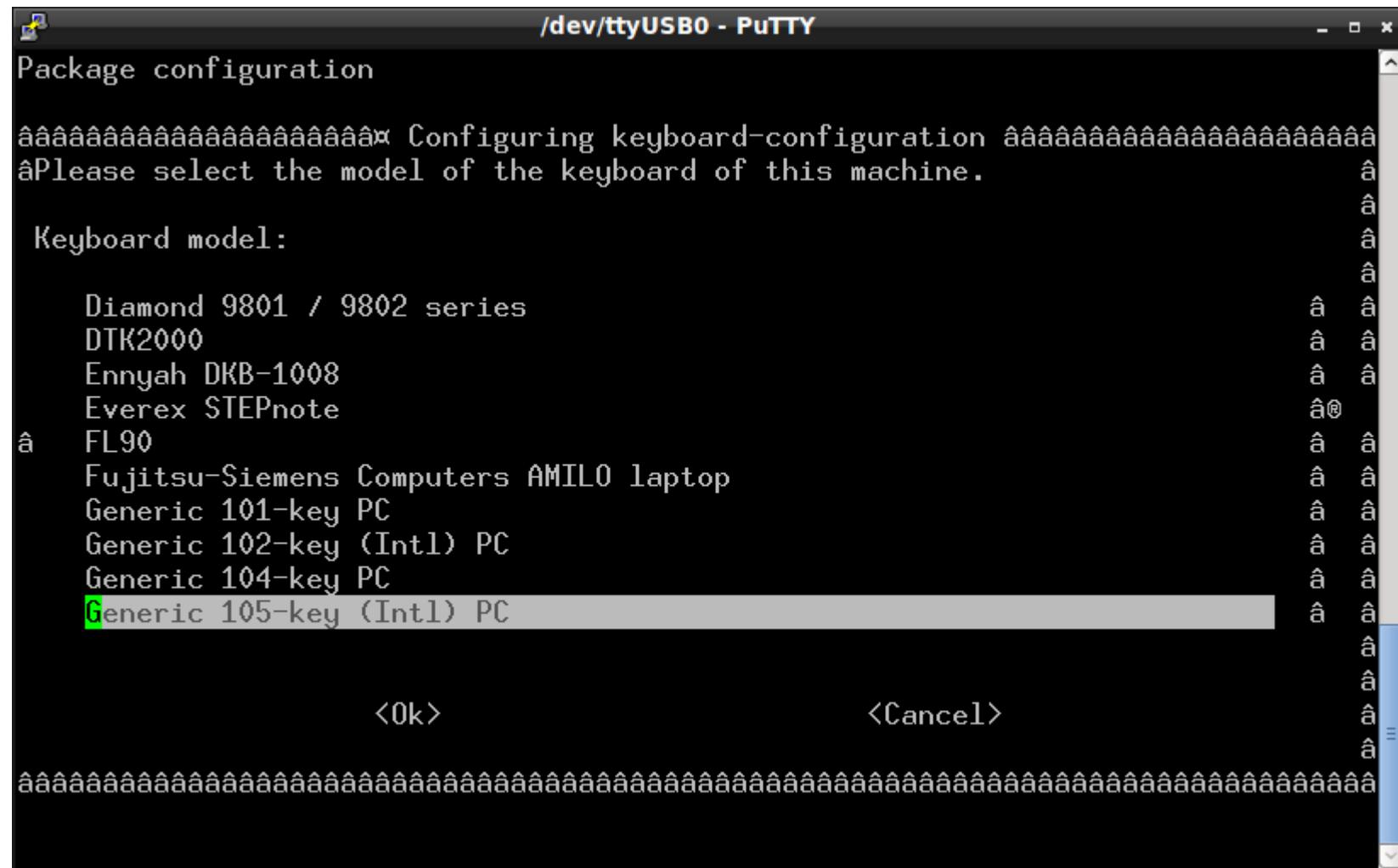
國際化設定



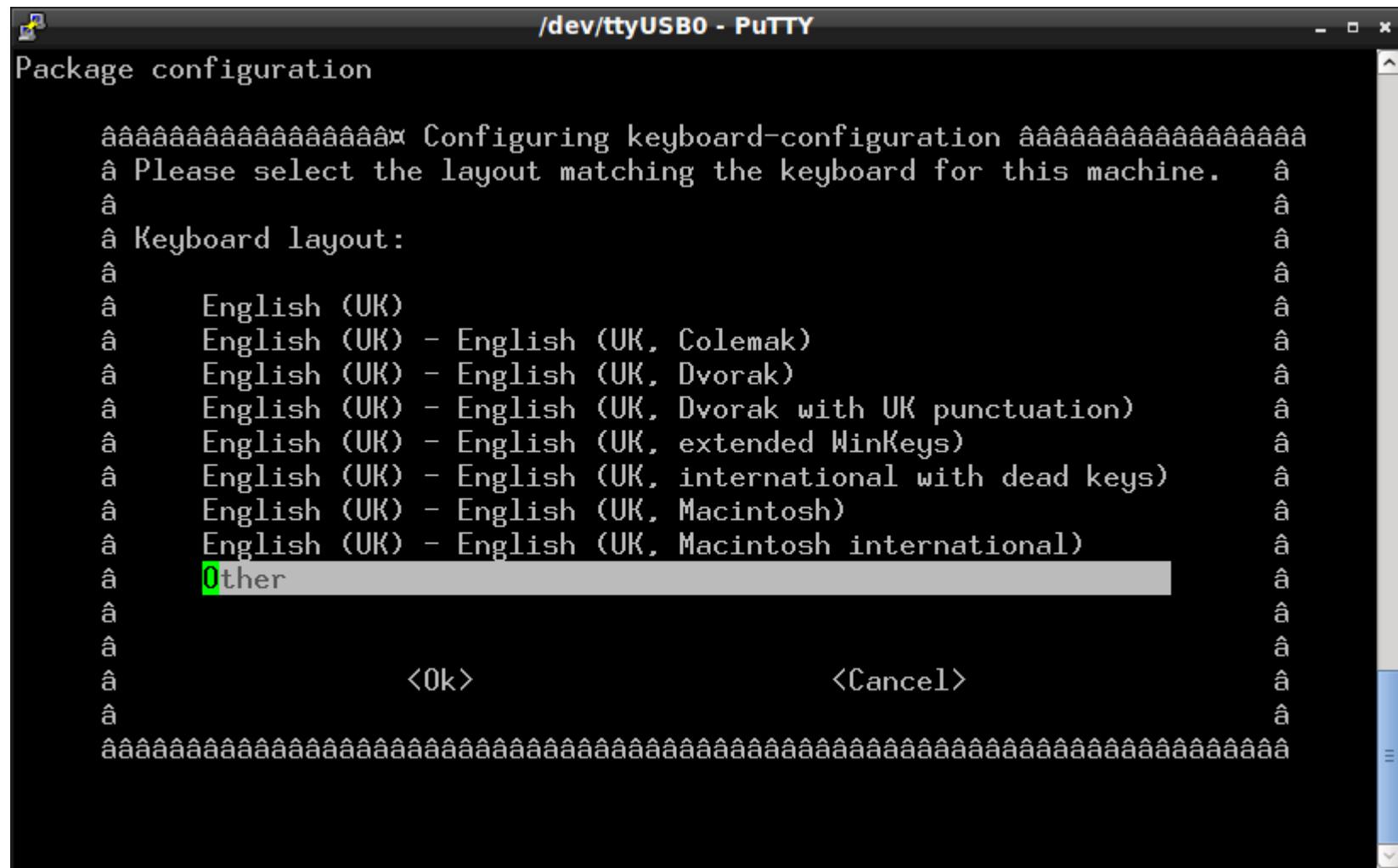
設定鍵盤配置



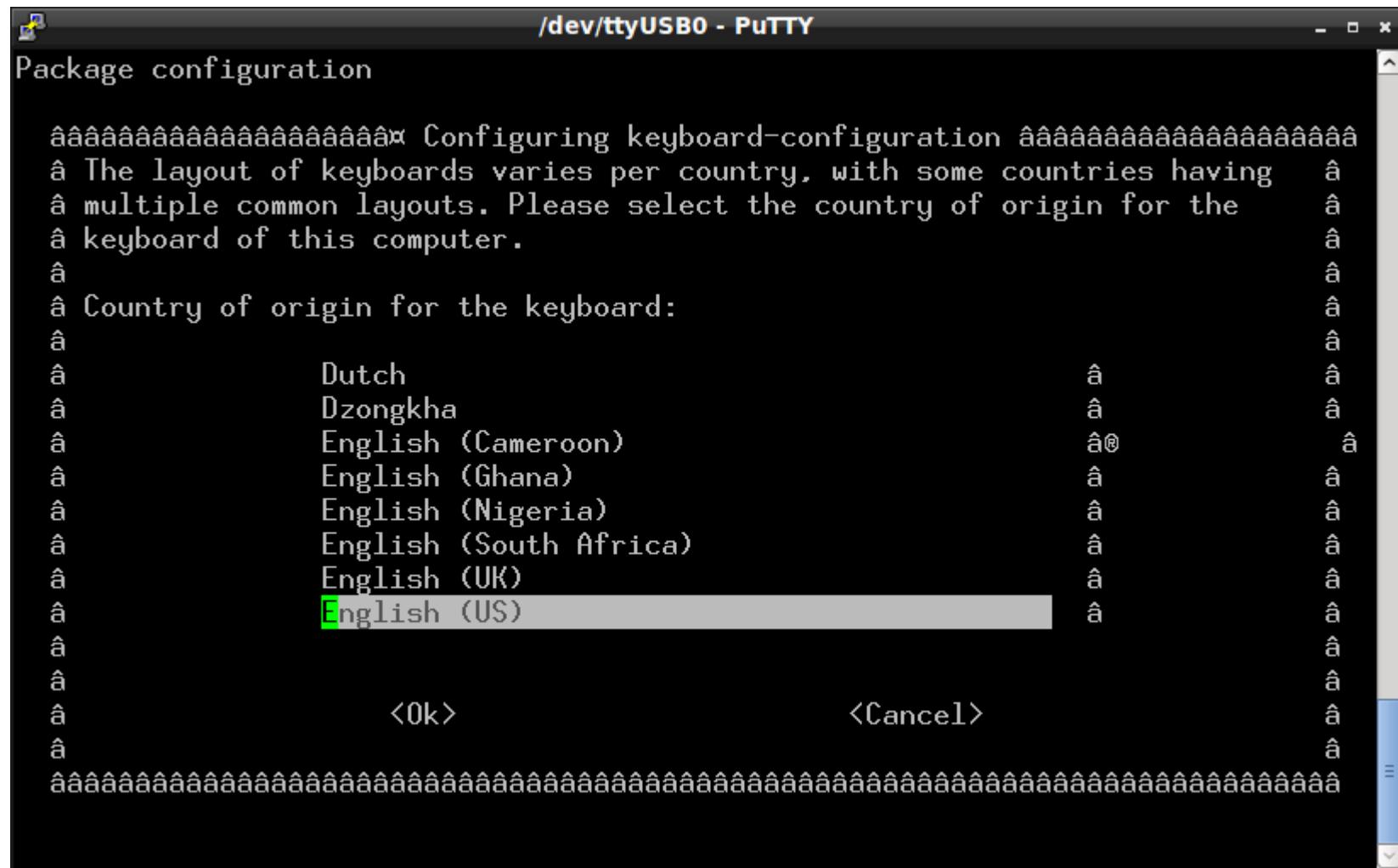
標準 105 鍵盤配置



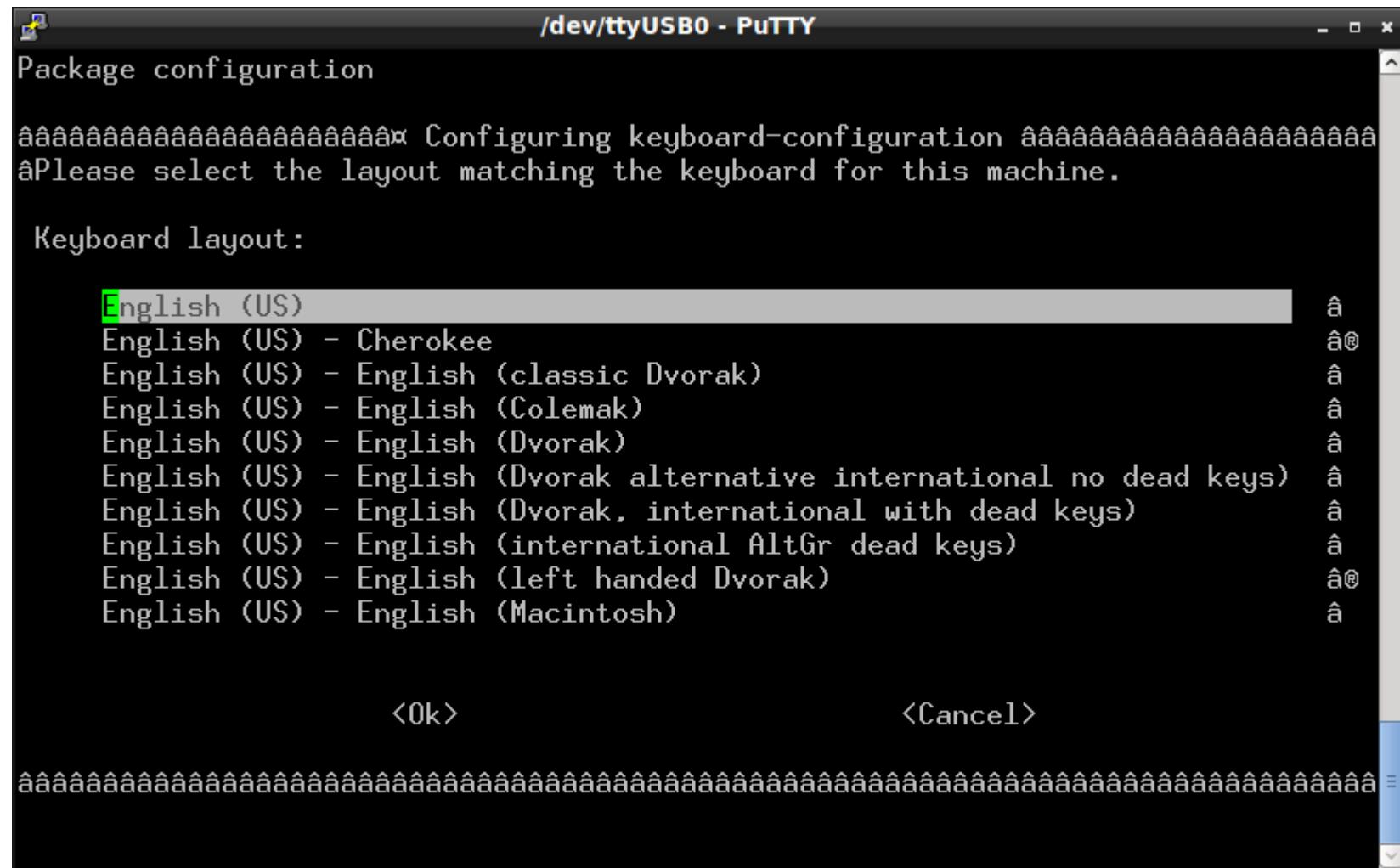
選擇非英式鍵盤



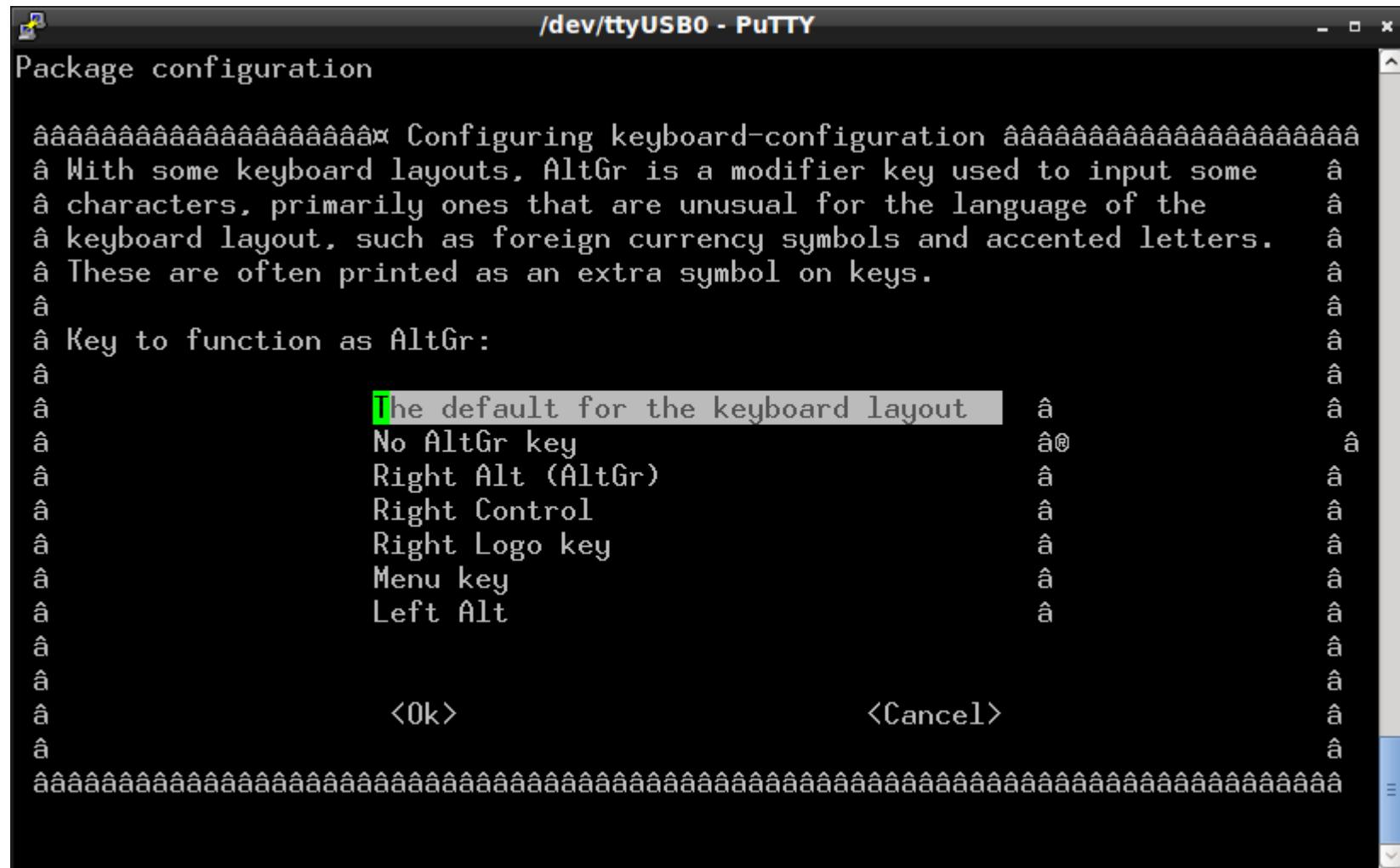
選擇美國



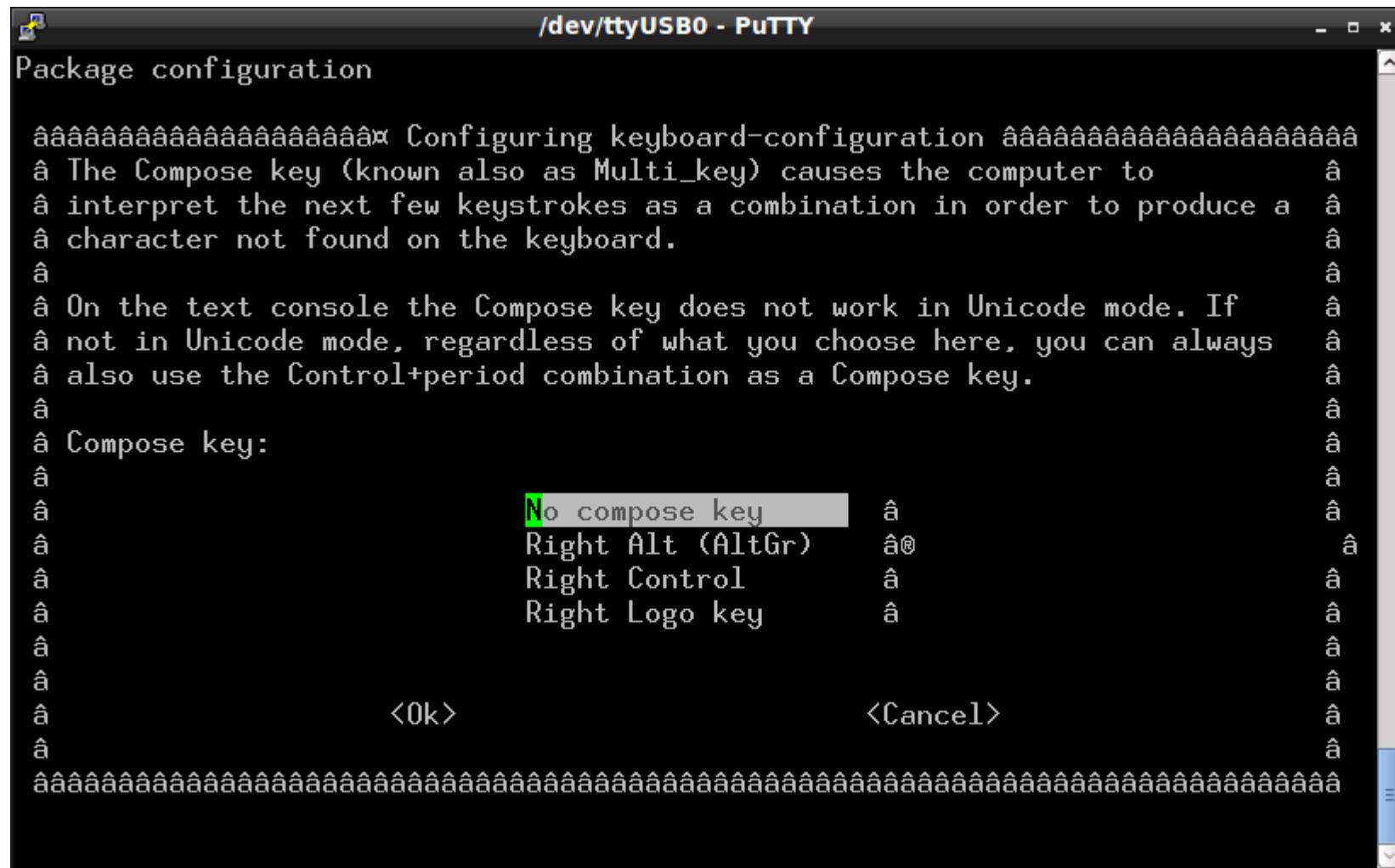
選擇美式鍵盤



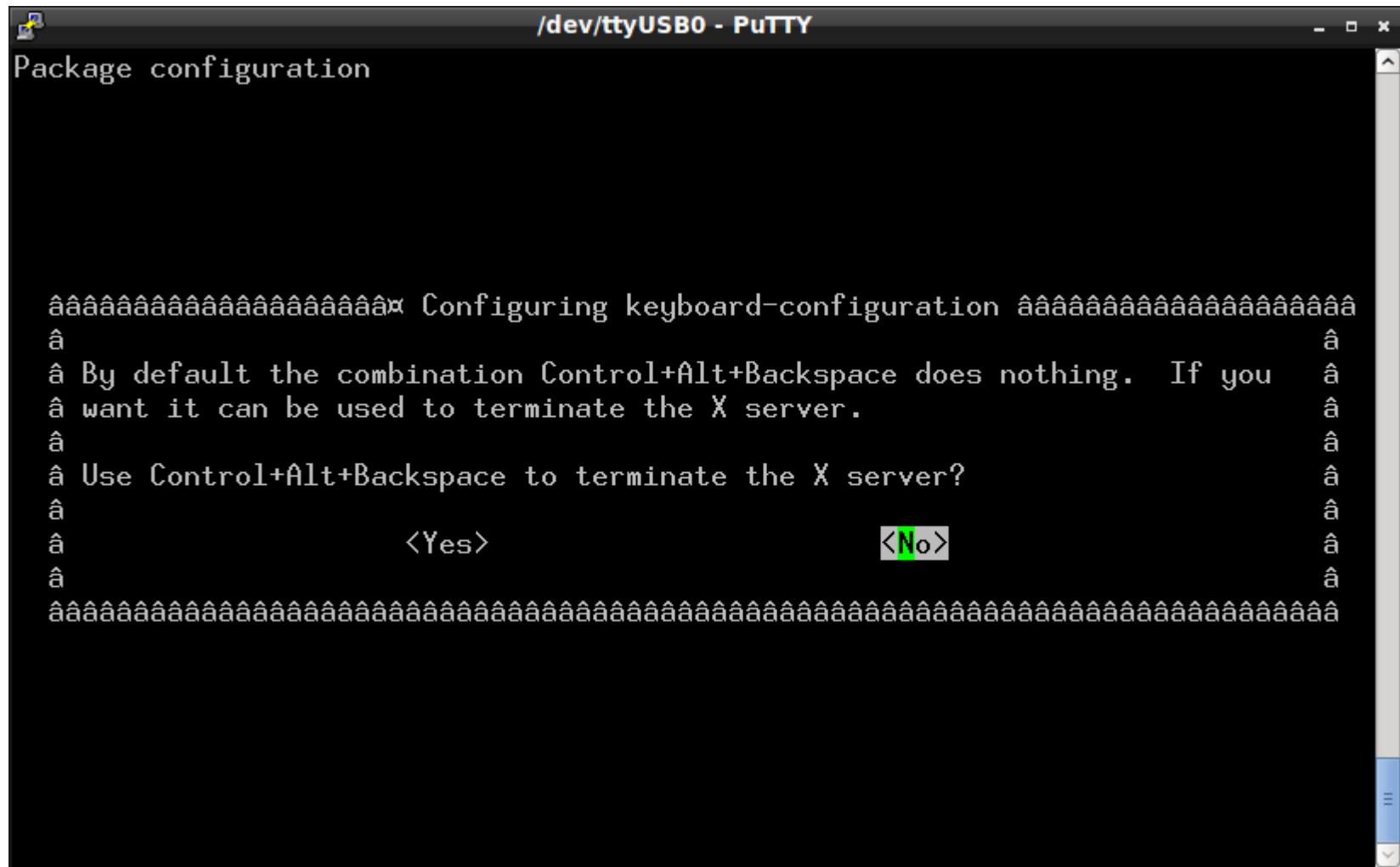
標準美式鍵盤



標準 105 不需要有組合鍵配置

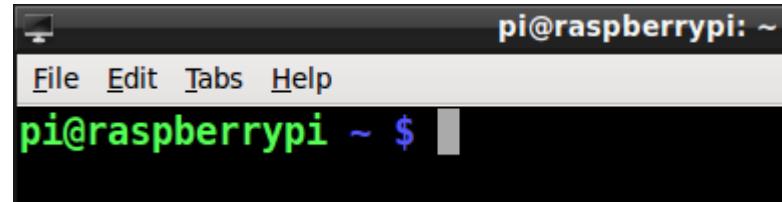


不需要停止 X Server



符號說明

- 登入畫面



- pi 是登入的使用者
- @ 表示”在”
- raspberryi 是主機名稱
- ~ 表示在家目錄 (home directory)
- \$ 表示該使用者所使用的 shell(一種文字工具介面)

正確的關機與重開機

- 將資料同步寫入硬碟中
 - \$ sudo sync
- 關機
 - \$ sudo shutdown -h now
- 重開機
 - \$ sudo shutdown -r now
- 關機組合技（兩個指令用 ';' 隔開）
 - \$ sudo sync; sudo shutdown -h now
- 登出系統
 - \$ logout

使用者帳號管理

我是誰？

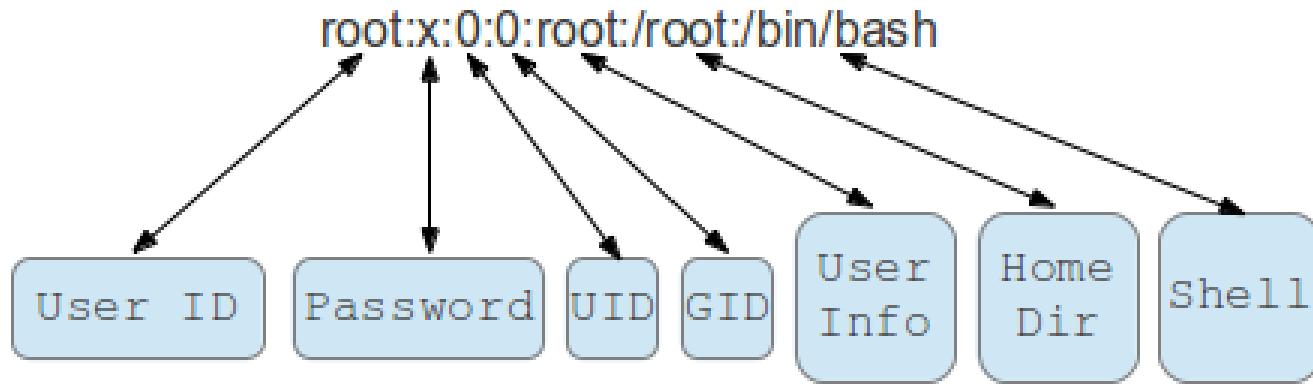
- 查詢使用者 id(UID) 與群組 id(GID)
 - \$ id [id]

```
uid=1000(pi) gid=1000(pi) groups=1000(pi),4(adm),20(dialout),24(cdrom),27(sudo),29(audio),44(video),46(plugdev),60(games),100(users),101(input),108(netdev),997(gpio),998(i2c),999(spi)
```

- UID, GID, 群組資料存放檔案位置
 - /etc/passwd
 - /etc/group
 - /etc/shadow

怎麼看檔案內容？

- 一次讀取檔案內容並且顯示到標準輸出
 - \$ cat [file]
 - \$ cat /etc/passwd



- \$ cat /etc/group

讓畫面容易看

- 清除整個畫面
 - \$ clear
- 翻頁檢視（按 'q' 離開）
 - \$ more /etc/passwd
 - \$ less /etc/passwd
- 列出前十筆
 - \$ head /etc/passwd
- 列出尾十筆
 - \$ tail /etc/passwd

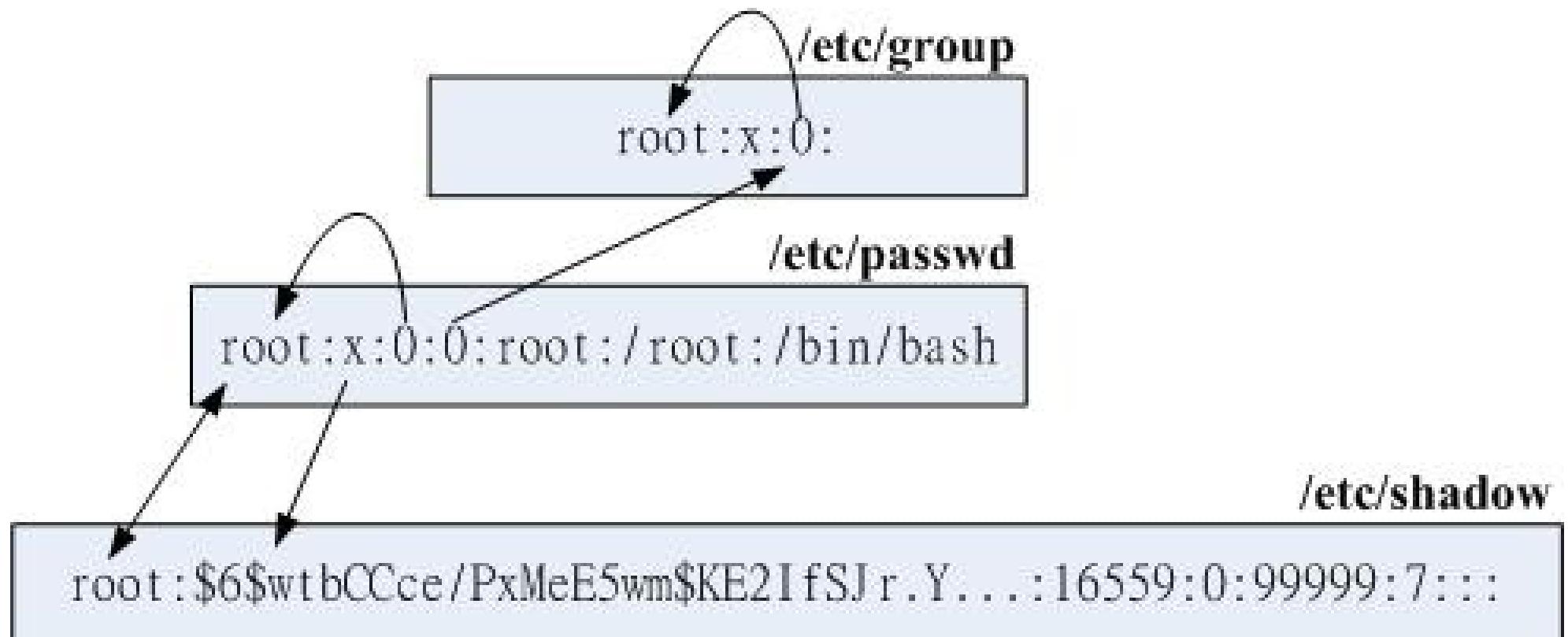
密碼檔 /etc/shadow

- 密碼檔不給看
 - \$ cat /etc/shadow
 - cat: /etc/shadow: Permission denied
- 加上 sudo 就可以了
 - \$ sudo cat /etc/shadow

Account name	Encrypted password	Date when password was last changed	Days before password may be changed	Days after which password must be changed	Period of notification (in days) before expiry of password
eziadm	\$1\$46mXiYMH\$BJ72Lcq3bUsAEPNsz24n40:	12100	0:99999:7:::		

Linux 帳號檔案

- /etc/passwd, /etc/group 和 /etc/shadow 關係



- 新增使用者

- \$ sudo adduser [id]

```
Adding user `bob' ...
Adding new group `bob' (1001) ...
Adding new user `bob' (1001) with group `bob' ...
Creating home directory `/home/bob' ...
Copying files from `/etc/skel' ...
Enter new UNIX password:
Retype new UNIX password:
passwd: password updated successfully
Changing the user information for bob
Enter the new value, or press ENTER for the default
      Full Name []:
      Room Number []:
      Work Phone []:
      Home Phone []:
      Other []:
Is the information correct? [Y/n] y
```

- 刪除使用者

- \$ sudo userdel -r [id]

檔案權限

檔案與目錄

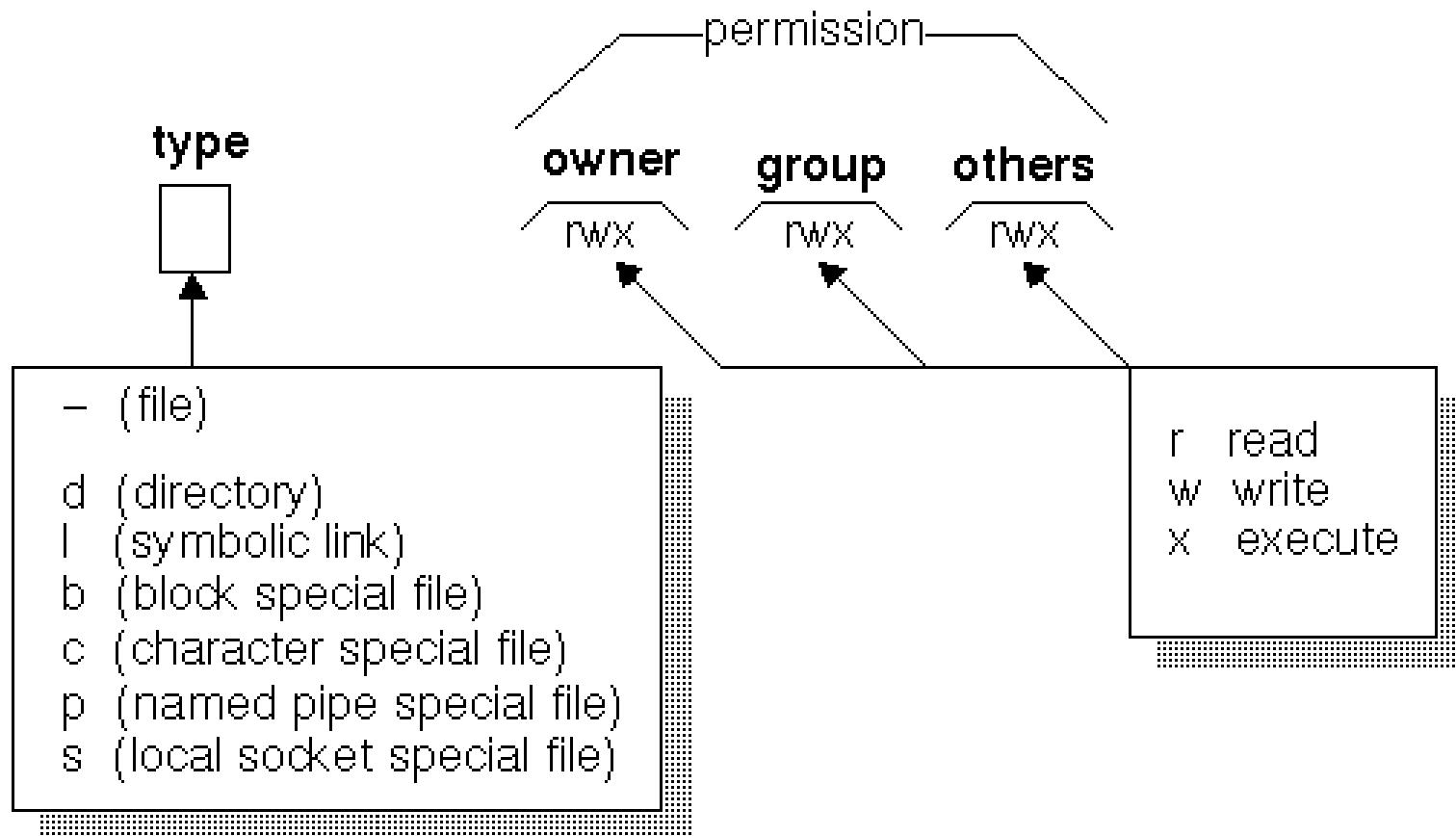
- 列出檔案與目錄
 - \$ ls
- 列出所有檔案與目錄
 - \$ ls -a
- 開頭是'.'的是隱藏檔

檔案與目錄

- 列出完整格式
 - \$ ls -l

Mode		Owner		Group	File Size	Last Modified	Filename
drwxrwxrwx	2	sammy	sammy		4096	Nov 10 12:15	everyone_directory
drwxrwx---	2	root	developers		4096	Nov 10 12:15	group_directory
-rw-rw----	1	sammy	sammy		15	Nov 10 17:07	group_modifiable
drwx-----	2	sammy	sammy		4096	Nov 10 12:15	private_directory
-rw-----	1	sammy	sammy		269	Nov 10 16:57	private_file
-rwxr-xr-x	1	sammy	sammy		46357	Nov 10 17:07	public_executable
-rw-rw-rw-	1	sammy	sammy		2697	Nov 10 17:06	public_file
drwxr-xr-x	2	sammy	sammy		4096	Nov 10 16:49	publicly_accessible_directory
-rw-r--r--	1	sammy	sammy		7718	Nov 10 16:58	publicly_readable_file
drwx-----	2	root	root		4096	Nov 10 17:05	root_private_directory

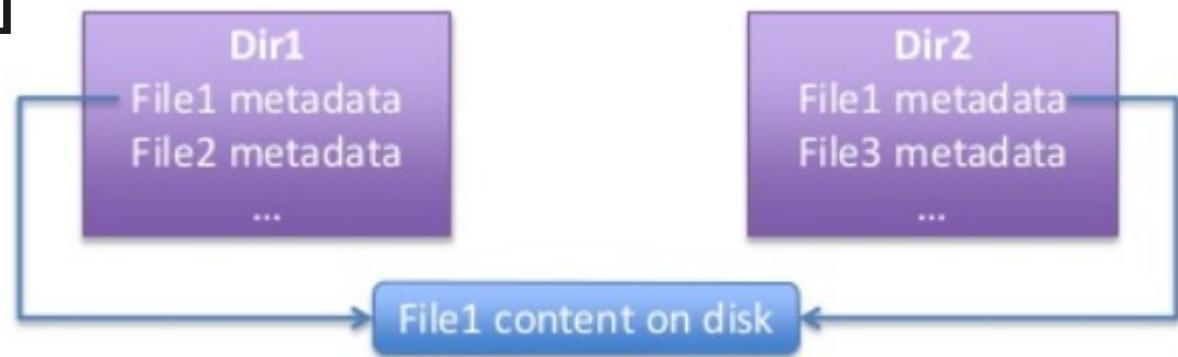
權限 (Mode/Permission) 意義



ZK-0536U-R

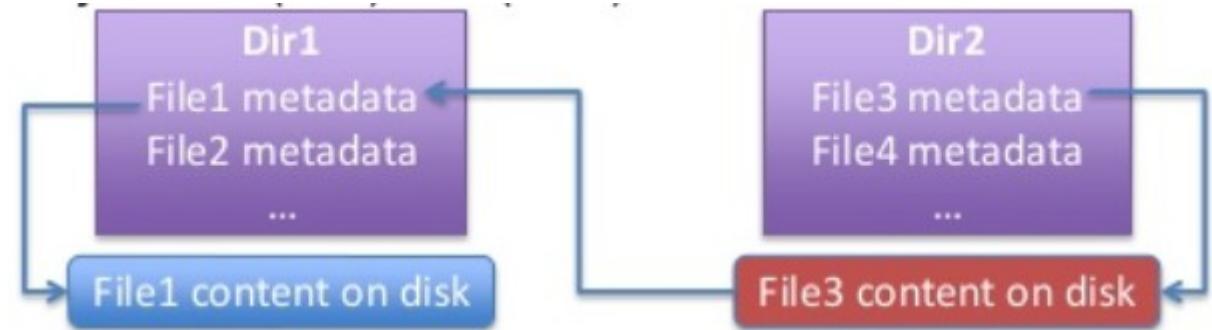
連結

- Hard Link(實體連結 = 實際連結)
 - \$ ln [a] [b]



- Symbolic Link(符號連結 = 捷徑)

- \$ ln -s [a]



修改檔案權限

- 修改檔案權限

- \$ chmod [u][g][o] [file]
- \$ chmod 155 Videos

Octal	Decimal	Permission	Representation
000	0 (0+0+0)	No Permission	---
001	1 (0+0+1)	Execute	--x
010	2 (0+2+0)	Write	-w-
011	3 (0+2+1)	Write + Execute	-wx
100	4 (4+0+0)	Read	r--
101	5 (4+0+1)	Read + Execute	r-x
110	6 (4+2+0)	Read + Write	rw-
111	7 (4+2+1)	Read + Write + Execute	rwx

檔案與目錄

- 組合技
 - \$ ls -al
- 用時間排序 & 組合技
 - \$ ls -alt
- 用時間排序 (反序)
 - \$ ls -altr

有哪些參數可以使用？

- 問 help
 - \$ ls --help
- 查 manual
 - \$ man ls

如何看密碼檔？

- 方法 1：加上 sudo 就可以了（標準作法）
 - \$ sudo cat /etc/shadow
- 方法 2：修改檔案權限（非標準作法）
 - 比較 /etc/passwd 和 /etc/shadow
 - \$ ls -l /etc/passwd /etc/shadow

```
-rw-r--r-- 1 root root 1700 Nov 16 18:24 /etc/passwd
-rw-r----- 1 root shadow 1089 Nov 16 18:24 /etc/shadow
```

- 練習

為什麼要加 sudo ?

- 不要使用 root 身份登入，而只是暫時將權限給予一般使用者
- 問：什麼時候需要使用 sudo ?
- 答：需要的時候
- 切換成管理者
 - \$ sudo -i

```
pi@raspberrypi:~ $ sudo -i  
root@raspberrypi:~#
```

加入 sudoers

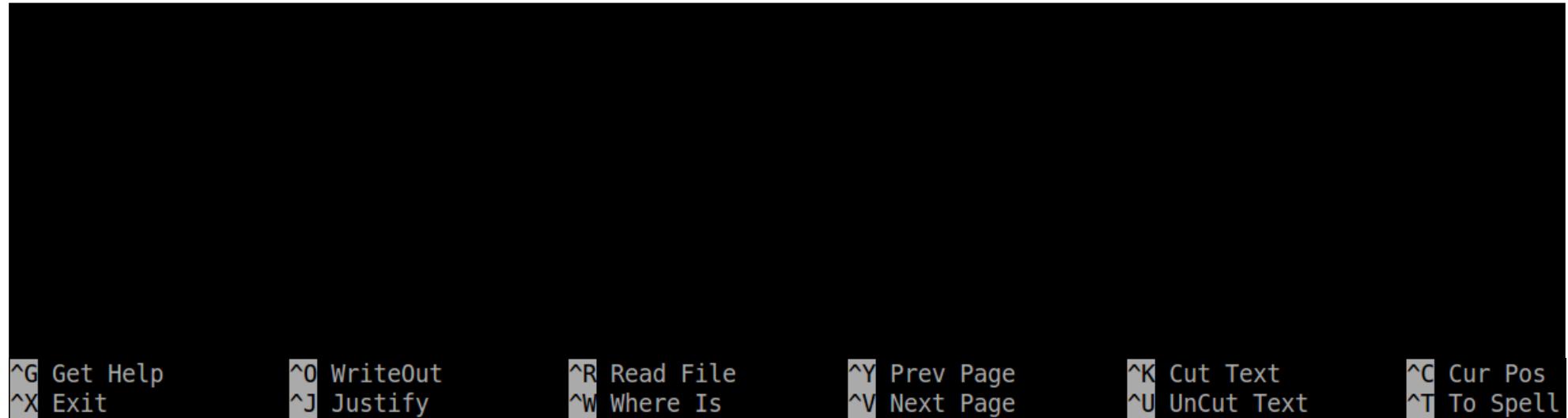
- 觀察 & 修改 /etc/sudoers 設定檔
 - \$ sudo less /etc/sudoers

```
19 # User privilege specification
20 root    ALL=(ALL:ALL) ALL
21
22 # Allow members of group sudo to execute any command
23 %sudo   ALL=(ALL:ALL) ALL
24
25 # See sudoers(5) for more information on "#include" directives:
26
27 #includedir /etc/sudoers.d
28
29 pi          ALL=(ALL)          NOPASSWD: ALL
30 帳號名稱    來源主機=(可切換帳號) 可執行的指令
```

nano 編輯器

- 建立新檔案

- \$ nano [file]
- \$ sudo nano /etc/sudoers



- 離開: Ctrl + X

> 令存新檔:y

> 不存離開:n

> 離開:Ctrl + C

shell 好幫手

- 重複執行命令
 - \$ [↑]
- 自動補完
 - \$ [tab]

練習：

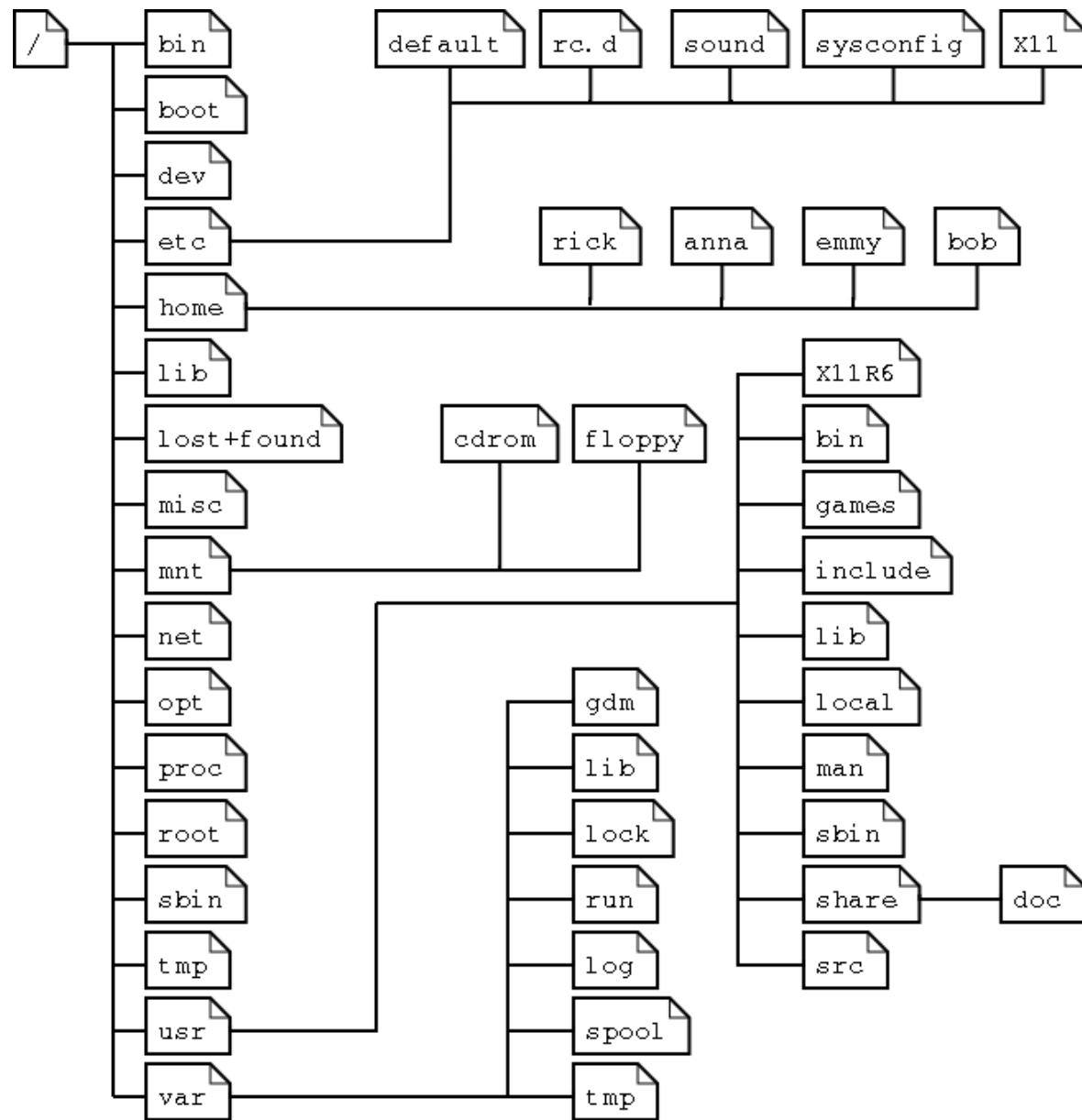
新增使用者 bob 並且將 bob 加入 sudoers,
讓 bob 可用 sudo cat 看密碼檔

操作情境

- 新增使用者 bob
- 用 bob 登入系統
- 用 cat 讀 /etc/shadow
- 登出 bob
- 用 pi 登入系統
- 修改 /etc/sudoers , 新增 bob
- 登出 pi
- 用 bob 登入系統
- 用 sudo cat 讀 /etc/shadow

檔案系統結構

Linux File System Layout



我在哪裡？

- 跳到某個目錄
 - \$ cd [directory]
- 回家目錄 (home directory)
 - \$ cd ~
- 目錄間切換
 - \$ cd -
- 目前目錄位置
 - \$ pwd

絕對路徑與相對路徑

- 目前的目錄 '.'
- 上一層目錄 '..'
 - \$ cd ..
- 如何從 /home/pi 跳到 /var/log 目錄下?
 - 方法 1：從絕對路徑開始
 - \$ cd /var/log
 - 方法 2：從相對路徑開始
 - \$ cd ../../var/log

檔案與目錄建立

- 建立空檔案
 - \$ touch [file]
- 建立目錄
 - \$ mkdir [dir]
- 連續建立目錄
 - \$ mkdir -p [dir1]/[dir2]

檔案複製

- 複製檔案
 - \$ cp [old] [new]
- 強制複製
 - \$ cp -f [old] [new]
- 複製目錄
 - \$ cp -r [old] [new]
- 複製目錄組合技
 - \$ cp -rf [old] [new]
- 只複製目錄下的所有檔案（關鍵字 *）
 - \$ cp -rf [old]/* [new]

檔案移動與更名

- 移動檔案
 - \$ mv [old] [new]
- 強制移動
 - \$ mv -f [old] [new]
- 檔案更名
 - \$ mv [old] [new]

檔案刪除

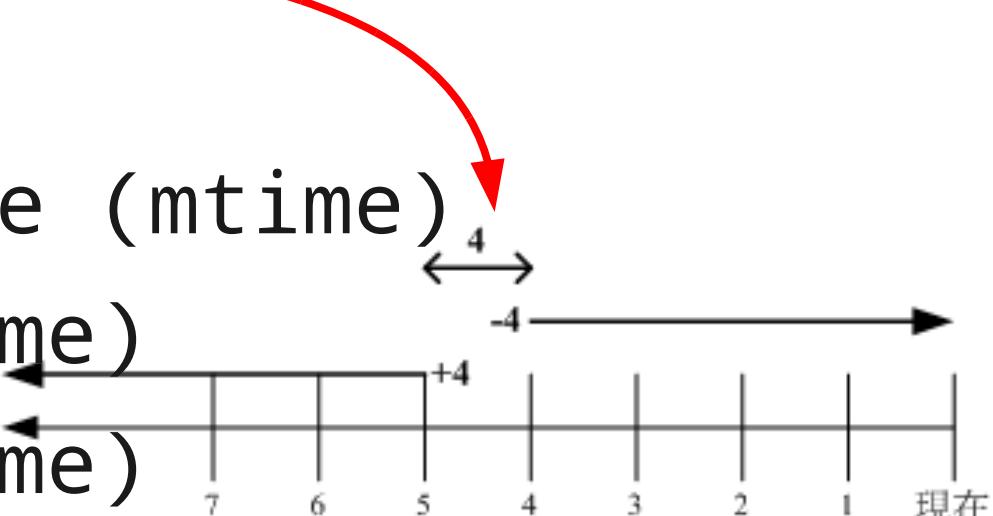
- 刪除檔案
 - \$ rm [file]
- 強制刪除檔案
 - \$ rm -f [file]
- 強制刪除目錄
 - \$ rm -rf [dir]

練習：

建立 /home/pi/bak/etc 目錄，並複
製 /etc/passwd 到 etc 下，名稱為 passwd.bak

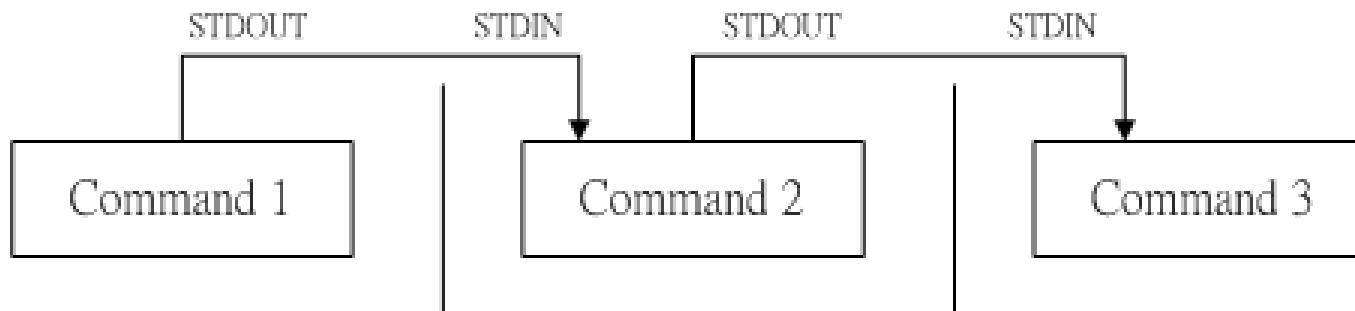
找檔案

- 找檔案
 - \$ find [path]
- 根據時間（日期）找檔案
 - \$ find -mtime [num]
 - \$ find -mtime 4
- 不同的時間意義
 - modification time (mtime)
 - status time (ctime)
 - access time (atime)



串接不同的輸出與輸入

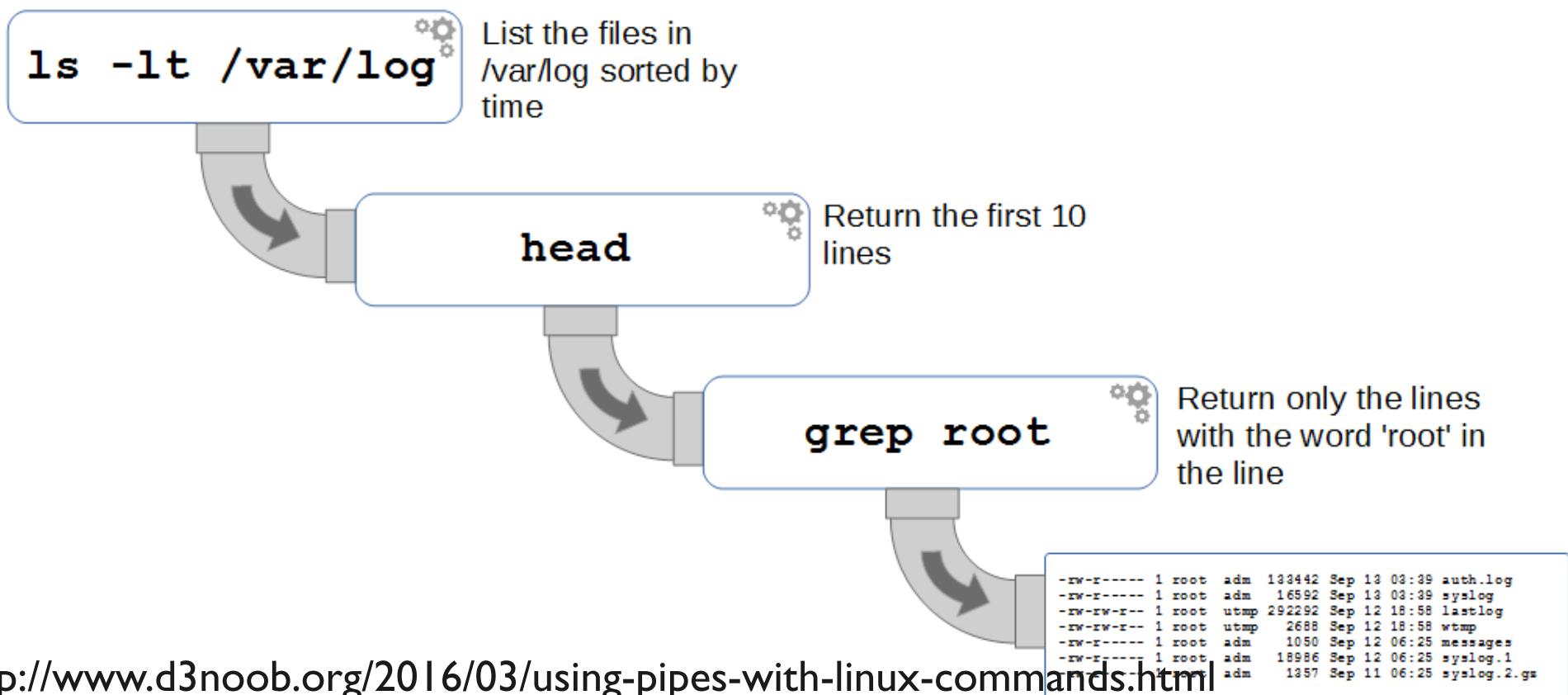
- 管線 (pipe) 命令 ' | '



- \$ find /var/log | less
- 找關鍵字 grep
 - \$ find /var/log | grep message

練習：

用時間排序，找出 /var/log 下前十筆有 root 關鍵字的檔案



壓縮與打包

打包與壓縮

- 打包：把一堆檔案集結成一個檔案（未壓縮）
- 壓縮：將檔案佔用的空間變小
- 壓縮率：壓縮後與壓縮前的比例

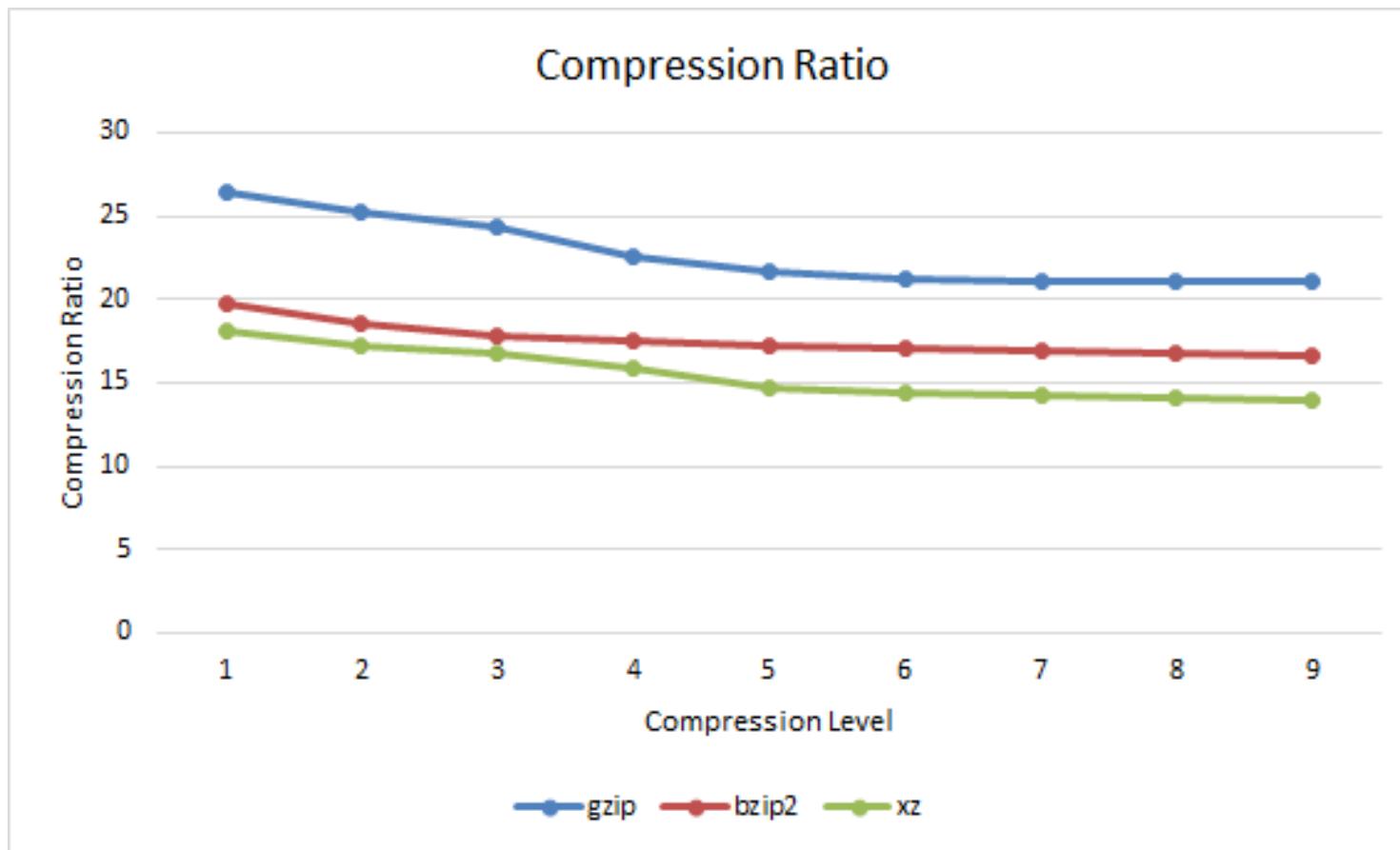
常見壓縮格式

- 常見格式：

- *.zip: zip 壓縮
- *.gz: gzip 壓縮
- *.bz2: bzip2 壓縮
- *.tar: tar 打包 (未壓縮)
- *.tar.gz: tar 打包 + gzip 壓縮
- *.tar.bz2: tar 打包 + bzip2 壓縮
- *.tar.xz: tar 打包 + xz 壓縮

壓縮技術評比

- 除了壓縮率，還需要考慮（解）壓縮時間，通用性



tar

- tar 打包，通常存成 .tar
 - \$ tar cvf [filename] [file1] [file2] ...
- 解 .tar
 - \$ tar xvf [filename]
- 參數：
 - -c：建立打包檔案
 - -x：解打包或解壓縮
 - -v：詳細資訊
 - -f：存檔名稱

tar

- tar 打包 + gzip 壓縮，通常存成 .tar.gz 或 .tgz(tarball)
 - \$ tar zcvf [filename] [file1] [file2] ...
- 解 .tar.gz
 - \$ tar zxvf [filename]
- 參數：
 - -z：用 gzip 壓縮 / 解壓縮

zip

- 需安裝套件 (\$ sudo apt-get install zip)
- 壓縮成 zip 檔，通常存成 .zip
 - \$ zip [filename] [file1] [file2] ...
- 解壓縮 zip 檔
 - \$ unzip [filename]

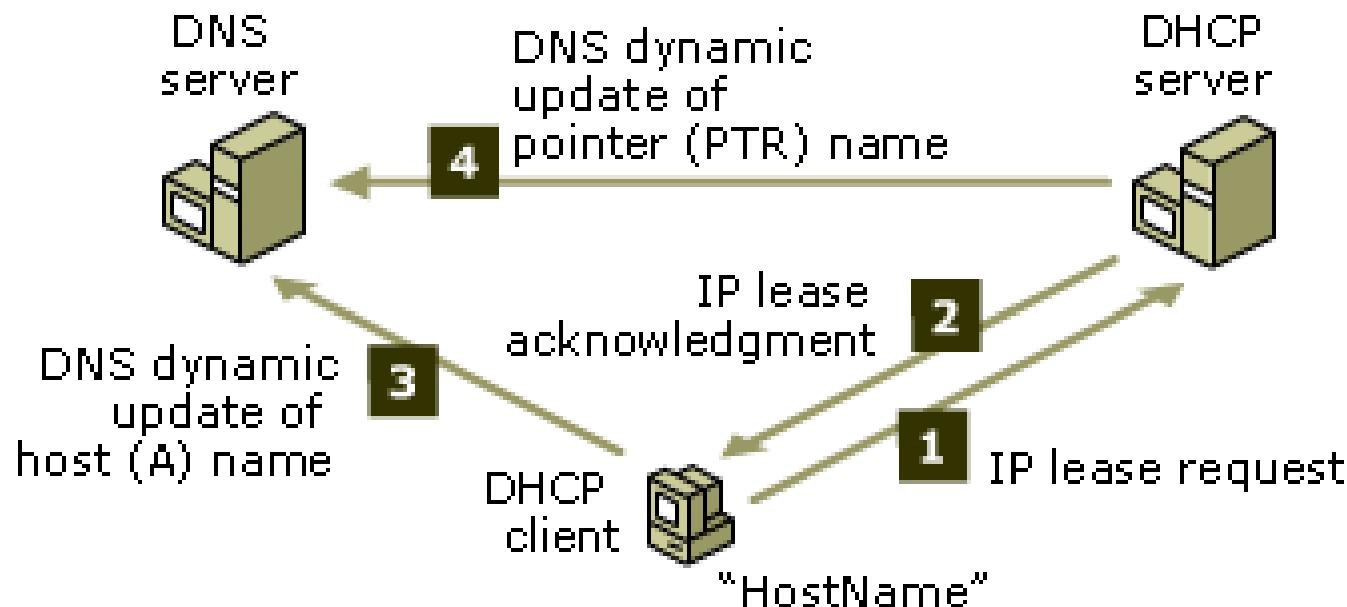
練習：

在 /home/pi/bak 將 /etc 做成 etc.tar.gz, 再將 tarball 在 /tmp 下解開

網路設定

DNS 和 DHCP

- DHCP: 動態配發 IP
- DNS: 根據網域名稱查詢 IP



網路狀態查詢

- \$ ifconfig [interface]
- 查詢 wlan0
 - \$ ifconfig wlan0

```
wlan0      Link encap:Ethernet  HWaddr 80:1f:02:8f:7e:b5
           inet addr:192.168.43.102  Bcast:192.168.43.255  Mask:255.255.255.0
                     UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
                     RX packets:28 errors:0 dropped:8 overruns:0 frame:0
                     TX packets:13 errors:0 dropped:0 overruns:0 carrier:0
                     collisions:0 txqueuelen:1000
                     RX bytes:7696 (7.5 KiB)  TX bytes:7414 (7.2 KiB)
```

- 設定網路 IP 與 gateway
 - \$ sudo ifconfig [interface] [ip] netmask [mask]
- 範例：
 - \$ sudo ifconfig eth0 192.168.2.2 netmask 255.255.255.0

無線網路查詢與設定

- 查詢 wlan0 連到哪一台 AP
 - \$ iwconfig wlan0

```
wlan0      IEEE 802.11bgn  ESSID:"sosorry2.4G"
           Mode:Managed  Frequency:2.462 GHz  Access Point: 74:DA:38:31:32:5C
                                         Bit Rate=54 Mb/s  Tx-Power=31 dBm
                                         Retry short limit:7  RTS thr:off  Fragment thr:off
                                         Power Management:on
                                         Link Quality=70/70  Signal level=-34 dBm
                                         Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
                                         Tx excessive retries:0  Invalid misc:0  Missed beacon:0
```

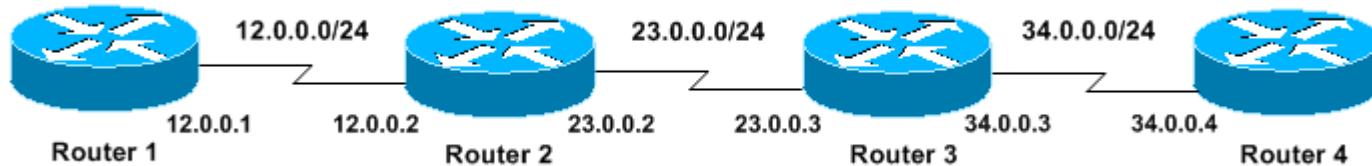
ESSID:sosorry2.4G

網路設定檔

- 網路卡設定檔
 - /etc/network/interfaces
- DNS 設定檔
 - /etc/resolv.conf
- 無線網路 ssid 和 psk 設定檔
 - /etc/wpa_supplicant/wpa_supplicant.conf

網路偵錯工具

- ping: 發送 ICMP ECHO_REQUEST 到對方主機
 - \$ ping [ip]/[host]
- traceroute: 印出經過的 router 資訊
 - \$ traceroute [ip]/[host]



- netstat: 印出網路連線與統計 (列出開哪些 port)
 - \$ netstat -ntulp

常見網路問題與排除

- 狀況一：
 - Pi 無法用瀏覽器開啟網頁
- 解決步驟：
 - 先 ping 8.8.8.8 看是否有回應（設 IP）
 - 如果有再 ping google.com 看是否有回應（設 DNS）
 - 如果也有就難搞了...（換瀏覽器或重啟機器）

常見網路問題與排除

- 狀況二：
 - 筆電（桌機）無法和 Pi 用 ssh 連線
- 解決步驟：
 - 確認筆電和 Pi 都有取得 IP
 - 確認筆電和 Pi 在同一網段
 - 先從筆電 ping 一下 Pi，也從 Pi 去 ping 筆電

超強網路工具

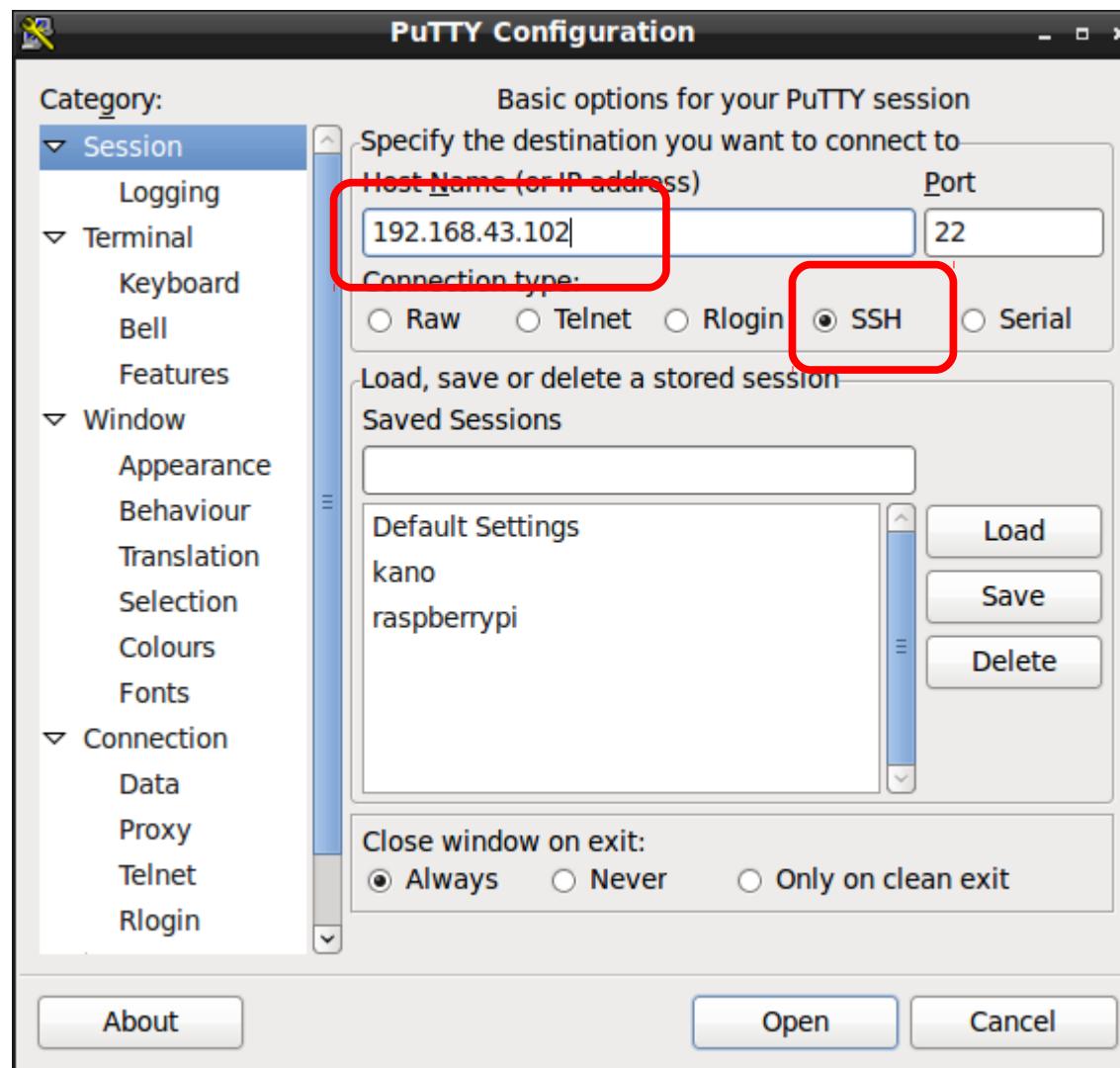
- Netcat(nc)
 - \$ nc
- 最輕量化的檔案傳輸方法
 - 主機端接收：
 - \$ nc -l [port] > [file]
 - 客戶端傳送：
 - \$ nc [主機端 ip] [主機端 port] < [file]

練習：

在客戶端 /home/pi/bak 將 /etc 做成 tarball,
再將 tarball 傳到主機端 /home/pi/bak 下

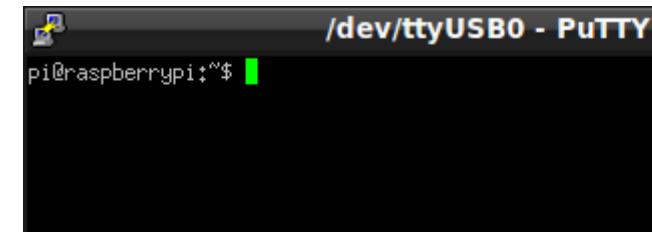
常用網路指令

SSH(Secure Shell)

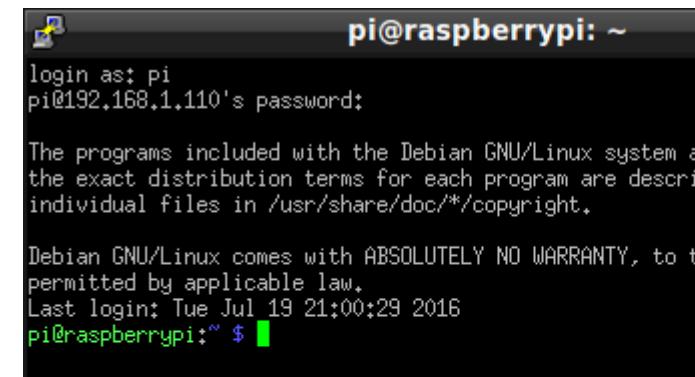
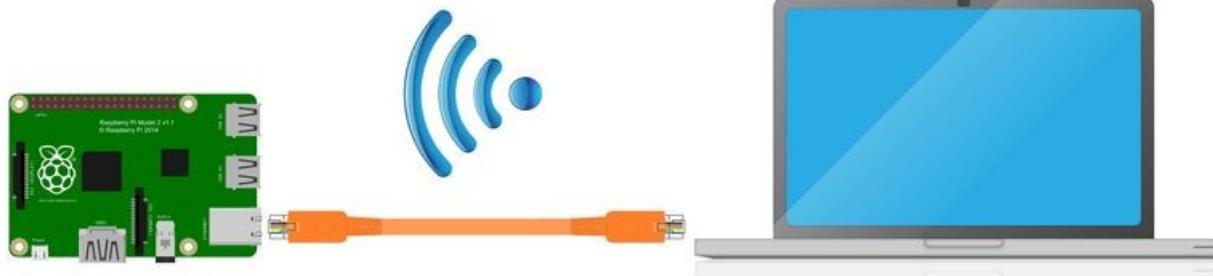


Serial 連線和 SSH 連線有什麼不同？

- Serial 以實體線路相連， 純文字， 是獨占式的連線

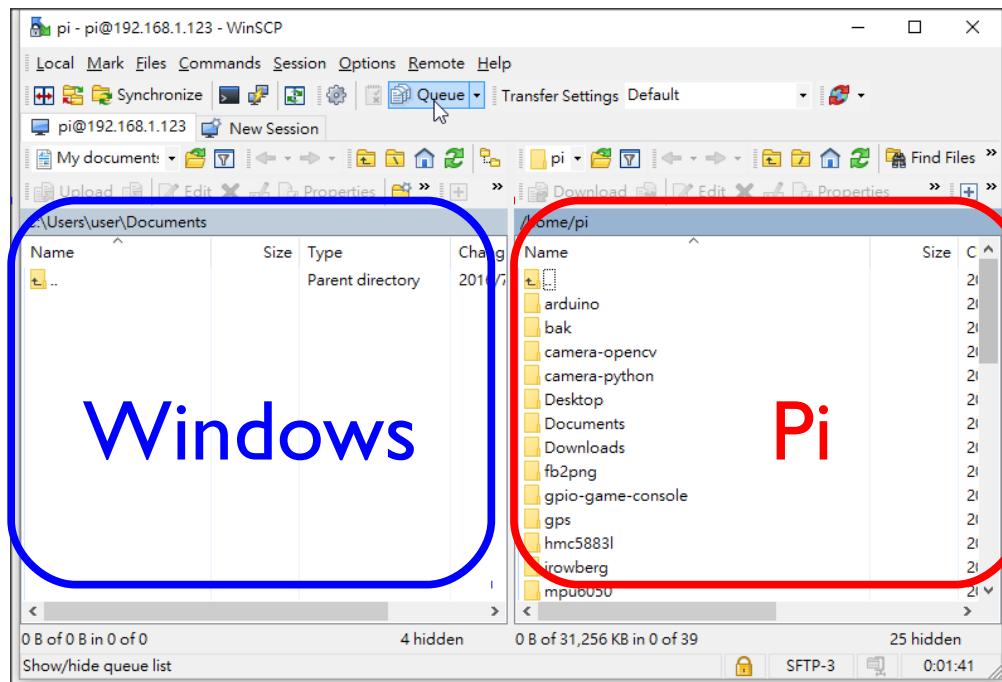


- SSH 是 TCP/IP 通訊協定，透過 Ethernet 或 WiFi 連線



SCP(Secure Copy)

- 透過 SSH(Secure Shell) 傳輸資料
- 在 Windows 上安裝 WinSCP
 - 下載：<http://winscp.net/eng/download.php#download2>



WGET

- 文字介面下載器
 - \$ wget [url]
 - \$ wget http://www.president.gov.tw/Portals/0/portal.css
- https 的下載
 - \$ wget [url] no-check-certificate

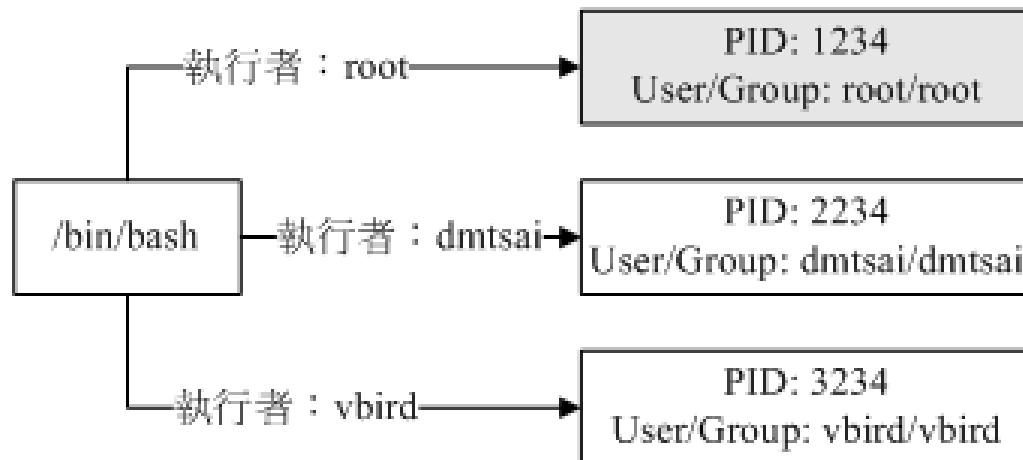
cURL

- Crawl URL
- 取得網頁內容，輸出至螢幕
 - \$ curl [url]
 - \$ curl http://www.example.com
- 設定 Browser 資訊 (user-agent) 來取得網頁內容
 - \$ curl -A [agent] [url]
 - \$ curl -A "Mozilla/4.0" http://www.example.com

程序管理

程式和程序

- 躺在硬碟的是程式 (program), 跑起來的是程序 (process)
- 什麼是執行檔？可以執行的檔案
- Linux 中檔案的副檔名只是參考用
- 每個程序都會有一個 PID，並且是某人所執行的



工作管理 (Job Control)

- 前景 (foreground)：佔住終端機的程序
- 背景 (background)：看不到但依舊存在的程序
- 前景和背景的分別 = 背景無法接收標準輸入 (stdin)
- 一秒變背景，加上 '&'

終止與暫停

- 終止程序 => [ctrl]-c
- 暫停程序 => [ctrl]-z
- 用 jobs + fg 把暫停中的程序喚起並回到前景

DEMO

將 git clone 轉為背景執行，再喚醒到前景

觀察系統所有程序

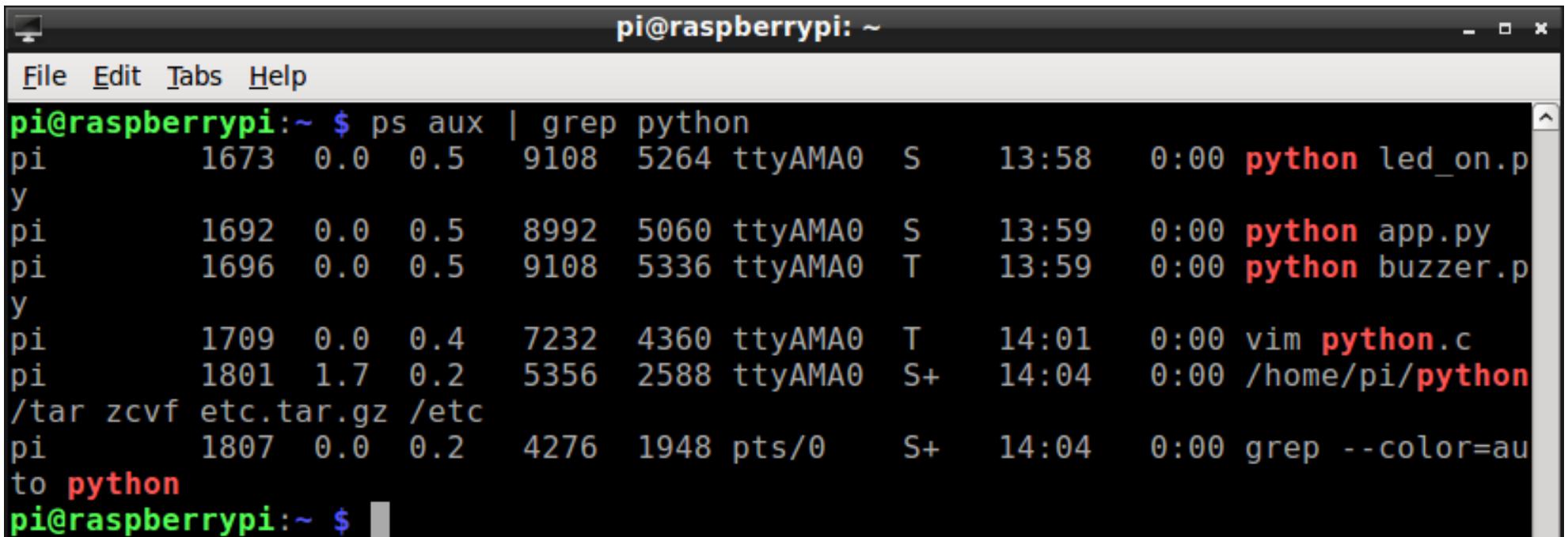
- 各別程序觀察
 - \$ ps aux
- 參數
 - -a：所有 process
 - -u：有效使用者
 - -x：完整資訊

USER 執行 COMMAND ? PID 為何 ?

USER	PID	%CPU	%MEM	VSZ	RSS	TTY	STAT	START	TIME	COMMAND
root	1	0.3	0.4	22936	4060	?	Ss	13:35	0:03	/sbin/init spla
sh										
root	2	0.0	0.0	0	0	?	S	13:35	0:00	[kthreadd]
root	3	0.0	0.0	0	0	?	S	13:35	0:00	[ksoftirqd/0]
root	5	0.0	0.0	0	0	?	S<	13:35	0:00	[kworker/0:0H]
root	6	0.0	0.0	0	0	?	S	13:35	0:00	[kworker/u8:0]
root	7	0.0	0.0	0	0	?	S	13:35	0:00	[rcu_sched]
root	8	0.0	0.0	0	0	?	S	13:35	0:00	[rcu_bh]
root	9	0.0	0.0	0	0	?	S	13:35	0:00	[migration/0]
root	10	0.0	0.0	0	0	?	S	13:35	0:00	[migration/1]
root	11	0.0	0.0	0	0	?	S	13:35	0:00	[ksoftirqd/1]
root	12	0.0	0.0	0	0	?	S	13:35	0:00	[kworker/1:0]
root	13	0.0	0.0	0	0	?	S<	13:35	0:00	[kworker/1:0H]
root	14	0.0	0.0	0	0	?	S	13:35	0:00	[migration/2]
root	15	0.0	0.0	0	0	?	S	13:35	0:00	[ksoftirqd/2]
root	16	0.0	0.0	0	0	?	S	13:35	0:00	[kworker/2:0]
root	17	0.0	0.0	0	0	?	S<	13:35	0:00	[kworker/2:0H]
root	18	0.0	0.0	0	0	?	S	13:35	0:00	[migration/3]
root	19	0.0	0.0	0	0	?	S	13:35	0:00	[ksoftirqd/3]

找出有 python 關鍵字的程序

- \$ ps aux | grep python



```
pi@raspberrypi: ~
File Edit Tabs Help
pi@raspberrypi:~ $ ps aux | grep python
pi      1673  0.0  0.5    9108  5264  ttyAMA0   S     13:58   0:00  python led_on.p
y
pi      1692  0.0  0.5   8992  5060  ttyAMA0   S     13:59   0:00  python app.py
pi      1696  0.0  0.5   9108  5336  ttyAMA0   T     13:59   0:00  python buzzer.p
y
pi      1709  0.0  0.4    7232  4360  ttyAMA0   T     14:01   0:00  vim python.c
pi      1801  1.7  0.2   5356  2588  ttyAMA0   S+    14:04   0:00  /home/pi/python
/tar zcvf etc.tar.gz /etc
pi      1807  0.0  0.2   4276  1948  pts/0     S+    14:04   0:00  grep --color=au
to python
pi@raspberrypi:~ $
```

訊號

- 程序間可以透過訊號 (signal) 互相控制
 - \$ kill -[s] [pid]
 - \$ kill -9 1234
- 常見訊號代號
 - 9, SIGKILL, 中斷
 - 19, SIGSTOP, 暫停

動態觀察程序變化

- 預設以 CPU 的使用率排序
 - \$ top -c

The screenshot shows a terminal window titled "pi@raspberrypi: ~". The window contains the output of the "top" command. The top section provides system statistics: load average (0.05, 0.01, 0.00), tasks (152 total, 1 running, 147 sleeping, 4 stopped, 0 zombie), CPU usage (%Cpu(s)), memory usage (KiB Mem: 947740 total, 430324 used, 517416 free, 92768 buffers, KiB Swap: 102396 total, 0 used, 102396 free, 216716 cached Mem), and a header for the process list.

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
1878	pi	20	0	5140	2552	2168	R	1.0	0.3	0:00.38	top -c
871	pi	20	0	94424	24996	20996	S	0.3	2.6	0:05.38	lxpanel --
1	root	20	0	22936	4060	2736	S	0.0	0.4	0:03.31	/sbin/init+
2	root	20	0	0	0	0	S	0.0	0.0	0:00.00	[kthreadd]
3	root	20	0	0	0	0	S	0.0	0.0	0:00.07	[ksoftirqd+]
5	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	[kworker/0+]
6	root	20	0	0	0	0	S	0.0	0.0	0:02.03	[kworker/u+]
7	root	20	0	0	0	0	S	0.0	0.0	0:00.45	[rcu_sched]
8	root	20	0	0	0	0	S	0.0	0.0	0:00.00	[rcu_bh]
9	root	rt	0	0	0	0	S	0.0	0.0	0:00.00	[migration+]
10	root	rt	0	0	0	0	S	0.0	0.0	0:00.00	[migration+]

系統狀態統計

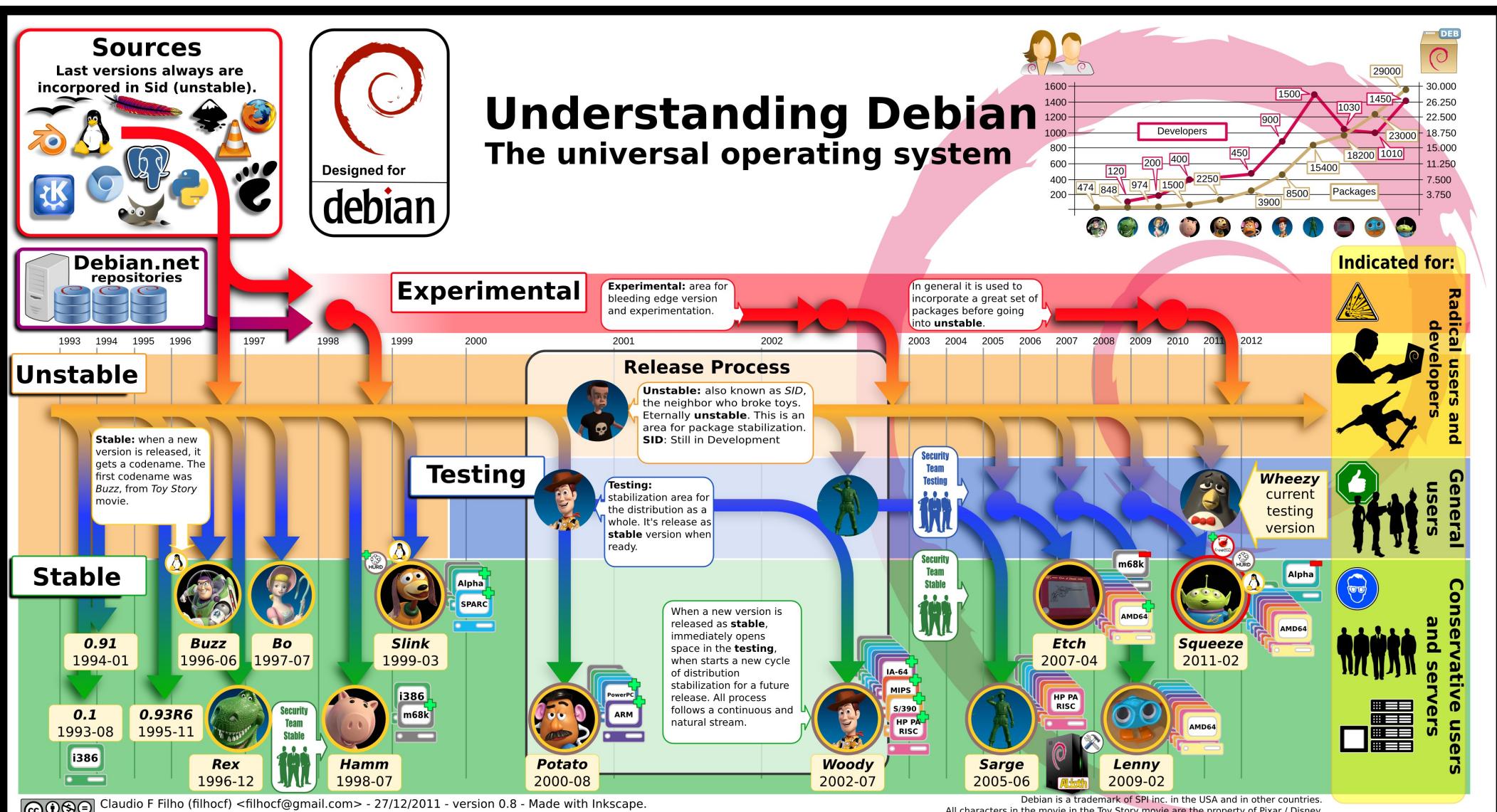
- 查詢硬碟使用率
 - \$ df -h
- 查詢目錄大小
 - \$ du -sh
 - \$ ncdt
- 查詢記憶體使用量
 - \$ free -m
- 查詢系統啟動時間與工作負載
 - \$ uptime

系統服務

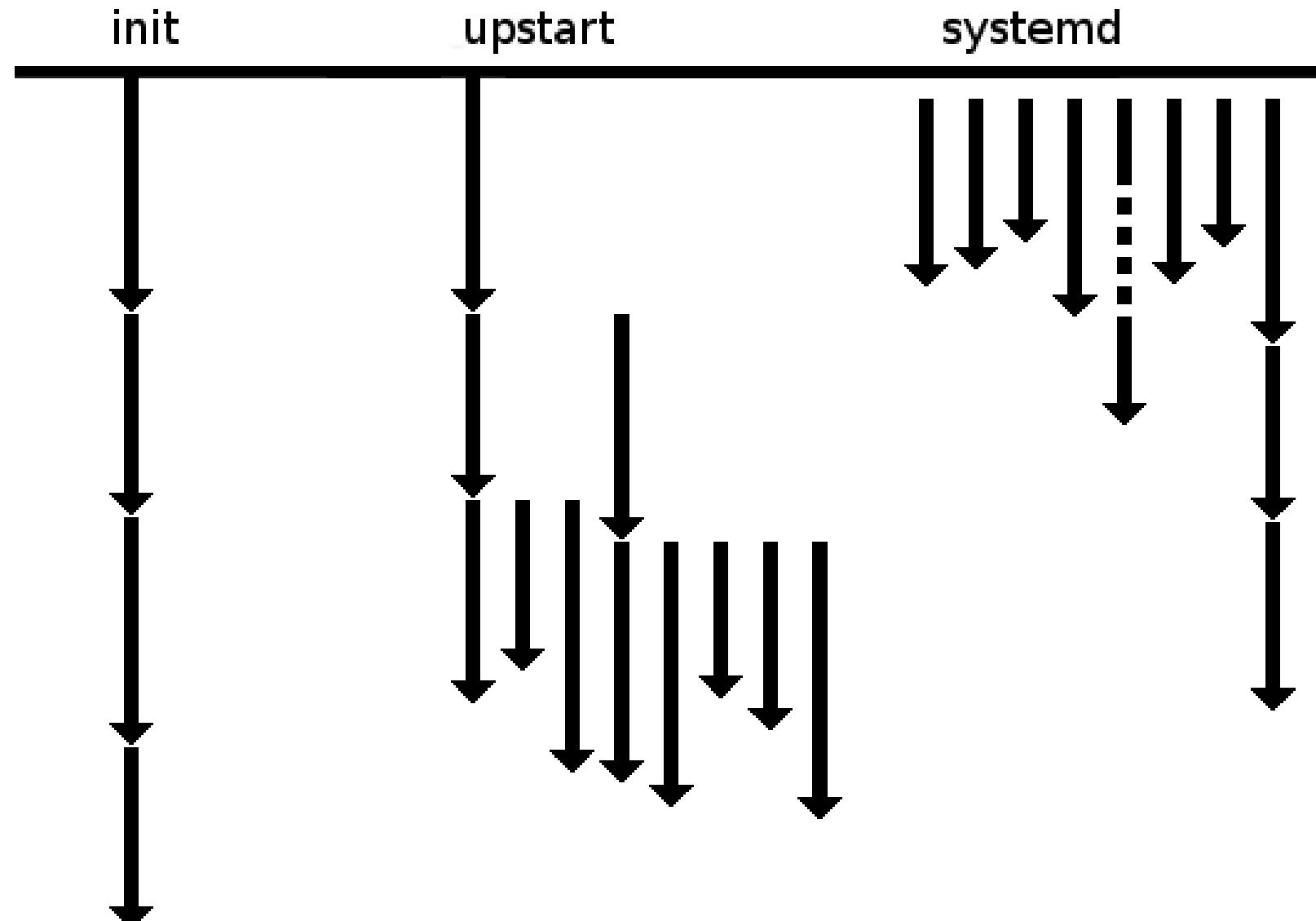
系統服務

- daemon 提供 service(常混用)
- service 是一個 background process
- 要成為一個 service 通常：
 - 和 parent 程序斷開
 - 更改工作目錄
 - 關掉標準輸出輸入錯誤
 - 提供控制方法 (停止 / 啟動 / 重新啟動)
 - 提供 logs 監控

Debian 的演進



系統服務的演進



核心載入後，交給 systemd 處理

- Systemd 是 Jessie 預設的初始化系統，包括
 - 啟動系統與個人服務
 - 提供管理工具

systemd

systemd 架構

systemd Utilities

systemctl journalctl notify analyze cgls cgtop logindctl nspawn

systemd Daemons

systemd
journald networkd
logind user session

systemd Targets

bootmode basic
shutdown reboot
multi-user
dbus telephony
dlog logind
graphical
user-session
user-session display service
tizen service

systemd Core

manager unit
systemd service timer mount target
snapshot path socket swap
login multiseat inhibit
session pam
namespace log
cgroup dbus

systemd Libraries

dbus-1 libpam libcap libcryptsetup tcpwrapper libaudit libnotify

Linux Kernel

cgroups

autofs

kdbus

系統服務管理

- 看系統服務狀態
 - \$ sudo systemctl status [srv]
- 立刻停止 / 啟動系統服務
 - \$ sudo systemctl start/stop [srv]
- 開機啟動 / 不啟動系統服務
 - \$ sudo systemctl enable/disable [srv]
- 重新載入 systemd，掃瞄新的或有變動的單元
 - \$ sudo systemctl daemon-reload

新增 systemd 設定檔

```
$ sudo nano /lib/systemd/system/my_systemd.service
```

```
[Unit]
Description>Add a New Systemd

[Service]
ExecStart=/home/pi/my_systemd.sh

[Install]
WantedBy=multi-user.target
```

```
$ sudo systemctl daemon-reload
```

DEMO

將 sshd 服務停止與啟動並觀察

軟體安裝與管理

從原始碼編譯成執行檔

- 撰寫程式
 - \$ nano hello.c

```
#include <stdio.h>

int main(void)
{
    printf("Hello World\n");
    return 0;
}
```

- 用 gcc 編譯程式成二進位檔案
 - \$ gcc hello.c -o hello
- 執行
 - \$./hello

使用 make+Makefile

- 建立 Makefile(命令要用 tab 開頭)
 - \$ nano Makefile

```
all:  
    gcc hello.c -o hello  
  
clean:  
    rm -f hello.o hello
```

- 使用 make 工具
 - \$ make
- 執行
 - \$./hello

使用 make+Makefile

- 建立 Makefile(命令要用 tab 開頭)
 - \$ nano Makefile

```
all:  
    tab gcc hello.c -o hello  
  
clean:  
    tab rm -f hello.o hello
```

- 使用 make 工具
 - \$ make
- 執行
 - \$./hello

用 Autotools 建立 Makefile 檔案

- 從原始碼編譯程式標準步驟：
 - 1. 下載 tarball 或是 source
 - 2. 用 `./configure` 工具偵測環境並產生 Makefile
 - 3. 用 `make` 進行編譯
 - 4. 用 `sudo make install` 安裝（非必要）

練習：

下載 which 原始碼，並安裝到 /usr/local/which

使用參數：--prefix=/usr/local/which

<ftp://ftp.gnu.org/gnu/which/which-2.21.tar.gz>

從原始碼編譯安裝的優缺點

- 優點：
 - 完全客製化，從版本到編譯選項到安裝路徑等
- 缺點：
 - 自己解決函式庫相依問題
 - 自己解決版本升級問題
 - 自己解決安裝移除程式問題
 - 自己解決所有事

dpkg

- dpkg 是 Debian-based 系統的套件管理員
- 統一的安裝 / 移除軟體介面
- 統一的安裝路徑
- 統一的版本資訊查詢介面

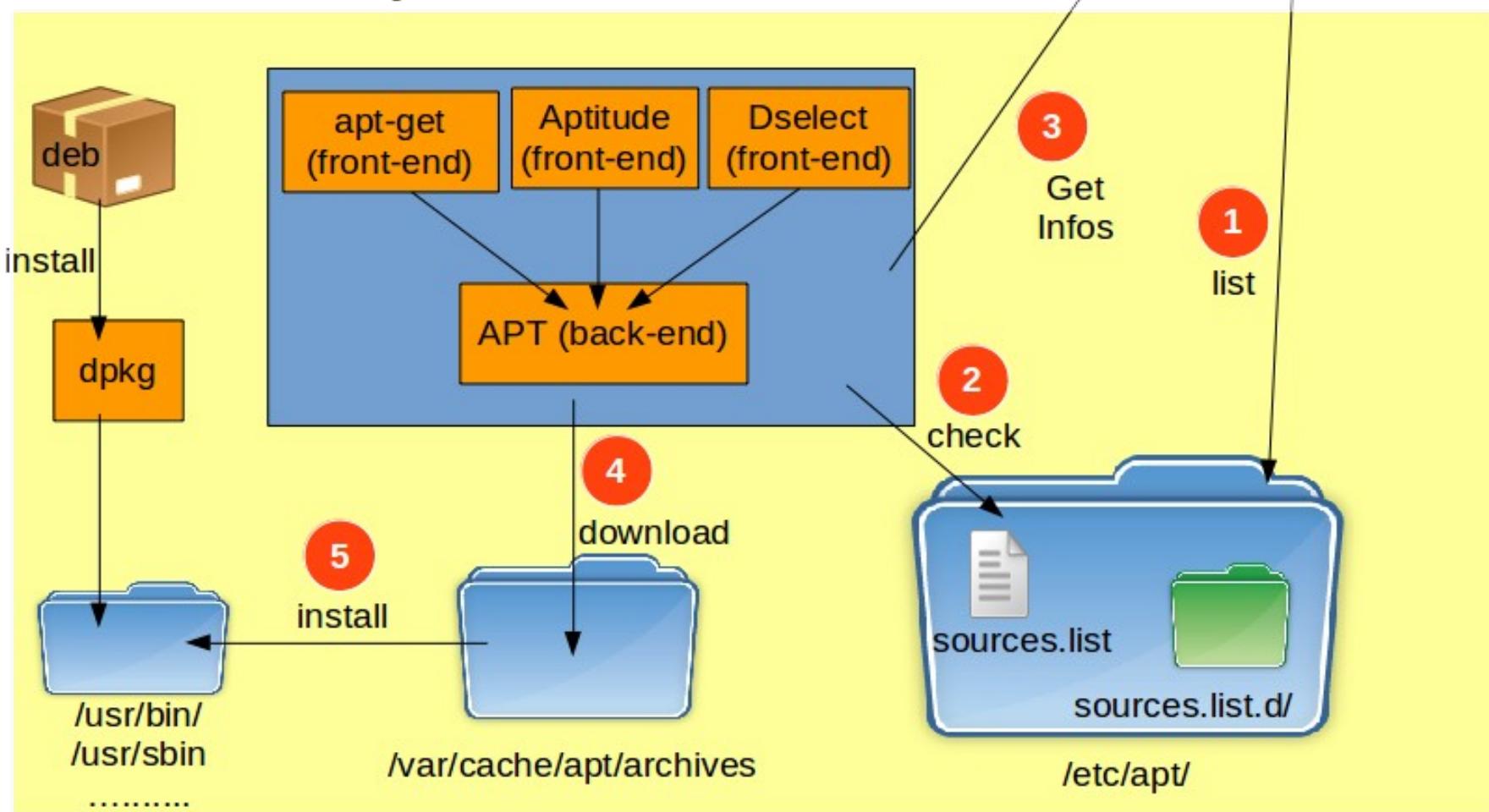
dpkg

- 安裝套件 (.deb)
 - \$ sudo dpkg -i [pkg]
- 移除套件
 - \$ sudo dpkg -r [pkg]
- 列出已安裝套件
 - \$ sudo dpkg -l
- 查詢套件所安裝檔案的路徑
 - \$ sudo dpkg -L [pkg]
- 範例：
 - \$ wget http://get.pi4j.com/download/pi4j-1.1.5.deb

套件管理系統

- 套件管理系統 (package management system)
功能
 - 由伺服器維護套件來源
 - 解決套件之間相依性問題
 - 提供查詢、安裝、升級與移除功能

Debian Based System



Repository and Package Index

- 伺服器清單
 - /etc/apt/sources.list
 - /etc/apt/sources.list.d
- 更新套件庫與更新系統套件
 - \$ sudo apt-get update && sudo apt-get upgrade

apt-get

- 安裝套件
 - \$ sudo apt-get install [pkg]
- 移除套件
 - \$ sudo apt-get remove [pkg]
- 移除套件並清除設定檔
 - \$ sudo apt-get remove --purge [pkg]
- 移除套件與相依套件
 - \$ sudo apt-get autoremove [pkg]

伺服器架設

常用伺服器

- VNC 伺服器
- 常用組合 LAMP=Linux+Apache+MySQL+PHP



Virtual Network Computing

- RFB 協定 + 螢幕畫面分享及遠端操作軟體
- 與作業系統無關，可跨平台使用
- Client/Server 架構

不同的 VNC

- 第一種：鏡像桌面 (x11vnc)
 - 連接到真實的 x11 display
- 第二種：虛擬桌面 (xvnc)
 - 連接到 X server

鏡像桌面 (x11vnc)



在 Pi 安裝和執行 x11vnc Server

- 安裝 x11vnc 套件
 - \$ sudo apt-get install -y x11vnc
- 執行 x11vnc
 - \$ x11vnc
- 設定 x11vnc 連線視窗大小
 - \$ x11vnc -geometry [width]x[height]
 - \$ x11vnc -geometry 800x600

pi@raspberrypi: ~

File Edit Tabs Help

pi@raspberrypi:~ \$ x11vnc

```
#####
#@ ##### YOU ARE RUNNING X11VNC WITHOUT A PASSWORD!!
#@ This means anyone with network access to this computer
#@ may be able to view and control your desktop.
#@ >>> If you did not mean to do this Press CTRL-C now!! <<<
#@ You can create an x11vnc password file by running:
#@     x11vnc -storepasswd password /path/to/passfile
#@ or     x11vnc -storepasswd /path/to/passfile
#@ or     x11vnc -storepasswd
#@ (the last one will use ~/.vnc/passwd)
#@ and then starting x11vnc via:
```

pi@raspberrypi: ~

File Edit Tabs Help

pi@raspberrypi: ~ \$ x11vnc

```
#####
#@          @#
#@ ** WARNING ** WARNING ** WARNING ** WARNING ** @#
#@          @#
#@          YOU ARE RUNNING X11VNC WITHOUT A PASSWORD!! @#
#@
```

```
#@ This means anyone w: 06/07/2016 06:00:59 WARNING: You are running x11vnc WITHOUT a password. See
#@ may be able to view 06/07/2016 06:00:59 WARNING: the warning message printed above for more info.
#@ >>> If you did not m 06/07/2016 06:00:59
#@          06/07/2016 06:00:59
#@
```

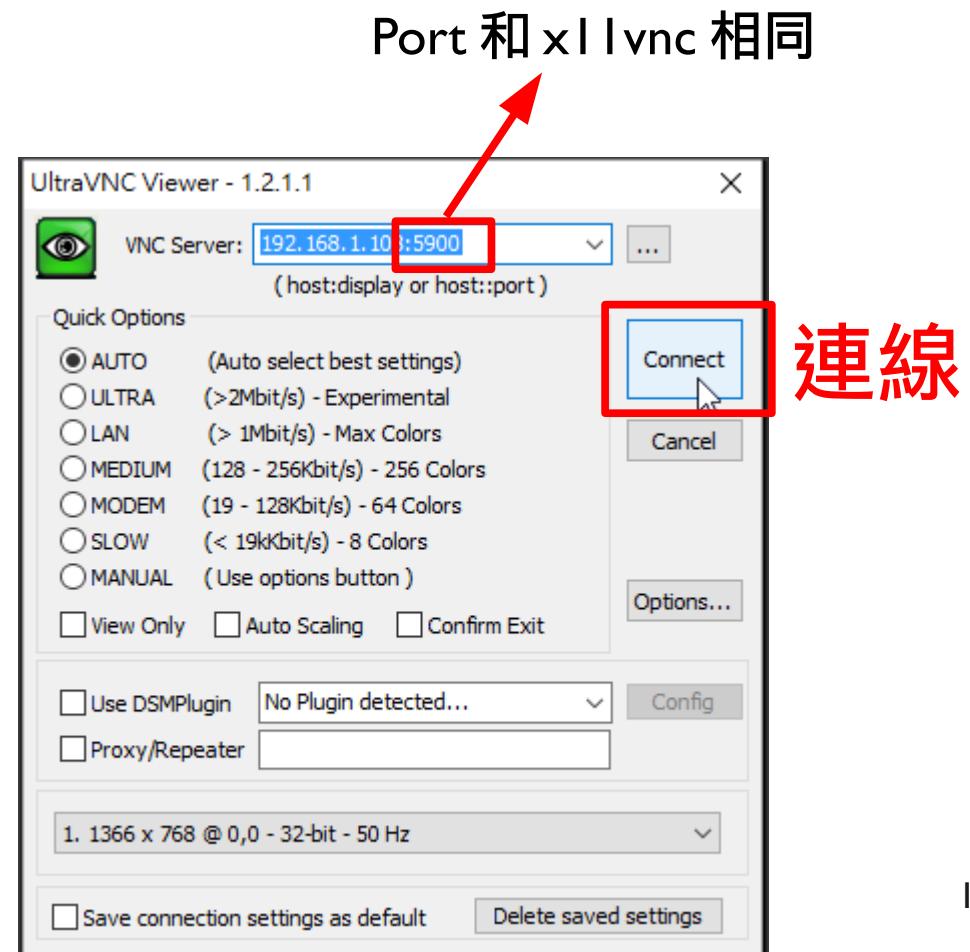
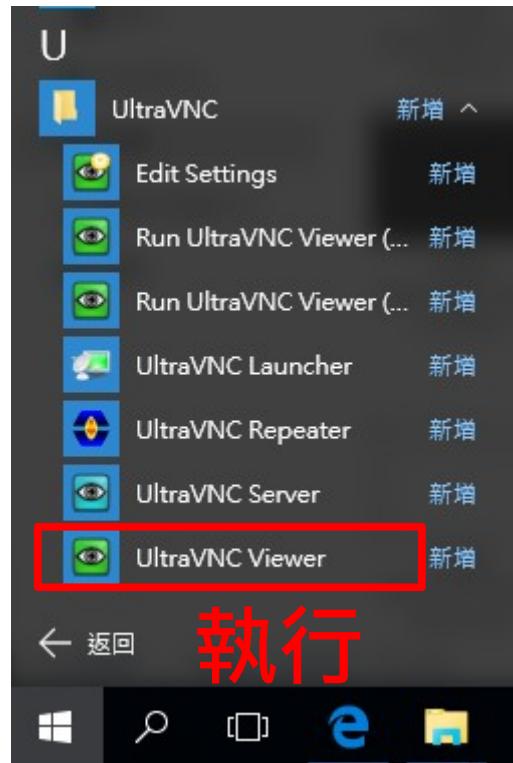
```
#@          The VNC desktop is:      raspberrypi:0
#@ You can create an x: PORT=5900
#@          x11vnc -storepa ****
#@ or x11vnc -storepa Have you tried the x11vnc '-ncache' VNC client-side pixel caching feature yet?
#@ or x11vnc -storepa
#@          The scheme stores pixel data offscreen on the VNC viewer side for faster
#@ (the last one will ) retrieval. It should work with any VNC viewer. Try it by running:
#@ and then starting x: x11vnc -ncache 10 ...
```

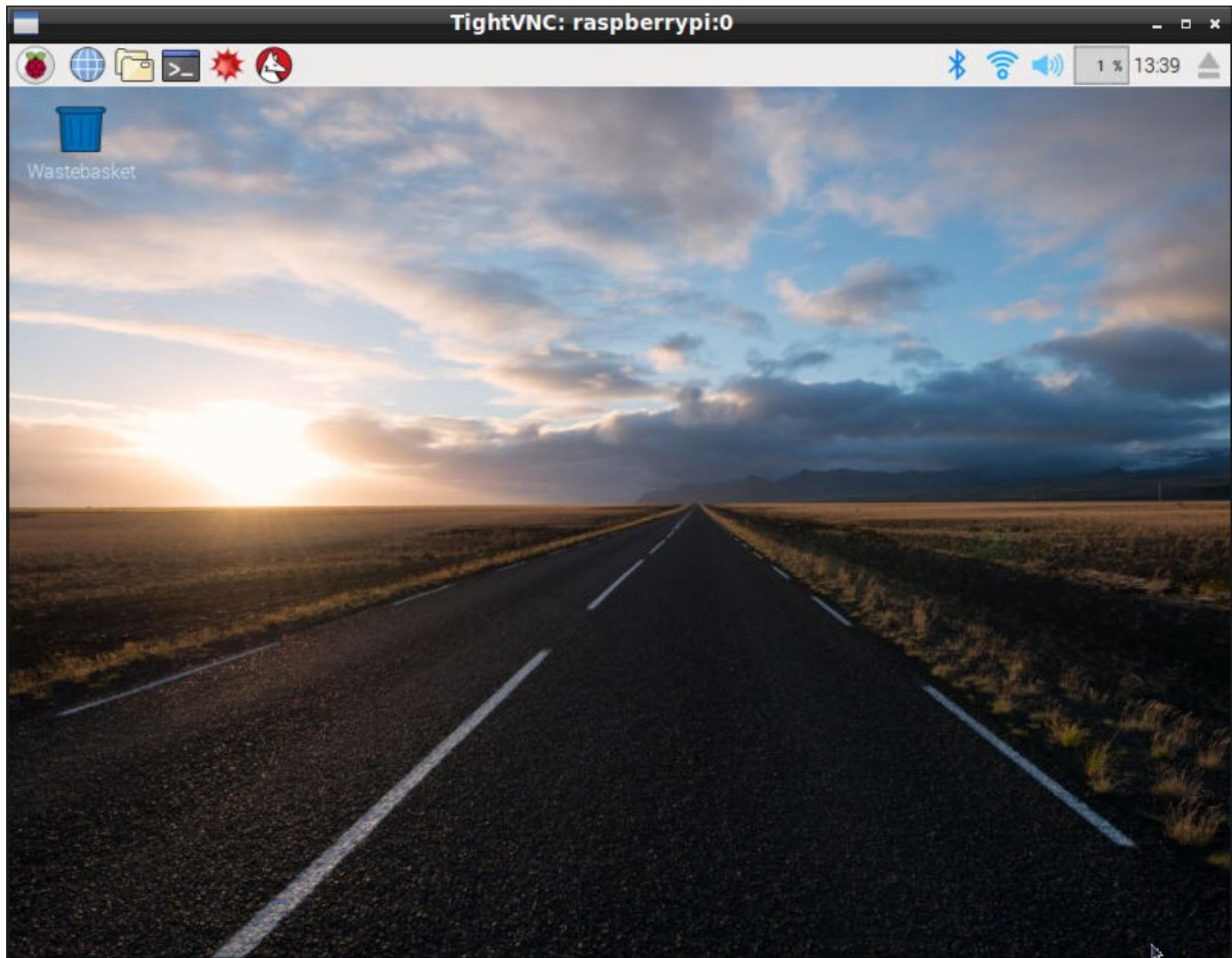
One can also add -ncache_cr for smooth 'copyrect' window motion.
More info: <http://www.karlrunge.com/x11vnc/faq.html#faq-client-caching>

```
06/07/2016 06:00:59 check_xrandr_event():
06/07/2016 06:00:59 Detected XRandR event at location 'check_xevents':
06/07/2016 06:00:59 check_xrandr_event: no change detected.
06/07/2016 06:00:59 check_xrandr_event: enabling full XRandR trapping anyway.
```

在 Windows 安裝 x11vnc Client

- 下載 UltraVNC (<http://goo.gl/jpvnYK>)
 - 下載後改名為 .exe
 - 只要安裝 Viewer





Demo

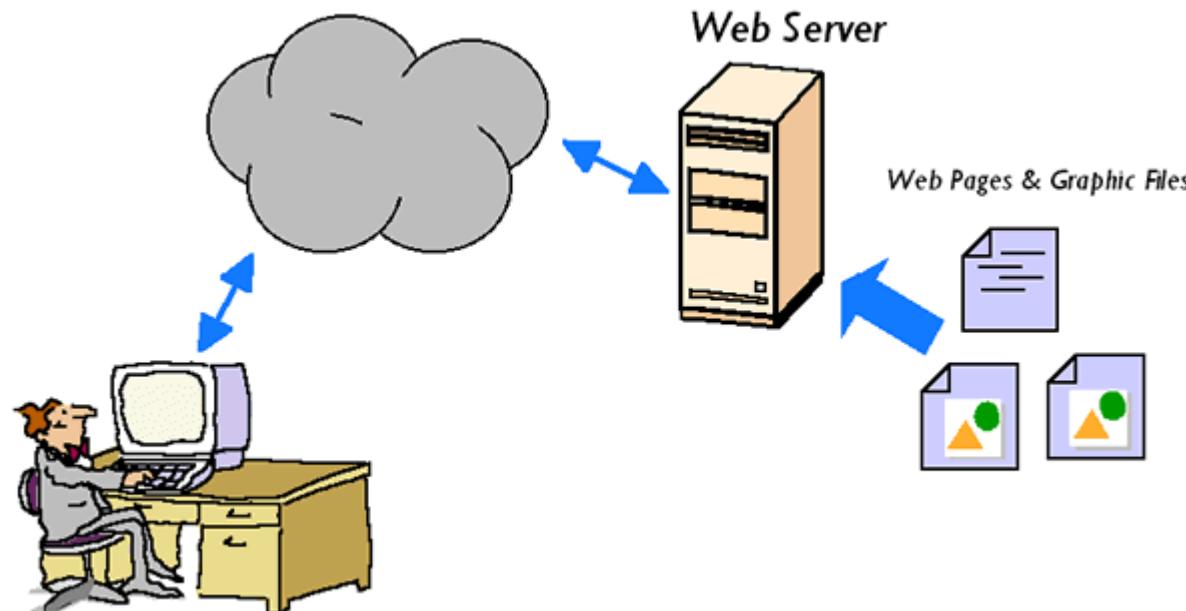
鏡像桌面和虛擬桌面的分別

Demo

UI 和 Command 的關係

網頁伺服器 (Web Server)

- 一個軟體
- 回應從 80/8080 port 進來的 HTTP 要求
- 可透過 CGI 或 module 方式擴充
- 如 Apache, Nginx, Boa



Apache Web Server

- 安裝
 - \$ sudo apt-get install -y apache2
- 設定檔路徑
 - /etc/apache2/sites-available/000-default.conf
- 預設網頁路徑
 - /var/www/html/index.html
- 預設 log 路徑
 - /var/log/apache2

第一個網頁



debian

Apache2 Debian Default Page

It works!

This is the default welcome page used to test the correct operation of the Apache2 server after installation on Debian systems. If you can read this page, it means that the Apache HTTP server installed at this site is working properly. You should **replace this file** (located at `/var/www/html/index.html`) before continuing to operate your HTTP server.

If you are a normal user of this web site and don't know what this page is about, this probably means that the site is currently unavailable due to maintenance. If the problem persists, please contact the site's administrator.

Configuration Overview

Debian's Apache2 default configuration is different from the upstream default configuration, and split into several files optimized for interaction with Debian tools. The configuration system is **fully documented in `/usr/share/doc/apache2/README.Debian.gz`**. Refer to this for the full documentation.

Documentation for the web server itself can be found by accessing the **manual** if the `apache2-doc` package was installed on this server.

The configuration layout for an Apache2 web server installation on Debian systems is as follows:

```
/etc/apache2/
|-- apache2.conf
|   '-- ports.conf
|-- mods-enabled
|   '-- *.load
|   '-- *.conf
|-- conf-enabled
|   '-- *.conf
|-- sites-enabled
```

用 systemd 管理 apache

- 看系統服務狀態
 - \$ sudo systemctl status apache2
- 立刻停止 / 啟動系統服務
 - \$ sudo systemctl start/stop apache2
- 開機啟動 / 不啟動系統服務
 - \$ sudo systemctl enable/disable apache2

從 log 瞭解系統狀態

- 正常存取 log
 - /var/log/apache2/access.log
- 伺服器錯誤 log
 - /var/log/apache2/error.log

PHP

- 安裝
 - \$ sudo apt-get install -y php5 libapache2-mod-php5
- 設定擋路徑
 - /etc/php5/apache2/
- 第一個 PHP 頁面
 - \$ cd /var/www/html
 - \$ sudo nano index.php

```
<?php  
phpinfo();
```

第一個 PHP 網頁

PHP Version 5.6.27-0+deb8u1



System	Linux raspberrypi 4.4.21-v7+ #911 SMP Thu Sep 15 14:22:38 BST 2016 armv7l
Build Date	Oct 24 2016 17:26:50
Server API	Apache 2.0 Handler
Virtual Directory Support	disabled
Configuration File (php.ini) Path	/etc/php5/apache2
Loaded Configuration File	/etc/php5/apache2/php.ini
Scan this dir for additional .ini files	/etc/php5/apache2/conf.d
Additional .ini files parsed	/etc/php5/apache2/conf.d/05-opcache.ini, /etc/php5/apache2/conf.d/10-pdo.ini, /etc/php5/apache2/conf.d/20-json.ini
PHP API	20131106
PHP Extension	20131226
Zend Extension	220131226
Zend Extension Build	API220131226,NTS
PHP Extension Build	API20131226,NTS
Debug Build	no
Thread Safety	disabled
Zend Signal Handling	disabled
Zend Memory Manager	enabled
Zend Multibyte Support	provided by mbstring
IPv6 Support	enabled
DTrace Support	enabled
Registered PHP Streams	https, ftps, compress.zlib, compress.bzip2, php, file, glob, data, http, ftp, phar, zip

MySQL Database

- 安裝

- \$ sudo apt-get install -y mysql-server php5-mysql
 - \$ sudo apt-get install php5-mysqlnd

- 設定檔路徑

- /etc/mysql/my.cnf

- 預設 log 路徑

- /var/log/mysql

- 登入並建立第一個資料庫

- \$ mysql -uroot -p
 - mysql> create database wordpress;
 - mysql> exit

Wordpress

- 下載最新版本

- \$ cd /var/www/html
- \$ sudo wget https://wordpress.org/latest.tar.gz
- \$ sudo tar zxvf latest.tar.gz

Wordpress 設定頁面



Welcome to WordPress. Before getting started, we need some information on the database. You will need to know the following items before proceeding.

1. Database name
2. Database username
3. Database password
4. Database host
5. Table prefix (if you want to run more than one WordPress in a single database)

We're going to use this information to create a `wp-config.php` file. **If for any reason this automatic file creation doesn't work, don't worry. All this does is fill in the database information to a configuration file. You may also simply open `wp-config-sample.php` in a text editor, fill in your information, and save it as `wp-config.php`. Need more help? [We got it.](#)**

In all likelihood, these items were supplied to you by your Web Host. If you don't have this information, then you will need to contact them before you can continue. If you're all ready...

[Let's go!](#)

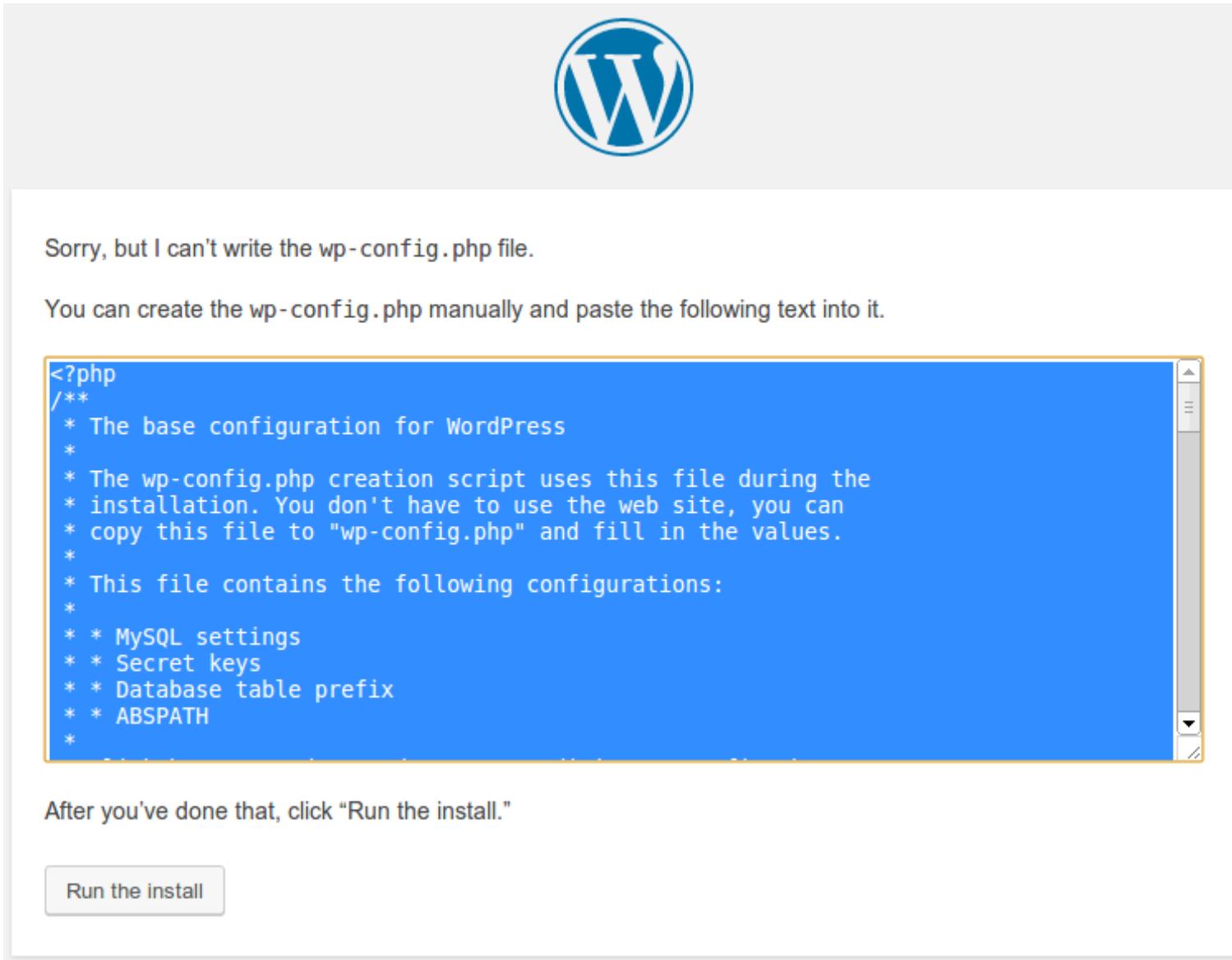
資料庫資訊



Below you should enter your database connection details. If you're not sure about these, contact your host.

Database Name	<input type="text" value="wordpress"/>	The name of the database you want to use with WordPress.
Username	<input type="text" value="root"/>	Your database username.
Password	<input type="password" value="*****"/>	Your database password.
Database Host	<input type="text" value="localhost"/>	You should be able to get this info from your web host, if localhost doesn't work.
Table Prefix	<input type="text" value="wp_"/>	If you want to run multiple WordPress installations in a single database, change this.

無法正確產生 wp-config.php



The screenshot shows the WordPress installation process. At the top, the classic blue 'W' logo is displayed. Below it, a large white text area contains the following content:

Sorry, but I can't write the wp-config.php file.
You can create the wp-config.php manually and paste the following text into it.

```
<?php  
/**  
 * The base configuration for WordPress  
 *  
 * The wp-config.php creation script uses this file during the  
 * installation. You don't have to use the web site, you can  
 * copy this file to "wp-config.php" and fill in the values.  
 *  
 * This file contains the following configurations:  
 *  
 * * MySQL settings  
 * * Secret keys  
 * * Database table prefix  
 * * ABSPATH  
 */
```

After you've done that, click "Run the install."

[Run the install](#)

手動複製貼上

- \$ cd /var/www/html/wordpress
- \$ sudo nano wp-config.php

填入相關資訊



Welcome

Welcome to the famous five-minute WordPress installation process! Just fill in the information below and you'll be on your way to using the most extendable and powerful personal publishing platform in the world.

Information needed

Please provide the following information. Don't worry, you can always change these settings later.

Site Title

Username

Usernames can have only alphanumeric characters, spaces, underscores, hyphens, periods, and the @ symbol.

Password NKLyb4BwGQqk1caE*I Hide Strong

Important: You will need this password to log in. Please store it in a secure location.

Your Email

第一個 Wordpress

Raspberry Pi

Just another WordPress site

Hello world!

November 18, 2016

1 Comment

Welcome to WordPress. This is your first post. Edit or delete it, then start writing!



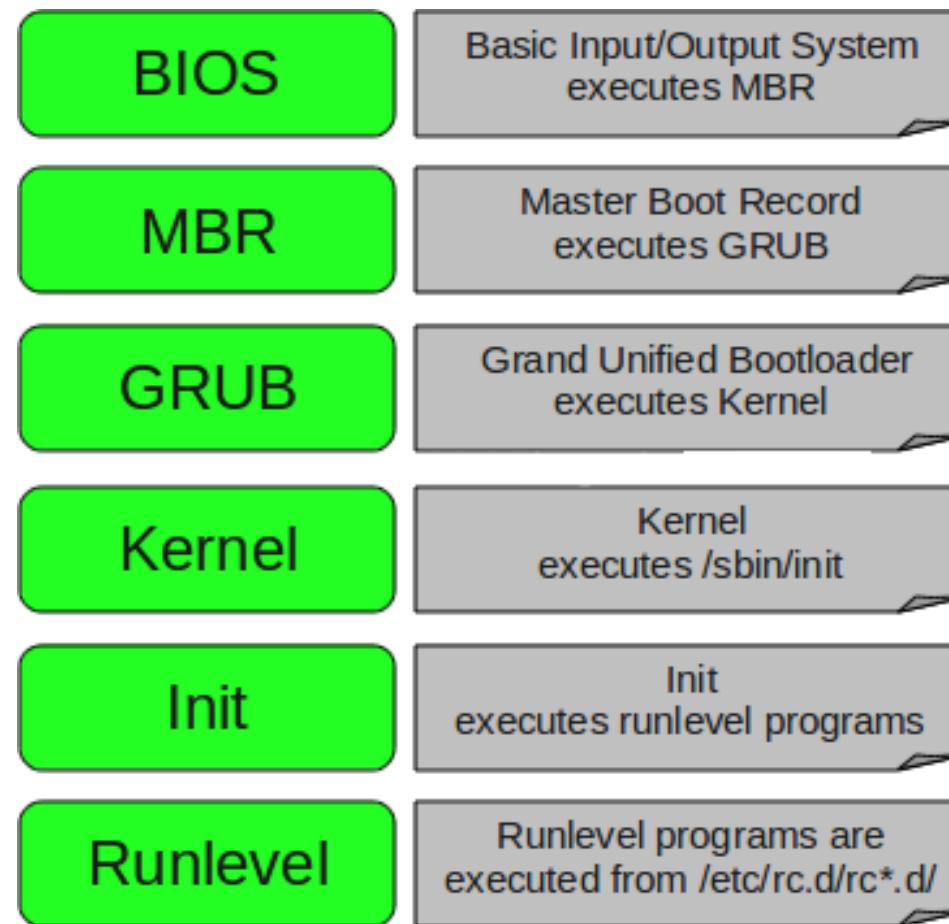
RECENT POSTS

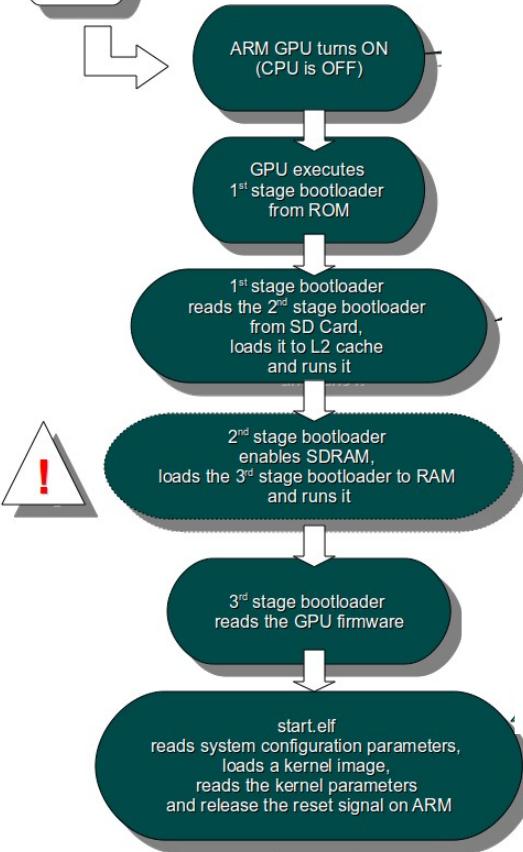
- [Hello world!](#)
-

RECENT COMMENTS

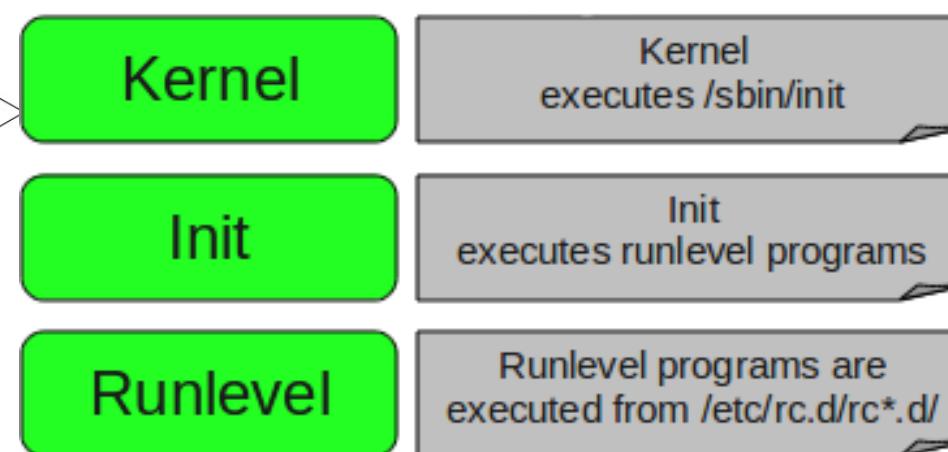
開機流程介紹

Linux 開機流程

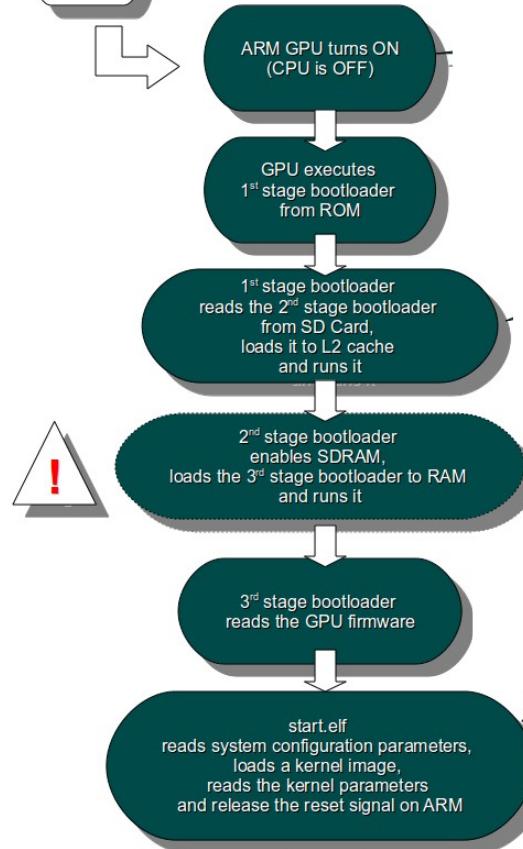




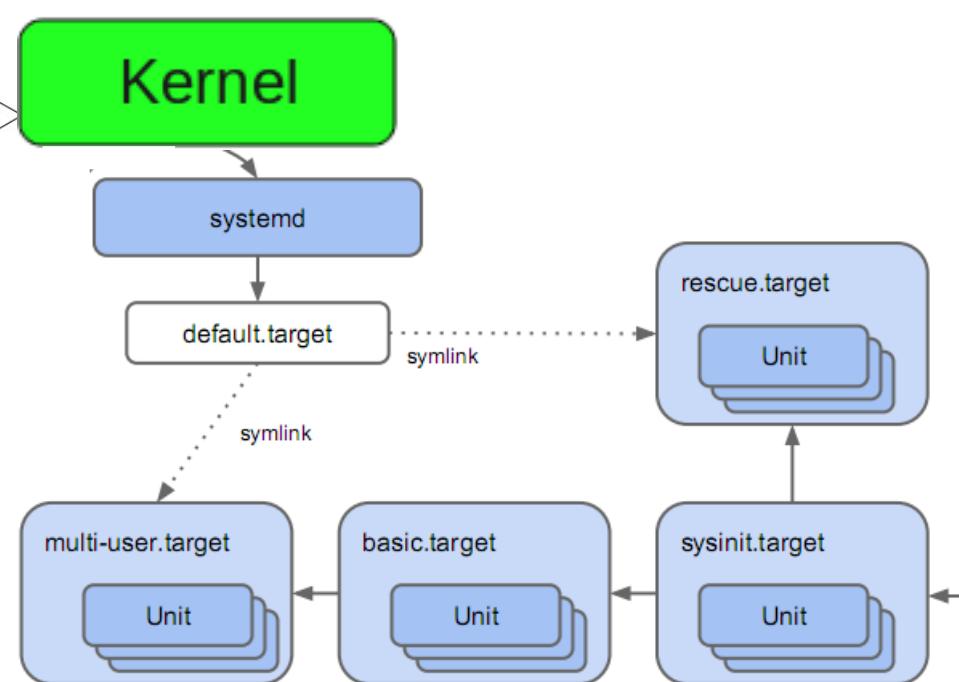
Pi 開機流程



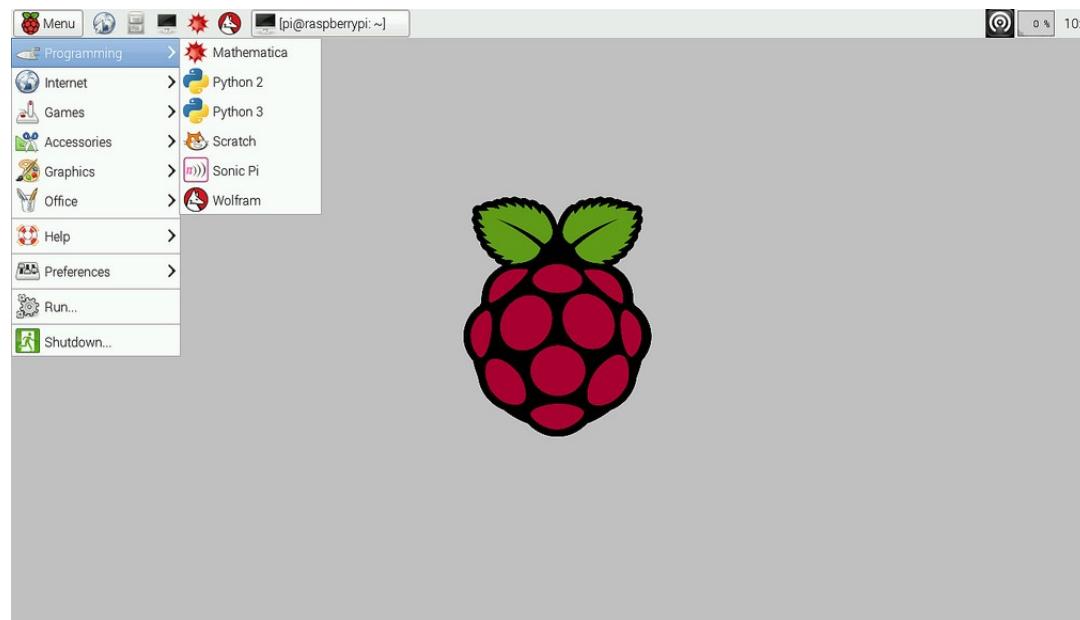
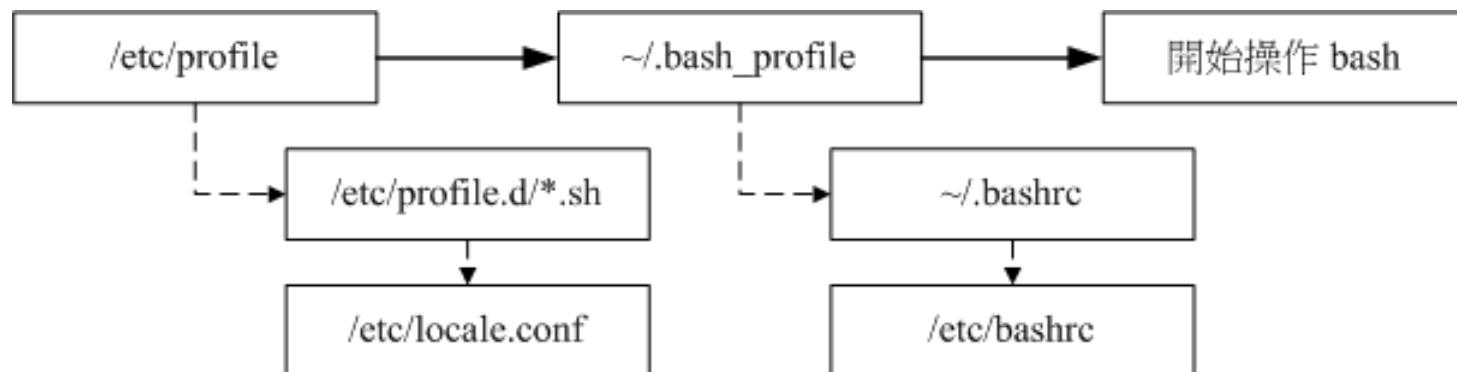
Power ON



Raspbian Jessie Pi 開機流程



使用者登入與進入桌面環境



開機就執行？

- 一次性的執行，可以放在 /etc/rc.local 裡
- 以服務的方式執行，需寫 systemd 設定檔
- 有畫面的程式前景執行，用 LXDE 的 autostart

一次性的執行

- \$ sudo nano /etc/rc.local

```
/your/command/here
```

```
# Print the IP address
_IP=$(hostname -I) || true
if [ "$_IP" ]; then
    printf "My IP address is %s\n" "$_IP"
fi

exit 0
```

有畫面的程式前景執行

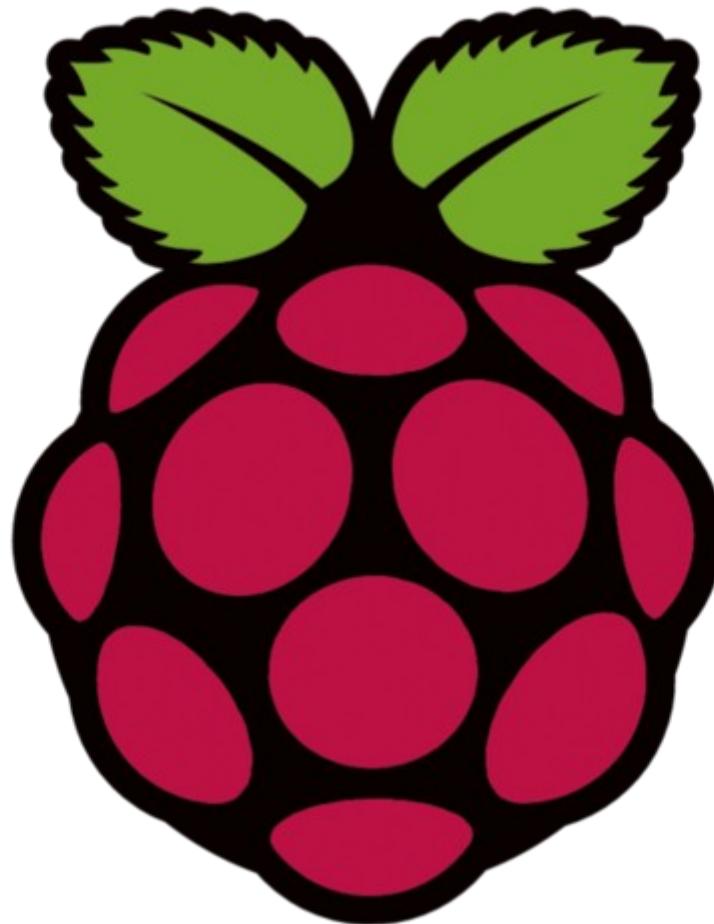
- \$ nano ~/.config/lxsession/LXDE-pi/autostart

```
@lxpanel --profile LXDE-pi  
@pcmanfm --desktop --profile LXDE-pi  
@xscreensaver -no-splash  
@/your/command/here
```

需求

- 1. 一開機就將 /etc 打包壓縮到 /home/pi/bak/rc.tar.gz
- 2. 一開機就執行 chromium-browser
如何看一開機就執行？
在 Pi 上安裝 x11vnc， 指令 sudo apt-get install x11vnc
在 windows 安裝 ultravnc， 請參考 p120-p127

Raspberry Pi Rocks the World



Thanks