

Computer Science Basics

Unix

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Unix

- ▶ **Last Week**

- ▶ **GNU/Linux**

- ▶ **Shell**

 - Main Functionalities
 - Rights Management
 - Install software

- ▶ **Binary vs text files**

- ▶ **Conclusion**

Last Week

Operating System

Name some Operating Systems

What are the main tasks of Operating Systems?

What means “virtualization” for memory? Why is it important?

What is the difference between a Process and a Program?

GNU/Linux

Linux

Unix Family

- Multi-task and multi-user Operating Systems
- First version in 1969
- Very popular for servers in the 1980s
- Many different versions:
FreeBSD, NetBSD, OpenBSD, Solaris, OSX, iOS, GNU/Linux et Dalvik/Linux (Android).

GNU/Linux

- Free and open source operating system
- Multitask and multiuser
- Kernel was developed by Linus Torvald in 1991
- Free software, source code is available
- Available in different distributions: Red Hat, Slackware, Debian, Ubuntu ...
- Available for PCs, but more used on servers, smartphones and tablets.

Install GNU/Linux

Install the operating system

- Download the system from a server
- Boot from that disk
- Follow the instructions (choice of the language, keyboard, users)

root

- One user is specific: root
- Super-user
- Can do everything on the system
- Normal users can not change config files or install / configure applications

Shell

Command Shell

GNU/Linux can be manipulated using a graphical interface

- Each distribution has its own interface
- Quite useful for administration tasks

Shell: Much more useful

- Direct access to information
- Clear commands (no ambiguities)
- Standard for all Unix systems (including Mac OSX, Linux, ...)
- There is no alternative to manage a server
- Problem: you need to know some commands by heart.

Visit directories

See the content of the current directory:

```
$ ls
```

```
Desktop      Downloads          examples-php  Pictures  Templates
Documents   examples.desktop  Music         Public    Videos
```

The color allows you to distinguish files from folders.

Print the working directory `pwd`

```
$ pwd
```

```
/home/emmanuel
```

```
$
```

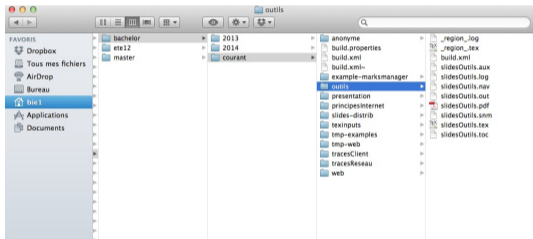
Change the working directory `cd`

```
$ cd Videos
```

```
$ pwd
```

```
/home/emmanuel/Videos
```

Directory tree



Files and directories form a tree

To visit a directory

```
cd myDirectory
```

To visit parent directory

```
cd ..
```

One can move many levels in one command

```
cd ../../myDirectory
```

The file hierarchy (Cont.)

```
$ pwd
/home/emmanuel
$ ls
Desktop    Downloads          examples-php  Pictures  Templates  Videos
Documents  examples.desktop  Music         Public    tmp
$ cd examples-php/
$ ls
base  basic.zip
$ cd base
$ pwd
/home/emmanuel/examples-php/base
$ cd ../../Downloads/
$ pwd
/home/emmanuel/Downloads
$
```

Manipulate directories

Create a directory: `mkdir myDirectory`

Copy one or many files : `cp originalFile copyFile`

- You can use jokers
- * anything (many characters)
- ? one single character

Remove a file: `rm myFile`

- The same jokers can be used

Remove a directory: `rm -r myDirectory`

Directories (Cont.)

Example:

- Create a directory `tmp`
- Visit this directory
- Copy the file `basic.zip` from the directory `../examples-php/` into `tmp`.

```
$ mkdir tmp
```

```
$ cd tmp
```

```
$ cp ../examples-php/basic.zip .
```

```
$
```

Rights on a file

Each file belongs to one user and one group

- To see the details: `ls -l` ou `ll`

```
$ ls -l
total 52
drwxr-xr-x 2 emmanuel emmanuel 4096 Feb 17 21:57 Desktop
drwxr-xr-x 2 emmanuel emmanuel 4096 Feb 17 21:57 Documents
drwxr-xr-x 2 emmanuel emmanuel 4096 Feb 17 21:57 Downloads
-rw-r--r-- 1 emmanuel emmanuel 8445 Feb 17 21:51 examples.desktop
drwxrwxr-x 3 emmanuel emmanuel 4096 Feb 18 10:21 examples-php
drwxr-xr-x 2 emmanuel emmanuel 4096 Feb 17 21:57 Music
drwxr-xr-x 2 emmanuel emmanuel 4096 Feb 17 21:57 Pictures
drwxr-xr-x 2 emmanuel emmanuel 4096 Feb 17 21:57 Public
drwxr-xr-x 2 emmanuel emmanuel 4096 Feb 17 21:57 Templates
drwxrwxr-x 2 emmanuel emmanuel 4096 Feb 18 15:01 tmp
drwxr-xr-x 2 emmanuel emmanuel 4096 Feb 17 21:57 Videos
```

Rights (Cont.)

Different rights

- Read - r
- Write - w
- Execute - x

Different users

- user owner of the file (user - u)
- users belonging to the group (group - g)
- any other user (other - o)

Representation of the rights

`rwxr-xr--`

`\ / \ /`

`v v v`

`| | rights for other users (o)`

`| rights for the group (g)`

`rights for the user (u)`

Change Rights

sudo to execute a command as the root

Change Owner - chown

```
$ ll
total 8
-rw-r--r-- 1 root root 178 Feb 17 22:04 index.html
$ chown emmanuel index.html
chown: changing ownership of 'index.html': Operation not permitted
$ sudo chown emmanuel index.html
[sudo] password for emmanuel:
$ ll
total 8
-rw-r--r-- 1 emmanuel root 178 Feb 17 22:04 index.html
$
```

Change Rights (Cont.)

Change Group - chgrp

```
$ ls -l
total 8
-rw-r--r-- 1 emmanuel root 178 Feb 17 22:04 index.html
-rw-r--r-- 1 root    root 177 Feb 17 22:01 index.html~
lrwxrwxrwx 1 root    root  22 Feb 17 22:16 phpmyadmin -> /usr/share/phpmyadmin/
$ chgrp emmanuel index.html
$ ls -l
total 8
-rw-r--r-- 1 emmanuel emmanuel 178 Feb 17 22:04 index.html
-rw-r--r-- 1 root    root    177 Feb 17 22:01 index.html~
lrwxrwxrwx 1 root    root      22 Feb 17 22:16 phpmyadmin -> /usr/share/phpmyadmin/
```

Change Rights (Cont.)

Change the rights on a file or a directory - chmod

```
$ cp index.html test.html
cp: cannot create regular file 'test.html': Permission denied
$ cd ..
$ ls -l
total 48
...
drwxr-xr-x  2 root root    4096 Feb 17 22:16 www
$ chmod og+w www
chmod: changing permissions of 'www': Operation not permitted
$ sudo chmod og+w www
$
```

Install software

At the beginning of Unix

- Download source files
- Read the documentation
- Configure system
- Install new libraries
- Compile
- Install

Package managers

- You can download and install any application in one sentence
- Manages dependences automatically
- Very easy to manage software
- Automatic update of the programs (for patching management)

Install software (Cont.)

Install a package ¹

```
sudo apt install apache2
```

Remove a package

```
sudo apt remove apache2
```

Update Package Index for the list of available packages

```
sudo apt update
```

Update packages for patching all the software you have (all the programs at once)

```
sudo apt upgrade
```

¹apache2 is an example for a package

Binary vs text files

Binary vs. text files

Different file formats

- Proprietary file formats: doc, ppt, xls
- Images: jpeg, gif, png
- Documents: pdf
- Executable: exe, dll, so, class
- Texts: txt, xml, html, tex
- Program source files: java, asm, cpp, c

Two big families

- Binary files (office, images, executables, ...)
- Text files (txt, tex, html, source files, ...)

Text files

Text files

- ASCII files
- Each letter is encoded on 1 byte
- Standardized on 7 bits (for English)
- 94 visible characters
- Plus other invisibles like: carriage return, tab, space, bell, ...

Text files encoding

- Different encoding formats for accents
- Depends on the language: western Europeans, eastern Europeans, ...
- ISO latin1, UTF-8, ...

Letters encoded on more than one byte

- Unicode permits to encode any language
- Characters can be coded on more than one byte
- Arabic, chinese, hebrew, ...

How to see text data?

- Using any text editor or IDE: notepad (windows), gEdit, Emacs, Kate, Eclipse, Net Beans ...

Binary files

Proprietary file formats

- Office files (Word, Excel, Powerpoint, ...)
- Many other applications

Executable files

- Windows: exe,
- Linux: elf (32 bits), elf64 (64-bit)
- Contain machine instructions encoded in binary
- Can be analyzed using a **decompiler**

Images

- tiff: bitmap of an image (high-quality photos)
- jpeg: format family, lossy compression (for online photos)
- gif: 8-bit color, animations possible (legacy)
- png: 32-bit color, no animations, modern lossless compression (screenshots)
- File formats are known, libraries manipulate those binary files

Hexadecimal Editor can read any binary format (in hex)

Example of Binary File

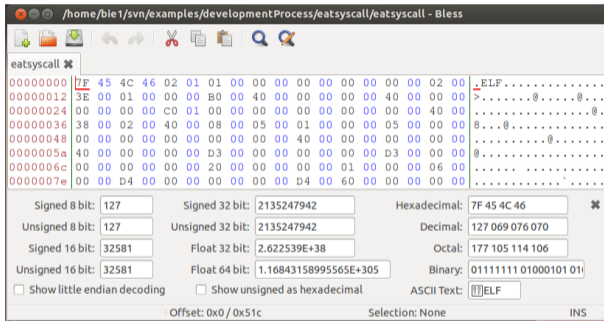
Using the editor Bless

- Can open a file

Two versions

- See the text version on the left (bytes are interpreted as chars)
- See the binary version on the right
- Can read and edit any binary
- You can edit executable files: BUT DO NOT DO IT!

The binary editor Bless



Interpreting Raw Data

Data is ultimately always encoded in binary

- Common format for text is ASCII
- Capital letter “S” is encoded with 0x53
- Corresponds also to the decimal number 83
- In the computer it is a set of 8 bits 01010011
- This pattern can be anything else in a binary computer program
- Can be part of an instruction
- Can be part of a 16-bit number
- Can be part of a 32-bit integer
- Can be any data (floating point numbers, objects, address, ...)

Example

- 0x 53 may be interpreted as value 83
- 0x 53 61 may be interpreted as the decimal 21'345
- 0x 53 61 6D 0A may be interpreted as the decimal 1'398'893'834
- 0x 53 61 6D 0A 77 61 73 0A may be interpreted as the floating point $4.54365038640977 \cdot 10^{93}$

Conclusion

Conclusion

Unix is representing 95% of all servers

- GNU/Linux, Solaris, FreeBSD, OpenBSD, MacOS-X, ...

But also 100% of all Smartphones

- Android and iOS are both Unix systems.

Different types of files : Text files

- stored in ASCII or other encodings (topic of next week)
- Source of programs, texts, XML, HTML, CSS,

Different types of files : Binary files

- Write data with a specific encoding
- Programs (runnable), Databases, ...
- Some standards are proprietary some are open.
- We will see standards for images.