Introduction to Linux

What is Linux

- Linux is a kernel
- Core of an OS

Linux Distribution

- Linux Distro. - complete linux package
- Main two is Debian and Redhat

Linux Architecture

- Kernel - core of the OS
- Daemons - programs in the background
- Shells - interface
- GDE - graphical desktop environment for the user
- Linux File system
  - Hierarchical Treelike struct.
  - Highest point if the root (/)

Software Licensing Agreement

- Open Source - for free to use
- Closed Source - not distributed code
  - Freeware - free but no open source
  - Shareware - free on a trial
- Free software - can be free of charge or obtained by a fee and distributed with the source code.

Ubuntu

- Ubuntu is a Linux distro that is free distro

Debian

- Debian is all-volunteer org. for free software.

GNU/Linux

- Linux is modelled on the Unix OS
- Free/Open Source made by the people

Installing Ubuntu/Virtualization/Raspberry Pi

Virtualization

- Two Types
    - Server-side
        - Thick client or Fat client
        - Thin client
        - Zero Client
        - Runs on hardware
    - Client-side
        - Manage virtual machine
        - Runs on Host OS
            - VirtualBox,etc

VirtualBox

- Powerful type 2 virtualization product
- Open Source

VMWare Workstation Player

- Free also but less features

Min/Req Requirements

- AMD 5 or Intel 5 processor
- Dual Core 1.3GHz or faster
- 4GB RAM
- Enough Storage for task

VirtualBox Extension Pack

- Base Package - all open source components
- Extension Package - Extends funct. of VM base package.

VirtualBox Settings

Drag n Drop - Bidirectional Shared Clipboard - bidirectional Enable Disk Encryption

Creating Virtual OS

Name: Indicate OS and Purpose Machine Folder: Location of host machine Type: Linux Version: Ubuntu 64-bit Memory Size: 2048mb VDI Type 50gb Recommended Optical then Hard Disk Boot Order 2 CPU cores 100% Execution Cap. 128mb of Video Memory Enable 3d Acceleration Add Optical Drive Ubuntu iso in controller IDE

What is Raspberry Pi

- Low Cost computer
- Need Pi, Power Supply, Memory, Input, and Display.
- Raspberry Pi Imager used to install OS.# Desktop Environments
- GUI - Graphical User Interface

- DE - Desktop Environment
- Most common are GNOME and KDE
- Contents
    - Display Manager
    - File Manager
    - Icons (Programs)
    - Launcher
    - Menus
    - System Tray
    - Widgets
    - Window Manager

Gnome

- Default for Ubuntu and other distros.
- GNU Network Object Model Environment
- Free Software project to develop a desktop environment and applications for it.

KDE

- Kool Desktop environment

The Bash Shell

- Unix shell and command language software.
- CLI - command-line interface
    - Terminal Emulator
    - Linux Console

Managing Software

- Package - archives that contain software.

Debian Package Management System

- DPMS to manage software on all Debian distros.
- .deb extension
- dpkg (Debian package) applications

Advanted Package Tool

- APT - tool for managing debian packages
- sudo - requires privileges as root user
- install - install specified package
- remove - remove specified package
- ex. sudo apt install firefox flameshot caffeine -y
- ex. sudo apt purge firefox+ flameshot- caffeine- vlc+
- Search programs

  - apt search "web"
  - --help for more

Installing .deb files

- Get the file

  - sudo dkpg -i google-chrome-stable.deb

- gdebi - simple tool to install deb files

  - sudo gdebi google-chrome-stable.deb

Snaps and Flatpak

- Snaps - packages of apps

  - Snap Store - app store

- Flatpak - nextgen packaging software for linux.

Linux Directory Structure

- Branch based

Pwd Command

- Display current working directory
  - pwd

Cd Command

- Change current working directory
  - cd + destination
    - Home Directory
      - cd
      - cd ~
      - cd $HOME
  - Previous Directory
    - cd -
  - Go Back 1 Directory
    - cd ../

Ls command

- List content in a directory
- man ls for options
- ls
  - List hidden too
    - ls -a

- List files inside a directory
  - ls -a ~/Pictures
- Long List recursively
  - ls -lR ~/Pictures

Absolute vs Relative Path

- Absolute starts are root
  - /home/user/Downloads/song.mp3
- Relative starts anywhere relative to working directory
  - pwd is /home/user
    - /Downloads/song.mp3

Managing Files and Directories

- command -option argument
  - ls -l ~/Downloads

Mkdir

- Create single or multiple directories
- mkdir wallpapers
  - With space
    - mkdir wallpapers/new\ cars
    - mkdir wallpapers/'cities usa'
  - Multiple
    - mkdir wallpapers/{new,old}
  - Create parent same time
    - mkdir -p wallpapers_others/movies

Touch

- Create files
  - touch list
  - touch ~/Downloads/games.txt

Rm

- Remove Files
  - rm
    - Remove Directory
      - rm -r
    - Empty Directories
      - rmdir command
    - Non-empty directories
      - rm -r + directory

Mv

- Move or rename directories/files
  - mv + source + destination
  - Can rename
    - mv + file/directory to rename + new name
  - Move Multiple directories/files
    - mv games/ wallpapers/ rockmusic/

Cp

- Copies files/directories
  - cp + files to copy + destination
  - Copy directories
    - cp -r

Inodes

- Data structure that contains info about file except file name and its contents.
- stat script.sh

Hard Links

- Point to data on hard drive
- Create hard link
  - ln file ~/Downloads/fileHL

Soft Links

- Point to other files instead of data in the hard drive.
- Modify soft link, target file is modified too.
- ln -s file fileSL

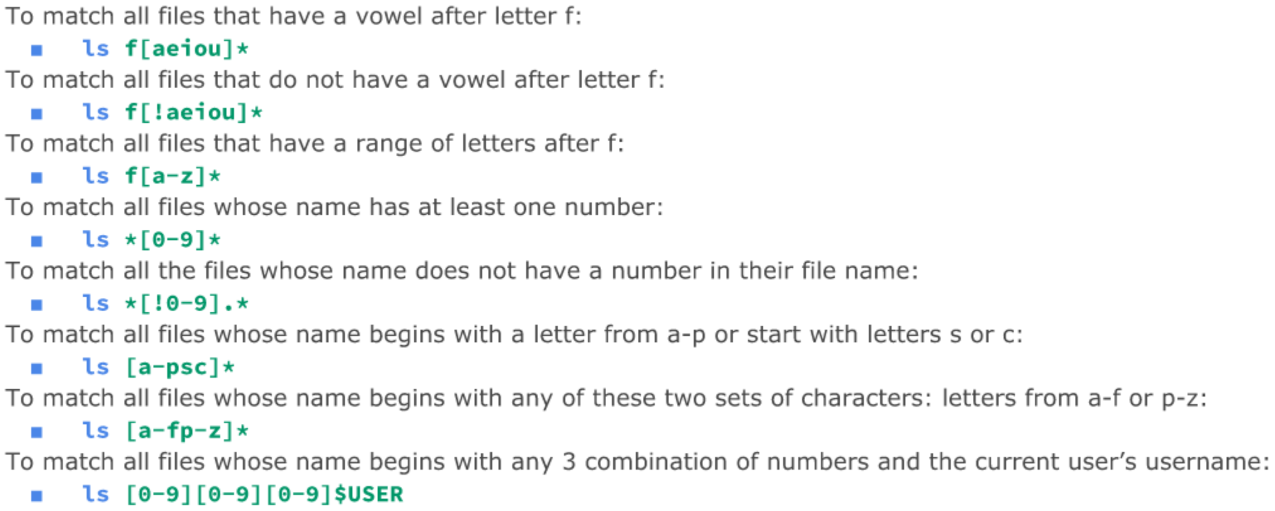
Help Command

- man ls
- q to exit

Wildcard

- "*" match anything in place of it.

- ? precisely one character



To match all files that have a vowel after letter f:

- `ls f[aeiou]*`

To match all files that do not have a vowel after letter f:

- `ls f[!aeiou]*`

To match all files that have a range of letters after f:

- `ls f[a-z]*`

To match all files whose name has at least one number:

- `ls *[0-9]*`

To match all the files whose name does not have a number in their file name:

- `ls *[!0-9].*`

To match all files whose name begins with a letter from a-p or start with letters s or c:

- `ls [a-psc]*`

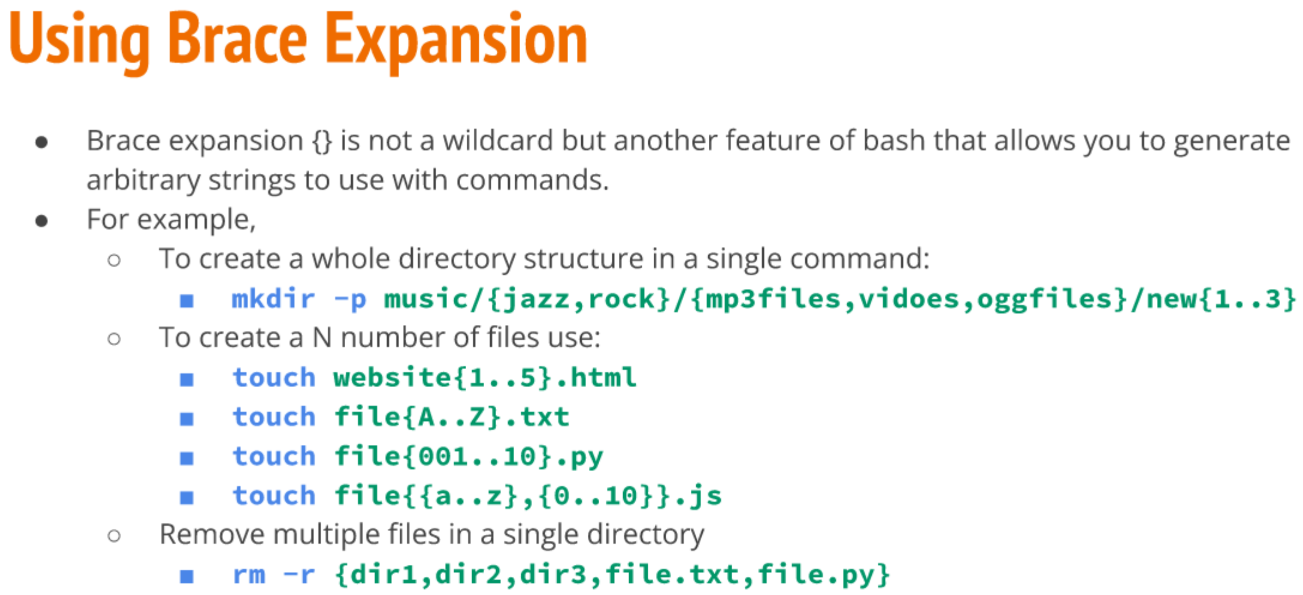
To match all files whose name begins with any of these two sets of characters: letters from a-f or p-z:

- `ls [a-fp-z]*`

To match all files whose name begins with any 3 combination of numbers and the current user's username:

- `ls [0-9][0-9][0-9]$USER`

Brace Expansion



Using Brace Expansion

- Brace expansion {} is not a wildcard but another feature of bash that allows you to generate arbitrary strings to use with commands.
- For example,
  - To create a whole directory structure in a single command:
    - `mkdir -p music/{jazz,rock}/{mp3files,vidoes,oggfiles}/new{1..3}`
  - To create a N number of files use:
    - `touch website{1..5}.html`
    - `touch file{A..Z}.txt`
    - `touch file{001..10}.py`
    - `touch file{{a..z},{0..10}}.js`
  - Remove multiple files in a single directory
    - `rm -r {dir1,dir2,dir3,file.txt,file.py}`

Handling Text

Cat

- Concatenate file
- cat + file + file2
  - Add Numbers
    - cat -n

Tac

- Cat but reverse

More

- Pager program for displaying one page at a time. Loads all pages

- more + file
- 10 lines at a time
  - more -10 /var/log/syslog

Less

- Pager pogram to display one at a time.

Head

- Displays top N number of lines of file.
- head + option + file
- head -5 /etc/passwd

Tail

- Same as Head but the tail.
- tail -5 /etc/passwd

Cut

- cut specific section of each line of a file
- cut + option + file
- First field of each line using tab as field separator.
  - cut -f1 hostnames.txt
- : as field separator
  - cut -d: -f1 /etc/passwd

Paste

- Merge to join files horizontally in columns
- paste users.txt ips.txt

Sort

- Sorts file
  - Reverse
    - sort -r
  - Column Number
    - sort -k 2 users.txt*
  - Remove duplicate
    - sort -u users.txt

Wc

- Print the number of lines,characters,bytes of a file
- wc + option + file
- Bytes
  - wc -c users.txt

- Lines
  - wc -l users.txt

Tr

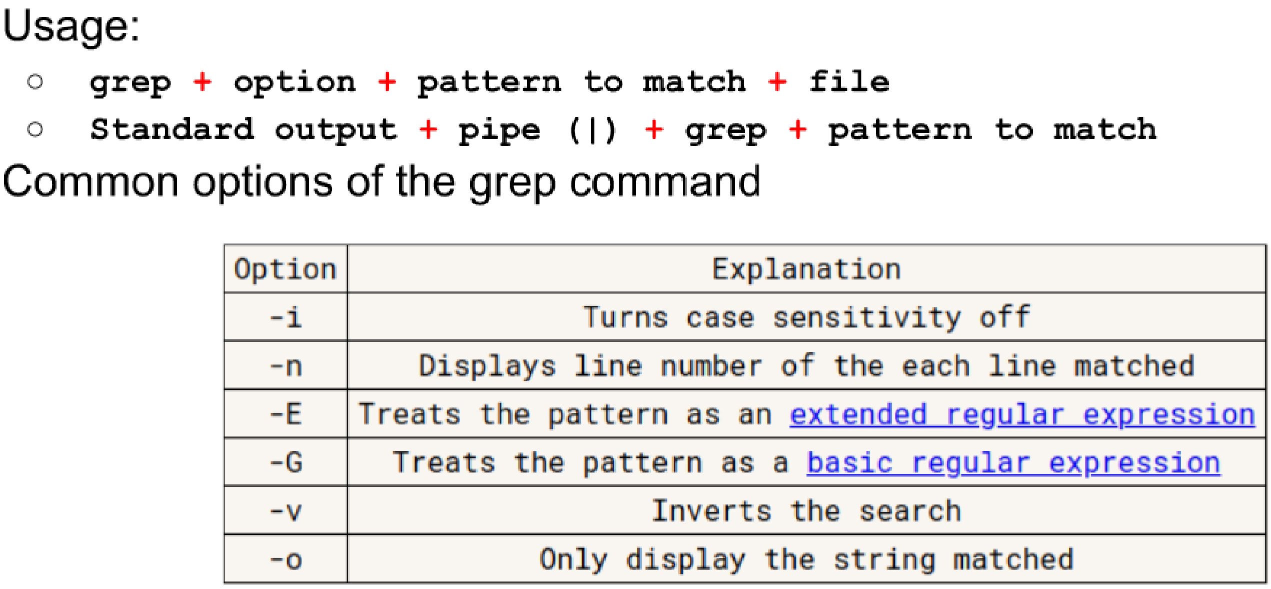
- Translate character to another
- Output | tr + option + set +set

Diff

- Display difference between files
- diff + option + file1 + file2

Grep

- Match string pattern from a file or standard output when using the pipe.



Usage:

- **grep + option + pattern to match + file**
- **Standard output + pipe (|) + grep + pattern to match**

Common options of the grep command

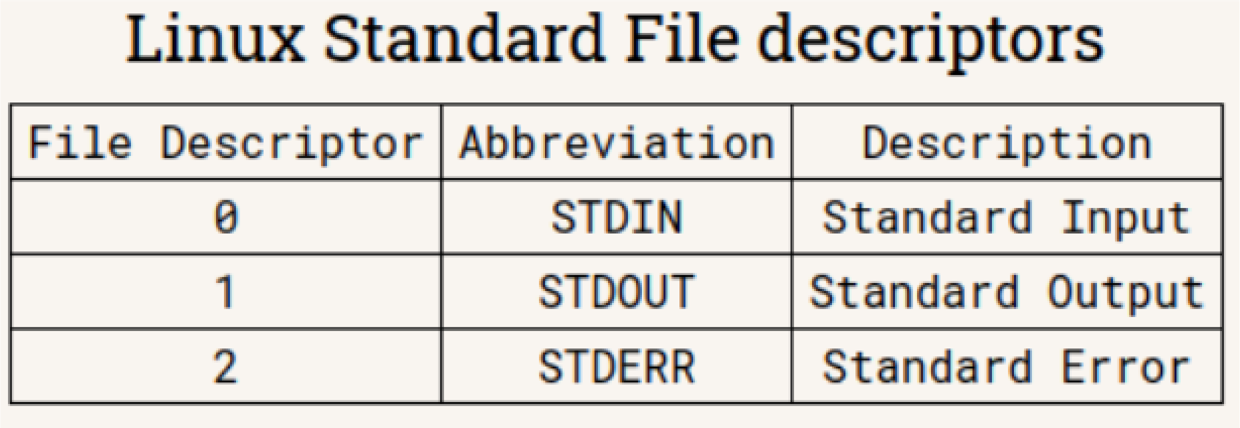
Option	Explanation
-i	Turns case sensitivity off
-n	Displays line number of the each line matched
-E	Treats the pattern as an extended regular expression
-G	Treats the pattern as a basic regular expression
-v	Inverts the search
-o	Only display the string matched

Rev

- Reversing characters position in a given text.
- rev + file

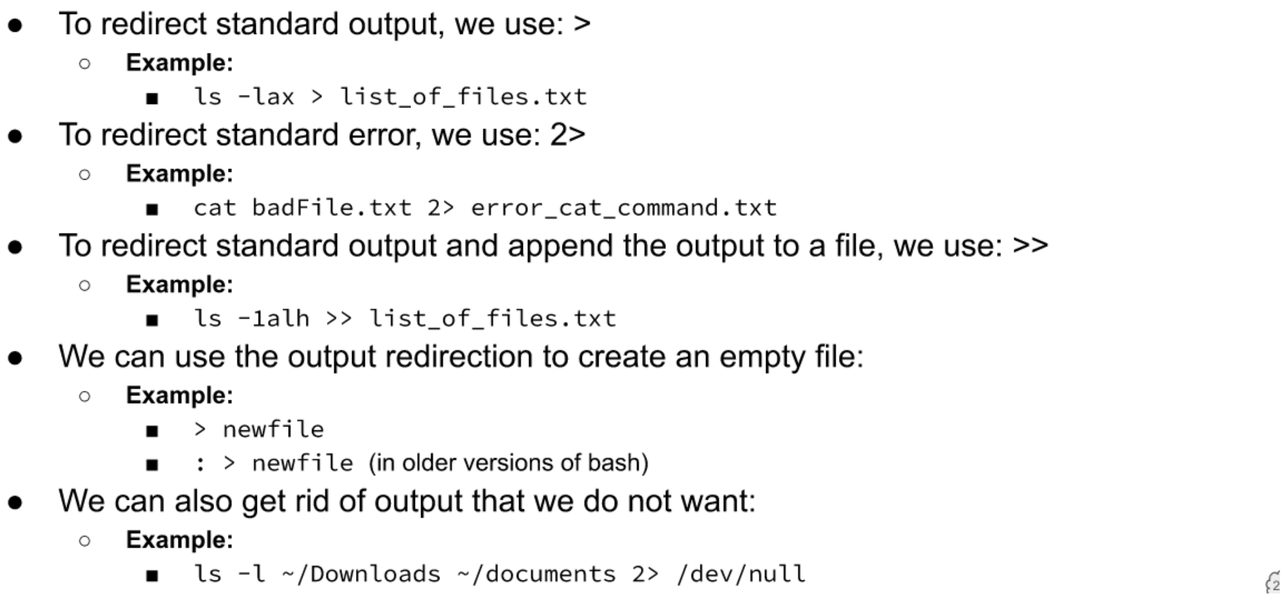
I/O Redirection

- File descriptor - positive integers used for identifying open files in a given session



Linux Standard File descriptors

File Descriptor	Abbreviation	Description
0	STDIN	Standard Input
1	STDOUT	Standard Output
2	STDERR	Standard Error



- To redirect standard output, we use: >
  - **Example:**
    - `ls -lax > list_of_files.txt`
- To redirect standard error, we use: 2>
  - **Example:**
    - `cat badFile.txt 2> error_cat_command.txt`
- To redirect standard output and append the output to a file, we use: >>
  - **Example:**
    - `ls -1alh >> list_of_files.txt`
- We can use the output redirection to create an empty file:
  - **Example:**
    - `> newfile`
    - `: > newfile` (in older versions of bash)
- We can also get rid of output that we do not want:
  - **Example:**
    - `ls -l ~/Downloads ~/documents 2> /dev/null`

Pipe

- Used to redirect output to another command
- command 1 | command 2

Alias

- Create short command for a long command
- alias name_of_alias="command here"
- ex. alias="git add ."

Vim

- Command-Line text editor
- sudo apt install vim
- To quit, type:
  - :qa!
  - : - prefix for entering command line mode
  - q - quit

  - a - short for all buffers
  - ! - force
  - set number : set line numbers
- Insert Mode: writing text
- Normal mode: manipulate text
- Command mode: vim commands
- Visual mode: navigation/manipulation of text selections
- Select mode: similar to visual mode
- Ex-mode: command line mode but for batch processing

Insert Text:

- Create file

  - vim notes.txt

- Use arrow keys to move

- Enter for next line

- Backspace for delete

- Ex.

  - Start Vim
    - vim
  - Enter insert mode
    - Press letter i
    - Type Text Here
  - Enter normal mode
    - Press esc key
  - Quit vim
    - Type :q!

- Saving

  - :w will save the file
  - :w new.txt will save file as new.txt
  - :wq will save the file and quit
  - :wqa! will save the file and close all files open in the buffer.

- Editing

  - :E new.txt will open new.txt and allow you to edit

- Ctrl + g will show the file you are currently editing in the status line.

- Navigating in normal mode

  - H = left
  - J = down

  - K = up
  - L = right

- Search words in vim

  - /hello to search forward for word
  - ?hello to search backward for word
  -
    - will search for the next occurrence under the cursor
  - "#" will search backward for the previous occurence of the worder under the cursor.

- Delete, copy, paste

- dw = delete current word

- u = undo

- yy = copies a whole line

- x = for cut

- yp = copy the current word

- p = paste after cursor

- P = paste before the cursor

Managing Data

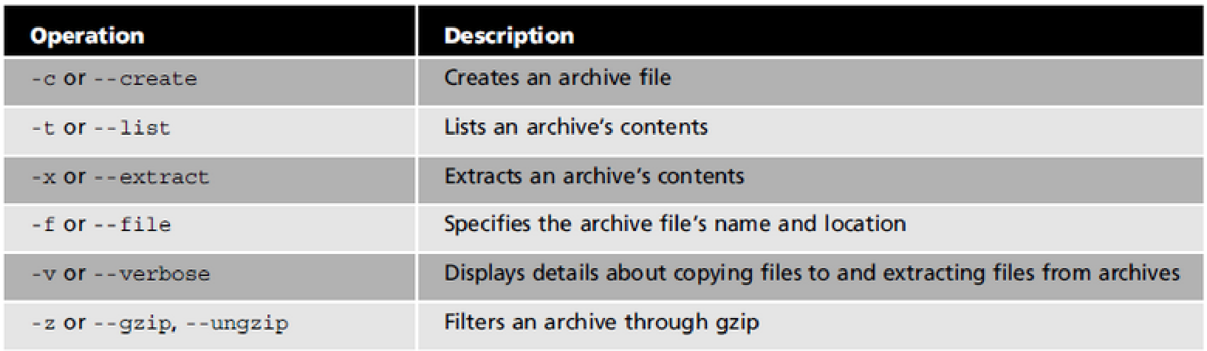
- Backup : copies files and directories to an archive.
- System backup : restore data in case of system failure
- Archive : file containing many files
- Important directories
  - /etc
  - /home
  - /opt
  - /root
  - /var

Archive Utilies

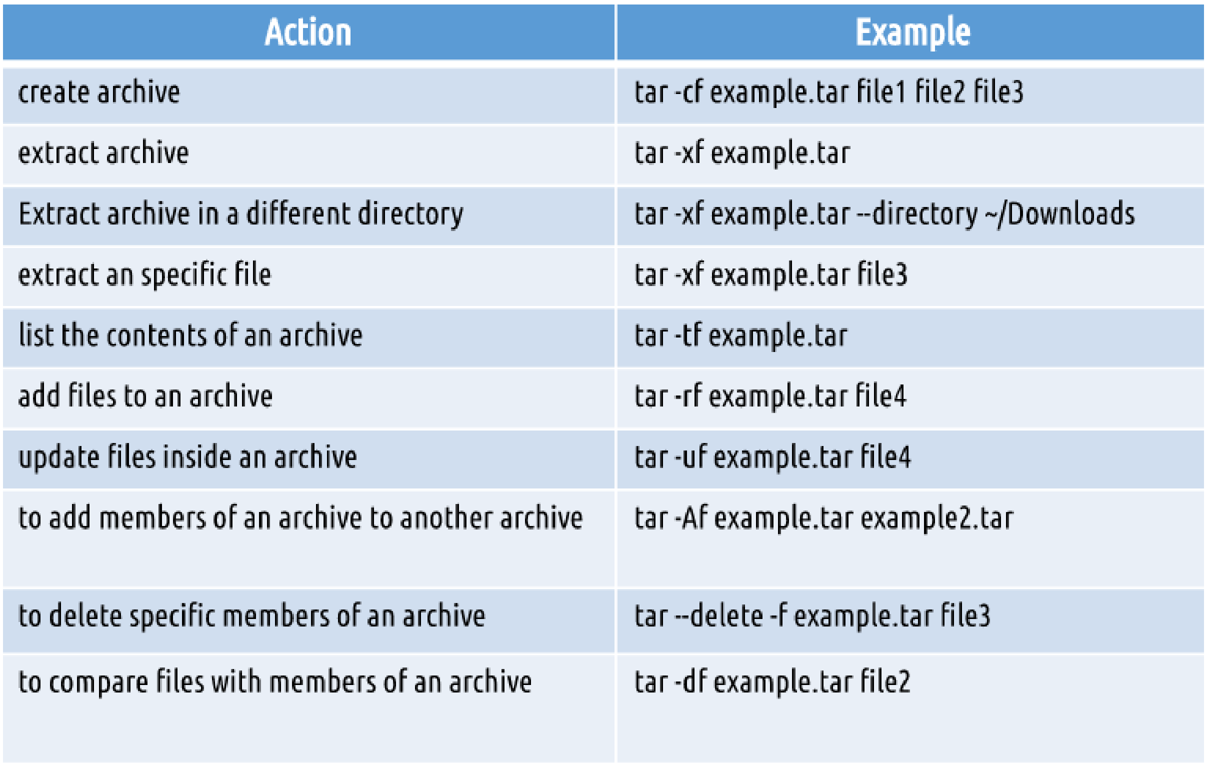
Tar

- Create archive
  - tar + option + archive name + files
- Extract archive

  - tar + options + file to extract



Operation	Description
-c or --create	Creates an archive file
-t or --list	Lists an archive's contents
-x or --extract	Extracts an archive's contents
-f or --file	Specifies the archive file's name and location
-v or --verbose	Displays details about copying files to and extracting files from archives
-z or --gzip, --ungzip	Filters an archive through gzip



Action	Example
create archive	tar -cf example.tar file1 file2 file3
extract archive	tar -xf example.tar
Extract archive in a different directory	tar -xf example.tar --directory ~/Downloads
extract an specific file	tar -xf example.tar file3
list the contents of an archive	tar -tf example.tar
add files to an archive	tar -rf example.tar file4
update files inside an archive	tar -uf example.tar file4
to add members of an archive to another archive	tar -Af example.tar example2.tar
to delete specific members of an archive	tar --delete -f example.tar file3
to compare files with members of an archive	tar -df example.tar file2

- -f is always required
- -v to display details, recommended

CPIO

- Create archive
  - ls | cpio -ov > archive.cpio
- Extract archive
  - cpio -iv < archive.cpio
- Archive specific files
  - find . -iname *.sh | cpio -ov > scriptsArchive.cpio
- Create tar archive with cpio
  - ls | cpio - ov -H tar -F sample.tar

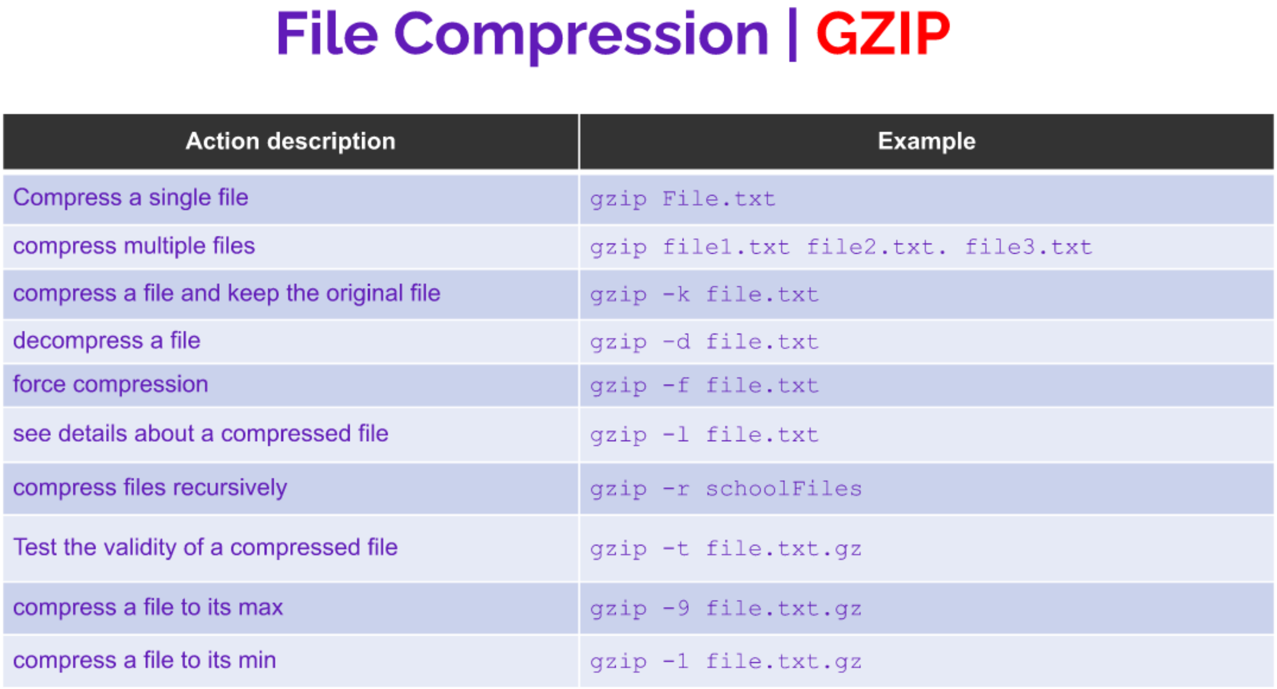
AR

- Create archive
  - ar r test.a *.txt
- List content of archive
  - ar t test.a
- Add new member

  - ar r test.a test3.txt
- Delete member
  - ar d test.a test3.txt

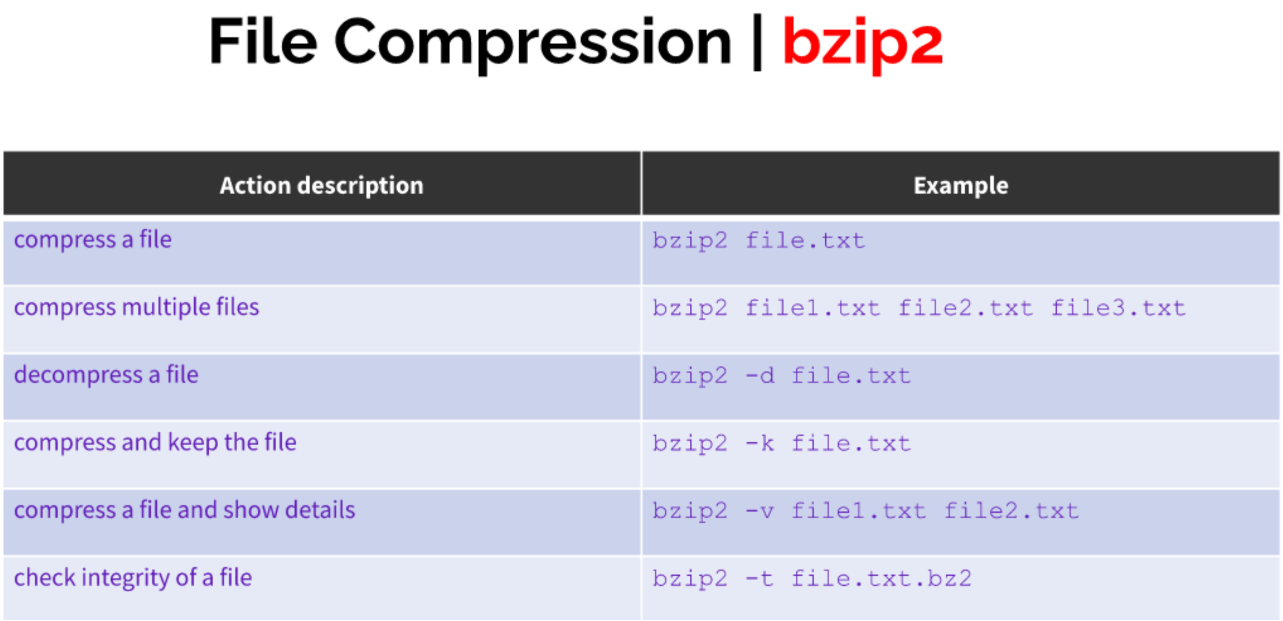
File Compression

- Gzip, bzip2 and xz commands are for compression



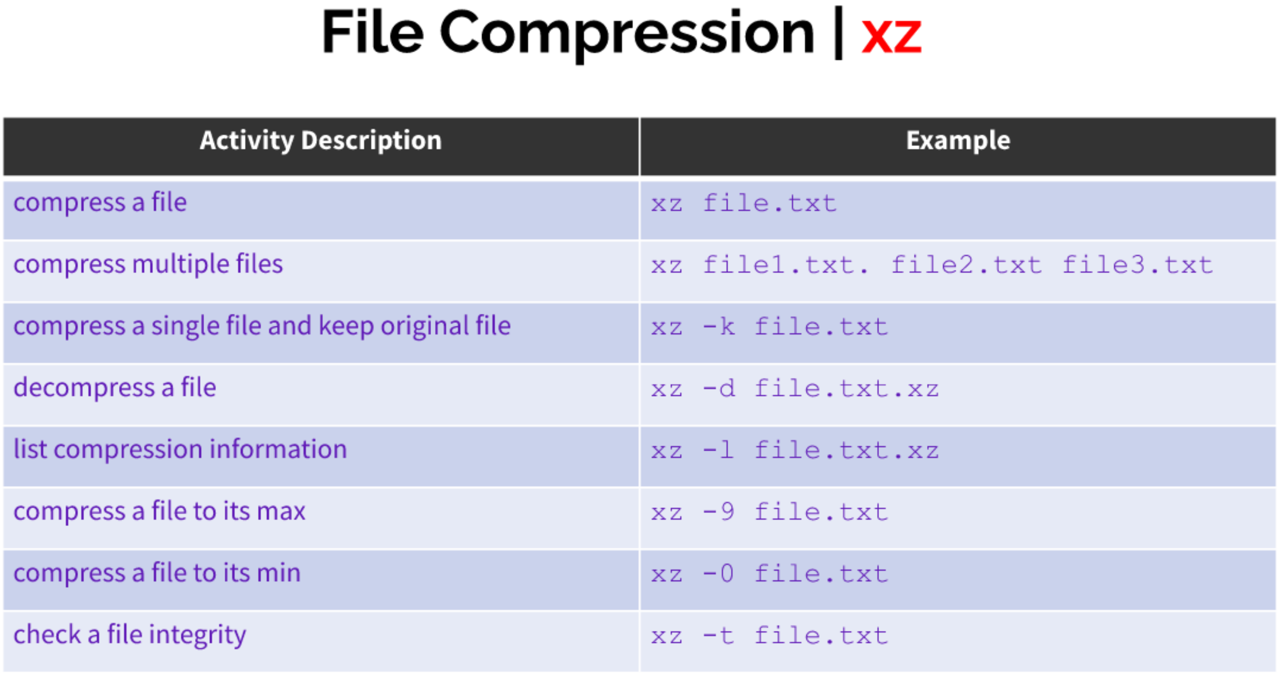
File Compression | GZIP

Action description	Example
Compress a single file	`gzip File.txt`
compress multiple files	`gzip file1.txt file2.txt. file3.txt`
compress a file and keep the original file	`gzip -k file.txt`
decompress a file	`gzip -d file.txt`
force compression	`gzip -f file.txt`
see details about a compressed file	`gzip -l file.txt`
compress files recursively	`gzip -r schoolFiles`
Test the validity of a compressed file	`gzip -t file.txt.gz`
compress a file to its max	`gzip -9 file.txt.gz`
compress a file to its min	`gzip -1 file.txt.gz`



File Compression | bzip2

Action description	Example
compress a file	`bzip2 file.txt`
compress multiple files	`bzip2 file1.txt file2.txt file3.txt`
decompress a file	`bzip2 -d file.txt`
compress and keep the file	`bzip2 -k file.txt`
compress a file and show details	`bzip2 -v file1.txt file2.txt`
check integrity of a file	`bzip2 -t file.txt.bz2`

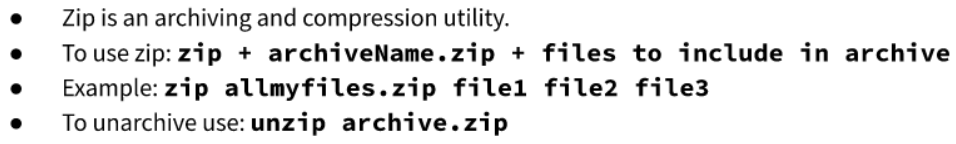


File Compression | xz

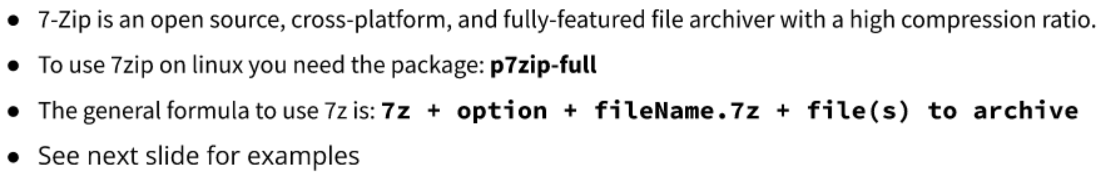
Activity Description	Example
compress a file	`xz file.txt`
compress multiple files	`xz file1.txt. file2.txt file3.txt`
compress a single file and keep original file	`xz -k file.txt`
decompress a file	`xz -d file.txt.xz`
list compression information	`xz -l file.txt.xz`
compress a file to its max	`xz -9 file.txt`
compress a file to its min	`xz -0 file.txt`
check a file integrity	`xz -t file.txt`

- gunzip = gzip -d
- bunzip = bzip2 -d
- unxz = xz -d
- To decompress in different directory
    - Utility -options < path of compressed file > file with the same new without extension
        - gzip -dkc < ~/compresssed.iso.gzip > ~/Downloads/compressed.iso

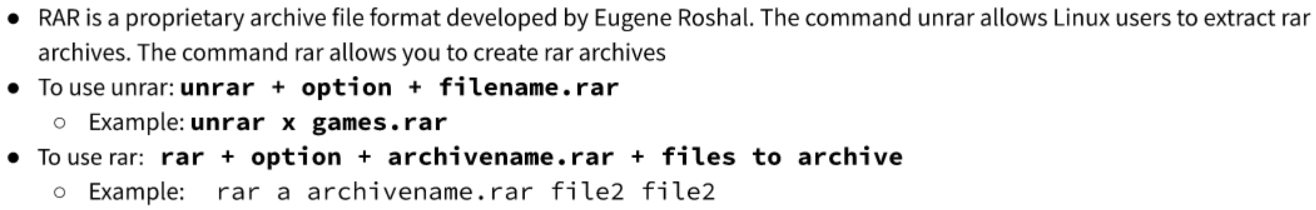
File Compression | zip, 7zip, and rar



- Zip is an archiving and compression utility.
- To use zip: **`zip + archiveName.zip + files to include in archive`**
- Example: **`zip allmyfiles.zip file1 file2 file3`**
- To unarchive use: **`unzip archive.zip`**

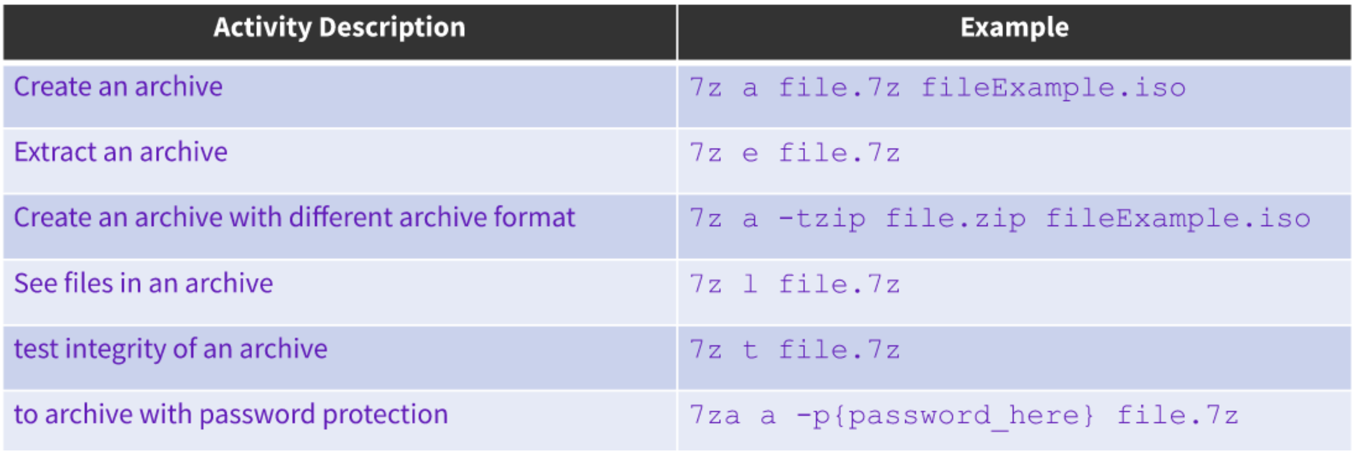


- 7-Zip is an open source, cross-platform, and fully-featured file archiver with a high compression ratio.
- To use 7zip on linux you need the package: **p7zip-full**
- The general formula to use 7z is: **`7z + option + fileName.7z + file(s) to archive`**
- See next slide for examples



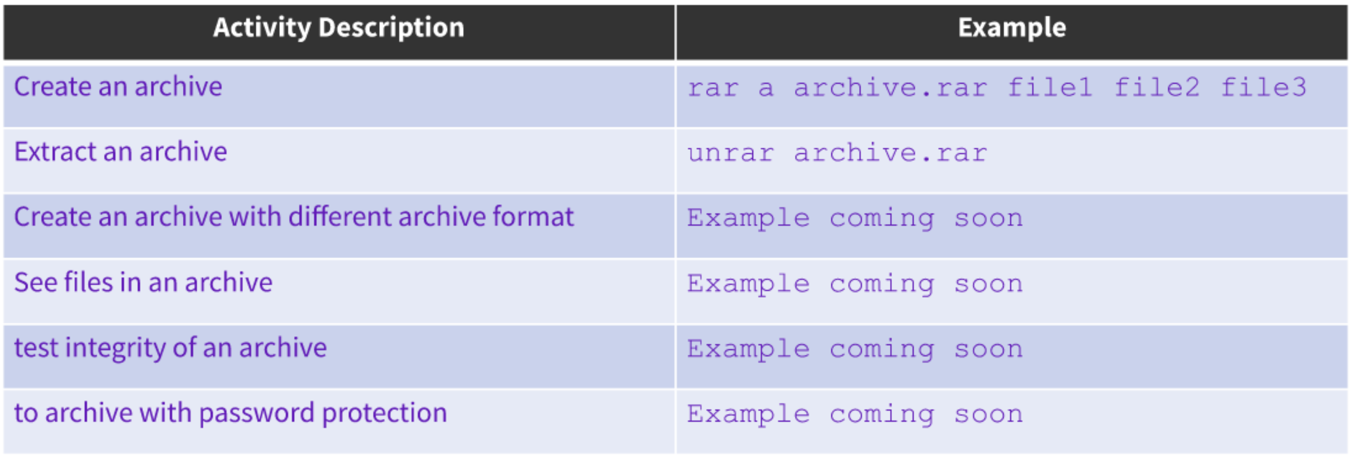
- RAR is a proprietary archive file format developed by Eugene Roshal. The command unrar allows Linux users to extract rar archives. The command rar allows you to create rar archives
- To use unrar: **`unrar + option + filename.rar`**
  - Example: **`unrar x games.rar`**
- To use rar: **`rar + option + archivename.rar + files to archive`**
  - Example: `rar a archivename.rar file2 file2`

Compression and Decompression | 7zip



Activity Description	Example
Create an archive	`7z a file.7z fileExample.iso`
Extract an archive	`7z e file.7z`
Create an archive with different archive format	`7z a -tzip file.zip fileExample.iso`
See files in an archive	`7z l file.7z`
test integrity of an archive	`7z t file.7z`
to archive with password protection	`7za a -p{password_here} file.7z`

Compression and Decompression | rar



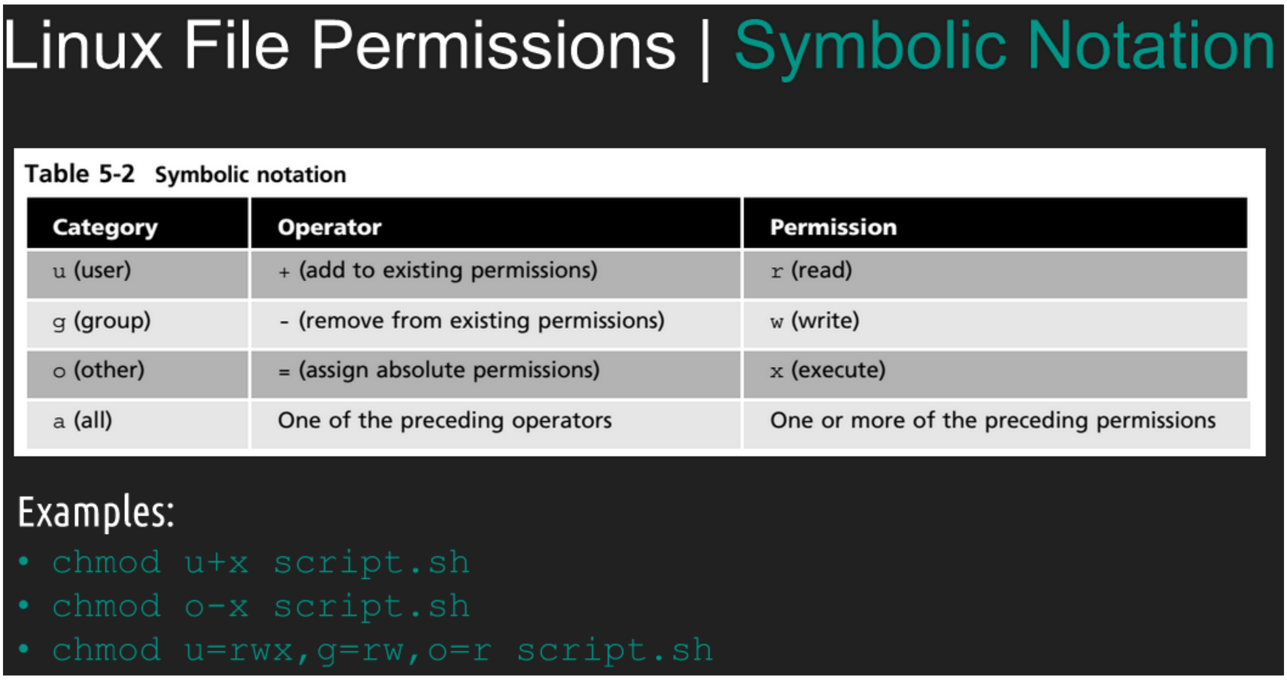
Activity Description	Example
Create an archive	`rar a archive.rar file1 file2 file3`
Extract an archive	`unrar archive.rar`
Create an archive with different archive format	Example coming soon
See files in an archive	Example coming soon
test integrity of an archive	Example coming soon
to archive with password protection	Example coming soon

Linux File Permissions

- Ownership
- ls -l to show owner and group owner
- /etc/passwd for list of users
- /etc/group for list of groups
- Change group owner
  - chown
    - ex.
      - chown john file.txt
      - chown :marketinGroup file.txt
      - chown john:marketinGroup file.txt
- rwx rwx rwx
  - file owner, group, other
- Files
  - Read - give permission to view
  - Write - give permission to open and edit file content
  - Execute (x) - Allow user to run file
- Directories
  - Read - List directory's content
  - Write - Add and remove files in subdirectories
  - Execute (x) - Allow to switch directory with cd command
- Hyphen (-) represents permission not granted.
  - ex. r-- means only read permission

Chmod

- Symbolic Notation



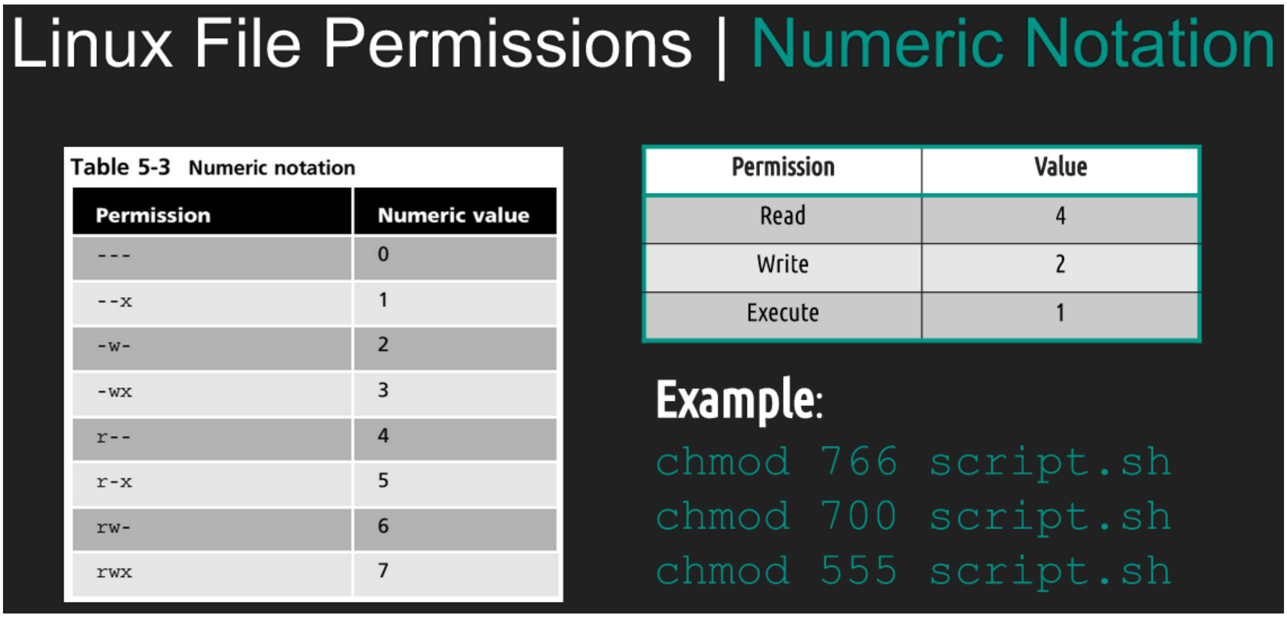
Linux File Permissions | Symbolic Notation

Table 5-2 Symbolic notation

Category	Operator	Permission
u (user)	+ (add to existing permissions)	r (read)
g (group)	- (remove from existing permissions)	w (write)
o (other)	= (assign absolute permissions)	x (execute)
a (all)	One of the preceding operators	One or more of the preceding permissions

Examples:

```
• chmod u+x script.sh
• chmod o-x script.sh
• chmod u=rwx,g=rw,o=r script.sh
```



Linux File Permissions | Numeric Notation

Table 5-3 Numeric notation

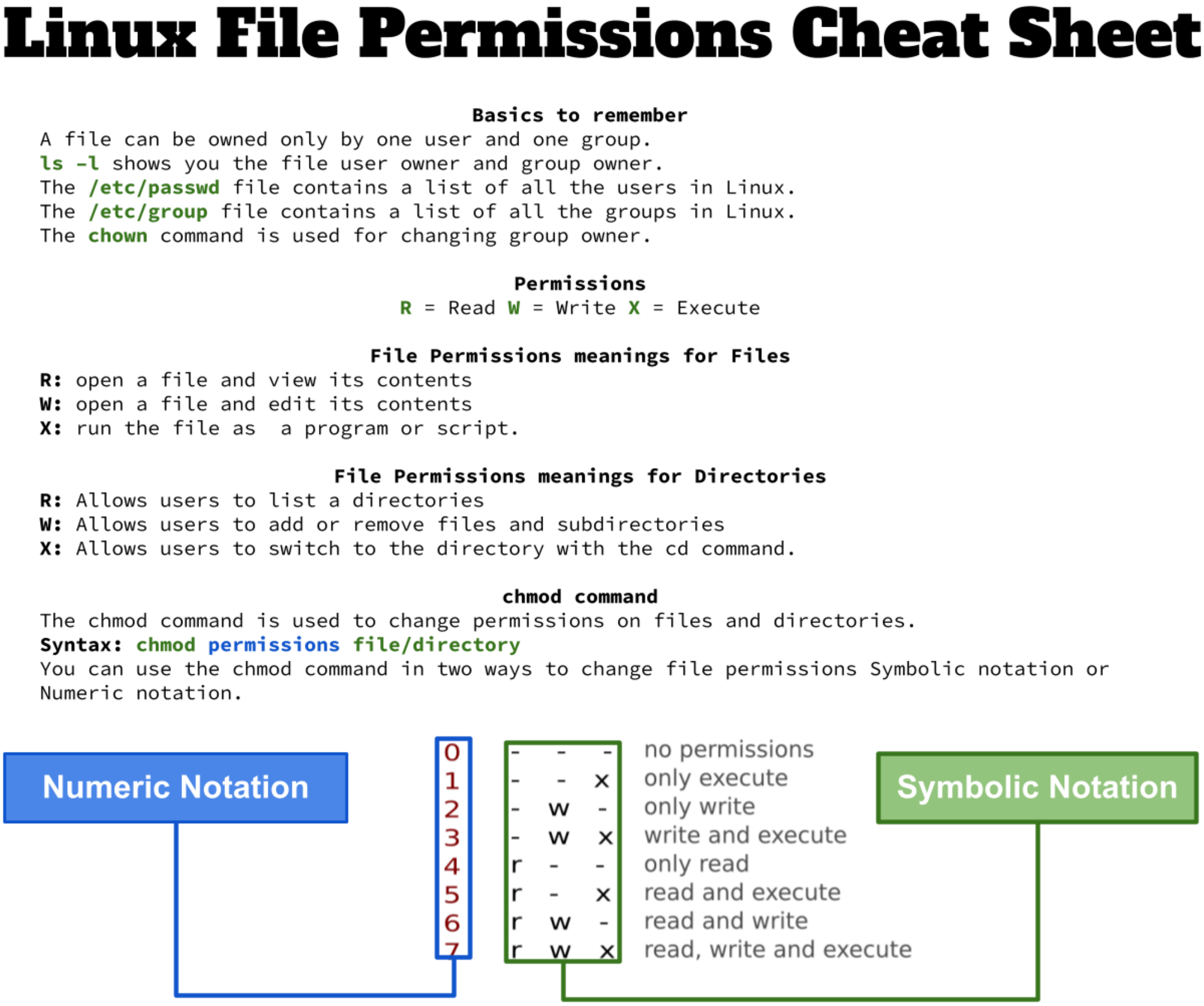
Permission	Numeric value
---	0
--x	1
-w-	2
-wx	3
r--	4
r-x	5
rw-	6
rwx	7

Permission	Value
Read	4
Write	2
Execute	1

Example:

```
chmod 766 script.sh
chmod 700 script.sh
chmod 555 script.sh
```

Cheat sheet:



Linux File Permissions Cheat Sheet

Basics to remember

A file can be owned only by one user and one group.
ls -l shows you the file user owner and group owner.
The **/etc/passwd** file contains a list of all the users in Linux.
The **/etc/group** file contains a list of all the groups in Linux.
The **chown** command is used for changing group owner.

Permissions

R = Read **W** = Write **X** = Execute

File Permissions meanings for Files

R: open a file and view its contents
W: open a file and edit its contents
X: run the file as a program or script.

File Permissions meanings for Directories

R: Allows users to list a directories
W: Allows users to add or remove files and subdirectories
X: Allows users to switch to the directory with the cd command.

chmod command

The chmod command is used to change permissions on files and directories.
Syntax: **chmod permissions file/directory**
You can use the chmod command in two ways to change file permissions Symbolic notation or Numeric notation.

Numeric Notation	Symbolic Notation	
0	- - -	no permissions
1	- - x	only execute
2	- w -	only write
3	- w x	write and execute
4	r - -	only read
5	r - x	read and execute
6	r w -	read and write
7	r w x	read, write and execute

Managing User Accounts

- Involves adding, modifying, and deleting user accounts and info.
- To add user accounts
  - user add or adduser command
    - In Ubuntu, adduser is recommended over useradd due to useradd being a low-level-utility
- To modify user's info
  - Use usermod program
- To delete a user
  - userdel program
- Files involved with user creation process:
  - /etc/login.defs
  - /etc/default/useradd
  - /etc/skel/
  - /etc/passwd
  - /etc/shadow
  - /etc/group

- Add user in Ubuntu
  - Run adduser followed by the username.
  - superuser privileges required
  - Will be asked to choose a password.
  - During process, add other details about the user, Optional, can be modified in the future.
- Delete a user in Ubuntu
  - userdel command followed by the user
  - Does not delete user's home directory
  - Pass -r option for the command to delete the home directory.
  - Sudo required

Purpose of the User Account Files

- /etc/login.defs file

  - Contains directives for use in various shadow password suite commands.

  - Shadow password suite is an umbrella term for commands dealing with account credentials such as useradd, userdel, and passwd.

  - Controls password length, whether it has a home directory, to when the user was created.

  - How to view without any comments

    - grep -ve ^$ /etc/login.defs | grep -v ^#
      - Suppress all comments which line start with # symbol

  - Important Directives:

    - UID - User ID Number to identify user accounts
    - User Account - normal account authorized by a human grant access to the system
    - UID_MIN / UID_MAX indicates lowest/highest UID allowed for user accounts.

  - System Accounts - provide service daemons or perform special task, such as the root user account.

  - SYS_UID_MIN and SYS_UID_MAX - sets min/max UID for system account.

  - See UID of all users in /etc/passwd

    - cut -d 'd' -f 1,3 /etc/passwd
    - awk -F : '{print $1,$3}' /etc/passwd

  - PASS_MAX_DAYS - number of days for password change required.

  - PASS_MIN_DAYS - number of days after password is changed until the password may be changed again.

  - PASS_MIN_LENGTH - min password length

  - PASS_WARN_AGE - number of days a warning is issued to the user prior to password expiration.

- CREATE_HOME - Default is no, Yes will make home directory

- ENCRYPT_METHOD - used to hash account passwords.

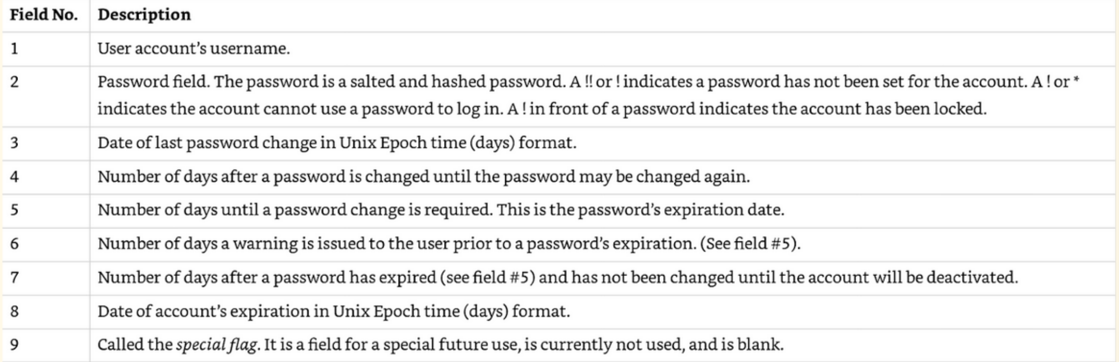
- /etc/default/useradd file

  - system default config. for creating new users with the useradd utility
  - view default parameters
    - useradd -D
    - cat /etc/default/useradd
  - Useradd utility won't have home directory unless given the option -m.
  - View all directives
    - cat /etc/default/useradd
    - grep -ve ^$ /etc/default/useradd | grep -v ^#
      - HOME - base directory
      - INACTIVE - number of days till account deactivates
      - SHELL - user account default shell program
      - /etc/skel/ directory
        - stores files that are copied to each user's home directory.

- /etc/passwd file

  - info about every account
  - 7 fields divided by a :
  - Fields
    - 1 - username
    - 2 - password field/ No longer used to store passwords. Indicated by x
    - 3 - UID
    - 4 - GID
    - 5 - Comment field optional
    - 6 - Home Directory
    - 7 - Default shell. If set to /sbin/nologin or /bin/false, can't log in.
      - /bin/false will kick out from system when trying to log in
      - /sbin/nologin shell tries to log in, message will display that user is kicked out.
      - Message displayed by the /sbin/nologin is stored in /etc/nologin.txt

- /etc/shadow file

  - contains user's passwords.
  - 

Field No.	Description
1	User account's username.
2	Password field. The password is a salted and hashed password. A !! or ! indicates a password has not been set for the account. A ! or * indicates the account cannot use a password to log in. A ! in front of a password indicates the account has been locked.
3	Date of last password change in Unix Epoch time (days) format.
4	Number of days after a password is changed until the password may be changed again.
5	Number of days until a password change is required. This is the password's expiration date.
6	Number of days a warning is issued to the user prior to a password's expiration. (See field #5).
7	Number of days after a password has expired (see field #5) and has not been changed until the account will be deactivated.
8	Date of account's expiration in Unix Epoch time (days) format.
9	Called the *special flag*. It is a field for a special future use, is currently not used, and is blank.

    - Unix Epoch Time - point in time for Unix

  - Creating a user with useradd

    - useradd is a low-level utility
      - -md are options needed for adding a home directory to the new user.
      - /home/student is a new user's home directory
      - -s specifying user login shell
      - /bin/bash the new user's login shell
      - student the user's username

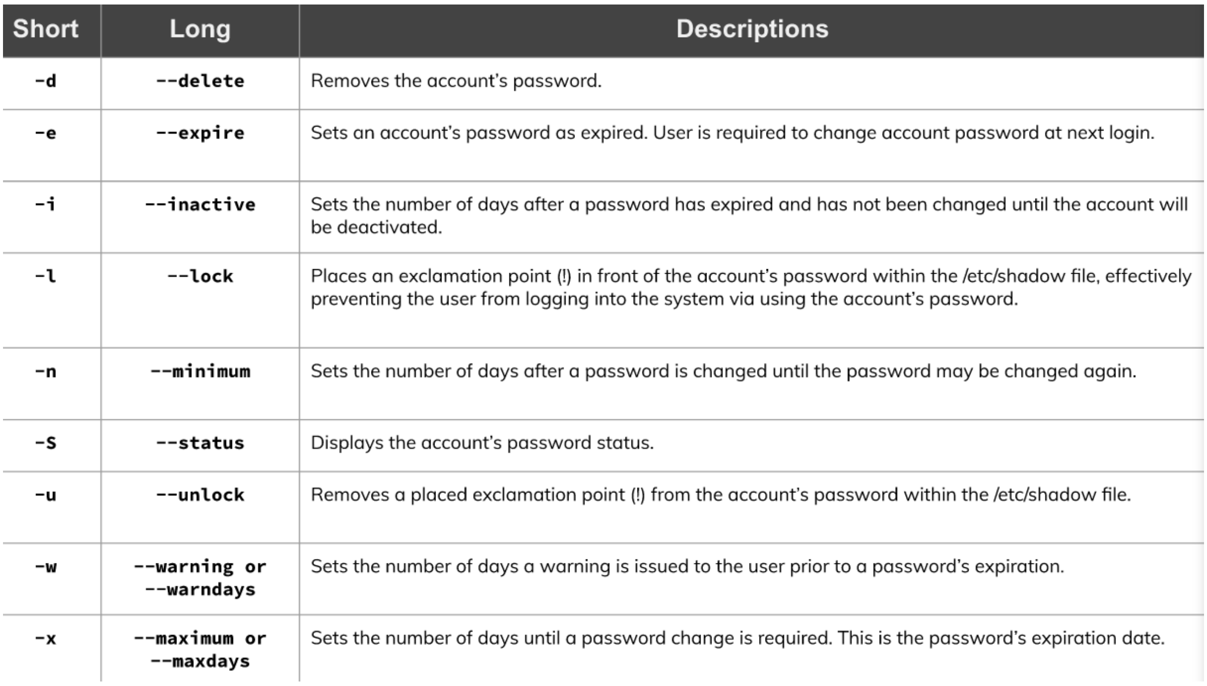
  - Viewing user's account info

    - grep student/etc/passwd
    - sudo grep student /etc/shadow
    - ls -A /home/student/
    - sudo ls -A /etc/skel/

  - getent utility - used to view user's account and password.

    - getent passwd student

- Maintaing Passwords

  - useradd does not create passwords for users
    - passwd utility is used for that.
  - Change password for another user:
    - passwd + username
  - For current user
    - passwd with no arguments
  - Passwd utility can also lock and unlock accounts with -l and -u options.
  - 

Short	Long	Descriptions
-d	--delete	Removes the account's password.
-e	--expire	Sets an account's password as expired. User is required to change account password at next login.
-i	--inactive	Sets the number of days after a password has expired and has not been changed until the account will be deactivated.
-l	--lock	Places an exclamation point (!) in front of the account's password within the /etc/shadow file, effectively preventing the user from logging into the system via using the account's password.
-n	--minimum	Sets the number of days after a password is changed until the password may be changed again.
-S	--status	Displays the account's password status.
-u	--unlock	Removes a placed exclamation point (!) from the account's password within the /etc/shadow file.
-w	--warning or --warndays	Sets the number of days a warning is issued to the user prior to a password's expiration.
-x	--maximum or --maxdays	Sets the number of days until a password change is required. This is the password's expiration date.

  - Another password is chage
    - Modifying password information
    - Display password information

- Modifying User Accounts

    - Example
        - sudo useradd sampleuser
        - Give home directory
            - sudo usermod -md /home/sampleuser sampleuser
        - Give user a password
            - sudo passwd sampleuser
        - Login with the new user
            - su sampleuser
        - Change default loginshell
            - Log out: exit
            - Change default shell: sudo usermod -s /bin/bash sampleuser

- Deleteing User Accounts

    - userdel utility -r switch
    - sudo userdel -r sampleuser
    - Make sure to check company policies

Managing Groups

- Groups organizational structure is part of DAC, discretionary access control.
- User given membership to particular group called account's default group.
- GID to identify Groups
- groupadd utility to add group to user
- -G command to override default behavior
- addgroup used instead since groupadd is a low-level utility.
- /etc/gshadow file is where group passwords are stored
- groupmod command for modifying particular groups.