

Introduction to **GWAS**

Basic Linux and the Shell

Christian Werner

(Quantitative geneticist and biostatistician) **EiB, CIMMYT**, Texcoco (Mexico)

Filippo Biscarini

(Biostatistician, bioinformatician and quantitative geneticist) **CNR-IBBA**, Milan (Italy)



HerrFaloppio

Oscar González-Recio

(Computer biologist and quantitative geneticist) **INIA-UPM**, Madrid (Spain)



OscarGenomics



a light touch on Linux and the command line - **let's start!**



click on the **terminal icon**
to launch "**the shell**"

- similar in Mac OS
- On Windows we use MobaXterm

a light touch on Linux and the command line - **let's start!**

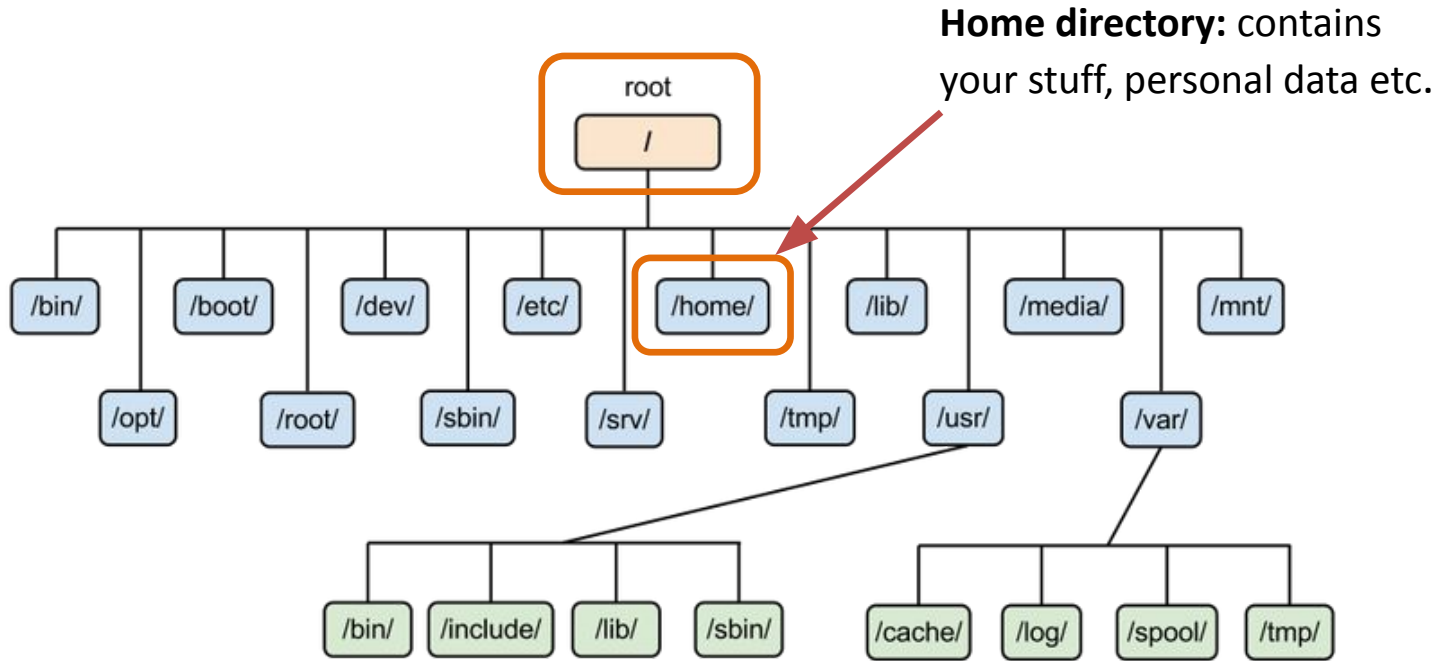
```
bash /Users/flavio
bash-3.2$ help
GNU bash, version 3.2.57(1)-release (x86_64-apple-darwin16)
These shell commands are defined internally. Type 'help' to see this list.
Type 'help name' to find out more about the function 'name'.
Use 'info bash' to find out more about the shell in general.
Use 'man -k' or 'info' to find out more about commands not in this list.

A star (*) next to a name means that the command is disabled.

JOB_SPEC [ & ]                (( expression ))
. filename [arguments]         :
[ arg... ]                     [[ expression ]]
alias [-p] [name=value] ... ]  bg [job_spec ... ]
bind [-lpsPVS] [-m keymap] [-f fi break [n]
builtin [shell-builtin [arg ...]] caller [EXPR]
case WORD in [PATTERN] [PATTERN]. cd [-L|-P] [dir]
command [-pVv] command [arg ...] compgen [-abdefgjklsuv] [-o option]
complete [-abdefgjklsuv] [-pr] [-o continue [n]
declare [-afFrtx] [-p] [name=val dirs [-clpv] [+N] [-N]
disown [-h] [-ar] [jobspec ...] echo [-neE] [arg ...]
enable [-pnds] [-a] [-f filename] eval [arg ...]
exec [-cl] [-a name] file [redirec exit [n]
export [-nf] [name=value] ... ] or false
fc [-e ename] [-nrl] [first] [last fg [job_spec]
for NAME [in WORDS ... ] do COMMA for (( exp1; exp2; exp3 )); do COM
function NAME { COMMANDS ; } or NA getopt optstring name [arg]
hash [-lr] [-p pathname] [-dt] [na help [-s] [pattern ...]
history [-c] [-d offset] [n] or hi if COMMANDS; then COMMANDS; [ elif
```

the shell takes commands from the keyboard (the “**command line**”), interprets them and passes them on to the **operating system**.

Linux file system - **hierarchy**



Linux file system - **hierarchy**

A Path in Linux is a unique location to a file or a folder in a file system

Absolute Path

- Specified location of a file or directory from the root directory (/)
- “Complete path” from the start of the file system
- `cd /home/christian/music/Miley_Cyrus`

Relative Path

- path related to the present working directory (pwd)
- Starts from the directory you are in at the moment
- `cd music/Miley_Cyrus`

print working directory

`$~ pwd`

Overview

- **Change directory**
- **Check directory content**
- **Create and remove directories**
- **Copy and move directories and files**
- **Check files**
- **Create, modify and remove files**

Linux file system - **change directory**

change directory

\$~ cd

cd has different flavours ...

- `cd ..` (relative path - one directory up)
- `cd ../..` (relative path - two directories up)
- `cd music/Slayer` (relative path - only move down)
- `cd /user/music/` (absolute path - up and down)

Tab key

1x autocomplete path (if unique)

2x show all path options

Linux file system - **directory listing**

Check out what is in your folder:

list screen

\$~ ls *directory* (relative or absolute path)

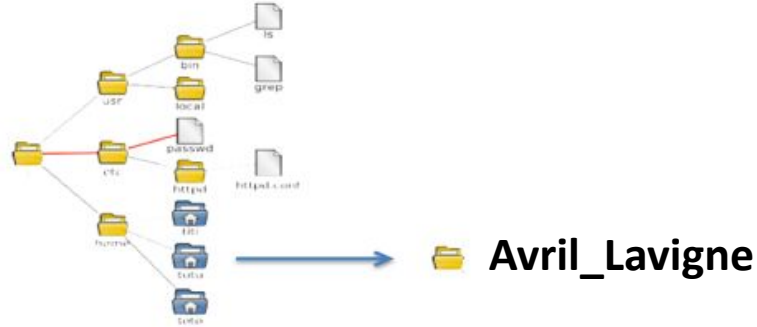
Enhanced options

- `ls -a` (including hidden files)
- `ls -l` (long format: more details)
- `ll` (alternative to `ls -l`)
- `ls -lr` (long + reverse order)
- `ls -lt` (long + sorted by time)

Check manual!

\$~ man ls

Linux file system - create and remove directories



make directory

`$~ mkdir Avril_Lavigne`

remove directory

`$~ rmdir Avril_Lavigne`

or

`$~ rm -R Avril_Lavigne`

rm is more general

- removes each file specified in the command line
- by default, it does not remove directories (-R is necessary)

Linux file system - move (rename) and copy files

move (rename) a file or directory

```
$~ mv <path_to_file> <path_to_destination>
```

Danger of overwriting!!

Ask if file should be overwritten

```
$~ mv -i <path_to_file> <path_to_destination>
```

Do not overwrite file

```
$~ mv -n <path_to_file> <path_to_destination>
```

Do overwrite file

```
$~ mv -f <path_to_file> <path_to_destination>
```

copy a file

```
$~ cp <path_to_file> <path_to_destination>
```

Danger of overwriting!!

```
$~ cp -i <path_to_file> <path_to_destination>
```

```
$~ cp -n <path_to_file> <path_to_destination>
```

```
$~ cp -f <path_to_file> <path_to_destination>
```

Linux file system - check files without opening

`$~ more <path_to_file>` {scroll down with Enter/Space; quit with q}

`$~ head -n <path_to_file>` {n = number or rows to show; e.g. -10}

`$~ tail -n <path_to_file>` {same as head but from the end}

```
tail -n +2 my_file
```

← (view everything but first line)

Linux file system - word count

word count

`$~ wc <path_to_file>`

```
Harpia:CEU_daughter_high_coverage pabloorozco$ wc head10.sam
  10      31     231 head10.sam
```

lines

words

characters

`$~ wc -l <path_to_file>` how many lines?

`$~ wc -w <path_to_file>` how many words?

`$~ wc -m <path_to_file>` how many characters?

Text editors in the command line

Various text editors to choose from...

vi / vim

gedit

textpad

emacs

Text editing in the shell is much more powerful than graphical text editors like notepad.

- Notepad++ is a nice graphical text editor



Create and open a file using vim

`$~ vim <my_file>`

Exiting Vim

```
:w - Write (Save)
:wq - Write and quit
:q - Quit, fails if unsaved
:q! - Quit, even if unsaved
```

Movement

```
$ - Jump to end of line
^ - Jump to start of line
h - Move left
j - Move down
k - Move up
l - Move right
```

Modes

```
ESC - Return to normal mode
i - Insert at cursor position
a - Insert after cursor position
o - Insert on line below cursor
v - Enter visual mode
ctrl+v - Enter visual mode (vertical)
V - Enter visual mode (full lines)
```



Text editors in the command line

bash scripts

- plain text file which contains a series of commands
- Anything you can run normally on the command line can be put into a script and it will do exactly the same thing

```
#!/bin/sh

pwd
ls

COURSE="introduction to GWAS"
echo $COURSE
```

Always starts with the “**shebang**” (which shell to use)

... followed by commands

Running bash scripts \$~ ./<my_script>

Connect to our instance on Amazon Web Services (AWS)

AWS: on-demand cloud computing platform

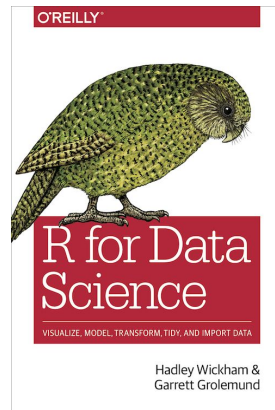
```
filippo@filippo-LB:~$ cd Dropbox/cursos/laval2019/  
filippo@filippo-LB:~/Dropbox/cursos/laval2019$ ssh -i GWAS2019.pem ubuntu@ec2-54-190-27-29.us-west-2.compute.amazonaws.com
```

We will set up your connection now.

Windows first, then Mac / Linux.

<https://r4ds.had.co.nz/>

<https://www.tidyverse.org/>



The tidyverse is an opinionated collection of R packages designed for data science. All packages share an underlying design philosophy, grammar, and data structures.