REMEMBERING LINUX...

Reviewing what you need from Operating Systems for this course

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Source: Bing Chat AI

Logo: @creative_vanesa (*Instagram*)

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What is the purpose of this presentation?

- In this course there are several aspects to consider from the point of view of the inner workings of an OS
- To be able to handle them properly, you need to use concepts that you saw in the subject of Operating Systems
  - But the experience of these years has shown that not everyone remembers them
- Therefore, we have decided to make this small presentation to remind them to those who need it
- This content is **NOT EVALUABLE** in our course, it is only for help purposes

Machine entities from a security point of view

- Once inside a machine, there are three main entities we must consider from a security point of view
  - **Users**
  - **Files** and partitions
  - **Programs** (software)
- We will deal with them more thoroughly in the OS security topic
- But the entities itself were reviewed in the SO course

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Files & Partitions

What you can find on your hard drive

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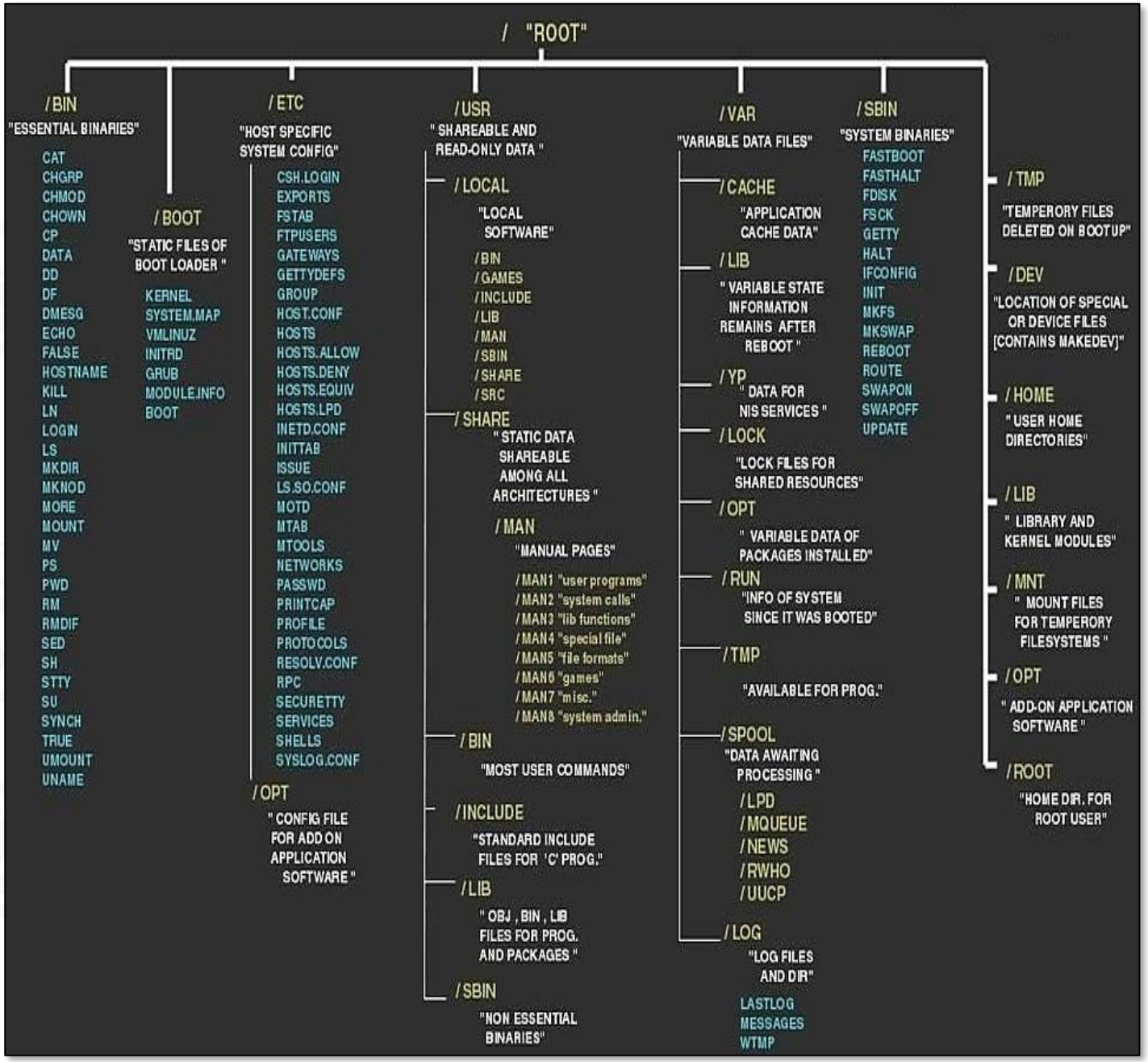
FILES AND PARTITIONS

Computer Security

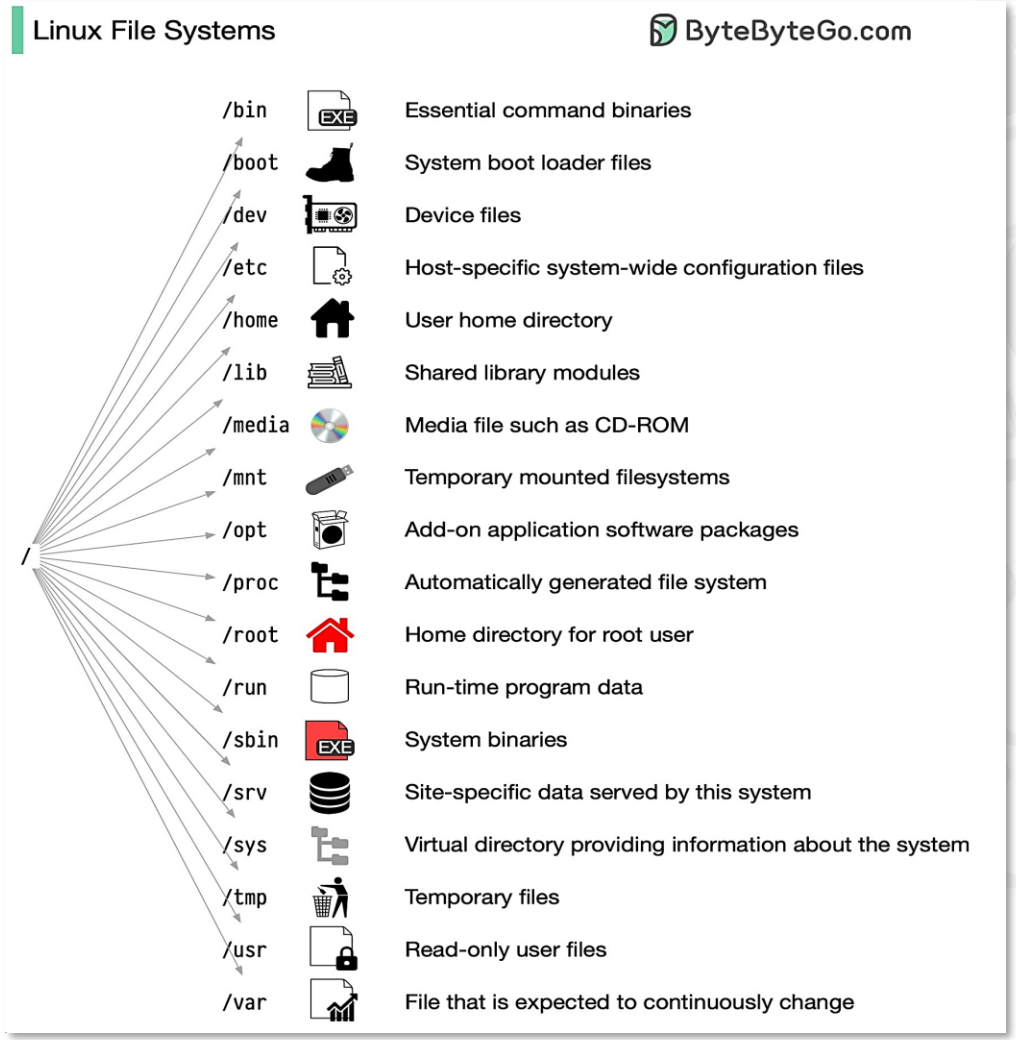
- **Every OS has a predefined structure of directories, files, and partitions**
  - Partitions group files under a directory in an isolated storage space
  - Typically, transparent to the user
- **The image shows a typical Linux installation**
  - We need to know where are the critical parts of the filesystem
    - Private files, device files, important services, logs…
  - Without this knowledge, we cannot perform security operations effectively

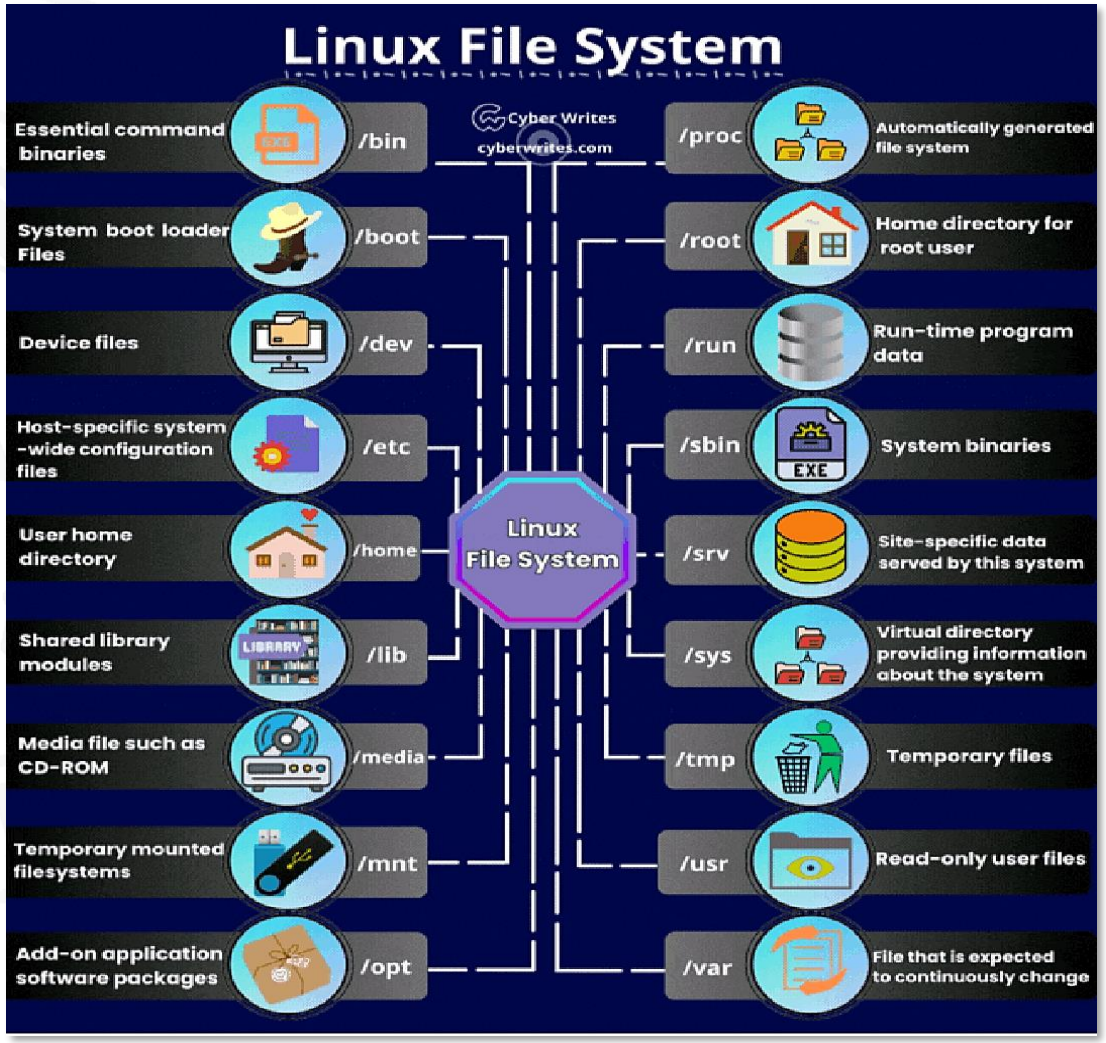
Source: https://www.wifislax.com/sistema-de-archivos-linux-en-una-sola-imagen/



Files & Partitions

- If the previous diagram is too detailed, and you just want to know the purpose of each directory, you can use either of these two





FILE PERMISSIONS

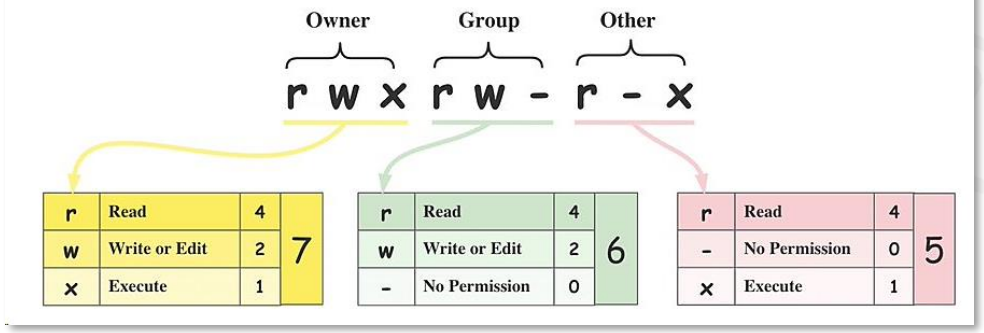
Computer Security

- If you don't remember how they are managed, these two diagrams can surely help you

Linux File Permissions

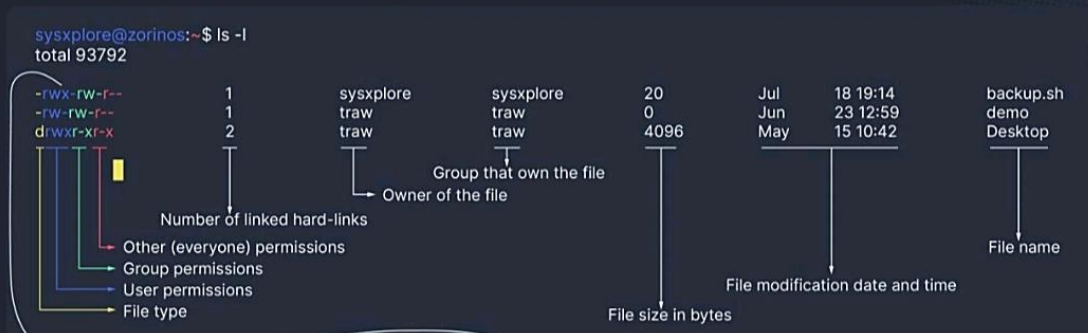
blog.bytebytego.com

Binary	Octal	String Representation	Permissions
000	0 (0+0+0)	---	No Permission
001	1 (0+0+1)	--x	Execute
010	2 (0+2+0)	-w-	Write
011	3 (0+2+1)	-wx	Write + Execute
100	4 (4+0+0)	r--	Read
101	5 (4+0+1)	r-x	Read + Execute
110	6 (4+2+0)	rw-	Read + Write
111	7 (4+2+1)	rwx	Read + Write + Execute



Linux file permissions cheatsheet

@sysxplore



Binary	Octal	Permissions	Representation
000	0 (0+0+0)	No Permission	---
001	1 (0+0+1)	Execute	--x
010	2 (0+2+0)	Write	-w-
011	3 (0+2+1)	Write + Execute	-wx
100	4 (4+0+0)	Read	r--
101	5 (4+0+1)	Read + Execute	r-x
110	6 (4+2+0)	Read + Write	rw-
111	7 (4+2+1)	Read + Write + Execute	rwx

@sysxplore

Capital S is an error it occurs if you set SUID bit or SGID bit to a file without execute (x) bit set

Capital T is an error it occurs if you set Stick bit to a file without execute (x) bit set

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Source: Bing Chat AI

Commands & Processes

Software you may need to use during the course

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Software: Inside any OS there are...

- **Commands**: invoked by users to achieve different effects
  - The image shows the typical commands of a Linux system
  - More complete listing: https://ss64.com/bash/
- **Background running applications**
  - They are called **services** (Windows) or **Daemons** (Linux)
  - Implement different features of the OS
    - Most are required to its proper operation
  - They are running continuously or periodically (programmed)
    - Or once a certain application runs

Unix/Linux Command Reference

FOSSwire.com

File Commands

ls – directory listing
ls -al – formatted listing with hidden files
cd *dir* - change directory to *dir*
cd – change to home
pwd – show current directory
mkdir *dir* – create a directory *dir*
rm *file* – delete *file*
rm -r *dir* – delete directory *dir*
rm -f *file* – force remove *file*
rm -rf *dir* – force remove directory *dir* *
cp *file1 file2* – copy *file1* to *file2*
cp -r *dir1 dir2* – copy *dir1* to *dir2*; create *dir2* if it doesn't exist
mv *file1 file2* – rename or move *file1* to *file2* if *file2* is an existing directory, moves *file1* into directory *file2*
ln -s *file link* – create symbolic link *link* to *file*
touch *file* – create or update *file*
cat > *file* – places standard input into *file*
more *file* – output the contents of *file*
head *file* – output the first 10 lines of *file*
tail *file* – output the last 10 lines of *file*
tail -f *file* – output the contents of *file* as it grows, starting with the last 10 lines

Process Management

ps – display your currently active processes
top – display all running processes
kill *pid* – kill process id *pid*
killall *proc* – kill all processes named *proc* *
bg – lists stopped or background jobs; resume a stopped job in the background
fg – brings the most recent job to foreground
fg *n* – brings job *n* to the foreground

File Permissions

chmod *octal file* – change the permissions of *file* to *octal*, which can be found separately for user, group, and world by adding:

- 4 – read (r)
- 2 – write (w)
- 1 – execute (x)

Examples:
chmod 777 – read, write, execute for all
chmod 755 – rwx for owner, rx for group and world
For more options, see **man chmod**.

SSH

ssh *user@host* – connect to *host* as *user*
ssh -p *port user@host* – connect to *host* on port *port* as *user*
ssh-copy-id *user@host* – add your key to *host* for *user* to enable a keyed or passwordless login

Searching

grep *pattern files* – search for *pattern* in *files*
grep -r *pattern dir* – search recursively for *pattern* in *dir*
command* | grep *pattern – search for *pattern* in the output of *command*
locate *file* – find all instances of *file*

System Info

date – show the current date and time
cal – show this month's calendar
uptime – show current uptime
w – display who is online
whoami – who you are logged in as
finger *user* – display information about *user*
uname -a – show kernel information
cat /proc/cpuinfo – cpu information
cat /proc/meminfo – memory information
man *command* – show the manual for *command*
df – show disk usage
du – show directory space usage
free – show memory and swap usage
whereis *app* – show possible locations of *app*
which *app* – show which *app* will be run by default

Compression

tar cf *file.tar files* – create a tar named *file.tar* containing *files*
tar xf *file.tar* – extract the files from *file.tar*
tar czf *file.tar.gz files* – create a tar with Gzip compression
tar xzf *file.tar.gz* – extract a tar using Gzip
tar cjf *file.tar.bz2* – create a tar with Bzip2 compression
tar xjf *file.tar.bz2* – extract a tar using Bzip2
gzip *file* – compresses *file* and renames it to *file.gz*
gzip -d *file.gz* – decompresses *file.gz* back to *file*

Network

ping *host* – ping *host* and output results
whois *domain* – get whois information for *domain*
dig *domain* – get DNS information for *domain*
dig -x *host* – reverse lookup *host*
wget *file* – download *file*
wget -c *file* – continue a stopped download

Installation

Install from source:
./configure
make
make install
dpkg -i *pkg.deb* – install a package (Debian)
rpm -Uvh *pkg.rpm* – install a package (RPM)

Shortcuts

Ctrl+C – halts the current command
Ctrl+Z – stops the current command, resume with **fg** in the foreground or **bg** in the background
Ctrl+D – log out of current session, similar to **exit**
Ctrl+W – erases one word in the current line
Ctrl+U – erases the whole line
Ctrl+R – type to bring up a recent command
!! - repeats the last command
exit – log out of current session

* use with extreme caution.

Typical Linux Commands

Computer Security

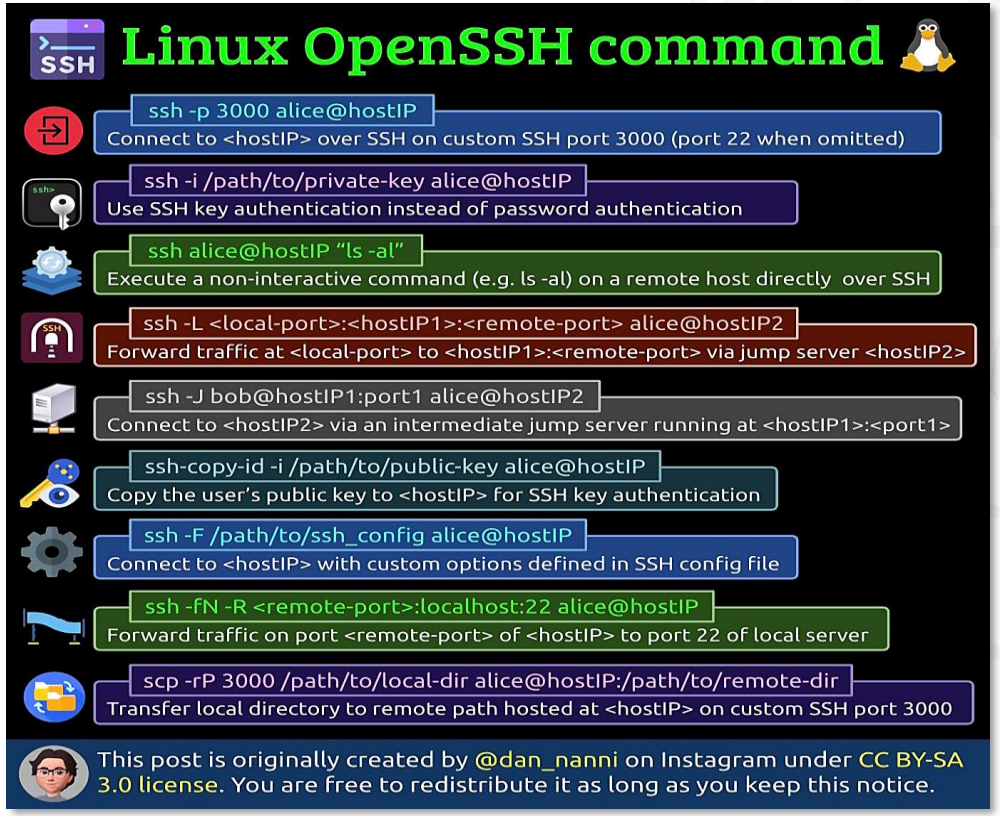
- If the commands in the previous image are too many, here you can find the most common ones
- In the course you will have to use a small set of them
  - ¡But it doesn't hurt to have a quick reference just in case! ☺

Source: https://twitter.com/Sheraj99/status/1622735819298545664

SSH

Computer Security

- It is a tool that allows you to establish secure remote connections with servers
- Used to authenticate and encrypt connections
- Enables remote control of servers and secure data transfer



CHEAT SHEET

SSH - common commands and secure config

BlowStack

SSH connections

connects to a server (default port 22)
$ ssh user@server

uses a specific port declared in sshd_config
$ ssh user@server -p other_port

runs a script on a remote server
$ ssh user@server script_to_run

compresses and downloads from a remote server
$ ssh user@server "tar cvzf - ~/source" > output.tgz

specifies other ssh key for connection
$ ssh -i ~/.ssh/specific_ssh_fkey

SSH service

starts ssh service
$ (sudo) service ssh start

checks ssh service status
$ (sudo) service ssh status

stops ssh service
$ (sudo) service ssh stop

restarts ssh service
$ (sudo) service ssh restart

SCP (Secure Copy)

copies a file from a remote server to a local machine
$ scp user@server:/directory/file.ext local_destination/

copies a file between two servers
$ scp user@server:/dir/file.ext user@server:/dir

copies a file from a local machine to a remote server
$ scp local_destination/file.ext user@server:/directory

uses a specific port declared for SHH in sshd_config
$ scp -P port

coppies recursive a whole folder
$ scp -r user@server:/directory local_destination/

copies all files from a folder
$ scp user@server:/directory/* local_destination/

copies all files from a server folder to the current folder
$ scp user@server:/directory/* .

compresses data on network using gzip
$ scp -C

prints verbose info about the current transfer
$ scp -v

Full articles about cyber security at
https://blowstack.com/blog/cyber-security

SSH keys

generates a new ssh key
$ ssh-keygen -t rsa -b 4096

sends the key to the server
$ ssh-copy-id user@server

converts ids_rsa into ppk
$ puttygen current_key -o keyname.ppk

SSH config

opens config file (usual location)
$ sudo nano /etc/ssh/sshd_config

changes default SSH port (22)
Port 9809

disables root login
PermitRootLogin no

restricts access to specifucusers
AllowUsers user1, user2

enables login through ssh key
PubkeyAuthentication yes

disables login through password
PasswordAuthentication no

disables usage of files .rhosts and .shosts
IgnoreRhosts yes

disables a less secure type of login
HostbasedAuthentication no

number of unauthenticated connections before dropping
MaxStartups 10:30:100

no. of failed tries before the servers stops accepting new tries
MaxAuthTries 3

max current ssh sessions
MaxSessions 1

disables interactive password authentication
ChallengeResponseAuthentication no

no empty password allowed
PermitEmptyPasswords no

disables Rhost authtentication
RhostsAuthentication no

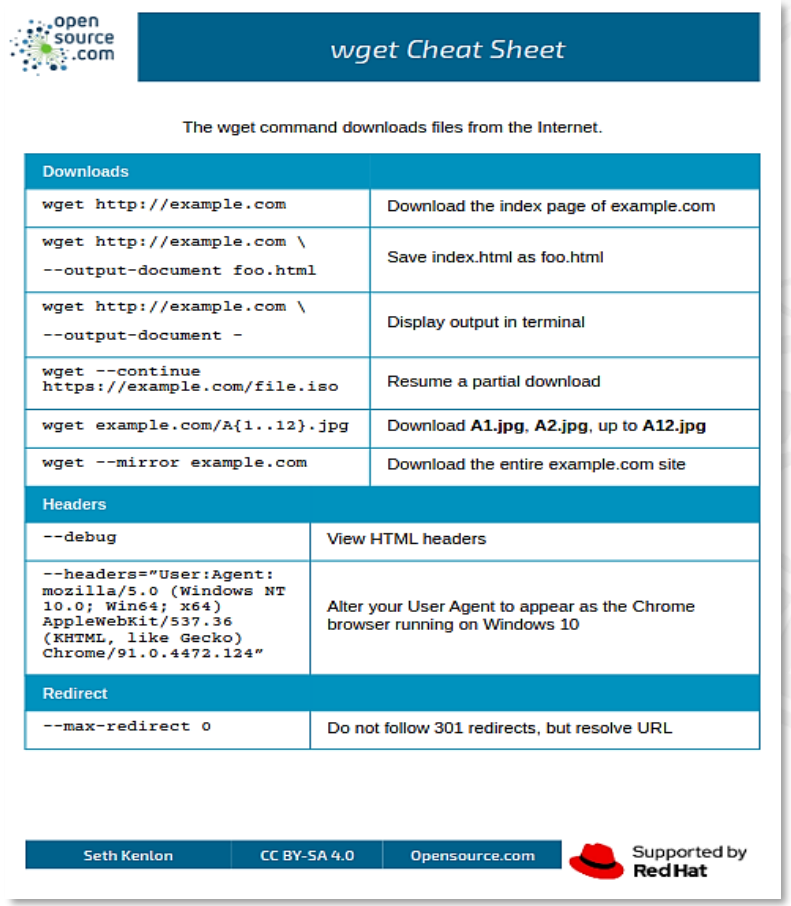
disables port forwarding (blocks i.e MySQL Workbench)
AllowTcpForwarding no
X11Forwarding no

prints much more info about SSH connections
LogLevel VERBOSE

Author: Piotr Golon, piotr.golon@blowstack.com, https://blowstack.com

WGET

- **Command that allows you to download files from the Internet**
  - Supports downloads via FTP, SFTP, HTTP and HTTPS
- **It's useful for downloading content, from individual files to entire webs**



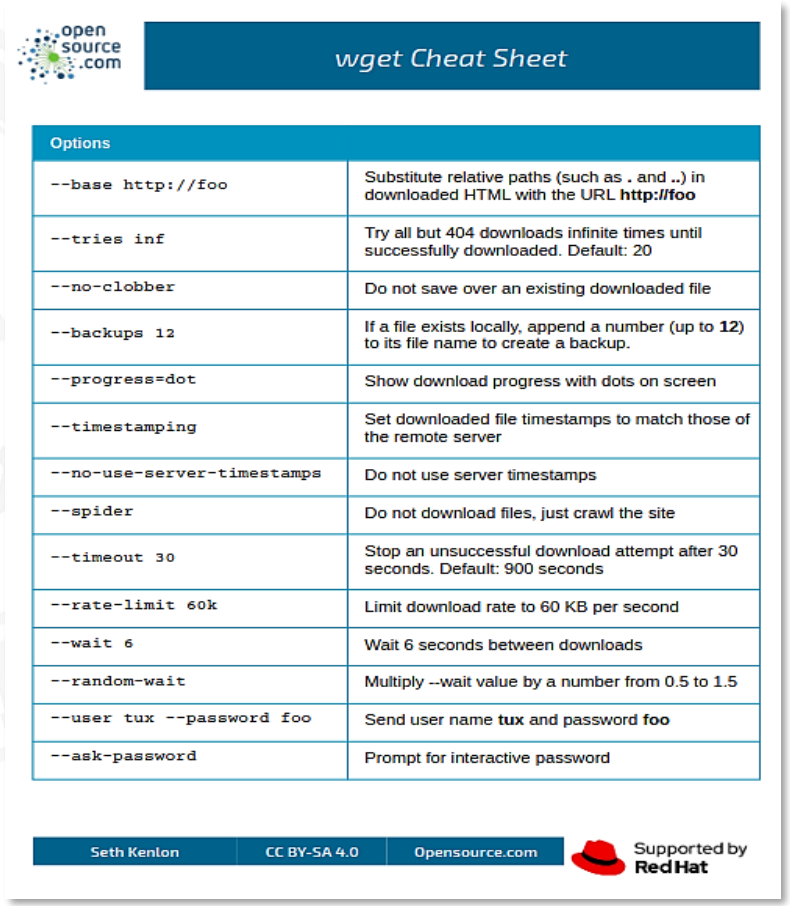
open source .com

wget Cheat Sheet

The wget command downloads files from the Internet.

Downloads	
`wget http://example.com`	Download the index page of example.com
`wget http://example.com \ --output-document foo.html`	Save index.html as foo.html
`wget http://example.com \ --output-document -`	Display output in terminal
`wget --continue https://example.com/file.iso`	Resume a partial download
`wget example.com/A{1..12}.jpg`	Download **A1.jpg**, **A2.jpg**, up to **A12.jpg**
`wget --mirror example.com`	Download the entire example.com site
Headers	
`--debug`	View HTML headers
`--headers="User:Agent: mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/91.0.4472.124"`	Alter your User Agent to appear as the Chrome browser running on Windows 10
Redirect	
`--max-redirect 0`	Do not follow 301 redirects, but resolve URL

Seth Kenlon | CC BY-SA 4.0 | Opensource.com | Supported by RedHat



open source .com

wget Cheat Sheet

Options	
`--base http://foo`	Substitute relative paths (such as **.** and **..**) in downloaded HTML with the URL **http://foo**
`--tries inf`	Try all but 404 downloads infinite times until successfully downloaded. Default: 20
`--no-clobber`	Do not save over an existing downloaded file
`--backups 12`	If a file exists locally, append a number (up to **12**) to its file name to create a backup.
`--progress=dot`	Show download progress with dots on screen
`--timestamping`	Set downloaded file timestamps to match those of the remote server
`--no-use-server-timestamps`	Do not use server timestamps
`--spider`	Do not download files, just crawl the site
`--timeout 30`	Stop an unsuccessful download attempt after 30 seconds. Default: 900 seconds
`--rate-limit 60k`	Limit download rate to 60 KB per second
`--wait 6`	Wait 6 seconds between downloads
`--random-wait`	Multiply --wait value by a number from 0.5 to 1.5
`--user tux --password foo`	Send user name **tux** and password **foo**
`--ask-password`	Prompt for interactive password

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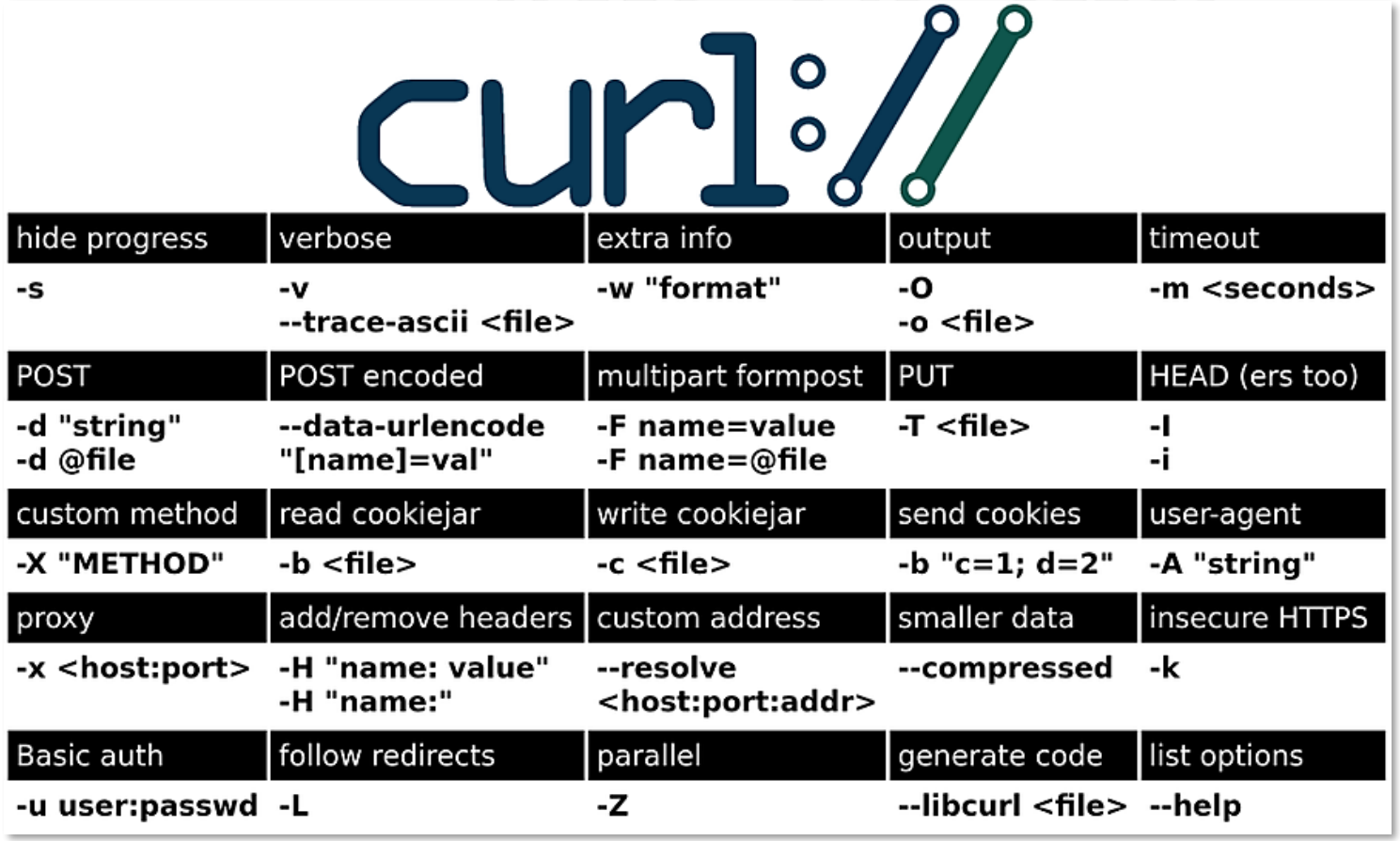
CURL

- Tool to transfer data to or from a server using different protocols such as HTTP, FTP, POP3, among others
- It's useful for verifying connectivity to URLs and transferring data



Fuente: https://daniel.haxx.se/blog/2020/01/20/curl-cheat-sheet-refresh/

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Source: Bing Chat AI

Users

The ones who can actually do something in the OS

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Users according to their capabilities: Privileged user accounts

- **These have more privileges than "ordinary" users**
  - Able to install/remove software, upgrade the OS, modify system or application configurations…
- **They might also have access to files that are not normally accessible to standard users**
- **Normally we have these privileged accounts**
  - **Root / Administrator account**: the system administrator
    - Able to perform any change in the OS https://www.ssh.com/iam/user/root/
  - **System accounts**: usually with known user IDs
    - Created during the OS installation for management
  - **Service accounts**: run applications/other processes
    - Also created to own data and configuration files
    - They are not intended to be allowed interactive login (bash terminals)
    - Or be used by humans in any way
    - Only for administrative operations

```
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin,
irc:x:39:39:ircd:/var/run/ircd:/usr/sbin/nologin
gnats:x:41:41:Gnats Bug-Reporting System (admin):/var,
n
nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/no
libuuid:x:100:101::/var/lib/libuuid:
syslog:x:101:104::/home/syslog:/bin/false
messagebus:x:102:106::/var/run/dbus:/bin/false
```

Users according to their capabilities: "Ordinary" user accounts

- **OS users that only perform "normal" operations**
  - Like creating documents, editing photos, browsing, playing games… any operation that **do not require any special privilege**
  - Some of them may be **sudoers**
    - Tools like `sudo` can be used to grant certain users **the temporal ability to run selected commands as `root`**
    - This way, it is not necessary to enable a `root` account with interactive login capabilities
    - Only selected users (the ones in the `sudoers` group) can temporarily "promote" themselves to `root` to execute administrative operations
      - Once the operation ends, the user returns to their normal privilege status
    - Not every user is a `sudoer`
      - Any beyond the first created user (that is usually a sudoer automatically) must be manually added to this group
- **In case of attack, the criminal will try to log in as `root` or as a sudoer**
  - If it is not possible, it will try to perform a **privilege scalation**
  - We will deal with this later in the year!

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Source: Bing Chat AI

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