

Introduction to the Raspberry Pi



Overview

- A brief history of the Raspberry Pi
- Operating systems available for the Raspberry Pi
- Getting started with the Pi and the BASH Shell
- Some useful hints and tips!
- Some more advanced scenarios

The Raspberry Pi

A small (credit card sized?) computer, designed with educational aims, but with much potential for interacting with the physical world

First Version released in 2012

Intended to teach children programming but Immediately popular with hobbyists!



The Beginning - Raspberry Pi

Released in 2012

Cost +/- £20 (Model A) / +/- £30 (Model B)

Size of a credit card

32-bit ARMv6 CPU (700MHz) - 256MB RAM (Model B Later had 512MB)

Powered by Micro-USB

Model B: Ethernet, 2 x USB, HDMI, Audio, Composite Video, GPIO

Operating System on SD card

Raspberry Pi - Model B+

Released July 2014

Same Price

Now 4 USB ports

Now uses Micro-SD card (less prone to damage)

Increase number of GPIO pins

Raspberry Pi - Model B 2

Released February 2015

Upgraded ARMv7 CPU (900 MHz)

Now 1GB of RAM

Raspberry Pi - Model B 3

Released February 2016

Upgraded ARMv8 64-bit Capable CPU (1.2 GHz)

802.11n Wireless

Bluetooth 4.1

Can require a higher current power supply!

Raspberry Pi B 2 now also available with ARMv8 (although only 900 MHz)

Raspberry Pi Zero

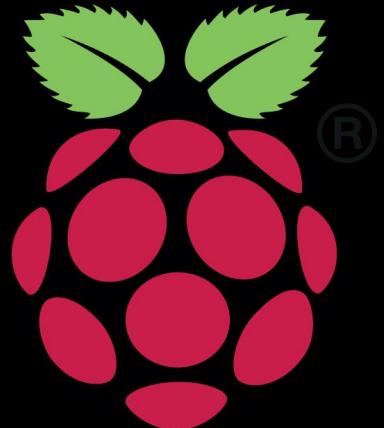
- Released November 2015
- Less than half the size of the original Pi
- Same CPU as the original Raspberry Pi (but 1GHz instead of 700MHz)
- 512 MB of RAM
- Same 40 pin GPIO (header connector not included)
- No ethernet / wifi / bluetooth
- May need some adaptors
- Can now be attached to Pi Cameras (May 2016 Revision)

What do people use a Raspberry Pi for?

- To explore educational software.
- As a platform for learning to develop software.
- To stream multimedia around the house (audio, video).
- To play Minecraft?

What can you do with a Raspberry Pi

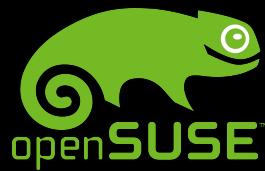
- Measure sensors (temperature, humidity, light, etc)
- Observe experimental results remotely
- Log data at regular intervals for retrieval at a later date
- Control experiments



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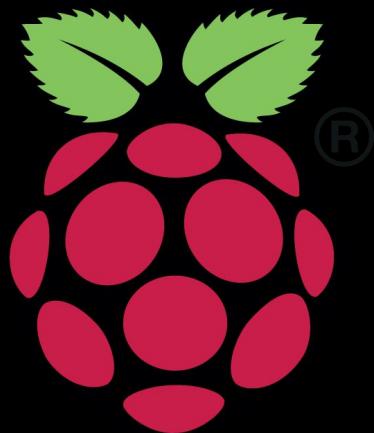
Raspbian: A Pi Operating System



ubuntu®

One of many available operating systems

How do you install the OS?

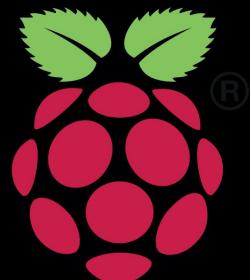


- Either download an ‘image’ of one of the available operating systems or download NOOBS
- Write the ‘image’ to the SD card using a special tool (different depending upon your operating system)
- Follow the instructions!

NOOBS: <https://www.raspberrypi.org/learning/software-guide/>

Images: <https://www.raspberrypi.org/documentation/installation/installing-images/README.md>

What software is available



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- Lots of software is packaged and available as “Packages”
- Easiest to search for available packages and names online
- Can be installed in aptitude (we shall see this later).
- Is distributed with an optional GUI

```
_ ,met$$$$$gg.  
.g$$$$$$$$$$$$$P.  
,g$P"" """"Y$$.". .  
',$$P' '$$.  
',$$P ,ggs. '$$b:  
d$$' ,,$P'' . $$  
$$P d$' , $$P  
$$: $$.- ,d$$'  
$$: Y$b. ,d$P'  
Y$$. `."Y$$$$P"'. '$$'  
`$$b " -  
`Y$b  
`Y$$. ,d$$$g$$ ,d$$b. $$,d$$$b.'$$' g$$$$$b. '$$,d$$b.  
`Y$b. ,,$P' `Y$. $$' '$$ " ' '$$ '$$' '$$  
`Y$b. $$' $$ '$' '$$' '$$ ,ggggg$$ '$' $$  
`Y$b. $$' $$ '$$ggggg$$ '$$ '$$ '$$ ,,$P" '$$ '$$ '$$  
`Y$b. $$' ,,$$ '$$. '$$ ,,$P '$$ '$' ,,$$ '$$ '$$  
`Y$b. '$$' ,,$$ '$' ,,$$ ,g$P' '$$ 'b. ,,$$ '$$ '$$  
`Y$b. '$$' ,,$$ '$' ,,$$ ,`Y$P'$$. '$$' ,,$$ '$$ '$$  
`Y$b. '$$' ,,$$ '$' ,,$$ ,`Y$P'$$. '$$' ,,$$ .
```

Good Evening **adsized**! You're Logged Into **edi**! | <http://www.sjjones.me.uk>

```
--| System Information |-----  
  HOST : edi  
  KERNEL : 3.16.0-4-amd64 x86_64  
  CPU : Intel(R) Xeon(R) CPU E3-1231 v3 @ 3.40GHz  
  MEMORY : 3921 MB  
  SWAP : 13 MB  
  LOAD AVG : 0.19, 0.23, 0.20  
  UPTIME : 4 days 6 hours 16 minutes 43 seconds  
  USERS : 1 session is active (adsized)  
--| User Information |-----  
  USERNAME : adsized  
  HOME : /home/adsized  
  GROUPS : adsized sudo  
  PROCESSES : You are running 6 of 159 processes  
-----  
adsized@edi:~$ █
```

I've setup my Pi and have this!

What do I do now?

Good Evening adsized! You're Logged Into edi! | <http://www.sjjones.me.uk>

```
--- | System Information | -----
    HOST      : edi
    KERNEL    : 3.16.0-4-amd64 x86_64
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```

Welcome to the

Bourne Again Shell

```
_ ,met$$$$$gg.  
.g$$$$$$$$$$$$$P.  
,g$P"" """/Y$$.". .  
',$$P' '$$. '$$.  
',$$P' ,ggs. '$$b:  
d$$' ,,$P'' . $$$.  
$$P d$' , $$P  
$$: $$. - ,d$$'  
$$: Y$b. __,d$P'  
Y$$. `."Y$$$$P"'. '$$'  
`$b " - __ '$$ '$$  
'Y$b '$$ '$$  
'Y$$. ,d$$$g$$ ,d$$b. $$,d$$$b.'$$' g$$$b. '$$,d$$b.  
'$b. ,,$P' `Y$. $$' '$$ '' '$$ '$$' '$$  
'Y$b. $$' $$ '$' '$$' '$$ ,ggggg$$ '$' $$  
'Y$b. '$$ '$$ $ggggg$$ '$$ '$$ '$$ ,,$P" '$$ '$$ '$$  
`Y$b. '$$ ,,$$ '$. '$$ ,,$P '$$ '$' ,,$$ '$$ '$$  
'Y$b. ,,$$ '$$_. '$$ ,g$P' '$$ `b. ,,$$ '$$ '$$  
`Y$$P'$$. 'Y$$P' ,,$$P"'. '$$. `Y$$P'$$. '$$. ,$$.
```

A.K.A BASH

Good Evening **adsized!** You're Logged Into **edi!** | <http://www.sjjones.me.uk>

```
---| System Information |-----  
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    KERNEL : 3.16.0-4-amd64 x86_64  
    CPU : Intel(R) Xeon(R) CPU E3-1231 v3 @ 3.40GHz  
    MEMORY : 3921 MB  
    SWAP : 13 MB  
    LOAD AVG : 0.19, 0.23, 0.20  
    UPTIME : 4 days 6 hours 16 minutes 43 seconds  
    USERS : 1 session is active (adsized)  
---| User Information |-----  
    USERNAME : adsized  
    HOME : /home/adsized  
    GROUPS : adsized sudo  
    PROCESSES : You are running 6 of 159 processes
```

adsized@edi:~\$ █

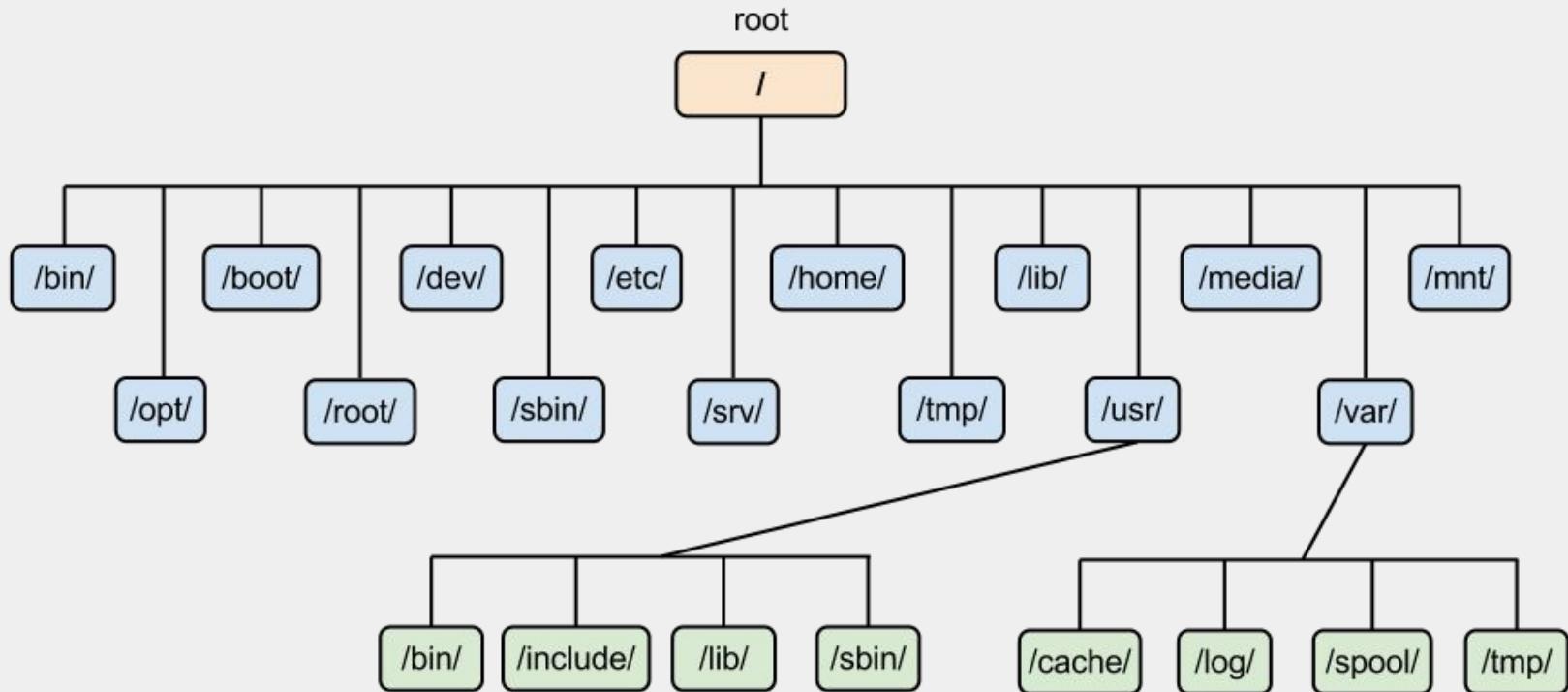
The BASH Prompt

```
adam@raspberrypi:/home/adam $ █
```

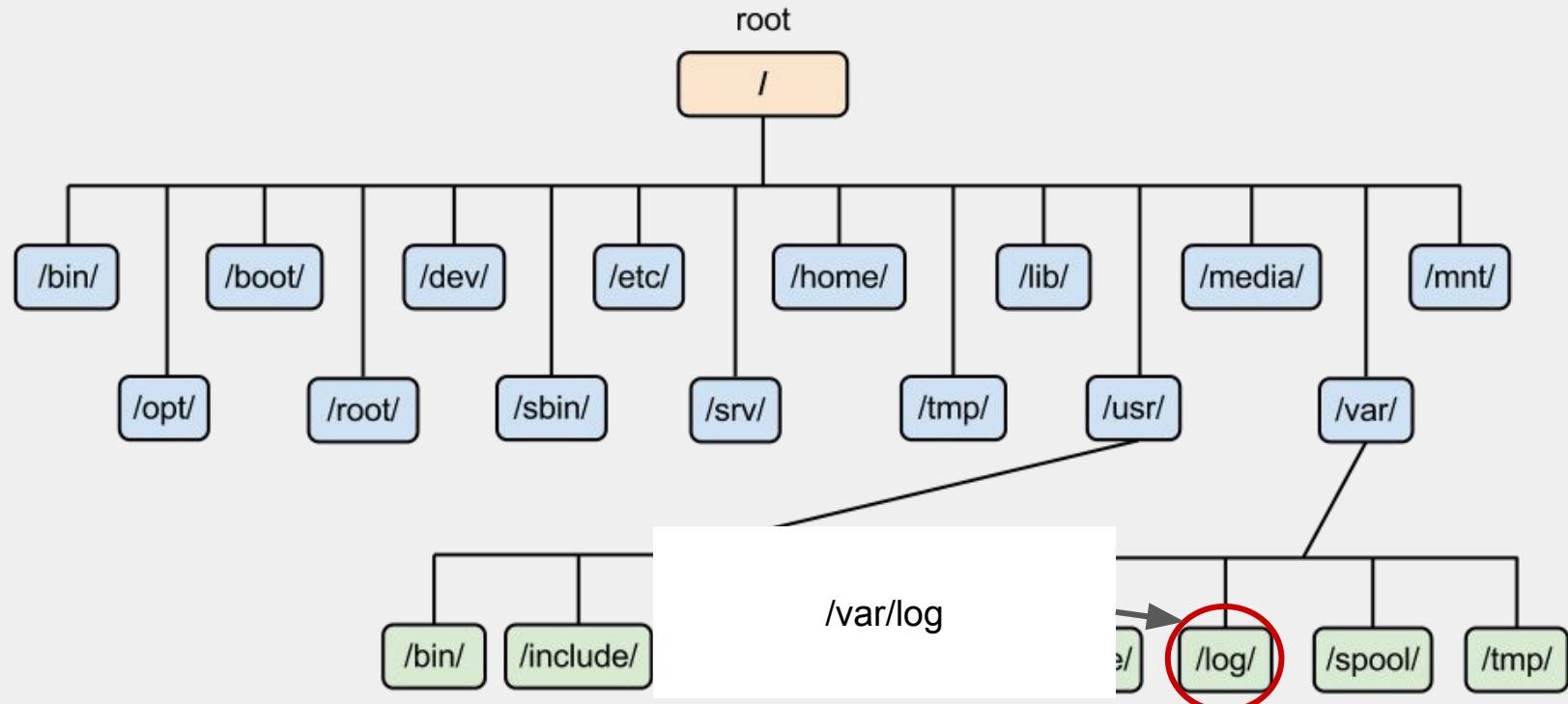
The BASH Prompt

user @ hostname : /file/path \$ █

A Quick Aside - The Linux File System Layout



The Linux File System Layout



What about ~

You are almost certainly going to see the ~ character used throughout the BASH environment

~ = A shortcut to the home directory of the current user

Eg. For the user adam

~ = /home/adam

Listing Directories (pwd)

```
adam@raspberrypi:~ $ pwd  
/home/adam  
adam@raspberrypi:~ $ █
```

Listing Directories (ls)

```
adam@raspberrypi:~ $ ls  
Desktop  
Documents  
adam@raspberrypi:~ $ █
```

Listing Directories (ls)

```
adam@raspberrypi:~ $ ls -a
```

```
.
```

```
..
```

```
.hidden_file
```

```
Desktop
```

```
Documents
```

```
adam@raspberrypi:~ $ █
```

Changing Directories (cd)

```
adam@raspberrypi:~ $ cd Documents
```

```
adam@raspberrypi:~/Documents $ █
```

Moving Files or Folders (mv)

```
adam@raspberrypi:~/Documents $ ls
```

```
super_interesting_file.txt
```

```
adam@raspberrypi:~/Documents $ mv super_interesting_file.txt ..
```

```
adam@raspberrypi:~/Documents $ cd ..
```

```
adam@raspberrypi:~ $ ls
```

```
super_interesting_file.txt
```

```
adam@raspberrypi:~ $ █
```

Viewing the Contents of Text Based Files (cat)

```
adam@raspberrypi:~ $ cat super_interesting_file.txt
```

This is my super interesting file!

Isn't it nice...

```
adam@raspberrypi:~ $ █
```

Copying Files (cp)

```
adam@raspberrypi:~ $ cp super_interesting_file.txt super_interesting_file2.txt
```

```
adam@raspberrypi:~ $ ls
```

Desktop

Documents

super_interesting_file.txt

super_interesting_file2.txt

```
adam@raspberrypi:~ $ █
```

Copying Entire Directories (cp)

```
adam@raspberrypi:~ $ cp -R Documents PersonalFiles
```

```
adam@raspberrypi:~ $ ls
```

```
Desktop
```

```
Documents
```

```
PersonalFiles
```

```
super_interesting_file.txt
```

```
super_interesting_file2.txt
```

```
adam@raspberrypi:~ $ █
```

Removing Files (rm)

```
adam@raspberrypi:~ $ rm super_interesting_file2.txt
```

```
adam@raspberrypi:~ $ ls
```

Desktop

Documents

PersonalFiles

super_interesting_file.txt

```
adam@raspberrypi:~ $ █
```

Removing Directories (rm)

```
adam@raspberrypi:~ $ rm -r PersonalFiles
```

```
adam@raspberrypi:~ $ ls
```

```
Desktop
```

```
Documents
```

```
super_interesting_file.txt
```

```
adam@raspberrypi:~ $ █
```

Tips

You can use tab to complete the name of many commands and files.

You can press the up/down arrows to scroll through commands you have run previously.

Try and avoid using spaces in filenames!

For further useful commands and explanation see:

<http://www.tldp.org/LDP/abs/html/basic.html>

Some More Advanced Scenarios

A Little Experiment ?

```
adam@raspberrypi:~ $ ls /root
```

```
ls: /root: Permission denied
```

```
adam@raspberrypi:~ $ █
```

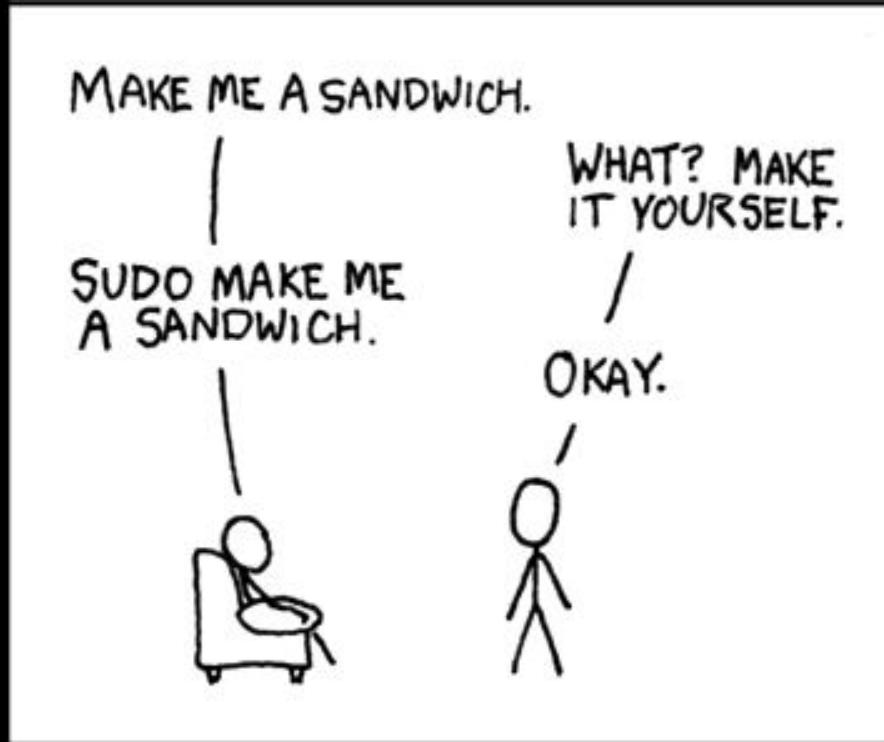
?

Root is the administrative user

But we shouldn't use root usually!

Not to worry ... “sudo” to the rescue

sudo



A Little Experiment ?

```
adam@raspberrypi:~ $ sudo ls /root  
[sudo] password for adsized:  
super_secret_file.txt  
adam@raspberrypi:~ $ █
```

Be very careful running commands as root!

!! Do Not Try This !!

```
adam@raspberrypi:~ $ sudo rm -rf /
```

!

Installing software

```
adam@raspberrypi:~ $ sudo apt-get install python
```

....

Viewing the last 5 commands executed

```
adam@raspberrypi:~ $ history | tail -n 5
```

```
ls
```

```
rm super_interesting_file2.txt
```

```
ls
```

```
rm -r PersonalFiles
```

```
ls
```

```
adam@raspberrypi:~ $ █
```

Finding Lines Matching a Pattern

```
adam@raspberrypi:~ $ history | grep "ls -a"
```

```
ls -a
```

```
adam@raspberrypi:~ $ |
```

Repeating the Last Command

```
adam@raspberrypi:~ $ echo "Hello World"
```

```
Hello World
```

```
adam@raspberrypi:~ $ !!
```

```
Hello World
```

```
adam@raspberrypi:~ $ !
```

Re-run Previous Commands

```
adam@raspberrypi:~ $ echo "Hello World 2"
```

```
Hello World 2
```

```
adam@raspberrypi:~ $ !-2
```

```
Hello World
```

```
adam@raspberrypi:~ $ !
```

This is great!
But you said something about a GUI?

Starting the GUI

```
adam@raspberrypi:~ $ startx
```

A white ceramic mug is filled to the brim with vibrant red raspberries. The mug is positioned on a light-colored wooden surface with visible grain. The raspberries are clustered together, their small seeds and stems clearly visible. The lighting is soft, highlighting the texture of the berries.

Questions?