Session #2 Part 1

The Command Line &

The Linux Filesystem Hierarchy

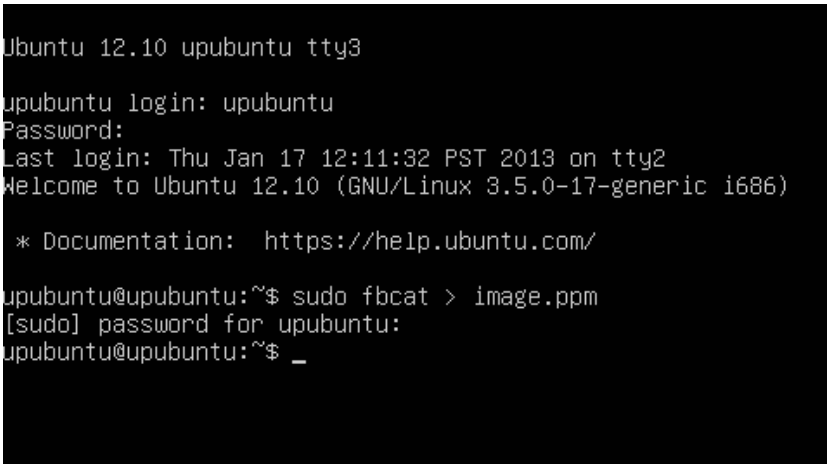
Summary

The Shell

What is the shell?

Remembering this diagram from last session, the shell is the first layer that a user can use to interact with the operating system.

It looks something like this:



This is the standard “TTY” shell that you can use, it is the default one you’ll find on Linux distributions that don’t have a GUI.

Ways to connect to a shell

You can access the TTY shell by pressing CTRL + ALT + any of the function keys ranging from 2 to 7.

Example: CTRL + ALT + F3

It doesn’t really seem like the nicest or most intuitive way to use your system, and what makes it even worse is that you have to exit the GUI every time you need to type a command.

That’s why we have the *glorious* terminal!

Note: If you’re using a laptop you may have to press the ‘Fn’ key alongside this combination to make it work.

Note: By default, most Linux distributions use TTY7 (F7) or TTY2 (F2).

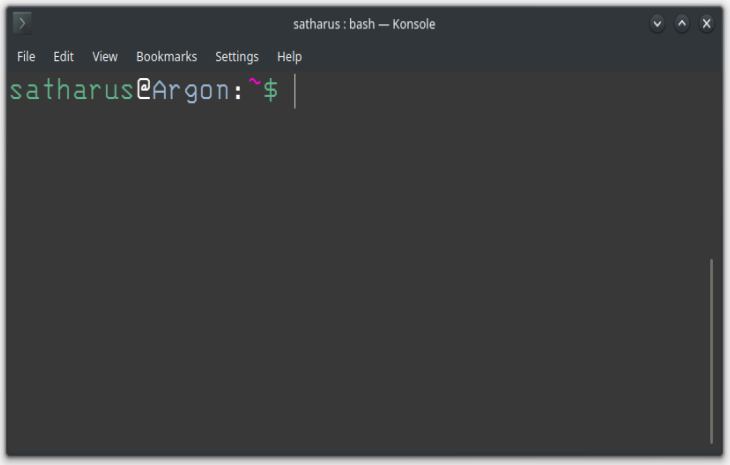
The Terminal Emulator

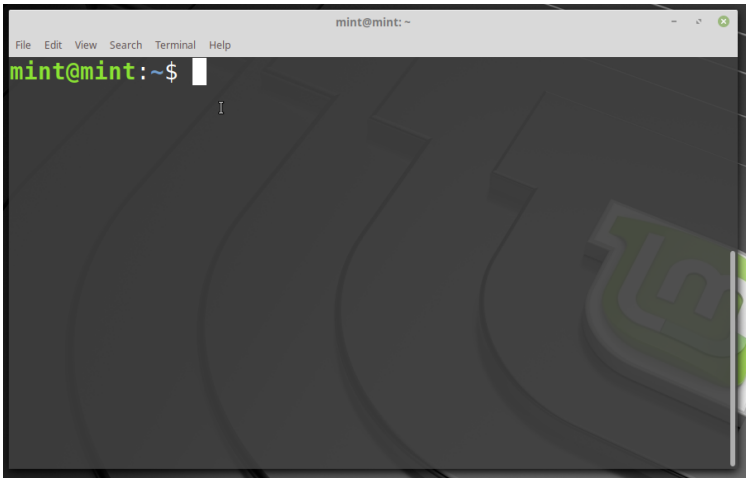
What is a terminal emulator?

The terminal emulator is a great way to connect to a shell without having to close your GUI. It is an amazing way to execute commands.

i.e Type commands in a window that is inside your GUI.

And it looks something like this:





Ways to open a terminal

The terminal can be opened using any of the following methods (and many more):

- CTRL + ALT + T (Works on Ubuntu and Linux Mint)
  - SUPER + T (Works on some distributions like elemetary OS)
- ALT + F2 then typing in “gnome-terminal” or “konsole” (The name of the terminal emulator that your distribution uses)
- Right click on the desktop and click on “Open a terminal”
- Opening the terminal from the GUI by searching for it in the menu. Search for (Terminal, Console, Konsole, etc..)

Note: The Windows key is called “Super” or “Meta” in Linux.

The Command Line

The Command Line Prompt

When you open the terminal you'll see something like this:

It is prompting you to enter a command, let's break it down:

`osc/root`: The username of the current logged in user.

`@`: Defines that you are connected to the machine that has the name after it

`mint`: The name of the computer running (Name of the host)

`~`: The working directory, the directoy that the terminal is working in right now.

> Note: The ~ "Tilde" symbol means the home directory of the user (/home/user) in Linux.

`$`: States that you are logged in as a regular user.

`#`: States that you are logged in as the system administrator (root).

So we can basically summarise it to the following:

```
USERNAME@HOSTNAME:WORKING_DIRECTORY($/#)
```

The Command Line Syntax

When ordering the computer to do something, i.e giving it a command, you have to take care of the syntax.

Just like programming languages, the Linux shell has specific syntax that you have to use. Just so that it could be understood by the shell.

The syntax goes as follows:

```
[COMMAND]        [OPTION]          [ARGUMENTS]
   ls          -ld, -la, -lA      file or directory
   rm           -r,  -f, -ir      file or directory
```

The Command: Intuitively, this is the command that you give to the system, i.e. delete, move, copy, list, etc..

The Option: Modifies the action of the command.

Example: List "ALL" files, delete "recursively", show the first "40" lines of a file, delete the file "by force"

The Arguments: What you're going to apply the command to.

i.e. Delete (command) a certain file (argument).

We can say in short that the options modify the command's effect on the argument.

Let's take the ls command as an example:

`ls` – lists the content of a directory(folder).

Running the command ls does the following:

```
osc@mint:~$ ls
Desktop    Downloads  Pictures  Templates
Documents  Music      Public    Videos
```

But that format isn't really good if you want a detailed view, so we add the `-l` option which makes it list the content but in a "long" form:

```
osc@mint:~$ ls -l
total 0
drwxr-xr-x 2 osc osc 40 Nov  8 12:28 Desktop
drwxr-xr-x 2 osc osc 40 Nov  8 12:28 Documents
drwxr-xr-x 2 osc osc 40 Nov  8 12:28 Downloads
drwxr-xr-x 2 osc osc 40 Nov  8 12:28 Music
drwxr-xr-x 2 osc osc 40 Nov  8 12:28 Pictures
drwxr-xr-x 2 osc osc 40 Nov  8 12:28 Public
drwxr-xr-x 2 osc osc 40 Nov  8 12:28 Templates
drwxr-xr-x 2 osc osc 40 Nov  8 12:28 Videos
```

Much better! Everything is clealer and organised in a list.

How about we take a look at the hidden files too?

The `-a` option lists “all files”, this command can be shortened down to `ls -la` or `ls -al`

Note: Hidden files and directories in Linux start their name with a dot”.”.

```
osc@mint:~$ ls -l -a
total 44
drwxr-xr-x 16 osc  osc   520 Nov  8 12:31 .
drwxr-xr-x  1 root root   80 Nov  8 12:27 ..
-rw-------  1 osc  osc   310 Nov  8 12:28 .ICEauthority
-rw-------  1 osc  osc    49 Nov  8 12:28 .Xauthority
-rw-r--r--  1 osc  osc   220 Nov  8 12:27 .bash_logout
-rw-r--r--  1 osc  osc  3771 Nov  8 12:27 .bashrc
drwx------  6 osc  osc   120 Nov  8 12:28 .cache
drwxrwxr-x  3 osc  osc    60 Nov  8 12:28 .cinnamon
drwxr-xr-x 12 osc  osc   280 Nov  8 12:28 .config
-rw-r--r--  1 osc  osc    27 Nov  8 12:28 .dmrc
drwx------  2 osc  osc    40 Nov  8 12:28 .gconf
drwx------  3 osc  osc    60 Nov  8 12:28 .gnupg
-rw-r--r--  1 osc  osc    22 Nov  8 12:27 .gtkrc-2.0
-rw-r--r--  1 osc  osc   516 Nov  8 12:27 .gtkrc-xfce
drwx------  3 osc  osc    60 Nov  8 12:28 .local
-rw-r--r--  1 osc  osc   807 Nov  8 12:27 .profile
-rw-r--r--  1 osc  osc     0 Nov  8 12:31 .sudo_as_admin_successful
-rw-------  1 osc  osc  9209 Nov  8 12:29 .xsession-errors
drwxr-xr-x  2 osc  osc    40 Nov  8 12:28 Desktop
drwxr-xr-x  2 osc  osc    40 Nov  8 12:28 Documents
drwxr-xr-x  2 osc  osc    40 Nov  8 12:28 Downloads
drwxr-xr-x  2 osc  osc    40 Nov  8 12:28 Music
drwxr-xr-x  2 osc  osc    40 Nov  8 12:28 Pictures
drwxr-xr-x  2 osc  osc    40 Nov  8 12:28 Public
drwxr-xr-x  2 osc  osc    40 Nov  8 12:28 Templates
drwxr-xr-x  2 osc  osc    40 Nov  8 12:28 Videos
```

Filesystems

What is a filesystem?

A filesystem is the way that the files are stored on a storage device (i.e. Hard Drive, USB Flash Drive, etc..).

Each operating system uses a certain filesystem:

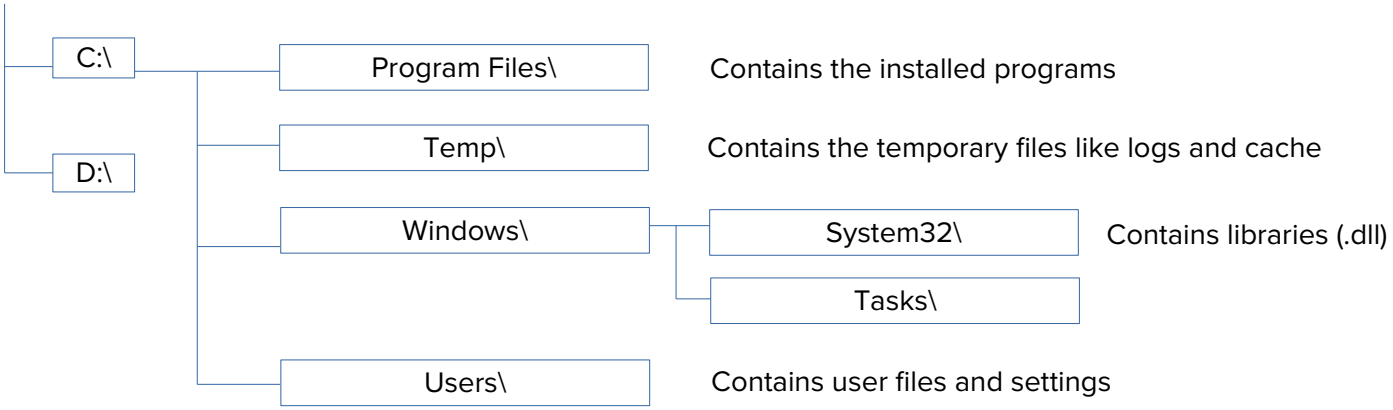
Linux → EXT4, XFS

Windows → NTFS, FAT32

Note: Linux supports NTFS and FAT32, but Windows doesn't support EXT4 or XFS, that's why you can't see the Linux partitions on Windows.

Windows Directory Structure

A directory structure is the way an operating system's files are arranged displayed to the user.



Windows, like every operating system, has a specific directory structure for its NTFS file system.

Each disk is assigned a letter, and you browse your files based on that.

Note: C:\ and D:\ could be 2 seperate physical hard drives.

Linux also has a directory structure, called

"Filesystem Hierarchy Standard" or "The Linux Filesystem Hierarchy".

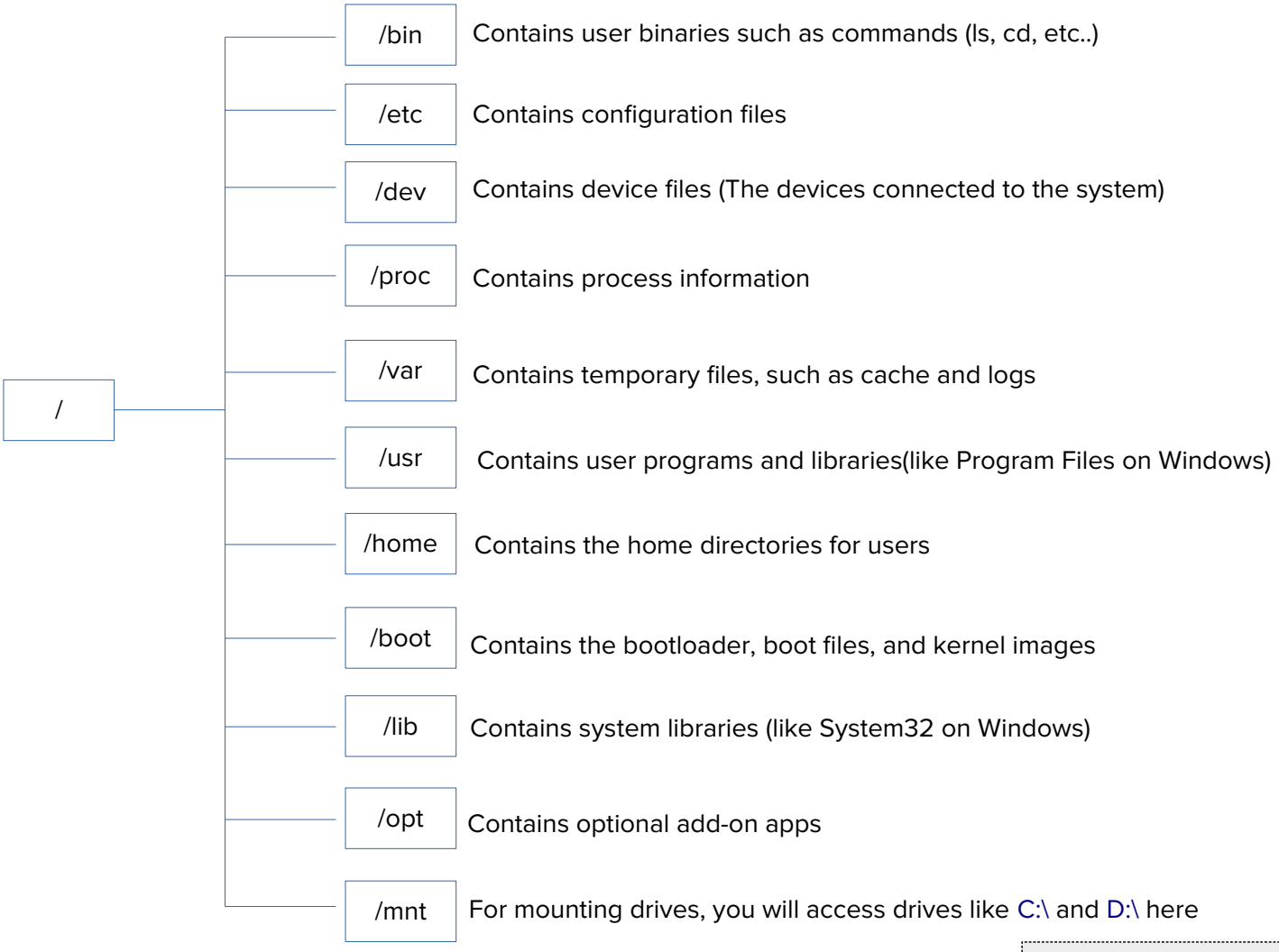
Linux Filesystem Hierarchy

The root '/' directory

The '/' directory or the "root" directory is where everything begins on Linux.

No matter what you want to access, where it is, it will somehow connect to the root directory.

Here's a demonstration of the Linux Filesystem Hierarchy:



Note: C:\ and D:\ here are not accessed as C:\ or D:\, but instead as directories under '/'.

From the previous, we can see that:

"Everything in Linux is a file". Even devices and processes, everything is a file under the '/' directory somehow.

Let's test it out!

```
osc@mint:~$ ls /
bin   cdrom  etc   lib    media  opt   rofs  run   srv  tmp  var
boot  dev    home  lib64  mnt    proc  root  sbin  sys  usr
```

If we list the content of the root directory using the `ls` command, we will find the directories in the previous diagram.

Now we know what a filesystem, directory, and file are. Let's talk about how we can access them.

Navigating through the filesystem

You opened a terminal, now what?

The first thing you want to do is to know where the terminal is working:

```
osc@mint:~$ pwd
/home/osc
```

`pwd`: Print Working Directory, tells you the directory your terminal is working in.

Now that you know where you are in the system, you should see the content of the directory using the `ls` command.

```
osc@mint:~$ ls
Desktop    Downloads  Pictures  Templates
Documents  Music      Public    Videos
```

What if we wanted to enter the Pictures directory?

```
osc@mint:~$ cd Pictures
osc@mint:~/Pictures$ pwd
/home/osc/Pictures
osc@mint:~/Pictures$
```

`cd`: Change Directory, changes the working directory to the specified argument.

Now the working directory is Pictures, notice how the text before $ also changed to ~/Pictures which is the same as /home/osc/Pictures, which is the working directory.

What if I wanted to go back to the home directory?

There are 4 ways:

`cd ~`: This basically means `cd /home/osc` since ~ means the home directory of the current user.

`cd /home/osc`: Tells the shell to change the working directory to /home/osc.

`cd`: Running the `cd` command without an argument takes you to the home directory by default.

`Cd ..`: .. refers to the parent directory, continue reading:

The '.' and '..' Links

Each directory has 2 hidden files (links) in it, '**.**' and '**..**'.

The '**.**' link refers to the directory itself.

The '**..**' link refers to the directory before it (parent directory).

Example: If the working directory is /home/osc/Pictures/, then:

'**.**' = /home/osc/Pictures/ and '**..**' = /home/osc/ which is the directory before it.

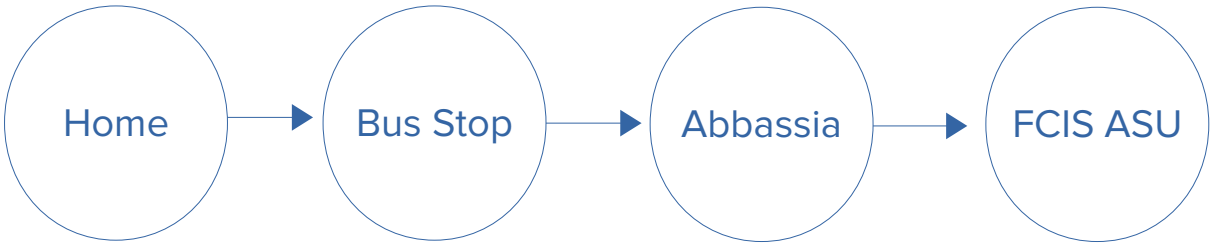
To verify:

```
osc@mint:~/Pictures$ ls -la
total 0
drwxr-xr-x  2 osc osc  60 Nov  8 16:04 .
drwxr-xr-x 16 osc osc 520 Nov  8 12:31 ..
-rw-r--r--  1 osc osc   0 Nov  8 16:04 Photo.jpg
osc@mint:~/Pictures$ ls .
Photo.jpg
osc@mint:~/Pictures$ cd ..
osc@mint:~$ pwd
/home/osc
```

This can be a little confusing at first, so practice with yourself and maybe try drawing it on a piece of paper to visualise how things really work.

Relative and absolute paths

Let's simplify this by taking a guy called "Jack" as an example, Jack goes to FCIS ASU every day, this is the path he takes daily:



Jack's route to college daily is Home->Bus Stop->Abbassia->FCIS ASU.

If he met someone at Abbassia and asked him: "Where are you going?"
Jack's response will be "FCIS ASU" only, because that's the next step.

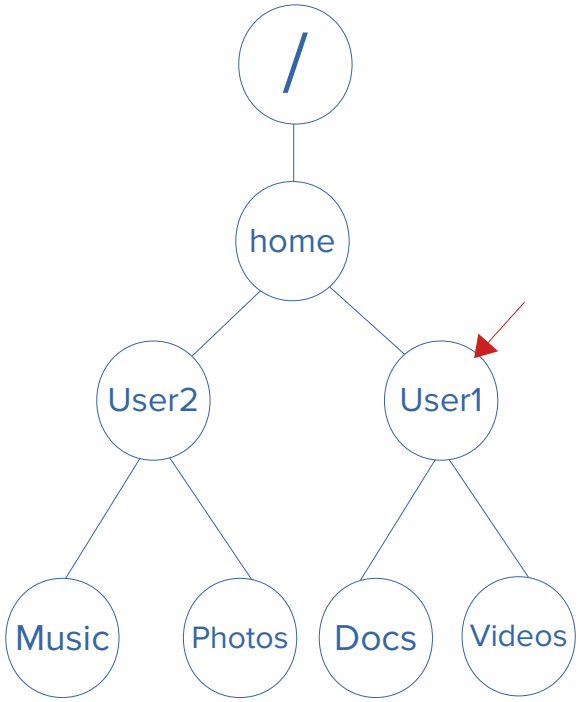
If someone asked Jack "What's your full route to college?"
Jack's response would be " Home->Bus Stop->Abbassia->FCIS ASU".

Note that his route from Abbassia is shorter because it is relative to Abbassia.

The same thing applies in Linux for directories and files.

Absolute Path: The total path leading to the directory.
Relative Path: The path relative to the working directory.

Example:
In the diagram,
Let the working directory be /home/User1



The relative path for “Videos” would be: Videos
The absolute path would be: /home/User1/Videos

Test yourself:

In the same diagram, let the working directory be /home/User1 and the user you’re logged in as called User1.

- Which directory does ‘.’ refer to?
- Which directory does ‘..’ refer to?
- What would be the working directory if you run `cd ..`?
- What would be the working directory if you run `cd .`?
- What would be the working directory if you run `cd Videos`?
- What would happen if you run `cd ../User2/`?
- What would happen if you run `cd`?
- What would happen if you run `cd User2`?
- What would happen if you run `cd /home/User2`?

Solution:

- The directory itself (User1).
- The parent directory (the directory before it: home).
- The working directory would be home.
- The shell will change the directory to the current working directory so nothing will change.
- The shell will change the working directory to /home/User1/Videos.
- The shell will change the working directory to /home/User2
  (This is the relative path)
- The shell will change the working directory to /home/User1 as you are logged in as User1, so nothing will change because the working directory is already /home/User1
- Error, there isn't a directory called "User2" under the directory "User1".
- The shell will change the working directory to /home/User2
  (This is the absolute path)