Introduction to Linux: **Core Commands**

Philipp Fruck & Pius Walter

Core Command

Goal of this lecture

- Learn the basic Linux command-line tools
- Understand what they do and when to use them
- Practice with useful flags

Why?

- Mastering the CLI -> faster, more precise, automatable workflows
- Essential for sysadmin, security, development work (and the upcoming semesters)

The Linux PATH

`PATH` is a special **environment variable** (we will learn more about them later)

- It contains a list of directories separated by colons (`:`)
- When you execute a command, the `SHELL` searches these directories in order until it finds a matching executable
  - The first binary that matches is executed
  - Directories coming first have higher precedence

The Linux PATH

`PATH` is a special **environment variable** (we will learn more about them later)

- It contains a list of directories separated by colons (`:`)
- When you execute a command, the `SHELL` searches these directories in order until it finds a matching executable
  - The first binary that matches is executed
  - Directories coming first have higher precedence

Example `PATH`:

```
/usr/local/bin:/usr/bin:/usr/local/sbin:/usr/sbin
```

Executing a command

Running a command can be as simple as executing `mycmd`

- If `mycmd` is found in the `PATH` (e.g. `/bin/mycmd`) it is executed
- Each command can be invoked with positional arguments, e.g. `mycmd arg1 arg2`

Executing a command

Running a command can be as simple as executing `mycmd`

- If `mycmd` is found in the `PATH` (e.g. `/bin/mycmd`) it is executed
- Each command can be invoked with positional arguments, e.g. `mycmd arg1 arg2`

- There are also additional flags that are not positional (mostly)
  - There can be short and long variants of the same flag
    - `mycmd -h`, `mycmd --help`
  - Typically, flags `-a`, `-b` can be combined to `-ab`

Executing a command

Running a command can be as simple as executing `mycmd`

- If `mycmd` is found in the `PATH` (e.g. `/bin/mycmd`) it is executed
- Each command can be invoked with positional arguments, e.g. `mycmd arg1 arg2`

- There are also additional flags that are not positional (mostly)
  - There can be short and long variants of the same flag
    - `mycmd -h`, `mycmd --help`
  - Typically, flags `-a`, `-b` can be combined to `-ab`

- Of course, there are exceptions...

Example in C

Let's build our own executable and run it as `/tmp/mycmd arg1 arg2`

```c
#include <stdio.h>
int main(int argc, char *argv[]) {
    for (int i = 0; i < argc; i++) {
        printf("%d: %s\n", i, argv[i]);
    }
}
```

———————————— [finished] ————————————

```
0: /tmp/mycmd
1: arg1
2: arg2
```

Example in C

Let's build our own executable and run it as `/tmp/mycmd arg1 arg2`

```c
#include <stdio.h>
int main(int argc, char *argv[]) {
    for (int i = 0; i < argc; i++) {
        printf("%d: %s\n", i, argv[i]);
    }
}
```

———————————— [finished] ————————————

```
0: /tmp/mycmd
1: arg1
2: arg2
```

For flags, use libraries like `getopt` (or something more modern)

Working with paths

Don't confuse absolute and relative paths!

- `/bin`: Is the global bin folder
- `bin`: The `bin` folder relative your current directory (e.g. `/home/user`)

Paths are case-sensitive

- `foobar` and `FooBar` are different files that can co-exist

Working with paths

Don't confuse absolute and relative paths!

- `/bin`: Is the global bin folder
- `bin`: The `bin` folder relative your current directory (e.g. `/home/user`)

Paths are case-sensitive

- `foobar` and `FooBar` are different files that can co-exist

`~` is a shortcut for your home directory

- `~/Downloads` instead of `/home/user/Downloads`

Working with paths

Don't confuse absolute and relative paths!

- `/bin`: Is the global bin folder
- `bin`: The `bin` folder relative your current directory (e.g. `/home/user`)

Paths are case-sensitive

- `foobar` and `FooBar` are different files that can co-exist

`~` is a shortcut for your home directory

- `~/Downloads` instead of `/home/user/Downloads`

`.` refers to your current directory

- `./foobar` == `foobar` == `././foobar`

Working with paths

Don't confuse absolute and relative paths!

- `/bin`: Is the global bin folder
- `bin`: The `bin` folder relative your current directory (e.g. `/home/user`)

Paths are case-sensitive

- `foobar` and `FooBar` are different files that can co-exist

`~` is a shortcut for your home directory

- `~/Downloads` instead of `/home/user/Downloads`

`.` refers to your current directory

- `./foobar` == `foobar` == `././foobar`

`..` refers to your parent directory

- From `/home/user`: `..` == `/home`, `../..` == `/`

Working with paths

Don't confuse absolute and relative paths!

- `/bin`: Is the global bin folder
- `bin`: The `bin` folder relative your current directory (e.g. `/home/user`)

Paths are case-sensitive

- `foobar` and `FooBar` are different files that can co-exist

`~` is a shortcut for your home directory

- `~/Downloads` instead of `/home/user/Downloads`

`.` refers to your current directory

- `./foobar` == `foobar` == `././foobar`

`..` refers to your parent directory

- From `/home/user`: `..` == `/home`, `../..` == `/`

Files starting with `.` are hidden by default

- e.g. config files: `~/.config`
- Don't confuse `./config` with `.config` or `~/.config`

Getting started

Command	Description	Useful Flags / Examples
`pwd`	**P**rint current **w**orking **d**irectory	
`ls`	**L**i**s**t directory contents	`-l` **l**ong format, `-a` show **a**ll files, `-sh` **s**ize (**h**uman-readable) of files
`cd`	**C**hange **d**irectory	`cd -` go back to previous directory `cd` without parameters goes back to home
`tree`	Show directory structure	`-L 2` **l**imit depth, `-a` show **a**ll files
`echo`	Print given arguments or variables	`echo $PATH`, `echo -n text without newline`
`clear`	Clear the current terminal screen	Similar to `Ctrl+l` which scrolls to new screen
`which`	Show full path of command	`-a` shows **a**ll matches

Getting started

Command	Description	Useful Flags / Examples
`pwd`	**P**rint current **w**orking **d**irectory	
`ls`	**L**i**s**t directory contents	`-l` **l**ong format, `-a` show **a**ll files, `-sh` **s**ize (**h**uman-readable) of files
`cd`	**C**hange **d**irectory	`cd -` go back to previous directory `cd` without parameters goes back to home
`tree`	Show directory structure	`-L 2` **l**imit depth, `-a` show **a**ll files
`echo`	Print given arguments or variables	`echo $PATH`, `echo -n text without newline`
`clear`	Clear the current terminal screen	Similar to `Ctrl+l` which scrolls to new screen
`which`	Show full path of command	`-a` shows **a**ll matches

> ranger, lf, mc, yazi are terminal file managers

File Manipulation

Command	Description	Useful Flags / Examples
cp	**Co**py files/directories	-r **r**ecursive, -i **i**nteractive (confirm overwrite)
mv	**Mo**ve/rename files	-i **i**nteractive (confirm overwrite)
rm	**Re**move files	-r **r**ecursive, -i **i**nteractive, -f **f**orce
rmdir	**Re**move empty **dir**ectories	-p remove empty **p**arent dirs
mkdir	Create (**ma**k**e**) **dir**ectory	-p create **p**arent dirs if missing
touch	Create empty file / update timestamp	-d specify a custom **d**ate
shred	Override a file to hide its contents	-u removes the file after shredding

File Manipulation

Command	Description	Useful Flags / Examples
cp	**Co**py files/directories	-r **r**ecursive, -i **i**nteractive (confirm overwrite)
mv	**Mo**ve/rename files	-i **i**nteractive (confirm overwrite)
rm	**Re**move files	-r **r**ecursive, -i **i**nteractive, -f **f**orce
rmdir	**Re**move empty **dir**ectories	-p remove empty **p**arent dirs
mkdir	Create (**ma**k**e**) **dir**ectory	-p create **p**arent dirs if missing
touch	Create empty file / update timestamp	-d specify a custom **d**ate
shred	Override a file to hide its contents	-u removes the file after shredding

rm does not use a trash can. If you remove something, it's gone

Danger Zone: rm -rf / will erase **everything** - don't run this!

Viewing Files

Command	Description	Useful Flags / Examples
`cat`	Show file contents	`cat file.txt`
`tac`	Reverse `cat`	`tac file.txt`
`less`	View file page by page	`/text` search forward, `?text` search backward
`more`	More primitive pager than `less`	
`head`	Show first lines of file	`-n 20` show first 20 lines
`tail`	Show last lines of file	`-f` **f**ollow file (useful for logs)
`wc`	Count lines, words, or bytes	`-l` **l**ines, `-w` **w**ords, `-c` **c**haracters

Viewing Files

Command	Description	Useful Flags / Examples
`cat`	Show file contents	`cat file.txt`
`tac`	Reverse `cat`	`tac file.txt`
`less`	View file page by page	`/text` search forward, `?text` search backward
`more`	More primitive pager than `less`	
`head`	Show first lines of file	`-n 20` show first 20 lines
`tail`	Show last lines of file	`-f` **f**ollow file (useful for logs)
`wc`	Count lines, words, or bytes	`-l` **l**ines, `-w` **w**ords, `-c` **c**haracters

Instead of `cd foo`, `cd bar`, `cat linux.txt` simply `cat foo/bar/linux.txt`

Editing Files

Basics

- When working on the CLI, you also need a text-based editor
- Today, `nano` and `vim` are the most common editors
- `nano` is a bit simpler and shows the required keyboard shortcuts
  - `^` is the `Ctrl` key

Editing Files

Basics

- When working on the CLI, you also need a text-based editor
- Today, `nano` and `vim` are the most common editors
- `nano` is a bit simpler and shows the required keyboard shortcuts
  - `^` is the `Ctrl` key

- `vim` is more advanced and allows faster editing, but is more complex!
  - Command driven editor with different modes
  - `i` for insert mode, `v` for visual mode
  - `:` for command mode, `Esc` to go back to regular mode
  - From insert mode: `Esc`, `:wq` to **w**rite and **q**uit
  - From regular mode: Use `/` to search (like in less)

Editing Files



Editing Files



Advanced

- Nowadays, there are more modern editors that support the Language Server Protocol (LSP)
  - If you want a really advanced text editor, have a look at `helix` or `neovim`

Improve Your Workflow

Command	Description	Useful Flags / Examples
`history`	Show command history	`!42` rerun command #42
`!!`	Run the same command again	
key: `↑`	Select last commands	
key: `⇥`	Autocomplete command/directory/file	note: case-sensitive
key: `^r`	Reverse Search	

> `^r` is the terminal notation for Ctrl+r

Improve Your Workflow

Command	Description	Useful Flags / Examples
`history`	Show command history	`!42` rerun command #42
`!!`	Run the same command again	
key: `↑`	Select last commands	
key: `⇥`	Autocomplete command/directory/file	note: case-sensitive
key: `^r`	Reverse Search	

> `^r` is the terminal notation for Ctrl+r

In `bash` your history is not shared across sessions.

Your history is persisted in `~/.bash_history`.

Improve Your Workflow

Command	Description	Useful Flags / Examples
`history`	Show command history	`!42` rerun command #42
`!!`	Run the same command again	
key: `↑`	Select last commands	
key: `⇥`	Autocomplete command/directory/file	note: case-sensitive
key: `^r`	Reverse Search	

> `^r` is the terminal notation for Ctrl+r

In `bash` your history is not shared across sessions.

Your history is persisted in `~/.bash_history`.

`HISTSIZE`: maximum number of commands kept in the current shell session's history.

`HISTFILESIZE`: maximum number of lines stored in `~/.bash_history`.

Thank you!

Thank you for your attention!

Don't forget the feedback in Moodle please!