Advanced Linux System Administration

Topic 2. Command Line (Shell)

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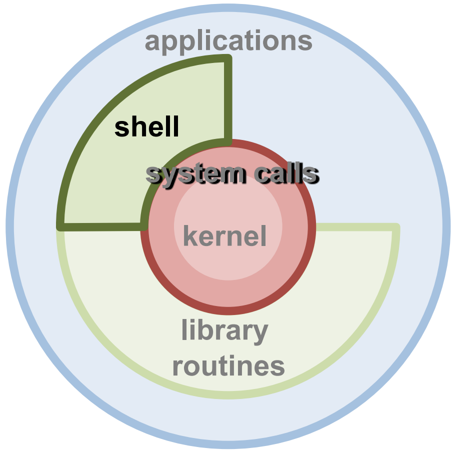
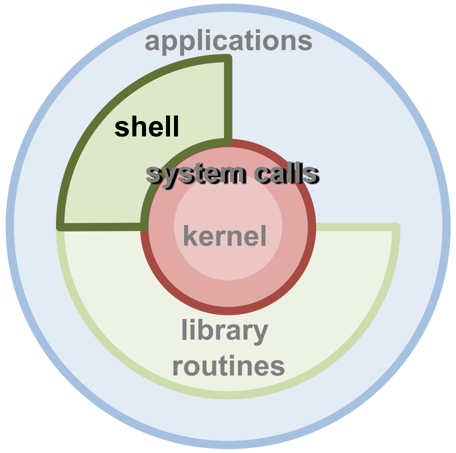
The shell



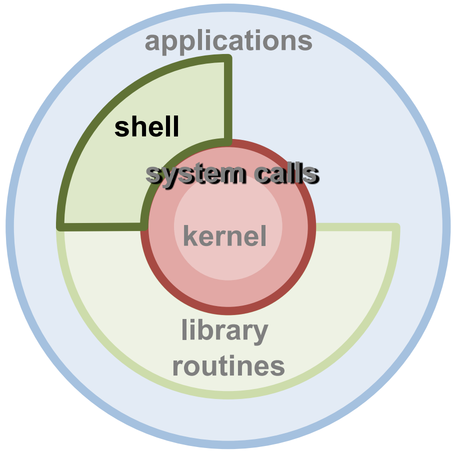
- **Interface** for system calls:
  - **POSIX** Compatibility (independent of the system).
  - Move from user mode to supervisor mode: TRAP.
  - Usually from C language.
- Command **Interpreter:**
  - Same privileges as other program.
  - Multiple interpreters available: sh, csh, ksh, tcsh, **bash**…
  - Responds with the prompt: test@si:~$ (normal account:$, root account:#).
- Session (login + passwd):
  - Local Access: 6 consoles in text mode (Ctrl+Alt+F1…F6) and 1 graphic console (Ctrl+Alt+F7).
  - Remote access: through network (telnet, rlogin, ssh...).

The shell



- Shell **Types:**
  - Bourne shell **"sh"** (/bin/sh): old UNIX syntax (SysV).
  - C shell **"csh"** (/bin/csh): C-like syntax (BSD).
  - **Bourne Again shell "bash"** (/bin/bash): Similar to its antecessor, but extended with many features from csh.
  - Tcsh **"tcsh"** (/bin/tcsh): improved version of the original C shell.
  - In general, differences are not relevant for day-to-day use.
- Shell **Goal:** interactive dialog between user and system:
  - Through a huge amount of orders/commands and applications:
    - Change execution mode (background/foreground).
    - Input/Output redirection.
    - Command Pipes and redirection.
    - Scripting.
    - 100% Customizable.

The shell



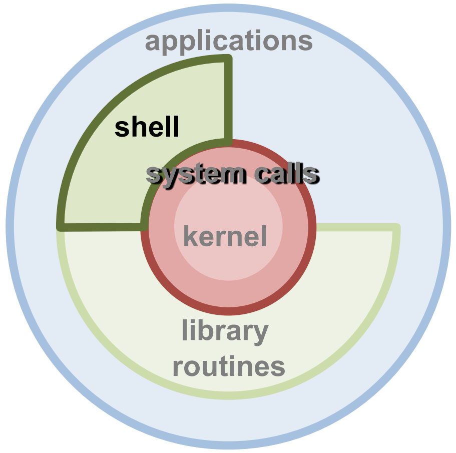
- **Command structure:**

```
user@machine:~$ command  -<options>  [arguments]
```

  - **Options:** command pieces that modify the initial behavior.
  - **Arguments:** file name or any other kind of data needed by the command.

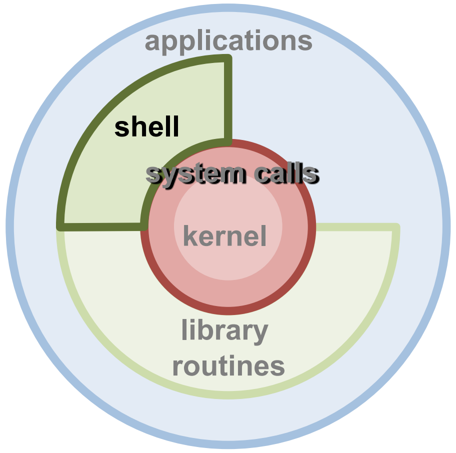
- **Man** command (formats and displays manual pages):
  - First command to learn. Displays on screen information about a command, programming function, configuration file, etc.
  - Syntax: $ man -<options> [command]:
    - –**a:** display all the manual pages that match "command", not just the first one.
    - –**K:** search for the specified string in all man pages.

The shell



- **Man** command: sections:
  - Manual organized in sections. /usr/share/man:
    - Usually, searching is performed in a specific order through all the sections, and only the first matching is displayed.
    - If the command specifies the section, search is only performed in that section.
  - Manual sections:
    1. User commands.
    2. System Calls (functions provided by the kernel).
    3. C Library functions (system library functions).
    4. Devices and special files (usually found under /dev).
    5. File formats and conventions. Example /etc/passwd.
    6. Games.
    7. Miscellanea: man(7), groff(7).
    8. System administration tools and Daemons.

The shell



- **Man** command: configuration:
  - Through the file /etc/manpath.config:
    - Can make use of a different configuration file: $ man –C new_file.
  - The command **manpath** indicates the routes to look for the manuals:
    - Can also be modified, through $ man –M path or modifying the environment variable $MANPATH.
  - The section order for searching can also be modified: $MANSECT.
  - The application employed to display manual pages can also be chosen: $PAGER (by default: less).
  - Also the language can be selected: $LANG.

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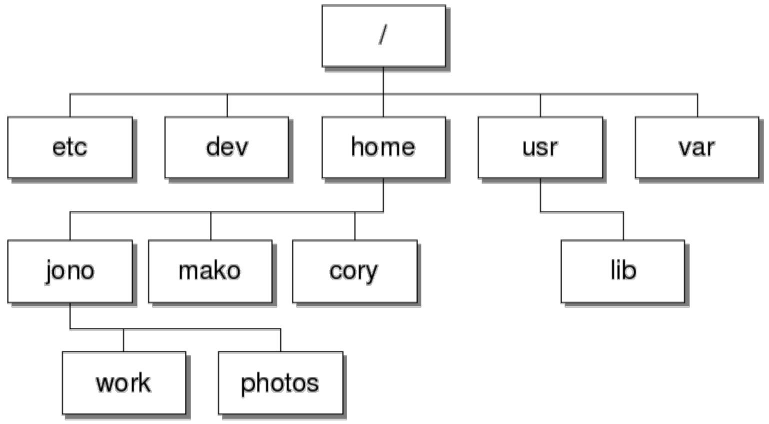
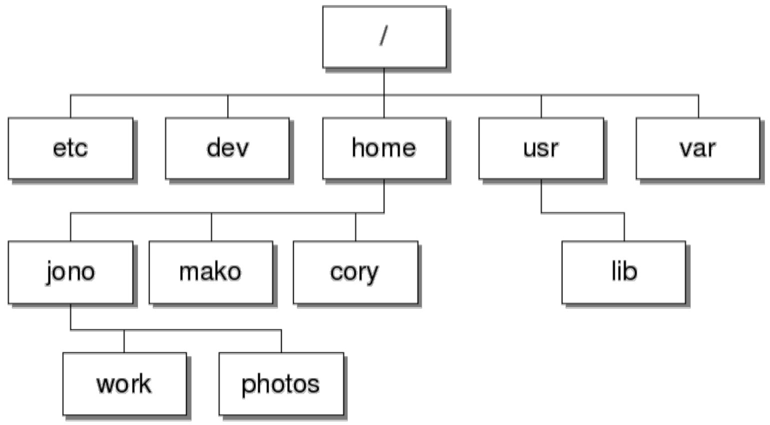
File System



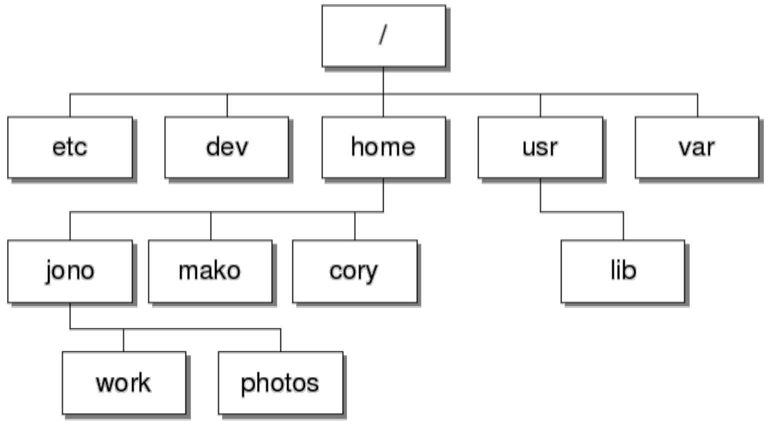
- Definition:
  - Logic structures and their corresponding methods employed by the Operating System to organize the files in the disk.
- Tree-like **Hierarchical** structure:
  - Efficient management of information (group related info into folders).
  - Folders separated by /
  - File access (path):
    - Absolute: cd /home/pepe.
    - Relative to current path (with "." o ".."): cd ../../../usr/local.
- Files starting with "." are "hidden".
- Security: protection of files against unauthorized accesses.

File System



- Unit Mounting:
  - A storage device (usb, cd, etc.) can be associated with a particular position in the directory tree.
- Same treatment to files and I/O devices:
  - Same program can employ files and/or devices indifferently.
- Different locations of the file tree can be linked (**ln** command).
- Definition of a folder/file **path:**
  - Directories to be traversed, starting from root directory, in order to reach that folder/file.

File System



/	Root directory.
/bin	Core operating system commands.
/boot	Kernel and files needed to load the kernel.
/dev	Device entries for disks, printers, pseudo-terminals, etc.
/etc	Critical startup and configuration files.
/mnt	Temporary mount points, mounts for removable media.
/lib	Libraries, shared libraries and parts of the C compiler.
/home	Default home directories for users.
/opt	Optional software packages (not consistently used).
/root	Home directory for the superuser.
/sbin	Command needed for minimal system operability.
/proc	Information about all running processes.
/tmp	Temporary files.
/usr	Hierarchy of secondary files and commands.
/usr/local	Software installed by users.
/var	System specific data and configuration files.

File System (Commands)

- Large amount of shell command to interact with FS.
- For a detailed description, take a look at the APPENDIX or consult system man pages.
- Navigating through the file system:
  - Command **pwd:** displays current.
  - Command **cd:** change to a different directory.
  - Command **mkdir:** create a new folder.
- File Manipulation:
  - Command **ls:** list folder contents in alphabetical order.
  - Command **cp:** copy files.
  - Command **mv:** move files (or rename).
  - Command **rm:** remove files or folders.

File System (Commands)

- File Manipulation (cont.):
  - Command **ln:** create a link between two files.
  - Command **whereis:** locate the path of a cmd's binary/src code/manual.
  - Commands **locate/<u>find</u>:** locate a file in the directory tree.
- File Contents:
  - Commands **cat/more/less:** show the contents of a file.
  - Command **wc:** count the number of bytes/words/lines in a file.
  - Commands **head/tail:** display in stdout the first/last lines of a file.
  - Command **<u>grep</u>:** display the lines of a file that match a text pattern.
  - Command **tar:** add the contents of a file tree to a single file.
  - Command **cut:** remove specific sections of each line of a file.
  - Command **sort:** arrange file lines in specific order (alphabetical).
  - Command **<u>vi</u>:** text editor in the terminal (present in every UNIX system).

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Shortcuts

- Some simple "tricks" that might make your life a bit easier…
- Commands/filenames/paths can be **autocompleted:**
  - Tab (in bash).
  - If it cannot be completely resolved, a list with all the alternatives is displayed.
- Moving the cursor through the command line (prompt):
  - [Ctrl+a]: go to the beginning of the command. [Ctrl+e]: move to the command end.
  - Cursor Left/Right: move through the command line (char by char).
  - [Ctrl left/right]: move word by word.
- Navigating through the command history:
  - Easiest way: Cursor Up/Down.

Shortcuts

- Command **history:**
  - The commands employed in a shell session are stored. With this command we can review command executed, repeat or edit previous commands:
    - **!!:** execute again the last command of the list (previous command).
    - **!letters:** execute again the last command executed starting with the letters indicated.
    - **!number:** execute the command in the list with that number.
  - List size can be configured ($HISTSIZE in bash) (set).
- Employing **regular expressions:**
  - Some characters cannot be employed in filenames, having a special purpose:
    - **"*":** replace all characters: $ ls -l pa* //$ rm -fr /* (oops!!).
    - **"?":** replace a single character: $ rm pepe? (remove pepea, pepeb, pepec, etc.).
    - **"[]":** replace a single numerical character: $ rm pepe[12] (remove pepe1 and pepe2).
    - **"{}":** for expansion: $rm p{e,i}pe (removes pepe and pipe).
    - **"~":** designates $HOME directory.
  - What if I need to search the character * in a file? (\\ o "").

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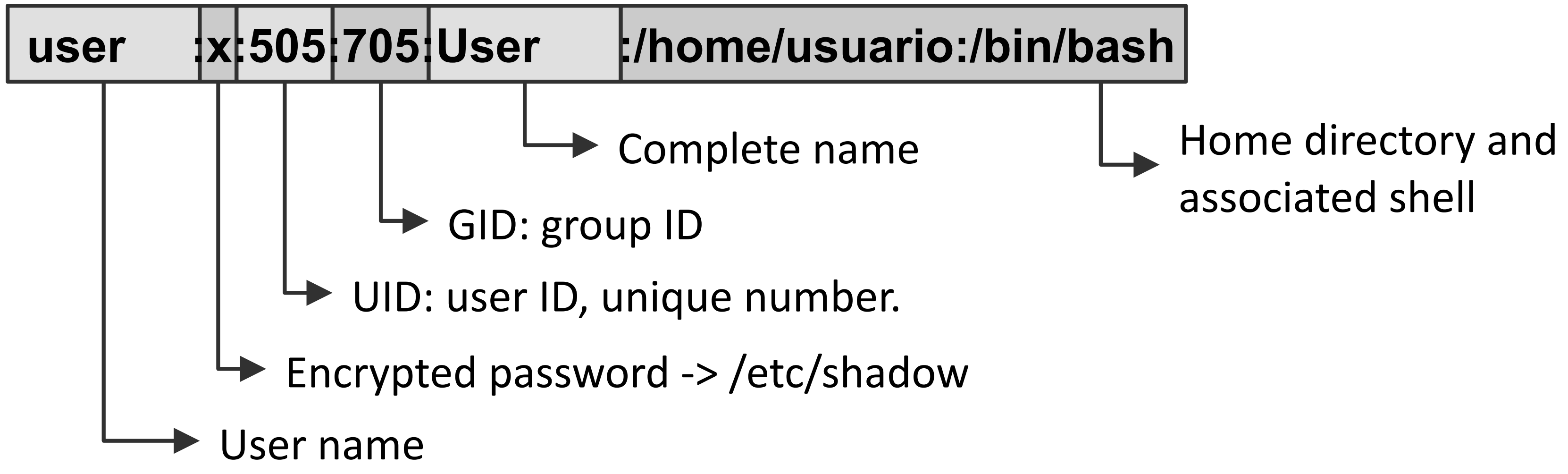
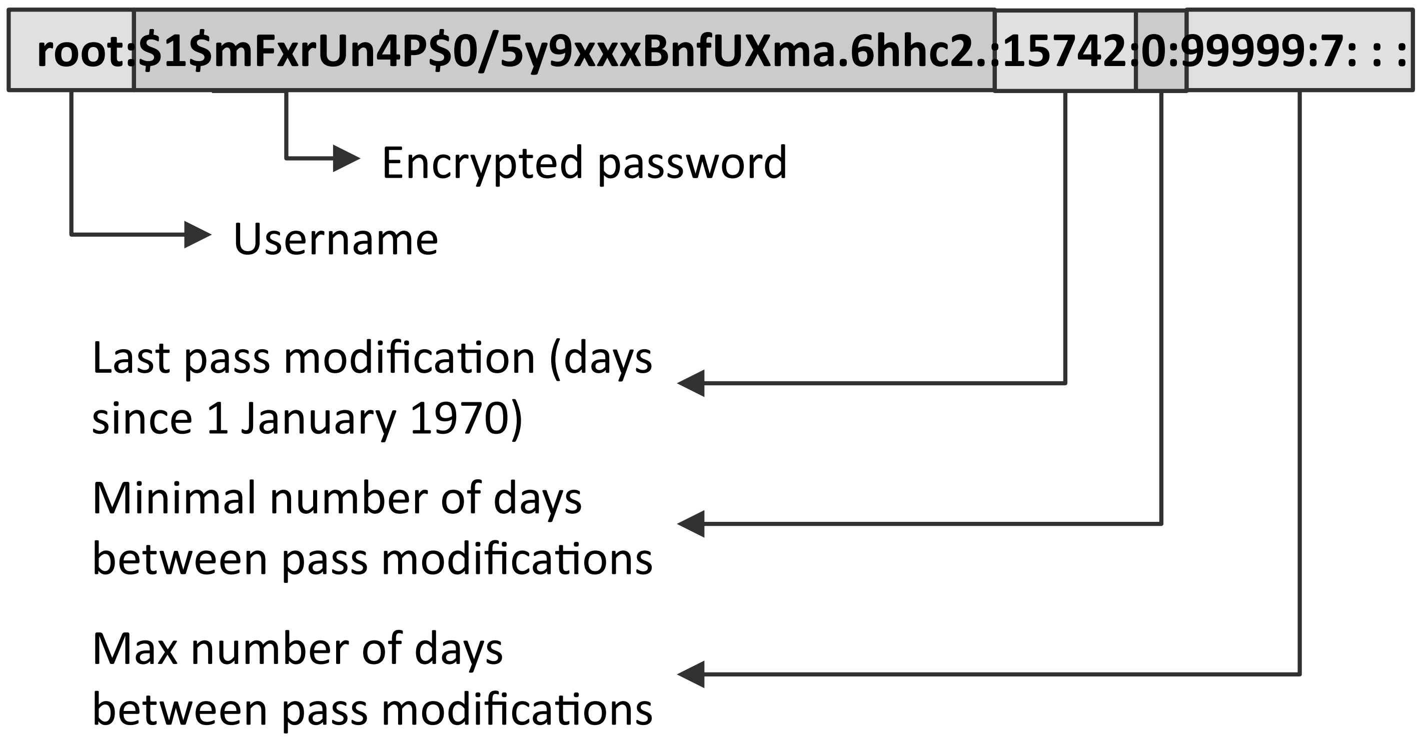
User Management

- In UNIX, users are organized in groups.
- The files /etc/passwd and /etc/group contain information about all the users and groups of the OS:
  - As well as system login, these files include basic user configuration (home directory, shell).
  - Group management: useful to control access to certain parts of the system.
  - For each user, passwd file contains a line with the following format:


user :x:505:705:User :/home/usuario:/bin/bash
Complete name
Home directory and associated shell
GID: group ID
UID: user ID, unique number.
Encrypted password -> /etc/shadow
User name

User Management

- The file/etc/shadow manages user passwords:
  - For each user, the file shadow contains a line with the following format:



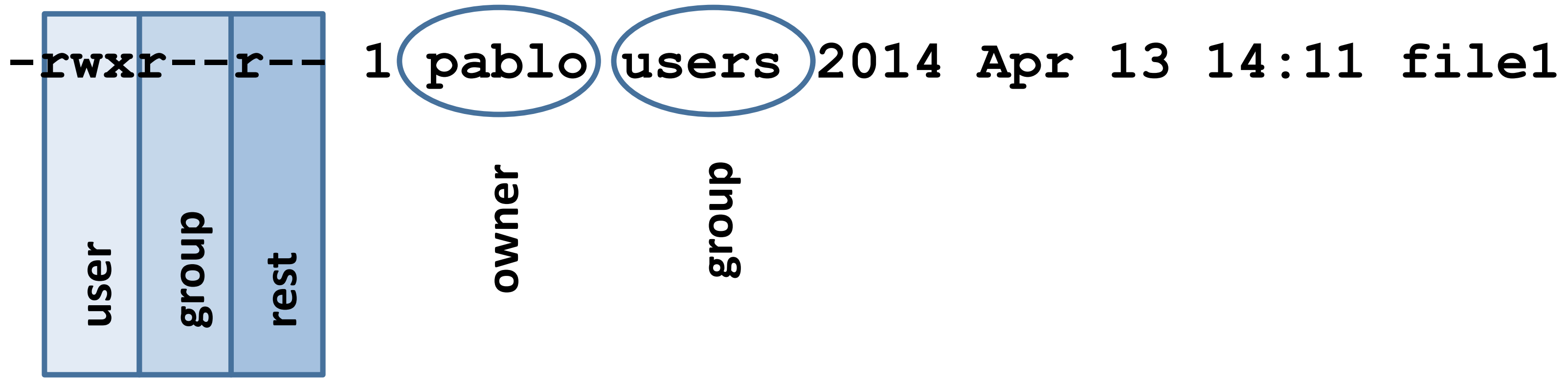
root:$1$mFxrUn4P$0/5y9xxxBnfUXma.6hhc2.:15742:0:99999:7: : :
Encrypted password
Username
Last pass modification (days since 1 January 1970)
Minimal number of days between pass modifications
Max number of days between pass modifications

User Management

- Based on users and groups, UNIX implements a protection mechanism for the File System based on permissions.
- Each file (and folder) has a single owner and access permissions.
- The different permissions are:
  - Read (r): allows read access to the contents (list directory files).
  - Write (w): allows content modification (create/remove/move files).
  - Execute (x): execute a file (no specific extension is required (windows exe)).
- File permissions can be configured according to three types:
  - User: file owner.
  - Group: rest of the users from the same group as the owner.
  - Rest: rest of system users.

User Management

- Conventional users only have write permissions in their $HOME directory: /home/<usuario>:
  - Also in temporary directories (such as /tmp).
- Superusers (system administrators) have unlimited access to the whole file system (Warning!!).
- Information about file/directory permissions with [ls –l]:



```
-rwxr--r-- 1 pablo users 2014 Apr 13 14:11 file1
```

User Management (Commands)

- Detailed description in the APPENDIX.
- Basic user management:
  - Command **whoami:** displays username.
  - Command **who:** shows users connected to the system.
  - Command **passwd:** change user password.
  - Command **finger:** shows the status of a user in the system.
  - Command **write:** sends a txt message to other user's terminal.
- File Permission management:
  - Command **chmod:** modify file or directory permissions.
  - Command **chown/chgrp:** modify UID/GID of a file.
  - command **umask:** modifies default permissions assigned to new files.

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Environment Variables

- Group of shell session variables with a pre-defined value. Their value is obtained this way: $ echo **$**VARIABLE.
- Allow the configuration of certain aspects in the cmd interpreter.
- Two kinds:
  - **User variables:** internal to our shell session:
    - Can be listed with command **env**.
  - **System variables:** common to every shell and other programs and users:
    - Can be listed with command **set**.
- Environment variables can be modified:
  - csh-like shells (csh, tcsh, zsh): **setenv/unsetenv:**
    - Example: $ setenv PATH /usr/local/bin:/bin:/usr/bin.
  - sh-like shells (sh, ksh, **bash**): **export:**
    - Example: $ export PATH=/usr/local/bin:/bin:/usr/bin.
  - After leaving a session, all modifications are lost.

Environment Variables

- Shell configuration files:
  - Objective: give a value to environment variables. Allows the permanent modification of shell aspect and behavior (changes are not lost).
  - Bash loading sequence (last file overwrites the rest):
    - **/etc/bashrc** → **/etc/profile** → **$HOME/.bashrc** → **$HOME/.bash_profile**.
    - Different for each kind of shell.
  - File example(bash):

The alias command allows command re-definition (more friendly shell).

```
# .bashrc
# User specific aliases and functions
alias rm='rm -i'
alias cls="clear"
alias cd..="cd .."

# Source global definitions
if [ -f /etc/bashrc ]; then
    . /etc/bashrc
fi

alias ls="ls --color -shaF"
```

Environment Variables

- Some important internal variables:
  - **$PATH:** indicates which are the directories where binaries can be found. Before executing a command, the shell searches in those directories.
  - **$HOME:** root directory of current user.
  - **$TERM:** kind of terminal we are employing to connect to the system.
  - **$SHELL:** user shell. Ex. /bin/bash.
  - **$TZ:** time zone. Has an influence on the timing format returned by date command. Any change in our files adjusts to the time zone specified by that variable.
  - **$*****:** in the man page of each shell we have the complete repertory of its environment variables.

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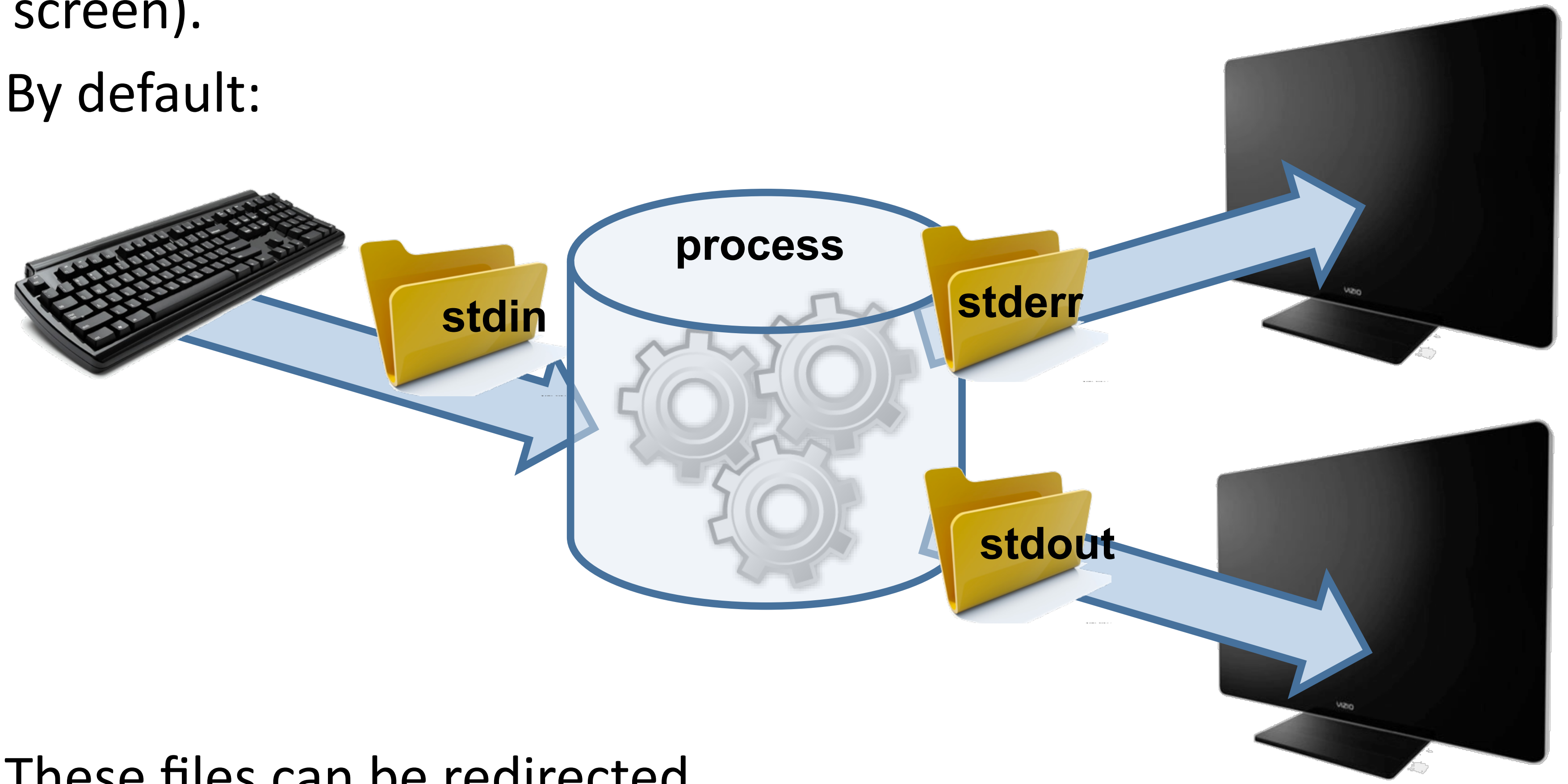
Redirection and Pipes

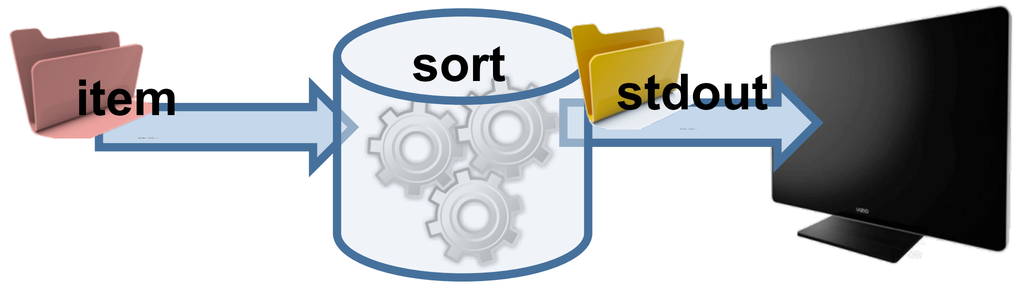
- In linux, always three files (remember, devices treated as files) opened by default: **stdin** (keyboard), **stdout** (screen) y **stderr** (also screen).
- By default:



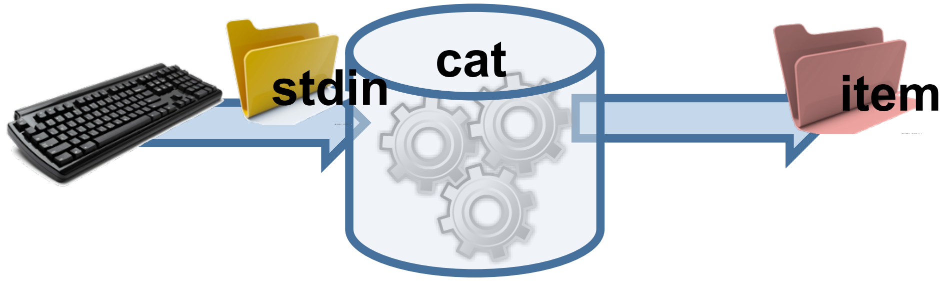
- These files can be redirected.

Redirection and Pipes

- **Definition:** redirection consists of the capture of a file/command/ program output in order to send it as input to another file/ command/program.
- Standard **input** redirection: do not use keyboard as input:
  - Syntax: $ sort < item.

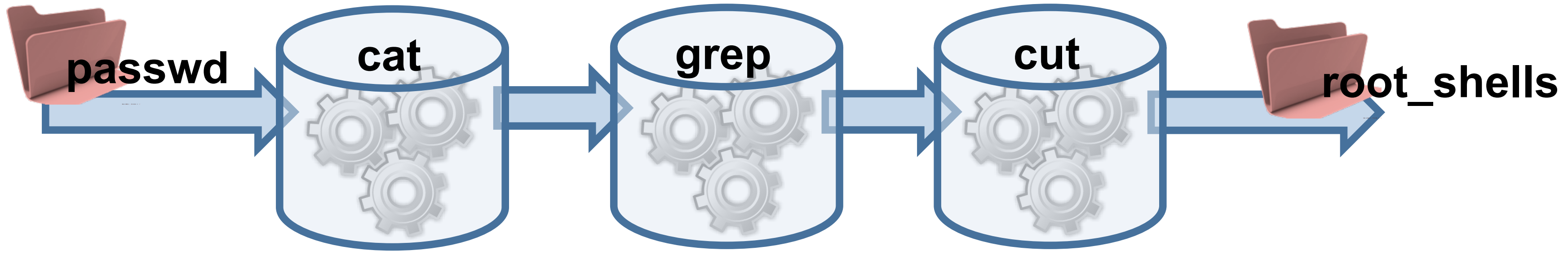


- Standard **output** redirection: output to a file (instead of the screen):
  - Syntax: $ cat > item (without overwriting item content: $ cat >> item).



Redirection and Pipes

- **Pipes:** allows two or more commands to be linked, where the output of a command is redirected to be the input of the following one:
  - Example: cat < /etc/passwd | grep root | cut –d : -f 7 > root_shells.



- **Concatenation:** concatenate command in the same line:
  - Example: ls –l; cd .. ; ls –l (also this way: ls –l && cd .. && ls –l).
  - **Nested** execution: (ls –l; cd ..); ls –l Difference with previous one?

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Shell Scripting

- Group shell commands to perform complex tasks in a single step.
- The simplest structure: text file with a command per line, but usually much more complex:
  - Conditional sentences, loops, functions…
- A script can create a sub-shell regardless of the one that executed it:
  - $ bash macro.
- Its structure depends on the shell we are employing.
- Example:

```
#!/bin/sh
echo "Today is:"
date
echo "have a nice day"
```

  - First line indicates which kind of shell executes the rest of the script.

Shell Scripting

```
# run ./script [name]
#!/bin/sh
echo -n "Your surname? "
read surname
echo "Hola, $1 $surname"
```

- **Execution:**
  - If the file does not have execution permissions: $ bash script.
  - Other way, modify permissions: chmod a+x script; ./script.
- **Input/Output:**
  - Read from keyboard with command **read**.
  - Write in screen with **echo/printf:**
    - echo –n suppress newline.
- **Command line arguments:**
  - Become variables whose names are numbers:
    - $1 - 9: command line parameters, number indicates its position.
    - $0: macro name(script name).
    - $#: number of command line argument.
    - $?: $$: PID associated with the macro.
    - $*: string containing all the arguments passed (beginning with $1).

Shell Scripting

```
if [ who | grep -s pepe > /dev/null ]
then
        echo "pepe is in the system"
else
        echo "not present"
fi
```

- **Control Flow:**
  - Sequence **if then else (elif):**
    - /bin/sh: if [<condition>] && [<condition>]; then.
    - /bin/bash: if [[<condition> && <condition>]]; then.
  - Bash comparison operators … and Bash file evaluation operators:

String	Numeric	True if
x = y	x – eq y	x is equal to y
x! = y	x – ne y	x not equal to y
x < y	x – lt y	x is less than y
…	le, gt, ge	…

Operator	True if
-d file	File exists and is a directory.
-e file	File exists.
-f file	File exists and is a regular file.
-r file	You have read permission on file.
-s file	File exists and is not empty.
-w file	You have write permission on file.

  - Sequence **case:**

```
rental=$1
case $rental in
        "car") echo "rent car";;
        "moto") echo "rent moto";;
        "bus") echo "rent bus";;
esac
```

Shell Scripting

```
for archivo in ‘ls’
do
        touch ${archivo}
        echo “archivo ${archivo} update”
done
```

- **Loops:**
  - Sequence **for:**
    - List of arguments: for files in fich1.sh fich2.sh fich3.sh; do.
    - Pattern matching expansion: for files in *.sh; do.
    - Command outputs the list: for files in ‘ls’; do.

```
a=1
b=$((2))
c=$a+$b
d=$a$b
e=$(($a+$b))
echo ”$c $d $e”
```

- **Variables:**
  - All bash variables are string valued:
    - Declaration: a = pepe, Utilization: echo “$a”.
  - Arithmetic with variables??: (( )):
    - Operation in (( )) is arithmetic, otherwise only concatenated strings.
  - Arrays:
    - Declaration: list = (aa bb cc dd). Utilization: echo “${list[num]}” (begins at zero).

Shell Scripting

- **Regular expressions:**
  - Employed to match a text string to a pattern (semi-generic pattern).
  - Pattern: built through a mix of literal and special characters.
  - Examples:
    - “pepito” matches “pepito”.
    - “p([a-z]+)o”:
      - pepito / pablo /po / p1o.
    - “p(\d*)o”:
      - pepito / p10o / po / pablo.
    - “^p(\w*)o$:
      - pepito / hola pepito / pasa julio.

Symbol	What it matches or does
.	Matches any character.
[chars]	Matches any character from a given set.
^	Matches the beginning of a line.
$	Matches the end of a line.
\w	Matches any word character ([A-Za-z0-9_]).
\s	Matches any whitespace character (space, tab, return).
\d	Matches any digit.
|	Matches either element to its left or to its right.
(expr)	Limits scope, group elements, capture matches.
?	Allows zero or one match of the preceding element.
*	Allows zero, one or many matches of preceding element.
+	Allows one or more matches of preceding element.
{n}	Matches n instances of preceding element.

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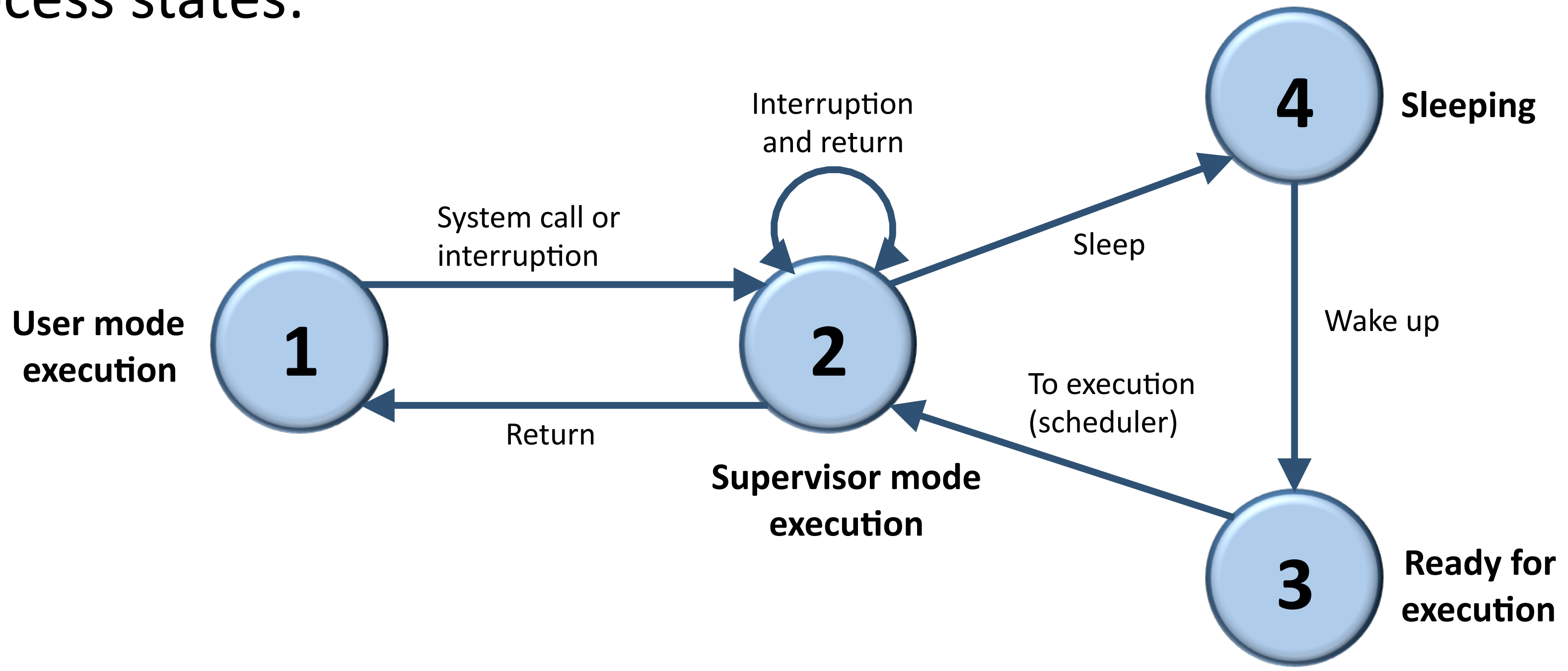
Process Management

- **Process:** sequence of instructions and data stored in memory able to perform some specific task.
- Unique ID (numerical) in the system: **PID**.
- Three main memory segments: code/data/stack.
- Process states:



Process Management

- Processes have a hierarchy similar to the file system (tree). Root process: **init:**
  - Each process (excluding init) has a father process.
  - The kernel (root) has absolute control of every system process.
- A process can be identified by its PID:
  - Only its owner can interact with that process (UID).
- The shell is a process, dependent on the terminal:
  - Foreground process: blocks shell utilization until it finishes execution:
    - $ ls –R / >/dev/null.
  - Background process: does not block shell:
    - $ ls –R / >/dev/null **&**.
  - Processes can be moved between foreground and background:
    - [**Ctrl+z**]: foreground process stopped (suspend execution).
    - **bg** moves process to background mode and **fg** moves it back to foreground.

Process Management

- /proc: pseudo file system associated with the processes:
  - Employed as interface to the data structures in the kernel associated with each process.
  - Content example (one folder for each process):

```
[ root si /tmp ] ls /proc/
1     211   2428  2490  2600  41    7          bus        execdomains  kallsyms     misc           scsi           timer_stats
1076  212   2439  2497  2603  42    741        cgroups    fb           kcore        modules        self           tty
1153  213   2440  2512  2605  4769  742        cmdline    filesystems  key-users    mounts         slabinfo       uptime
1620  2318  2459  2521  2618  4772  774        cpuinfo    fs           kmsg         mpt            stat           version
1687  2329  2465  2532  2691  5     775        crypto     ide          kpagecount   mtrr           swaps          vmallocinfo
173   2339  2468  2566  2719  5280  958        devices    interrupts   kpageflags   net            sys            vmstat
2     2397  2470  2594  3     5282  acpi       diskstats  iomem        loadavg      pagetypeinfo   sysrq-trigger  zoneinfo
2099  2410  2483  2596  39    5387  asound     dma        ioports      locks        partitions     sysvipc
210   2420  2489  2598  4     6     buddyinfo  driver     irq          meminfo      sched_debug    timer_list
```

  - In each folder...:

```
[ root si /tmp ] ls /proc/2719
attr    clear_refs       cpuset   exe     io        maps       mounts      oom_adj    root       smaps  status
auxv    cmdline          cwd      fd      limits    mem        mountstats  oom_score  sched      stat   task
cgroup  coredump_filter  environ  fdinfo  loginuid  mountinfo  net         pagemap    sessionid  statm  wchan
```

    - **fd:** files opened by the process.
    - **maps:** physical memory range associated with the process.
    - **stat:** current process status: PID, PPID, utime, etc.

Process Management

- See Appendix for detailed description.
- Process Management commands:
  - Command **top:** process monitoring in real time.
  - Command **ps:** reports information about active processes.
  - Command **kill:** send signals to a process.
  - Command **pstree:** hierarchical relations among processes.

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Advanced Commands

- Command **sed:** perform text modifications in an input file:
  - Line by line analysis.
  - Syntax: sed -<opts> ‘[instruction]‘ [file]:
    - Option **–i:** in place, the file passed as argument is overwritten.
  - Some useful instructions:
    - **i:** insert line before current one.
    - **p:** print current line in stdout.
    - **s:** replace string in current line.
  - Examples:
    - sed -i ‘s/Pepe/Manolo/g’ *.txt   replace pepe by manolo in every .txt file.
    - sed ‘/cadena/ s/vieja/nueva/g’ file > salida   only replace in lines containing the string (flag g: perform the change in every matching).
    - sed ‘2,3 p’ * print lines 2 and 3 of every file.
    - sed -i ‘/cadena/d’ archivo remove string from file named archivo.

Advanced Commands

- Command **xargs:** run the same command over a list of arguments separated by a space (or different lines):
  - Syntax: [Commands…] | xargs -<options> [command]:
    - Option **–i:** replace string.
    - Option **–n:** group the items.
  - Example:
    - $ ls *.c | xargs -i gcc -c {}.
    - $ ps -ef | grep "pepito" | awk '{print $2}' | xargs renice +10.
  - **–i** and **–n** may cause conflict when used together, last one "wins":
    - $ echo a b c d e f | xargs -n3 -i echo before {} after:
      - before a b c d e f after.
    - $ echo a b c d e f | xargs –i –n3 echo before {} after:
      - before {} after a b c.
      - before {} after d e f.

Advanced Commands

- **Awk** programming language: oriented to file processing:
  - Line-oriented (file is analyzed line-by-line).
  - Basic format of an awk program is: **pattern { action }:**
    - Pattern determines when to perform action.
    - If pattern condition returns true, in that line action is performed.
    - If pattern is left empty, action is performed in every line.
  - Awk variables:
    - $N: this var contains the N field of the line (default field separator: space).
    - $0: variable containing the whole line.
    - FS: determines a different field separator (option -F).
    - NF: contains the number of fields in a line.
    - NR: contains the line number.
  - Examples:
    - awk -F: ‘{if($2==“”) print $1”: no password!”}’ < /etc/passwd.
    - awk ‘{ if(NR>100) print NR, $0}’ < fichero.

APPENDIX

File System (Commands)

Navigating through the file system

- Command **pwd:** display the path of the current folder.
- Command **cd:** command to move to a different location.
  - Usually, each session starts at the home directory of the user.
  - Syntax: $ cd [directory]:
    - The destination folder can be expressed as an absolute path (from root: cd /home/pepe/) or as a relative path (from current folder: cd ../usr/bin).
    - If no destination is specified, the command moves to the $HOME dir of the user.
- Command **mkdir:** create a new directory:
  - Syntax: $ mkdir -<options> directory:
    - Option **–m:** establish the permissions of the created folder.

File System (Commands)

File Manipulation

- Command **ls:** one of the most employed. List the content of a directory alphabetically:
  - Syntax: $ ls -<options> [file…]:
    - If executed without arguments, list files and folder of current directory.
    - Option **–a:** include hidden files (starting with .) to be listed.
    - Option **–l:** detailed view (permissions, links, owner, group, size, modification date).
    - Option **–r:** opposite order for the list.
    - Option **–t:** order the list by modification date.
    - Option **–S:** order the list according to file size.
    - Option **–s:** show the size of each file.
    - Option **–A:** list all files except "." y ".."
    - Option **–R:** list the content of every folder recursively.
    - Option **–color** = [none/auto/always]: use colors for different file types.
  - Combined example: **$ ls –lart** What does this command do?

File System (Commands)

File Manipulation

- Command **cp:** copy files:
  - Syntax: $ cp -<options> [arch_1]…[arch_n] [destination-dir]:
    - Option **–f** (forced): overwrite destination file with the same name.
    - Option **–i** (interactive): opposite to –f, ask before overwriting.
    - Option **–p:** maintain permissions, user and group.
    - Option **–R:** copy directories recursively.
    - Option **–a:** equivalent to -pR.
    - Option **–u:** do not perform the copy if in destination folder there is a file with the same name and it is more recently modified.
    - Option **–v** (verbose): display information about the copy process.
- Command **mv:** move files (not copy) and/or rename:
  - Syntax: $ mv -<options> [source_1]…[source_n] [destination]:
    - If the last argument is a directory, each source file is moved to that directory.
    - If source and destination are files, file is renamed.

File System (Commands)

File Manipulation

- Command **rm:** remove files and folders:
  - Syntax: $ rm -<ops> [file]…:
    - Warning: use with care.
    - The argument [file] can be a file, a folder or a regular expression.
    - Option **–f** (forced): without error messages, without requesting confirmation.
    - Option **–r** (recursive): remove folder content recursively.
- Command **ln:** links between files:
  - Two types, static or symbolic.
  - Syntax: $ ln -<ops> [src] [dst]:
    - Option **–d:** allows superuser to perform static links to folders.
    - Option **–s:** create a symbolic link.
  - Example: $ ln –s /etc/passwd /home/usuario/claves.
  - Running ls –l in a folder with symbolic links:
    - lrwxrwxrwx 1 usuario usuario 11 Apr 8 13:33 claves -> /etc/passwd.

File System (Commands)

File Manipulation

- Command **whereis:** find the path of a binary/source code/manual of a command:
  - Syntax: $ whereis -<options> [file]…:
    - Option **–b:** look only for the binary file.
    - Option **–m:** look only for the man page.
    - Option **–s:** look only for the source code.
- Command **locate:** command for file searching:
  - Performed through an indexed database (speed). One file with a list of every file in the file system.
  - /var/lib/mlocate/mlocate.db.
  - Usually, the OS runs a command periodically to update this database.
  - Syntax: $ locate -<options> [pattern].

File System (Commands)

File Manipulation

- Command **find:** powerful command for file searching:
  - Basic for administration. Allows filtering searches and running actions on the result.
  - Syntax: $ find <starting_point> -<filters> -<action>.
  - Filters:
    - **–atime n:** only search for files opened n days ago (+n: more than n days ago).
    - **–mtime n:** file modified n days ago (+n…).
    - **–newer file:** files modified after file.
    - **–size n:** files with n-blocks size (block = 512 bytes) (+n…).
    - **–type c:** type of file (f = text, d = directory, etc.).
    - **–fstype type:** file type *.type.
    - **–name nam** name = nam.
    - **–perm p:** with permission p.
    - **–user usr:** owner usr.

File System (Commands)

File Manipulation

- Command **find** (continued):
  - The search filters can be combined:
    - To force precedence: \(… \).
    - Condition AND: –atime + 60 –mtime + 120.
    - Condition OR: –atime + 7 –o –mtime + 120.
    - Condition NOT: ! –name gold.dat.
  - Actions on the files found:
    - Action **–print:** display all the files found.
    - Action **–ls:** display with extended format.
    - Action **–exec cmd\;:** run a command on every file (without asking)
    - Action **–xdev:** only search in current file system.
  - Some examples:
    - $ find /home –size +2048 \(–mtime +30 -o -atime +120\) –exec ls {} \;
    - $ find /home –fstype f –name core –exec rm –f {} \;
    - $ find /home/pepito -name ‘*.c’ -exec mv {} /home/pepito/src \;

File Content (Commands)

- Command **cat:** display the content of a file in a single step:
  - Not useful with large files.
- Command **more:** show the content progressively (paging):
  - Number of paging lines same as terminal size.
- Command **less:** evolution of the more command:
  - Interactive, with its own commands (launched through a key or a key combo):
    - **Space bar:** advance a number of lines equal to the terminal.
    - **Cursors:** move fw/bw line by line.
    - **G/g:** go to the beginning/end of the text.
    - **/pattern:** enter a string to search in the file.
    - **n/N:** move to the next/previous result of the work searched.
    - **AvPag/RePag**.
    - **q:** exit the program.

File Content (Commands)

- Command **wc:** count the words in a file:
  - Syntax: $ wc -<opts> [file…]:
    - Option **–c:** count bytes.
    - Option **–l:** count lines.
    - Option **–w:** count words.
- Command **head:** display the first part of a file:
  - Syntax: $ head -<options> [file]:
    - Option **–c N:** display the first N bytes.
    - Option **–n N:** display the first N lines (10 by default).
- Commando **tail:** display the last part of a file:
  - Syntax: $ tail -<options> [file]:
    - Options **–c** and **–n:** same as head.
    - Option **–nf:** display the last part of a file as it grows. Very useful to control log files that grow over time.

File Content (Commands)

- Command **grep:** display those lines matching a pattern:
  - Syntax: $ grep -<opts> PATTERN [files…]:
    - Option **–c:** display the number of lines matching the pattern.
    - Option **–H:** display the name of the file on every match.
    - Option **–r:** dearch recursively inside the folders of the current directory.
  - When the patterns contains special characters (space, -, etc.), “” can be employed.
  - Regular expressions can also be used:
    - Example: search for lines with words starting with a: grep a* file.
- Command **tar:** add the content of a whole directory tree to a single file:
  - Not compressed, only packaged.
  - tar: $ tar -cvf fichero.tar /path/.
  - untar: $ tar -xvf fichero.tar.
  - working with **gzip** (compressor): $ tar -czvf fichero.tar.gz /path/.

File Content (Commands)

- Command **cut:** remove sections from each line of a file:
  - Syntax: $ cut -<opts> [files…]:
    - Option **–c N:** select the Nth character of each line (-N: from the beginning of the line to N).
    - Option **–b N:** select the Nth byte of each line (M-N: from byte M to N).
    - Option **–f N:** select the Nth field. Default delimiter: TAB.
- Command **sort:** sort the lines of a text file:
  - Syntax: $ sort -<opts> [file]:
    - Option **–d:** alphabetic order.
    - Option **–n:** numeric order.
    - Option **–b:** ignore blank spaces at the beginning of the line.

File Content (Commands)

- Command **vi:** text editor (terminal) included in every UNIX system:
  - A bit difficult for beginners. With practice, much faster than any graphic editor (in some cases it might be the only option).
  - Some improved versions available, such as **vim**, which are more friendly.
  - **Command mode:** exit, save, copy, search, etc.
  - **Edition mode:** text insertion.
  - From command to edition: [i], [a], [o], [O]…
  - From edition to command: [Esc].
  - **Moving through the text:**
    - [h],[l],[j],[k]: cursor; left, right, up, down (in vim cursors work…).
    - [G]: go to the last line ([5G]: go to the 5th line).
    - [0][$]: go to the beginning (zero)/end of the line.
  - Entering the edition mode:
    - [a][i]: append or insert.
    - [o][O]:

File Content (Commands)

- Command **vi** (continued):
  - **Entering edition mode:**
    - [a][i]: append or insert.
    - [o][O]: open above/below a line.
  - **Edition (managing the buffer):**
    - [x]: remove a character ([xx] remove a line, [4xx] remove 4 lines, [xw] remove a word).
    - [d]: cut ([dd] cut a line…).
    - [y]: copy ([yy]…).
    - [p]: paste.
    - [r]: replace.
    - [u]: undo.
    - [Ctrl+r]: redo.
    - [.]: repeat the last command.
  - **Search:**
    - Similar to less ([/pattern], [?pattern], [n], [N]).

File Content (Commands)

- Command **vi** (continued):
  - **Replace:**
    - [%s/old/new/g]]: replace old string by new string throughout the whole text.
  - **Exit:**
    - [:w]: save changes, without exiting.
    - [:q]: exit (fails if unsaved changes are found).
    - [:q!]: forced exit, unsaved changes are lost.
    - [:wq]: save and exit.

User Management (Commands)

- Command **whoami:** displays the name of the user running the command.
- Command **who:** displays the users logged in the system.
- Command **passwd:** change user's password:
  - Syntax: $ passwd [user]:
    - If no user is specified, it makes use of the one using the command.
- Command **finger:** shows the status of a user in a system:
  - Syntax: $ finger user@system:
    - Shows user information, session time, inactivity time, mail, .plan file.
- Command **write:** send text messages to the terminal of a connected user:
  - Syntax: $ write user [tty].
  - Complementary command **wall:** write to all (every user connected).
  - Command **talk** *user@machine:* establish complete communication (~IRC).

User Management (Commands)

- Command **chmod:** modify permissions of a file/folder:
  - Syntax: $ chmod [ugo] [+-] [rwx] [file or directory]:
    - Option **–R:** recursive.
    - Example: limit the access to $HOME to every user.
    - $ chmod –R g-rwx, o-rwx $HOME.
    - Permissions can be coded in octal/binary: chmod –R 700 $HOME.
- Command **chown/chgrp:** modify the UID/GID of a file:
  - Syntax: $ chown [-R] new_user file
- Command **umask:** modify the permissions assigned to new files by default:
  - Syntax: $ umask [inhibition code]:
    - Establishes which bits are 0 when creating the file.
    - Example: $umask 022 -> permissions for the created files: 644 (rw-r--r--).
- To run a file, execution permissions activated (x). Extensions (.exe) NOT necessary.