

Programming for Evolutionary Biology
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Leipzig, Germany

Introduction to Unix systems

Part 2: Introducing the terminal

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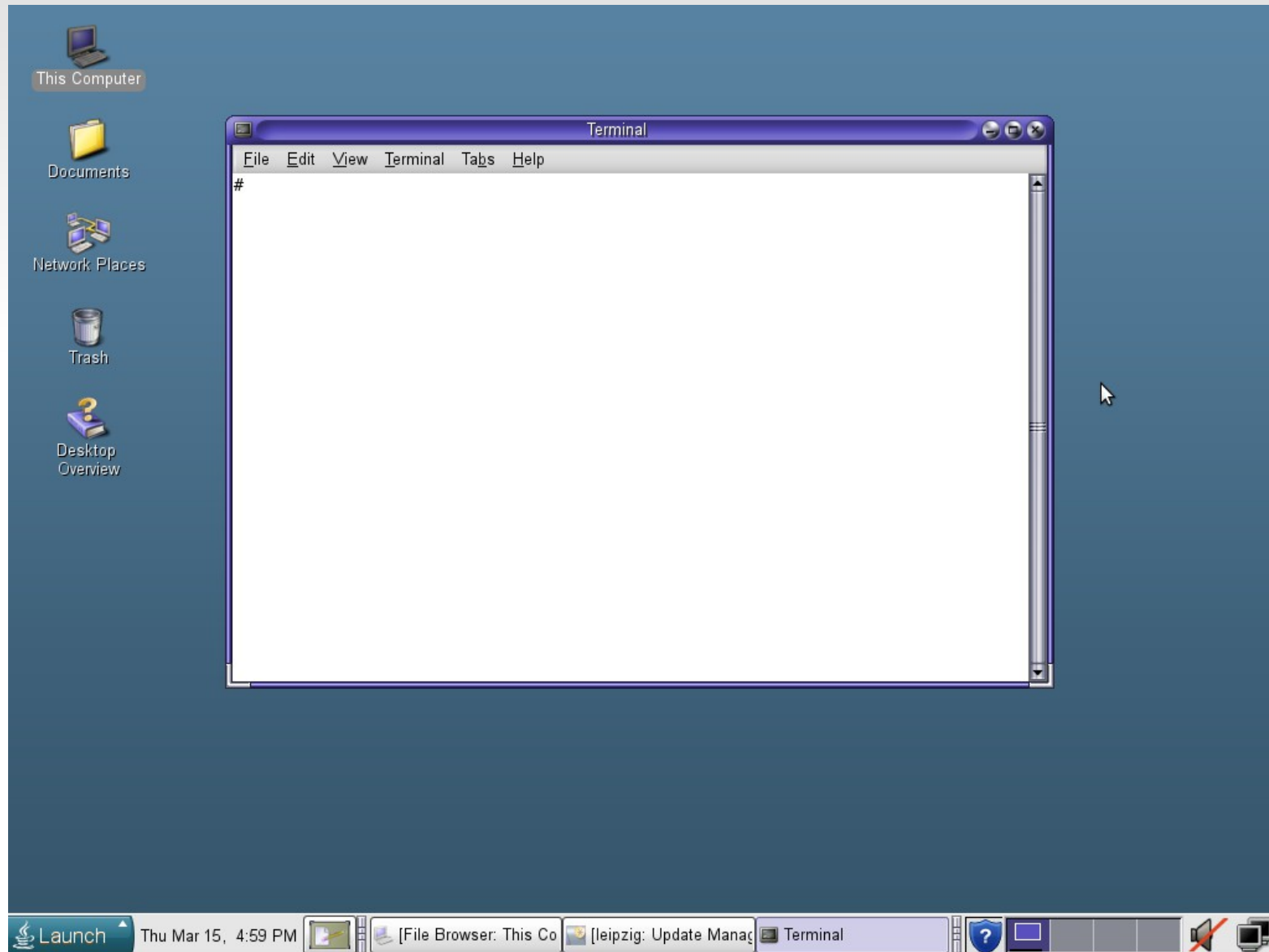
Schedule

- 9.30 – 11.00: “What is Unix?” and hands on a Fedora system
- **11.30 – 12.30: Introducing the terminal**
- 14:30 – 16:30: Grep & Unix philosophy
- 17:00 – 18:00: awk, sed and make

What is the terminal?

- The terminal is a software that allows to execute commands by typing
- Instead of clicking an icon in a menu, we call a software by writing its name

How does a terminal looks like?



The terminal: history and why

- Back in the '70s, when Unix was developed, computers did not have graphical interfaces
- Also, computer were mostly used for data analysis.

The terminal: history and why

- Back in the '70s, when Unix was developed, computers did not have graphical interfaces
- Also, computer were mostly used for data analysis.
 - The most common operations were analysis of datasets and manipulation of text files

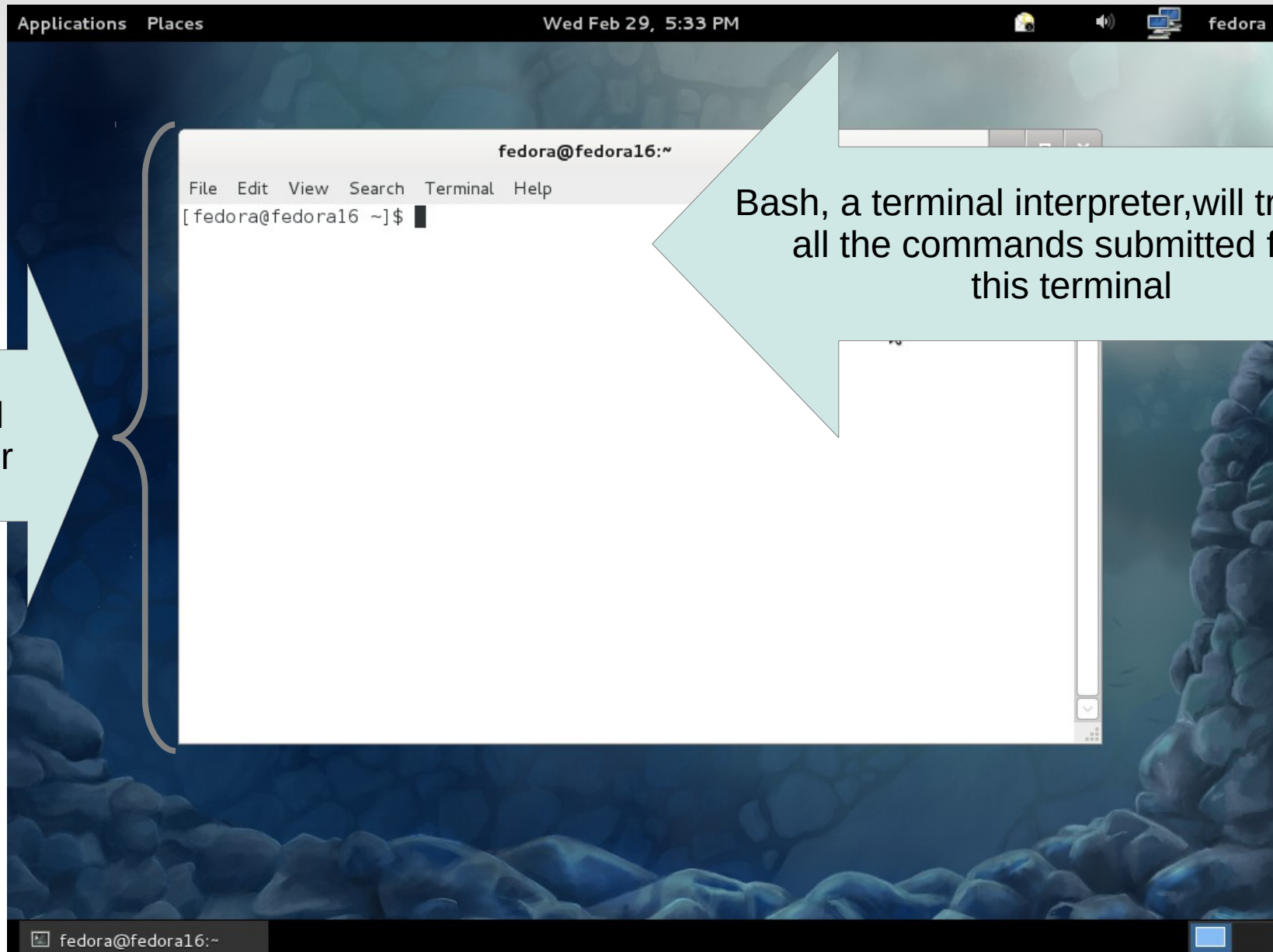
Why use the terminal today?

- A common problem in bioinformatics is to deal with big collections of text files
- The terminal is a good instrument to manage big collections of text files. More than 30 years of experience.

some Terminology

- **Terminal emulator:** the software that shows the window where you type the commands, and prints the output of the commands
- **Interpreter:** the software that translate commands to the computer
- **Bash:** name of the most commonly used interpreter

Terminal emulator, interpreter and bash

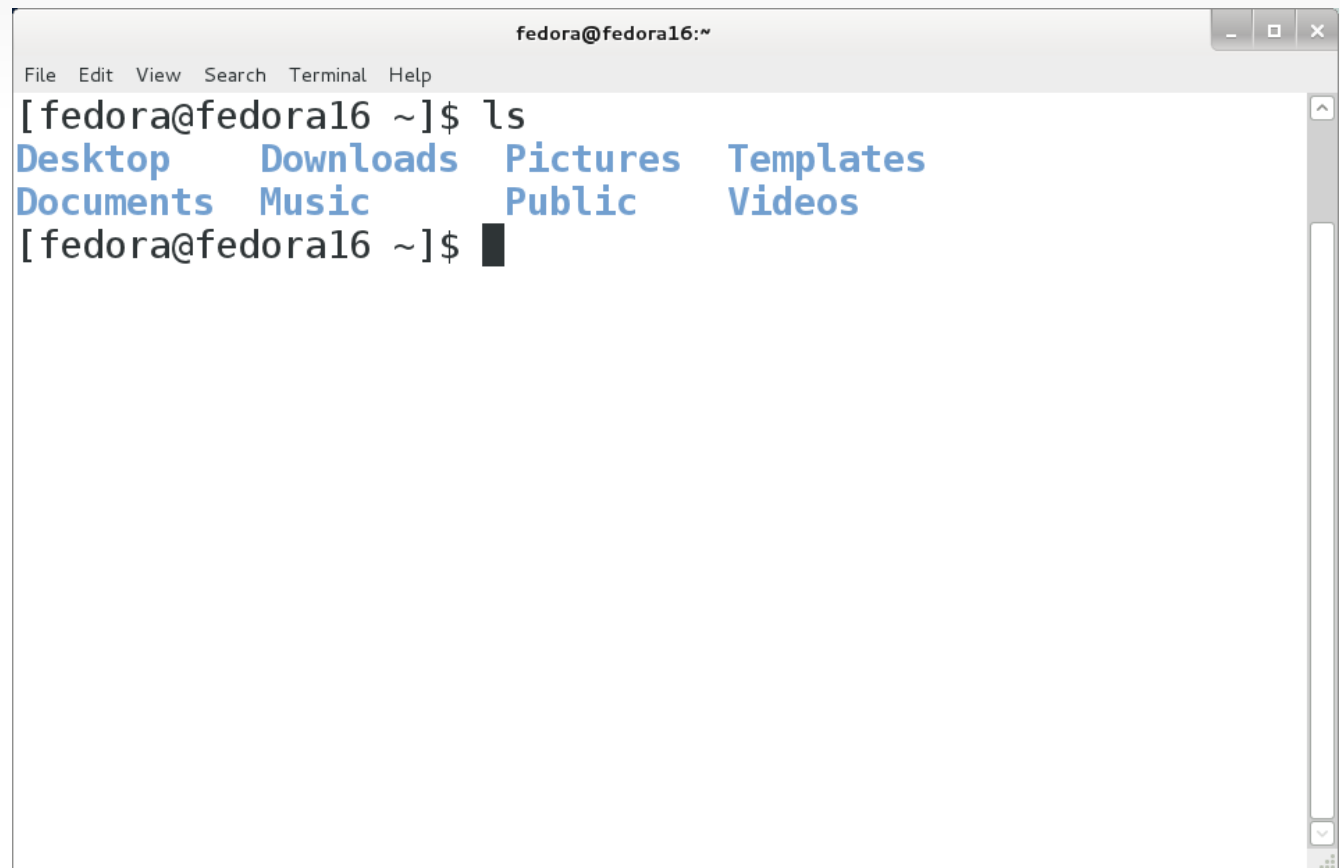


Terminal
Emulator

Bash, a terminal interpreter, will translate
all the commands submitted from
this terminal

Your first command: ls

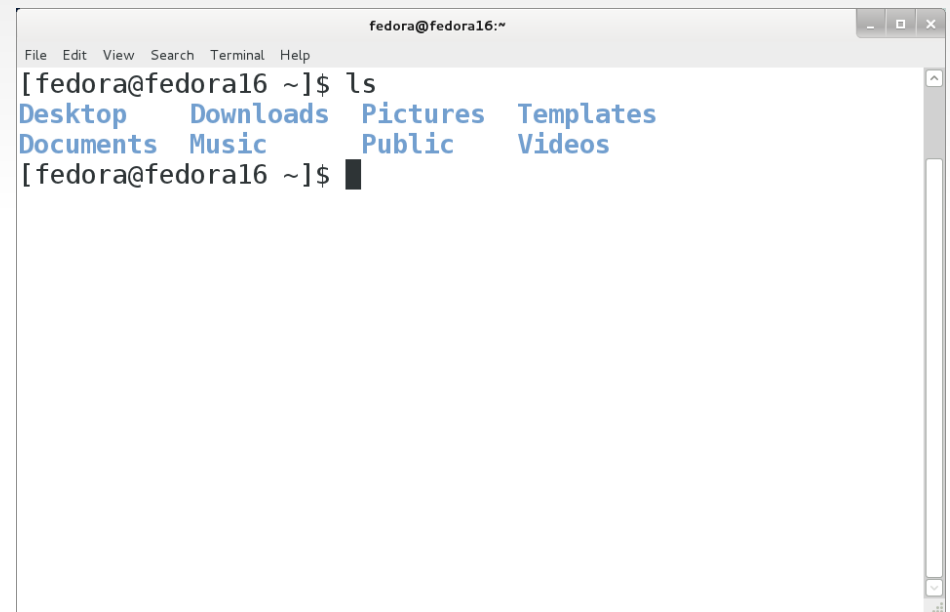
- **ls** is the command to show all the files in a folder
- It stands for “List Short” (list files in a short way)
- Try it!

A screenshot of a terminal window titled 'fedora@fedora16:~'. The window has a menu bar with 'File', 'Edit', 'View', 'Search', 'Terminal', and 'Help'. The terminal shows the command '[fedora@fedora16 ~]\$ ls' and its output: 'Desktop Downloads Pictures Templates' on the first line and 'Documents Music Public Videos' on the second line. The prompt '[fedora@fedora16 ~]\$' is followed by a black cursor block.

```
fedora@fedora16:~  
File Edit View Search Terminal Help  
[fedora@fedora16 ~]$ ls  
Desktop Downloads Pictures Templates  
Documents Music Public Videos  
[fedora@fedora16 ~]$
```

Output of “ls”

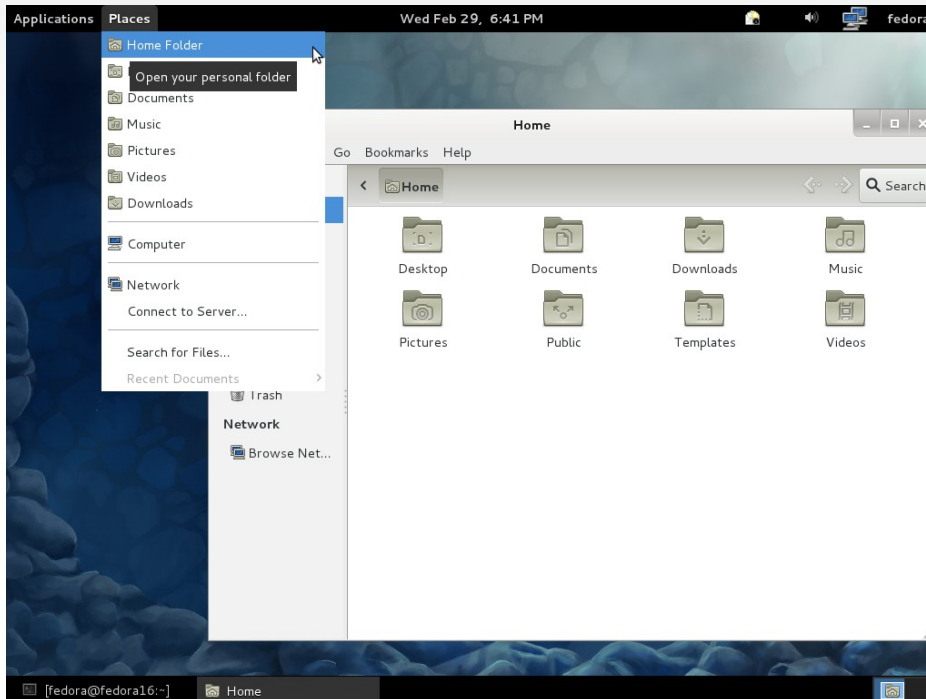
- **ls** will list the files in the current directory
- By default, when you open the terminal, you are in your “home” folder

A screenshot of a terminal window titled "fedora@fedora16:~". The window has a menu bar with "File", "Edit", "View", "Search", "Terminal", and "Help". The terminal shows the command prompt "[fedora@fedora16 ~]\$ ls" followed by the output: "Desktop Downloads Pictures Templates Documents Music Public Videos". The output is displayed in a grid-like format with blue text. The prompt "[fedora@fedora16 ~]\$" is followed by a black cursor.

```
fedora@fedora16:~  
File Edit View Search Terminal Help  
[fedora@fedora16 ~]$ ls  
Desktop Downloads Pictures Templates  
Documents Music Public Videos  
[fedora@fedora16 ~]$
```

“ls” is showing the contents of the “home” folder

- If you want to see which files are being shown by **ls**, you can type **nautilus** as we did in the previous session



```
fedora@fedora16:~  
File Edit View Search Terminal Help  
[fedora@fedora16 ~]$ ls  
Desktop Downloads Pictures Templates  
Documents Music Public Videos  
[fedora@fedora16 ~]$
```

Anatomy of a command

- Each command call is usually composed by three parts:
 - The command itself
 - Parameters (optionals)
 - Arguments

ls: some parameters

- Parameters are optional items that can be used to customize the behaviour of a command
- For example:
 - `ls -l` shows the list of files in a long format
 - `ls -a` shows hidden files
 - `ls -t` list files by modification time

“ls -l”

- **ls -l** shows the same files as **ls**, but on a more detailed format

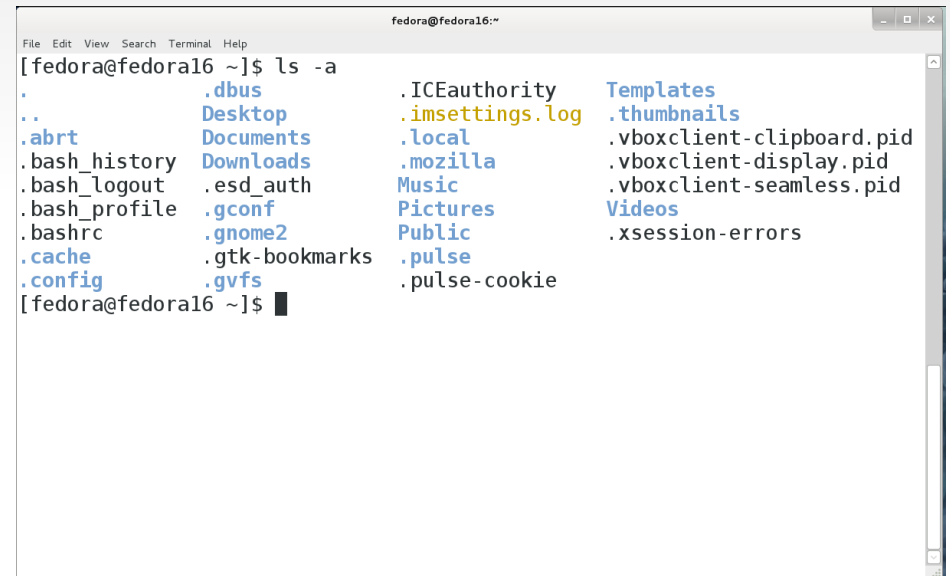


A terminal window titled "fedora@fedora16:~" showing the output of the command "ls -l". The output lists the contents of the home directory in a long format, including permissions, number of links, owner, group, size, date, and filename. The files listed are Desktop, Documents, Downloads, Music, Pictures, Public, Templates, and Videos.

```
fedora@fedora16:~  
File Edit View Search Terminal Help  
[fedora@fedora16 ~]$ ls -l  
total 32  
drwxr-xr-x. 2 fedora fedora 4096 Nov  9 14:13 Desktop  
drwxr-xr-x. 3 fedora fedora 4096 Mar 15 10:39 Documents  
drwxr-xr-x. 2 fedora fedora 4096 Nov  9 14:13 Downloads  
drwxr-xr-x. 2 fedora fedora 4096 Nov  9 14:13 Music  
drwxr-xr-x. 2 fedora fedora 4096 Nov  9 14:13 Pictures  
drwxr-xr-x. 2 fedora fedora 4096 Nov  9 14:13 Public  
drwxr-xr-x. 2 fedora fedora 4096 Nov  9 14:13 Templates  
drwxr-xr-x. 2 fedora fedora 4096 Nov  9 14:13 Videos  
[fedora@fedora16 ~]$
```

“ls -a”

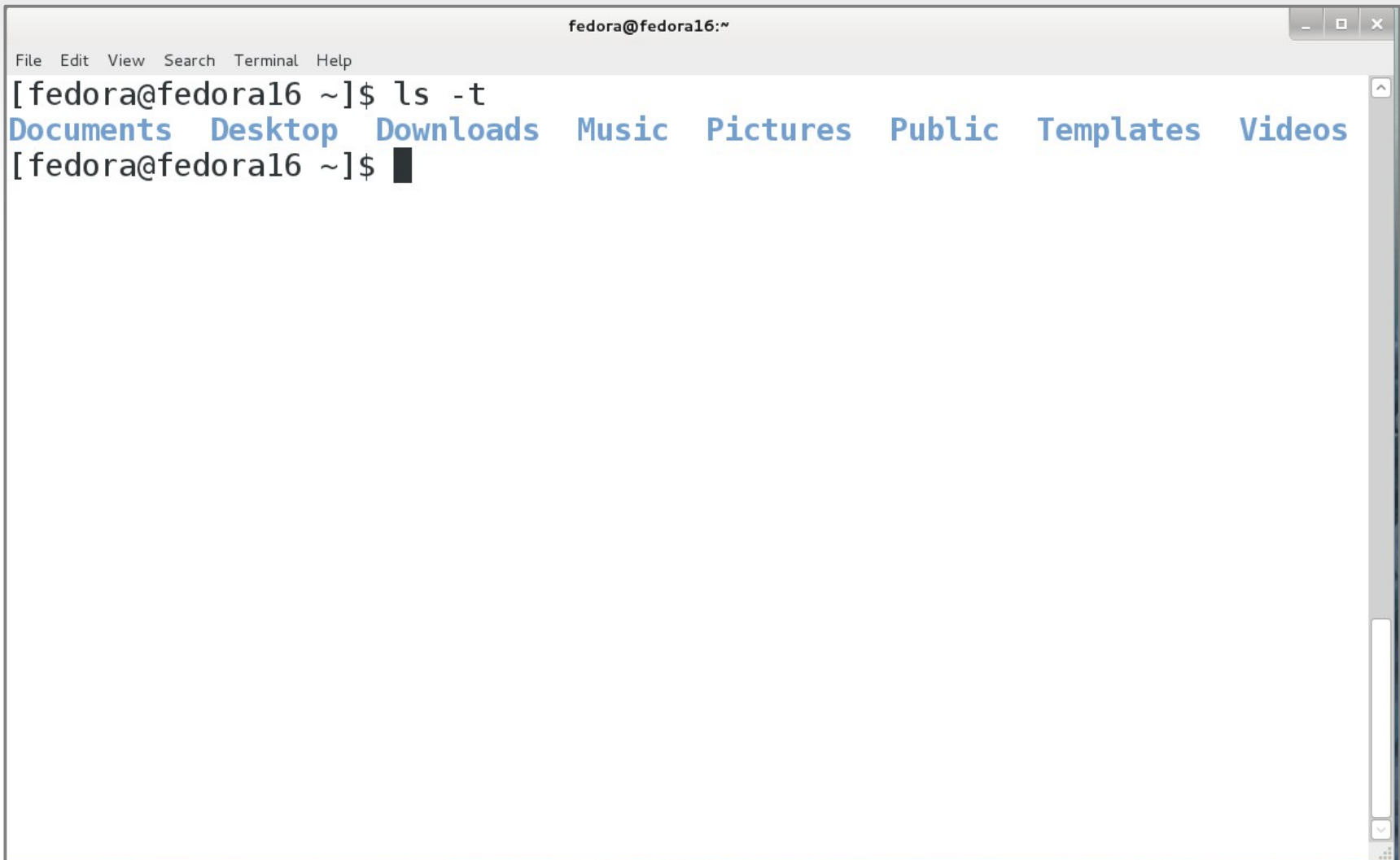
- **ls -a** shows all the files, including the hidden ones
- Hidden files have a name that begin with a “.”
- Most of them are configuration files, you can ignore them.



```
fedora@fedora16:~  
File Edit View Search Terminal Help  
[fedora@fedora16 ~]$ ls -a  
.  
..  
.abrt  
.bash_history  
.bash_logout  
.bash_profile  
.bashrc  
.cache  
.config  
.dbus  
Desktop  
Documents  
Downloads  
.esd_auth  
.gconf  
.gnome2  
.gtk-bookmarks  
.gvfs  
.ICEauthority  
.imsettings.log  
.local  
.mozilla  
Music  
Pictures  
Public  
.pulse  
.pulse-cookie  
Templates  
.thumbnails  
.vboxclient-clipboard.pid  
.vboxclient-display.pid  
.vboxclient-seamless.pid  
Videos  
.xsession-errors  
[fedora@fedora16 ~]$
```


“ls -t”

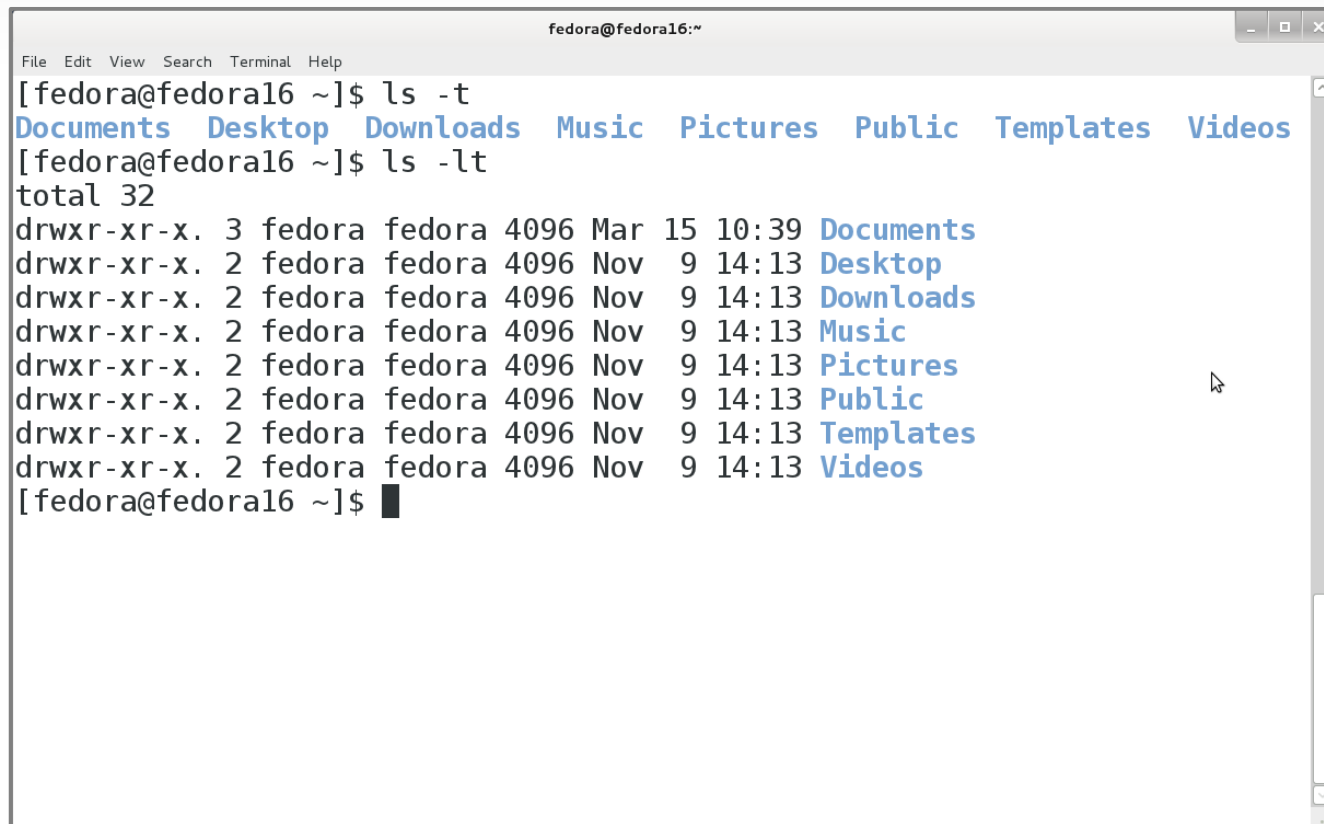
- **ls -t** lists the files by modification date

A screenshot of a terminal window titled 'fedora@fedora16:~'. The window has a menu bar with 'File', 'Edit', 'View', 'Search', 'Terminal', and 'Help'. The terminal shows the command '[fedora@fedora16 ~]\$ ls -t' and its output: 'Documents Desktop Downloads Music Pictures Public Templates Videos'. The output is displayed in blue text. The prompt '[fedora@fedora16 ~]\$' is followed by a black cursor. The window has standard Linux window controls (minimize, maximize, close) in the top right corner and a scrollbar on the right side.

```
fedora@fedora16:~  
File Edit View Search Terminal Help  
[fedora@fedora16 ~]$ ls -t  
Documents Desktop Downloads Music Pictures Public Templates Videos  
[fedora@fedora16 ~]$
```

“ls -lt”

- You can combine parameters together
- **ls -lt** shows the files in a long format, sorted by date



```
fedora@fedora16:~  
File Edit View Search Terminal Help  
[fedora@fedora16 ~]$ ls -t  
Documents Desktop Downloads Music Pictures Public Templates Videos  
[fedora@fedora16 ~]$ ls -lt  
total 32  
drwxr-xr-x. 3 fedora fedora 4096 Mar 15 10:39 Documents  
drwxr-xr-x. 2 fedora fedora 4096 Nov 9 14:13 Desktop  
drwxr-xr-x. 2 fedora fedora 4096 Nov 9 14:13 Downloads  
drwxr-xr-x. 2 fedora fedora 4096 Nov 9 14:13 Music  
drwxr-xr-x. 2 fedora fedora 4096 Nov 9 14:13 Pictures  
drwxr-xr-x. 2 fedora fedora 4096 Nov 9 14:13 Public  
drwxr-xr-x. 2 fedora fedora 4096 Nov 9 14:13 Templates  
drwxr-xr-x. 2 fedora fedora 4096 Nov 9 14:13 Videos  
[fedora@fedora16 ~]$
```

Arguments

- Arguments define the target of the command
- On which files/folders/targets do I want to run my command?
- Example:
 - `ls unix_intro` -> shows the files in the `unix_intro` directory

Quick exercise

- In the following call, which are the commands, the parameters and the arguments?
 - `ls -la /homes/evopserver`

How to get the documentation of a command?

- Three methods:

- `--help`
- `man`
- `info`

“ls --help”

- The simplest way to get the documentation of a command is by using the --help parameter
- For example:
`ls --help`
- Most unix command accept a --help or -h parameter

Consulting the documentation of a command: **man**

- The command **man** is used to see the documentation of a command
- Understanding how to read the documentation is the key to learn how to use the shell

Your second command: man

- The command “man” is used to see the documentation of a command
- Usage: `man <name of the command>`
- Try it:
 - `man ls`

“man ls”

```
LS(1)                                User Commands                                LS(1)

NAME
    ls - list directory contents

SYNOPSIS
    ls [OPTION]... [FILE]...

DESCRIPTION
    List information about the FILES (the current directory by default).
    Sort entries alphabetically if none of -cftuvSUX nor --sort.

    Mandatory arguments to long options are mandatory for short options
    too.

    -a, --all
        do not ignore entries starting with .

    -A, --almost-all
        do not list implied . and ..

    --author
        with -l, print the author of each file

    -b, --escape
        print C-style escapes for nongraphic characters

    --block-size=SIZE
        use SIZE-byte blocks. See SIZE format below

    -B, --ignore-backups
        do not list implied entries ending with ~

    -c
        with -lt: sort by, and show, ctime (time of last modification of
        file status information) with -l: show ctime and sort by name
        otherwise: sort by ctime

    -C
        list entries by columns
```

Understanding a man page

- Each manual page is composed by at least three sections:
 - NAME (the name of the command)
 - SYNOPSIS (how to launch the command)
 - DESCRIPTION/OPTIONS (description of what the command does, and its options)

“man ls”

```
LS(1)                                User Commands                                LS(1)

NAME
    ls - list directory contents

SYNOPSIS
    ls [OPTION]... [FILE]...

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    --author
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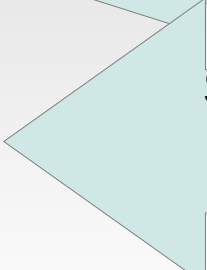
    -B, --ignore-backups
        do not list implied entries ending with ~

    -c
        with -lt: sort by, and show, ctime (time of last modification of
        file status information) with -l: show ctime and sort by name
        otherwise: sort by ctime

    -C
        list entries by columns
```



Name of the command



Synopsis (how to use it)
Options in square
brackets are optional



Parameters & arguments

Using a man page

- Use arrows or PageUp/PageDown keys to scroll the man page
- Press “/” followed by a word to search text
 - Example: /sort
- Press “q” to exit

Searching for a man page

- You can search all the manuals using the -k option
 - Example: `man -k "list dir"`
- Another similar command is "apropos"
 - Example: `apropos "list dir"`

Other sections in a man page

- SEE ALSO: some man pages contain references to similar commands
- EXAMPLES: some man pages contain an “examples” section

“SEE ALSO” and “EXAMPLES” sections

File Edit View Search Terminal Help

SEE ALSO

Regular Manual Pages

`awk(1), cmp(1), diff(1), find(1), gzip(1), perl(1), sed(1),
sort(1), xargs(1), zgrep(1), mmap(2), read(2), pcre(3),
pcresyntax(3), pcrepattern(3), terminfo(5), glob(7), regex(7).`

POSIX Programmer's Manual Page

`grep(1p).`

TeXinfo Documentation

The full documentation for **grep** is maintained as a TeXinfo manual. If the **info** and **grep** programs are properly installed at your site, the command

info grep

should give you access to the complete manual.

NOTES

GNU's not Unix, but Unix is a beast; its plural form is Unixen.

Manual page grep(1) line 640/664 100% (press h for help or q to quit)

“SEE ALSO” and “EXAMPLES” sections

File Modifica Visualizza Cerca Terminale Aiuto

--version

output version information and exit

Note, comparisons honor the rules specified by `LC_COLLATE'.

EXAMPLES

`comm -12 file1 file2`

Print only lines present in both file1 and file2.

`comm -3`

file1 file2 Print lines in file1 not in file2, and vice versa.

AUTHOR

Written by Richard M. Stallman and David MacKenzie.

REPORTING BUGS

Report comm bugs to bug-coreutils@gnu.org

-- MOST: *stdin*

(33,1) 43%

Press `Q' to quit, `H' for help, and SPACE to scroll.

“man -k 'list dir'” and apropos

```
File Edit View Search Terminal Help
[giovanni@evopserver ~]$ man -k "list dir"
dir (1) - list directory contents
lio_listio (3p) - list directed I/O (REALTIME)
ls (1) - list directory contents
ls (1p) - list directory contents
ntfsls (8) - list directory contents on an NTFS filesystem
vdir (1) - list directory contents
[giovanni@evopserver ~]$
[giovanni@evopserver ~]$ apropos "list dir"
dir (1) - list directory contents
lio_listio (3p) - list directed I/O (REALTIME)
ls (1) - list directory contents
ls (1p) - list directory contents
ntfsls (8) - list directory contents on an NTFS filesystem
vdir (1) - list directory contents
[giovanni@evopserver ~]$
```

Another way to access documentation: “info”

- The command “info” shows a more descriptive documentation of a command
- Example:
 - `info ls`

The “info” command

```
File Edit View Search Terminal Help
File: coreutils.info, Node: ls invocation, Next: dir invocation, Previous: directory listing
```

```
10.1 `ls': List directory contents
=====
```

The `ls' program lists information about files (of any type, including directories). Options and file arguments can be intermixed arbitrarily, as usual.

For non-option command-line arguments that are directories, by default `ls' lists the contents of directories, not recursively, and omitting files with names beginning with `.'. For other non-option arguments, by default `ls' lists just the file name. If no non-option argument is specified, `ls' operates on the current directory, acting as if it had been invoked with a single argument of `.'.

By default, the output is sorted alphabetically, according to the locale settings in effect.(1) If standard output is a terminal, the output is in columns (sorted vertically) and control characters are output as question marks; otherwise, the output is listed one per line

```
--zz-Info: (coreutils.info.gz)ls invocation, 58 lines --Top-----
```

Use arrows to scroll
Press Enter on a keyword to
open a page
Press “n” and “p” to change pages

Short exercise

- Which parameter can be passed to “**ls**” to sort files by size?
- How to show the contents of directory recursively
- Which command can be used to show the contents of a folder as a tree? (hint: use apropos)

How to get help: Internet



- Apart from “--help”, man and info, the best place to look for help on a command is.. Internet!

How to get help: Internet

- Apart from “--help”, man and info, the best place to look for help on a command is.. Internet!
- Tips to get better results when searching the documentation of a Unix command on Internet:
 - Add keywords such as “Unix”, “bash”, “fedora”
 - Use the “-” operator on google to remove junk results
 - If you have problem with a software or with your installation, copy and paste the error on google.

Adding keywords such as “Unix”, “bash”, “fedora”, “terminal”

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[Unix Command Summary](#)
www.math.utah.edu/.../unix/unix-commands.htm... - Traducir esta página
See the **Unix** tutorial for a leisurely, self-paced introduction on how to use the ... chmod.
This command is used to **change** the permissions of a file or **directory**.

[Quick Unix Reference](#)
sunsite.utk.edu/UNIX-help/quickref.html - Traducir esta página
Some of these commands may not be on your **Unix** Systems and some commands ...
go up two **directory** levels from here cd /full/path/name/from/root **change** ...

[Learn UNIX in 10 minutes](#)
freeengineer.org/learnUNIXin10minutes.html - Traducir esta página
Please include the word "**UNIX**" in your subject. Sections: **Directories**: Moving around
the file system: Listing **directory** contents: **Changing** file permissions and ...

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Sugerencia: [Buscar solo resultados en español](#). Puedes especificar el idioma de búsqueda en [Preferencias](#)

[Linux and UNIX rm command help](#)
www.computerhope.com/unix/urm.htm - Traducir esta página

-f, Remove all files (whether write-protected or not) in a directory without prompting ... -r, Recursively **remove directories** and subdirectories in the argument list.

[How to remove directory from \\$PATH](#)
www.linuxquestions.org/Linux-Newbie - Traducir esta página

19 Mar 2011 – I accidentally added a wrong **directory** to \$PATH. How do I **remove** it?

[rm\(1\): remove files/directories - Linux man page](#)
linux.die.net/man/1/rm - Traducir esta página



If the -I or --interactive=once option is given, and there are more than three files or the -r, -R, or --recursive are given, then rm prompts the user for ...


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The “-” operator on google

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Search  20 personal results. 133,000,000 other results (0.25 seconds)

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get.fedoraproject.org/
This is the latest version of the **Fedora** Linux operating system's Desktop Edition. It's everything you need to try out **Fedora** — you don't have to erase anything on ...



[Fedora Project Wiki - FedoraProject](#)
https://fedoraproject.org/wiki/Fedora_Project_Wiki
27 Feb 2012 – The **Fedora** Project wiki is a place for end users and developers to collaborate. Do you want to create some content? It's easy to get a **Fedora** ...

[Fedora Project - Get Fedora by Desktops, Formats or Sp...](#)
fedoraproject.org/get-fedora-options
Fedora is 100% free for you to enjoy and share. ... There are multiple desktops available for use with **Fedora**. ... The GNOME-based default **Fedora** Desktop.

[Fedora \(operating system\) - Wikipedia, the free encyclop...](#)
[en.wikipedia.org/wiki/Fedora_\(operating_system\)](http://en.wikipedia.org/wiki/Fedora_(operating_system))
Fedora formerly **Fedora** Core, is a RPM-based, general purpose collection of software, including an operating system based on the Linux kernel developed by

Troubleshooting in Linux

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[Bash: command not found!](#)

[www.linuxquestions.org > ... > Linux - General - Traducir esta página](#)
26 Oct 2005 – Hi I'm having a very weird problem. whatever command I type I keep getting "**bash: ls: command not found**". That go for all the command ...
[command not found error while executing a shell script](#) - 25 Jul 2010
[bash: g++: command not found](#) - 8 Jul 2010
[bash script variables](#) - 17 Nov 2004
[bash: <command name> command not found](#) - 14 Jul 2001
[Más resultados de linuxquestions.org »](#)

[Variables](#)

[tldp.org/LDP/Bash-Beginners.../sect_03_02.html - Traducir esta página](#)
Xdefaults XFILESEARCHPATH=/usr/X11R6/lib/X11/%L/%T/%N%C%S:/usr/X11R6/ ...
command not found franky ~> MYVAR1= "2" **bash: 2: command not found ...**

[cygwin - cywin bash script command not found when called from ...](#)

[stackoverflow.com/.../cywin-bash-script-comma... - Traducir esta página](#)
Una respuesta
Mejor respuesta: `#!/bin/bash echo "Testing" cd "/cygdrive/x/Internal Communications/Riccardo/" filename=htdocs-`date +%A`.tar.gz tar cvzf $filename ...`

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Navigating the file system from the terminal

- We will now see how to navigate folders and files from the terminal

Change directory: cd

- Let's start navigating the file system!
- The command `cd` allows you to move to another folder
- Let's enter the folder of the course:
 - `cd unix_intro`
 - `ls`

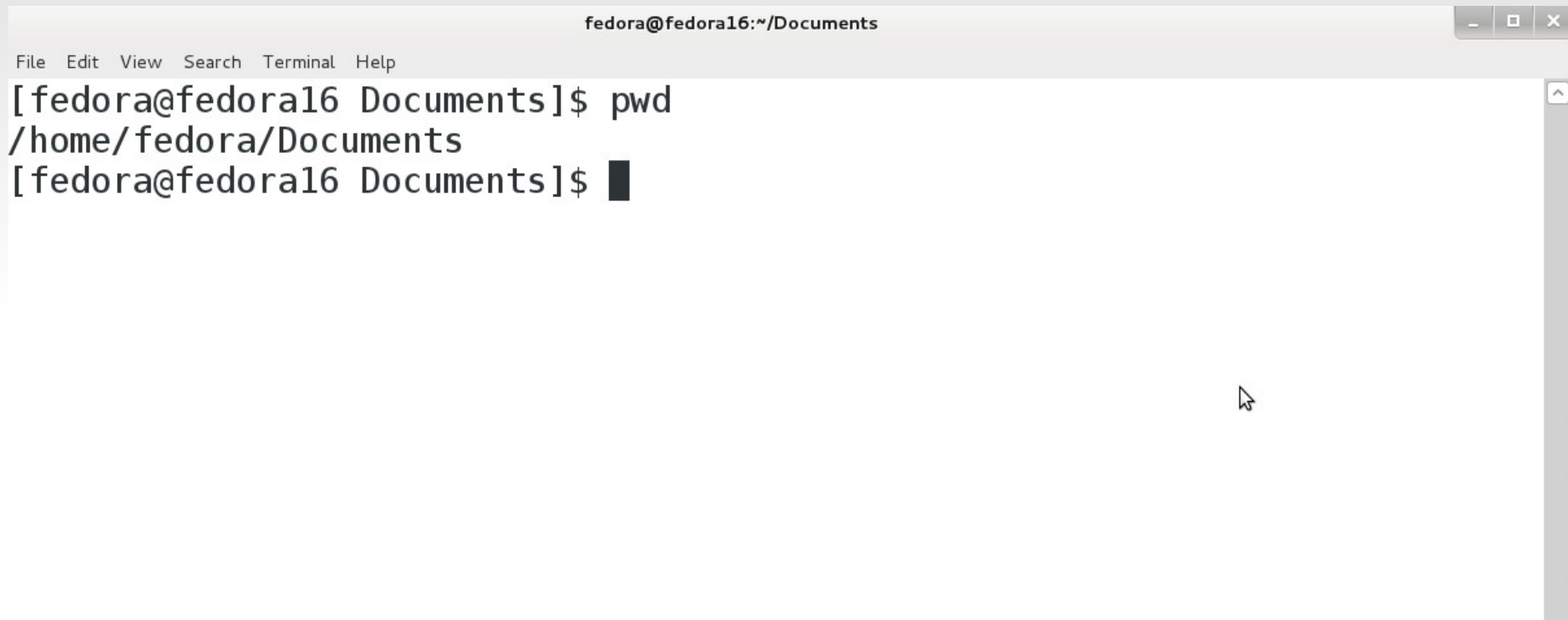
The “cd” man page

- Note: the `cd` command is documented inside the “bash” man page
 - Type `man bash` and then look for `ls`
- You can also look at:
 - `man dir` (dir is a similar command to ls)
 - `info coreutils ls`

Which folder am I?

- If you don't know which folder are you in, you can use the command `pwd`
- Also, if you run `cd` without arguments, it will return to the home folder

pwd



A terminal window titled "fedora@fedora16:~/Documents" with a menu bar containing "File", "Edit", "View", "Search", "Terminal", and "Help". The terminal shows the command "pwd" being executed, resulting in the output "/home/fedora/Documents". The prompt "[fedora@fedora16 Documents]\$ " is followed by a black cursor block.

```
fedora@fedora16:~/Documents
File Edit View Search Terminal Help
[fedora@fedora16 Documents]$ pwd
/home/fedora/Documents
[fedora@fedora16 Documents]$ █
```

If you get lost: type “cd” without arguments

- Typing `cd` without arguments will bring you to your home directory

“cd ..”

- “cd ..” lets you return to the parent folder
- Example:
 - `cd unix_intro` → goes to the `unix_intro` folder
 - `cd ..` → returns to the home folder

A tip: bash completion

- You can use the “tab” key on the keyboard to complete commands and arguments
- Example:
 - `cd Docu<tab>` will complete to `cd Documents`
- Thanks to tab completion, you can save a lot of typing

Let's look at the files in the course folder

- Type, in the following order:

`cd` (to go back to the home folder)

`cd /homes/evopserver/lectures/unix_intro` (use the tab key for autocompletion)

`ls`

`cd exercises`

`ls`

Check with your teaching assistant that you are in the correct folder.

Let's see some “fasta” files

- Go to the folder
/homes/evopserver/lectures/unix_intro/exercises/fasta
 - fasta, not fastq!
- You should see some fasta files there:
 - MGAT1.fasta, MGAT2.fasta, MGAT3.fasta, MGAT4A.fasta, MGAT5.fasta

head & tail

- The **head** and **tail** print the first or the last lines in a file
- Let's try it:
 - **head MGAT1.fasta** → the first lines of MGAT1.fasta
 - **tail MGAT3.fasta** → the last lines of the file
- **head** and **tail** are useful to inspect big text files

The symbol “*”

- The symbol * (wildcard) can be used to represent all the files in the current folder
- Try it:
 - `head *` → will show the first lines of all the files in the folder

The man page for “head”

- Exercise:
 - open the man page for **head**
 - determine which parameter is used for printing a custom number of lines

“cat” & “less”

- The **cat** command prints the content of a file to the screen
- The **less** command allows to read the content of a file, with the same interface as for the man pages

Launching gedit from the command line

- Note that you can use the command line to launch any software installed in the computer
 - `gedit` → text editor
 - `google-chrome` → web browser
 - `gnome-terminal` → other terminal

Other useful commands (1)

- `clean` → clear the terminal
- `rm` → delete files
- `mkdir` → create directory
- `more` → like `less`, good for piping

Other useful commands (2)

- `echo` → print a message
- `history` → show the history of the commands typed
- `dos2unix` → clean files edited in MS Windows notepad for unix

Resume of the session:

- `man` and `info` → documentation
- `cd`, `ls`, `pwd` → navigate folders
- `head`, `less` → show contents of files

Time for lunch!

See you here at 14:30!