

Outline

- Introduction - history
- Command line basics – getting help
- File system
- Working with files and directories
 - More file handling
- The shell revisited
- Monitoring resources

Finding files and more



More on files

- Search for files and directories
 - The **find** command performs a raw search on a file system to locate the specified items.
 - `$ find location -name some-name`
`($ find / -name matrix.c)`
 - You can also specify more than one location to search,
- Search the locate database for files and directories
 - The **locate** command displays the location of files that match the specified name.
 - Faster than **find** but lacks the ability to search for advanced characteristics such as file owner, size, and modification time.



More on files

- Display extended information about a file system, file, or directory
- What does a file contain?
 - Determine a file's type: **file**
 - will print a brief description of the file's contents
 - `$ file filename`
- The **stat** command displays extended information about files. It includes helpful information not available when using the **ls** command



Comparing files and directories

- `$ diff file1 file2`
Reports the differences between 2 files, or nothing if the files are identical.
- `$ diff -r dir1/ dir2/`
Reports all the differences between files with the same name in the 2 directories.
- These differences can be saved in a file using the redirection, and then later re-applied.
- <https://linuxacademy.com/blog/linux/introduction-using-diff-and-patch/>

Archiving



File Archiving: tar

- File and Directory Compression
- Files or directories can be stored as a "tarball" (.tar file) as well as compressed further using other programs.
- Saves and restores multiple files to/from a single file. Directories are added recursively.
- Format:
 - `$ tar [options] [options_values] [files]`
 - `c` – create a new archive
 - `v` – verbosely list files which are processed.
 - `f` – following is the archive file name
 - `z` – filter the archive through gzip (compress)
 - `x` – extract files from archive
 - `C` - specified directory
 - `j` - filter the archive through bzip (compress)



File Archiving: tar

- Examples:
 - `$ tar -cvf [FILE] [ITEMS]` Backup the specified item(s)
`$ tar -cvf /tmp/backup.tar ~/data ~/test`
 - `$ tar -czvf [FILE] [ITEMS]` Compress the archive to save space
 - `$ tar -xvf [FILE] [ITEMS]` Restore the specified item(s) **`$tar -xvf backup.tar`**
 - `$ tar -tf [FILE]` List all files in the specified archive
e.g. `$ tar -tf backup.tar`
- <http://www.thegeekstuff.com/2010/04/unix-tar-command-examples/>



File Compression: gzip

- **Compressing files:** `gzip filename` or `bzip2 filename`

- `$ gzip backup.tar`
- `$ bzip2 backup.tar`

The resulted file is `backup.tar.gz/ backup.tar.bz2`

- **Uncompressing files:** `gzip -d filename.gz` or `bzip2 -d filename.bz2`

- `$ gzip -d backup.tar.gz`
- `$ bzip2 -d backup.tar.bz2`

The uncompressed file is `backup.tar`

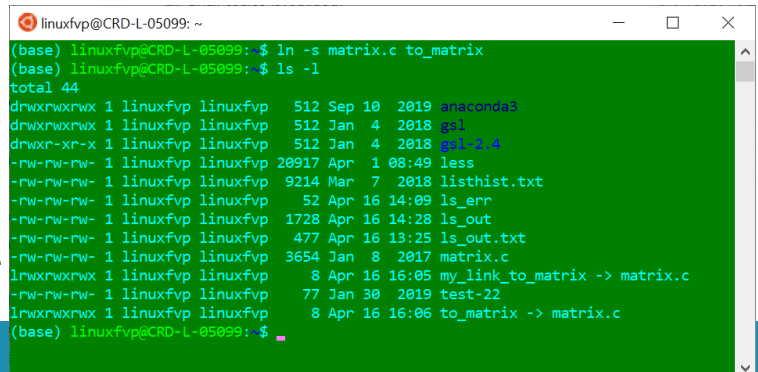
Links

Create links

- **Soft link:** similar to a shortcut in Windows. It is an indirect pointer to a file or directory; can point to a file or a directory on a different filesystem or partition.
- Symbolic links are created when using the `-s` option with the `ln` command.

```
ln -s [OPTIONS] FILE LINK
```

- Check with `ls -l`
- The first character “l”, indicates that the file is a symlink.
- The “->” symbol shows the file the symlink points to.



```
linuxfvp@CRD-L-05099: ~  
(base) linuxfvp@CRD-L-05099:~$ ln -s matrix.c to_matrix  
(base) linuxfvp@CRD-L-05099:~$ ls -l  
total 44  
drwxrwxrwx 1 linuxfvp linuxfvp 512 Sep 10 2019 anaconda3  
drwxrwxrwx 1 linuxfvp linuxfvp 512 Jan 4 2018 gsl  
drwxr-xr-x 1 linuxfvp linuxfvp 512 Jan 4 2018 gsl-2.4  
-rw-rw-rw- 1 linuxfvp linuxfvp 20917 Apr 1 08:49 less  
-rw-rw-rw- 1 linuxfvp linuxfvp 9214 Mar 7 2018 listhist.txt  
-rw-rw-rw- 1 linuxfvp linuxfvp 52 Apr 16 14:09 ls_err  
-rw-rw-rw- 1 linuxfvp linuxfvp 1728 Apr 16 14:28 ls_out  
-rw-rw-rw- 1 linuxfvp linuxfvp 477 Apr 16 13:25 ls_out.txt  
-rw-rw-rw- 1 linuxfvp linuxfvp 3654 Jan 8 2017 matrix.c  
lrwxrwxrwx 1 linuxfvp linuxfvp 8 Apr 16 16:05 my_link_to_matrix -> matrix.c  
-rw-rw-rw- 1 linuxfvp linuxfvp 77 Jan 30 2019 test-22  
lrwxrwxrwx 1 linuxfvp linuxfvp 8 Apr 16 16:06 to_matrix -> matrix.c  
(base) linuxfvp@CRD-L-05099:~$
```

Create links

- Editing a symbolic link file is the same as editing the source file
- Deleting the symbolic link does not delete the source file.
- Deleting the source file leaves a dangling link
- `$ ln -s file_v5.doc file_final.doc`
creates a symbolic link called `file_final.doc` that points to `file_v5.doc`
- `$ ln -s /home/demo/dir1/dir2/dir3 /home/demo/jump2dir`
creates a symbolic link called `jump2dir` that points to a deep directory (allows for quicker access)

File permissions

File access rights



Linux File Access permissions

- Linux is a multiuser system, the files of all users are stored in a single file structure
- Mechanism is required to restrict one user to access the files of another user
- User can impose access permission to each file to restrict its access



File access rights

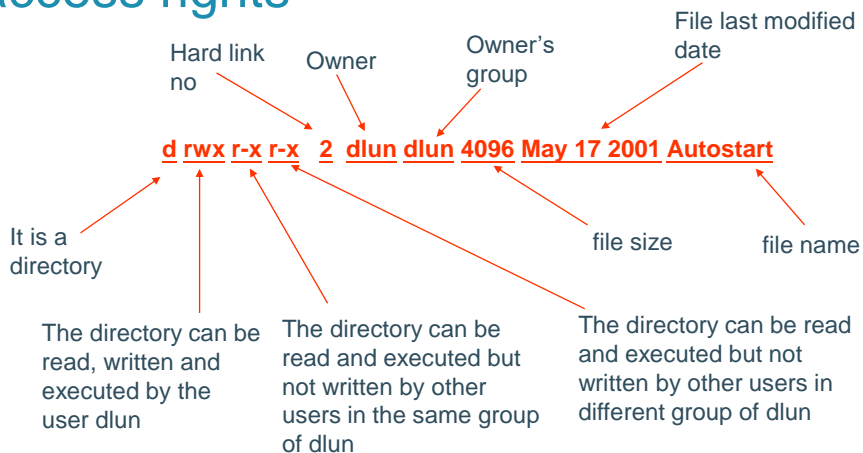
3 types of **access rights**

- Read access (r)
 - reading, opening, viewing, and copying the file is allowed
- Write access (w)
 - writing, changing, deleting, and saving the file is allowed
- Execute rights (x)
 - executing and invoking the file is allowed. This is required for directories to allow searching and access.

Use `ls -l` to check file access rights



File access rights



The group of a user is assigned by the administrator when a user is added to the system



File access rights

- Access permission can also be assigned to a directory
- Directory is also a file that contains the attributes of the files inside it
- If read permission is not given to a directory
 - cannot show the structure of this directory
 - e.g. cannot use ls
- If write permission is not given to a directory
 - cannot modify anything of the directory structure
 - e.g. cannot copy a file into this directory since it will modify the directory structure by adding one more file
- If execute permission is not given to a directory
 - nearly nothing can be done with this directory, even cd



Access rights examples

- -rw-r--r--
Readable and writable for file owner, only readable for others
- -rw-r-----
Readable and writable for file owner, only readable for users belonging to the file group.
- drwx-----
Directory only accessible by its owner
- -----r-x
File executable by others but neither by your group nor by yourself.



Access rights examples

```
dlun@enpklun.polyu.edu.hk: /home/dlun/Desktop/test/temp
File Edit Settings Help temp does not have execution right

[dlun@enpklun test]$ ls -l
total 12
-rw-r--r-- 1 dlun dlun 395 Jan 7 16:36 floppy.kdeInk
drw----- 2 dlun dlun 4096 Jan 9 11:06 temp
-rw-rw-r-- 1 dlun dlun 16 Jan 7 16:05 test1.txt
[dlun@enpklun test]$
[dlun@enpklun test]$ cd temp
bash: cd: temp: Permission denied
[dlun@enpklun test]$
[dlun@enpklun test]$
[dlun@enpklun test]$ chmod 700 temp
[dlun@enpklun test]$
[dlun@enpklun test]$ ls -l
total 12
-rw-r--r-- 1 dlun dlun 395 Jan 7 16:36 floppy.kdeInk
drwx----- 2 dlun dlun 4096 Jan 9 11:06 temp
-rw-rw-r-- 1 dlun dlun 16 Jan 7 16:05 test1.txt
[dlun@enpklun test]$ cd temp
[dlun@enpklun temp]$
```

Annotations:

- temp does not have execution right
- even cd is not workable
- execution right is added
- now we can change the directory to temp



chmod: changing permissions

- Permissions allow you to share files or directories or to lock them down to be private.
 - \$ chmod (change mode)
 - \$ chmod <permissions> <files>
- 2 formats for permissions:
- octal format (3 digit octal form)
 - symbolic format



chmod: changing permissions

- octal format (abc):

a,b,c = r*4+w*2+x*1 (r, w, x: booleans)

- | | |
|------------------------------|-----|
| • 0 none | --- |
| • 1 execute-only | --x |
| • 2 write | -w- |
| • 3 execute and write | -wx |
| • 4 read-only | r-- |
| • 5 read and execute | r-x |
| • 6 read and write | rw- |
| • 7 read, write, and execute | rwX |

- `$ chmod 644 <file>`
(rw for u, r for g and o)

660 : 110 110 000

⇒ rw- rw- ---

545 : 101 100 101

⇒ r-x r-- r-x



chmod: changing permissions

- symbolic format:

`$ chmod go+r:` add read permissions to group and others.

`$ chmod u-w:` remove write permissions from user.

`$ chmod a-x:` (a: all) remove execute permission from all.