UNIX/Linux Environment

UNIX & Linux commands (Part A)

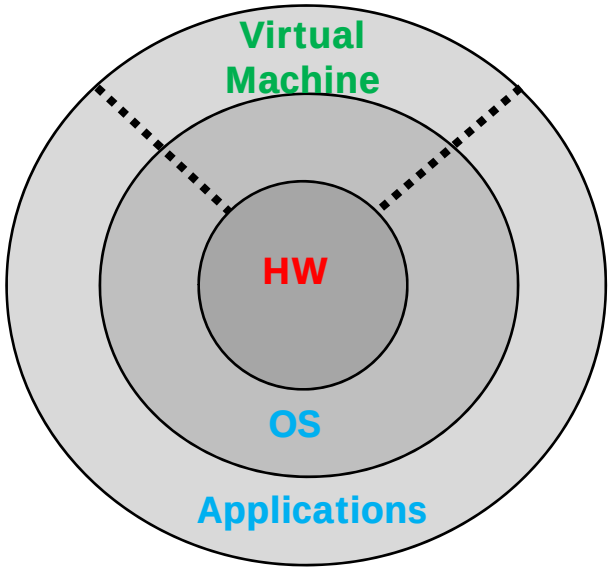
Stefano Quer – Pietro Laface
Dipartimento di Automatica e Informatica
Politecnico di Torino

Linux install

- Many possibilities exist to setup a UNIX-like (Linux) environment
- Among the most popular
  - Cygwin
    - Visit www.cygwin.com
    - Collection of tools that provide a Linux environment in Windows
      - Provides the main UNIX functions
      - Integrates with Windows
      - Far better command window than the standard Windows **`command.com`**
      - Free software

Linux install

- Linux LIVE versions
  - LIVE CD o LIVE USB versions
  - Exec Linux from CD or USB-pen
  - Reduced functions
- Virtual Machine
  - Is an emulation of a given computer system.
    - **Virtualbox**
    - **Qemu**
    - VMWare (Oracle VM)

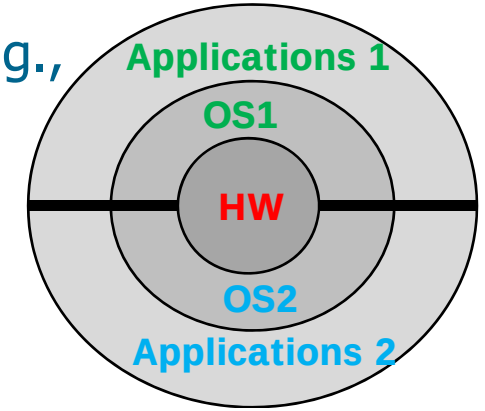


Linux install

- Multi-boot
  - It is necessary disc partitioning
  - Different partitions for different OSs
  - A boot-loader
    - LILO o **GRUB** in GNU Linux
    - NTLDR in Windows NT

    allows selecting which OS to boot

- For more detailed information
  - See common Linux distributions, e.g., Ubuntu (for desktop, 32 or 64 bit)
    - http://www.ubuntu.com/



Session

- Session opening
  - login: <username>
  - password: <password>

Linux is case sensitive

- Remote connection
  - ssh <username@hostname> (command line interface)
  - putty (graphical interface)

  both use a secure encrypted connection protocol.
- Session termination
  - exit
  - logout
  - ctrl-d

Help manual

- All commands are documented in manual pages
  - man <command>
  - Related commands
    - apropos <command>
    - whatis < command >
    - whereis < command >
- Available
  - Automatic command completion (Tab)
  - Up-down arrows for retrieving previously submitted commands

Commands

- Unix-like command syntax

```
command [options] [arguments]
```

-char or --string

- Command parsing
  - Long commands can be continued on the next line using `'\'` as the last character of the current line
  - Two or more commands can be given on the same line, separated by `';'`
    - **`command1 ; command2 ; ...`**
    - Commands on the same line are executed **sequentially**

Filenames

- A filename can include any character sequence
  - Some characters should not be used

    `/ \ “ ' * ; ? [ ] ( ) ~ ! $ { } < > # @ & |`
  - Formally a file has not extension and version
  - Some meaningful extension are often used

    `.c, .f, .p, .o, .a, .so, a.out, core`
- A filename beginning by `'.'` corresponds to an **hidden** file, i.e., a file that is not normally visible listing the content of a directory

File-system

- The Linux filesystem is
  - Hierarchic
  - Organized by means of tree directories
    - The root tree directory is `'/'` (slash)
    - The current directory is indicated by `'.'` (dot)
    - The current directory is indicated by `'.'` (dot dot)
    - Directories are separated by means of a `'/'`
      Uniform notation (discs, directories, files, special files, …)

Path

- A file is specified by its pathname
  - Absolute pathname
    - From the filesystem root
    - `/dir1/dir2/file`
  - Relative pathname
    - From the current working directory
    - `./subdir1/subdir2/file`
    - `subdir1/subdir2/file`

ls

- Command **ls** provides information about a file according to the specified options. If pathname is a directory, **ls** lists the files and subdirectories contained in that directory

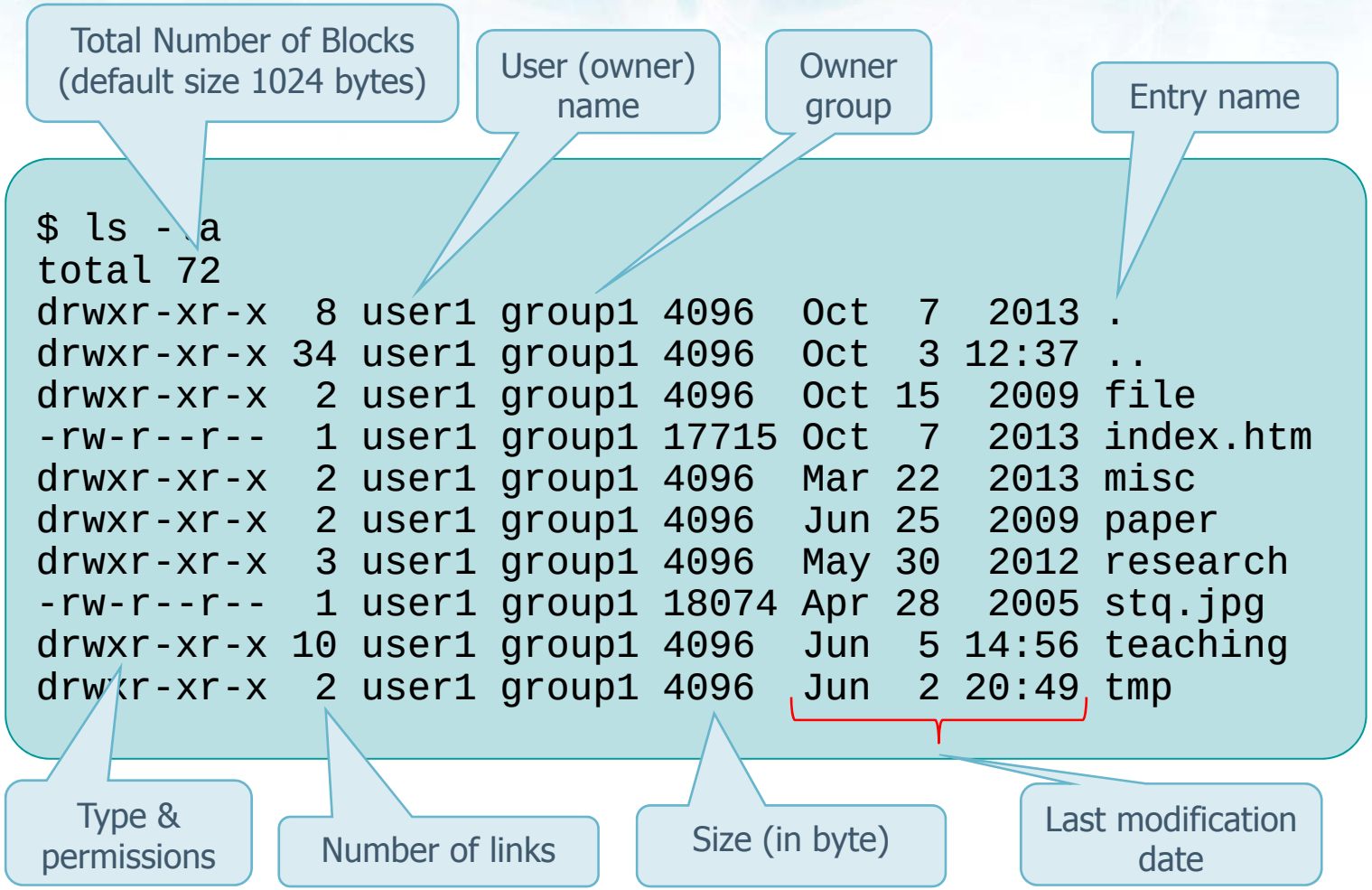
```
ls [-options] [file ...]
```

  - Options
    - -a Shows also hidden files ('.' filenames)
    - -l Long list (extended output)
    - -g Included group info
    - -t Sort files by date
    - -r Reverse order (alphabetic/date)
    - -R Recursive (includes files in subdirectories)

Example

```
$ ls -la
total 72
drwxr-xr-x  8 user1 group1 4096  Oct  7  2013 .
drwxr-xr-x 34 user1 group1 4096  Oct  3 12:37 ..
drwxr-xr-x  2 user1 group1 4096  Oct 15  2009 file
-rw-r--r--  1 user1 group1 17715 Oct  7  2013 index.htm
drwxr-xr-x  2 user1 group1 4096  Mar 22  2013 misc
drwxr-xr-x  2 user1 group1 4096  Jun 25  2009 paper
drwxr-xr-x  3 user1 group1 4096  May 30  2012 research
-rw-r--r--  1 user1 group1 18074 Apr 28  2005 stq.jpg
drwxr-xr-x 10 user1 group1 4096  Jun  5 14:56 teaching
drwxr-xr-x  2 user1 group1 4096  Jun  2 20:49 tmp
```

Example


Total Number of Blocks (default size 1024 bytes)
User (owner) name
Owner group
Entry name
$ ls -la
total 72
drwxr-xr-x 8 user1 group1 4096 Oct 7 2013 .
drwxr-xr-x 34 user1 group1 4096 Oct 3 12:37 ..
drwxr-xr-x 2 user1 group1 4096 Oct 15 2009 file
-rw-r--r-- 1 user1 group1 17715 Oct 7 2013 index.htm
drwxr-xr-x 2 user1 group1 4096 Mar 22 2013 misc
drwxr-xr-x 2 user1 group1 4096 Jun 25 2009 paper
drwxr-xr-x 3 user1 group1 4096 May 30 2012 research
-rw-r--r-- 1 user1 group1 18074 Apr 28 2005 stq.jpg
drwxr-xr-x 10 user1 group1 4096 Jun 5 14:56 teaching
drwxr-xr-x 2 user1 group1 4096 Jun 2 20:49 tmp
Type & permissions
Number of links
Size (in byte)
Last modification date

Example

File type

-	Normal file
d	Directory
s	Socket file
l	Link file

Three users types

u	user	(owner)
g	group	
o	others	other users

```
...
-rw-r--r--  1 user1 group1 17715 Oct  7  2013 index.htm
drwxr-xr-x  2 user1 group1 4096  Mar 22  2013 misc
...
```

Three base permissions

r	read
w	write
x	execute

Example

Permission can be defined as an octal value

rwx rwx rwx	→	777
rw– rw– rw–	→	666
rwx ––x –––	→	710

```
...
-rw-r--r--  1 user1 group 17715 Oct  7  2013 index.htm
drwxr-xr-x  2 user1 group 14096 Mar 22  2013 misc
...
```

Alternatively by means of
- a letter: u(ser), g(roup), o(ther), a(ll)
- a symbol: +, -, = (add, subtract, untouched)
- a character: r, w, x (read, write, execute)

Regular file management

- Copy
  - cp [-fir] src1 src2 ... dest
- Remove
  - rm [-fir] file1 file2 …
- Move (rename)
  - mv [-fi] file1 file2 ... dest
- Options
  - -f does not ask confirmation (force)
  - -i ask confirmation for each file (interactive)
  - -r Apply command recursively on all the subdirectory files
- Directories can often be managed as regular files

-f = –force
-i = --interactive
-r = –R = --recursive

Directory management

- Change current directory
  - cd dir
- Print working directory
  - pwd
- Create a directory
  - mkdir dir
- Remove a directory
  - rmdir dir
  - A directory can be removed only if it is empty, unless the options –rf are used with command
    - rm –rf dir

Permissions for directories

- The meaning of the permission characters is different for directories.
  - r Directory content can be listed
  - w Create, rename, or delete files within the directory, and modify the directory's attributes only **IFF the execute bit is set**.
  - x Directory can be crossed or **cd** can be performed

Permission management

- It is possible to change file permissions
  - chmod [-R] permissions file
- Permissions can be specified in different ways
  - Absolute, by means of three octal digits
    - chmod 775 filename
  - Symbolic, by means of a string of three (or more) characters
    - chmod g+r filename
    - chmod +x filename
    - chmod uo+rx filename

Permission management

- Changing the owner of a directory entry
  - chown [-R] user entry
- Changing the group of a directory entry
  - chgrp [-R] group entry
- These command can be combined
  - chown [-R] user[:group] entry
  - chown [-R] uid[:gid] entry
  - Options
    - -R Performed recursively on all entries of the directory tree

Output the content of a file

- Output and concatenate files
  - cat $filename_1$ $filename_2$ …
- Output the first **n** lines of a file
  - head [-n] filename …
- Output the last **n** lines of a file
  - tail [-n] [+n] [-r] [-f] filename …
  - Options
    - -n last n lines
    - +n all excluding the first n lines
    - -r lines are output in reverse order
    - -f outputs appended data as the file grows

Output the content of a file

- Additional output commands
  - pg filename ...
  - more filename ...
  - less filename ...
- Options

space	Next page
return	Next line
b	Previous page
/str	Find next occurrence of string str
?str	Find previous occurrence of string str
q	Quit

File comparison

- Difference between two files
  - diff [-options] file1 file2
  - Lists the line number of the lines
    - a added
    - d deleted
    - c changed
- Difference between two directories
  - diff [-options] dir1 dir2
  - Options
    - -i case insensitive
    - -w Ignores spaces
    - -b Ignores spaces at EOL, merges the others

Counts

- Outputs the number of lines, words, and bytes of a file
  - wc [options] [file...]
  - Options
    - -l Outputs only the number of lines
    - -w Outputs only the number of words
    - -c Outputs only the number of bytes

Warning: it also outputs the filename as its first line

Hard and Symbolic Links

- Link creation
  - ln [options] source [destination]
  - Default behavior
    - Creates a hard-link
    - If the destination is not present, creates a link with the same filename on the working directory.
  - Options
    - –s Creates a symbolic link
    - -f Force creation, removes file if already existent
    - --help Displays help

Hard and Symbolic Links

- Examples
  - `ln source alias`
  - `ln –s /home/foo/tmp/bar.exe /mnt/foo/bin/`

Symbolic link, possibly to a file in another filesystem

- Notice that
  - Command **rm**
    - Removes the data of a file only if its link number is equal to 0
  - Command **mv**
    - Performed as the sequence of commands **ln** followed by **rm**