Basic to advanced commands

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Image

i want you to take the most basic commands and tell me their basic to advanced funtionality , with options and everything, start with these first

Perfect. We'll do this **properly, from zero → power-user**, exactly like a Linux internals / SRE prep, not a surface-level cheatsheet.

I'll start **only with the commands shown in your list**, and for each command I'll cover:

1. **What it really is / does (mental model)**
2. **Basic usage**
3. **Important options (why they exist)**
4. **Advanced / real-world usage**
5. **Hidden tricks / gotchas**
6. **How pros actually use it**

We'll go **one command per message** unless you want me to speed up.

1️⃣ `pwd` — Print Working Directory

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1. What `pwd` *actually* does

`pwd` tells you:

> "Where am I **right now** in the filesystem tree?"

Linux doesn't think in "folders", it thinks in **inodes + paths**.
Your shell always maintains a **current working directory (CWD)**.

`pwd` simply prints that CWD.

---

2. Basic usage

```bash
pwd
```

Output:

```text
/home/saarthak/projects
```

That path is:

- **Absolute**
- Always starts from `/` (root)

---

3. Options (small command, but important distinction)

`-P` → Physical path (real path on disk)

```bash
pwd -P
```

Resolves **symlinks**.

Example:

```bash
/home/user/current -> /mnt/data/project
```

```bash
pwd      # shows logical path
pwd -P   # shows real physical path
```

`-L` → Logical path (default)

```bash
pwd -L
```

Uses shell's logical path tracking.

Why this matters:

- Faster
- Preserves user-friendly paths
- Avoids breaking scripts when symlinks are intentional

---

4. Why `pwd` matters more than it looks

Every relative command depends on it

```bash
cat file.txt
```

Linux interprets that as:

```bash
cat $(pwd)/file.txt
```

So:

- Wrong directory = wrong file
- Many “file not found” errors are **pwd mistakes**

---

5. Advanced / real-world usage

In scripts (very common)

```bash
echo "Script running from: $(pwd)"
```

Save current directory, move away, return

```bash
CUR_DIR=$(pwd)
cd /tmp
# do work
cd "$CUR_DIR"
```

(Pros do this all the time)

Debugging CI/CD pipelines

When something fails in GitHub Actions / Jenkins:

```bash
pwd
ls
```

First two debug commands **always**.

---

6. Shell built-in vs binary

- **`pwd`** is usually a **shell builtin**

- Also exists as `/bin/pwd`

Check:

```bash
type pwd
```

Output:

```text
pwd is a shell builtin
```

Why it matters:

- Builtins are faster
- Behavior slightly differs with symlinks

---

7. Gotchas

❌ Assuming `pwd` = where the script file is
✅ It's where the script was **executed from**

To get script location:

```bash
dirname "$(realpath "$0")"
```

---

8. Pro mindset summary

- `pwd` is your **ground truth**
- Every path resolution depends on it
- Always check it when confused
- In automation → print it early

Next command in your list:

👉 **`cd` (Change Directory)**
This one has **many hidden behaviors** (`-`, `~`, `CDPATH`, subshell traps).

Say **"next"** and we'll deep-dive `cd`.

you did them in a short way , i want like this for each command, do for the ones in the pictre, without missing any command , its options or its components

⭐ 1) ls — List directory contents
BASIC USAGE

```
ls
```

Lists files in the current directory.

```
ls dir_name
```

Lists files in another directory.

INTERMEDIATE OPTIONS

```
ls -l
```

Long format → shows permissions, size, owner, timestamps.

```
ls -a
```

Shows hidden files (dotfiles).

```
ls -lh
```

Human-readable sizes: K, M, G.

```
ls -R
```

Recursive listing (entire subtrees).

```
ls -t
```

Sort by modification time.

```
ls -S
```

Sort by file size (largest first).

ADVANCED / FUN & USEFUL COMBINATIONS

Latest file in folder:

```
ls -t | head -1
```

Largest file in folder:

```
ls -Sh | head -1
```

Show only directories:

```
ls -d */
```

Display file inode numbers (useful for weird FS issues):

```
ls -li
```

Got it.
You want **one complete, no-shortcuts, no-missing-parts reference**, **exactly like your `ls` example**, for **every command shown in the picture**.

I'll do **ALL commands**, **same depth**, **same structure**, **no skipping options**, **no hand-waving**.
This will read like **a personal Linux command handbook**.

Commands from the picture (in order):

1. `pwd`
2. `cd`
3. `ls`
4. `touch`
5. `file`
6. `cat`
7. `less`
8. `history`
9. `cp`
10. `mv`

⭐ 1) `pwd` — Print Working Directory

BASIC USAGE

```bash
pwd
```

Prints the **absolute path** of the current working directory.

Example:

```bash
/home/user/projects
```

INTERMEDIATE OPTIONS

```bash
pwd -L
```

Logical path (default).
Shows the path as tracked by the shell (may include symlinks).

```bash
pwd -P
```

Physical path.
Resolves symlinks and shows the **real location on disk**.

ADVANCED / USEFUL COMBINATIONS

Store current directory:

```bash
CUR=$(pwd)
```

Return after moving elsewhere:

```bash
cd /tmp
cd "$CUR"
```

Debug scripts / CI:

```bash
pwd && ls
```

INTERNAL NOTES

- Usually a **shell builtin**
- Critical for **relative path resolution**
- Many bugs = wrong **`pwd`**

⭐ 2) `cd` — Change Directory

BASIC USAGE

```bash
cd dir_name
```

Move into a directory.

```bash
cd ..
```

Go up one level.

```bash
cd
```

Go to **home directory**.

INTERMEDIATE OPTIONS & FEATURES

```bash
cd ~
```

Explicit home directory.

```bash
cd -
```

Switch to **previous directory** (VERY useful).

```bash
cd /absolute/path
```

```bash
cd relative/path
```

ENVIRONMENT VARIABLES

```bash
echo $HOME
```

```bash
echo $OLDPWD
```

`cd` updates:

- **`PWD`**
- **`OLDPWD`**

ADVANCED / PRO USAGE

Jump quickly:

```bash
cd /var/log/nginx
cd -
```

One-liner navigation:

```bash
cd ~/projects/app/src
```

Silent failure handling in scripts:

```bash
cd /path || exit 1
```

GOTCHAS

❌ **cd** into a file
❌ Missing permissions
❌ Broken symlink directories

⭐ 3) `ls` — List Directory Contents

(Your reference standard — included fully)

BASIC USAGE

```bash
ls
```

```bash
ls dir_name
```

INTERMEDIATE OPTIONS

```bash
ls -l
```

Long format.

```bash
ls -a
```

Include hidden files.

```bash
ls -lh
```

Human-readable sizes.

```bash
ls -R
```

Recursive.

```bash
ls -t
```

Sort by time.

```bash
ls -S
```

Sort by size.

ADVANCED / FUN & USEFUL

Latest file:

```bash
ls -t | head -1
```

Largest file:

```bash
ls -Sh | head -1
```

Only directories:

```bash
ls -d */
```

Inode numbers:

```bash
ls -li
```

⭐ 4) `touch` — Create / Update Files

BASIC USAGE

```bash
touch file.txt
```

Creates empty file **or** updates timestamp.

INTERMEDIATE OPTIONS

```bash
touch -a file
```

Update access time.

```bash
touch -m file
```

Update modification time.

```bash
touch -c file
```

Do NOT create file.

```bash
touch -t 202501011230 file
```

Set custom timestamp.

ADVANCED USES

Create multiple files:

```bash
touch f1 f2 f3
```

Create nested files:

```bash
touch dir/{a,b,c}.txt
```

Build skeleton projects:

```bash
touch main.py README.md .env
```

⭐ 5) `file` — Detect File Type

BASIC USAGE

```bash
file file.txt
```

Detects type using **magic bytes**, not extension.

INTERMEDIATE OPTIONS

```bash
file -i file
```

MIME type.

```bash
file -b file
```

Brief output.

```bash
file -z compressed.gz
```

Inspect compressed content.

ADVANCED USAGE

Check unknown binaries:

```bash
file *
```

Security triage:

```bash
file suspicious_file
```

⭐ 6) cat — Concatenate & Display Files

BASIC USAGE

```bash
cat file.txt
```

INTERMEDIATE OPTIONS

```bash
cat -n file
```

Number lines.

```bash
cat -b file
```

Number non-empty lines.

```bash
cat -A file
```

Show hidden characters.

ADVANCED USAGE

Combine files:

```bash
cat f1 f2 > merged.txt
```

Create file interactively:

```bash
cat > file.txt
```

Here-doc style:

```bash
cat <<EOF
hello
EOF
```

WARNING

❌ Don’t **`cat`** huge files
Use **`less`**

⭐ 7) `less` — Paged File Viewer

BASIC USAGE

```bash
less file.txt
```

NAVIGATION KEYS

- **`Space`** → page down
- **`b`** → page up
- **`/word`** → search
- **`n`** / **`N`** → next / prev
- **`q`** → quit

INTERMEDIATE OPTIONS

```
bash

less -N file
```

Show line numbers.

```
bash

less +F file
```

Follow mode (like **`tail -f`**).

ADVANCED USAGE

View command output:

```
bash

ps aux | less
```

Log analysis:

```
bash

less /var/log/syslog
```

⭐ 8) `history` — Command History

BASIC USAGE

```
bash

history
```

INTERMEDIATE OPTIONS

```
bash

history 20
```

Last 20 commands.

```
bash

!123
```

Run command #123.

```bash
!!
```

Repeat last command.

ADVANCED USAGE

Search:

```bash
Ctrl + r
```

Save history:

```bash
history > cmds.txt
```

Audit mistakes:

```bash
history | grep rm
```

⭐ 9) `cp` — Copy Files & Directories

BASIC USAGE

```bash
cp src dest
```

INTERMEDIATE OPTIONS

```bash
cp -r dir1 dir2
```

Recursive copy.

```bash
cp -i file dest
```

Prompt before overwrite.

```bash
cp -v file dest
```

Verbose.

```bash
cp -p file dest
```

Preserve metadata.

ADVANCED USAGE

Copy multiple files:

```bash
cp f1 f2 dir/
```

Backup while copying:

```bash
cp file{,.bak}
```

⭐ 10) `mv` — Move / Rename Files

BASIC USAGE

```bash
mv old new
```

INTERMEDIATE OPTIONS

```bash
mv -i file dest
```

Prompt before overwrite.

```bash
mv -v file dest
```

Verbose.

ADVANCED USAGE

Batch rename:

```
bash

mv *.txt backup/
```

Atomic replace:

```
bash

mv new.conf old.conf
```

Fast renames (same filesystem).

FINAL NOTE (IMPORTANT)

These commands are:

- **Foundation of Linux**
- **Used daily by DevOps, SREs, kernel engineers**
- **Building blocks for awk, find, xargs, sed**

If you want, next we can continue with:
👉 **`find`**
👉 **`du`**
👉 **`ps`**
👉 **`awk`** (FULL power-user breakdown, including hashmaps like you asked earlier)

Just say **"continue"** and which command next.

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Image

next ones

Perfect. Continuing **in the exact same deep, structured, zero-skip style**.
Next commands from your image:

12. **`mkdir`**

13. **`rm`**

14. **`find`**

15. **`help`**
16. **`man`**
17. **`whatis`**
18. **`alias`**
19. **`exit`**

I’ll keep **the same format you liked**.

⭐ 12) `mkdir` — Make Directories

BASIC USAGE

```bash
mkdir dir_name
```

Creates a directory.

```bash
mkdir dir1 dir2
```

Creates multiple directories.

INTERMEDIATE OPTIONS

```bash
mkdir -p parent/child/grandchild
```

Create **parent directories automatically** (MOST USED).

```bash
mkdir -v dir
```

Verbose (prints what it creates).

```bash
mkdir -m 755 dir
```

Set permissions at creation time.

ADVANCED / PRACTICAL USES

Create project structure:

```
bash

mkdir -p app/{src,tests,docs,config}
```

Create date-based folders:

```
bash

mkdir $(date +%Y-%m-%d)
```

Safe scripts (no error if exists):

```
bash

mkdir -p logs
```

GOTCHAS

❌ **`mkdir a/b`** fails if **`a`** doesn't exist
✅ Use **`-p`**

⭐ 13) `rm` — Remove Files & Directories

BASIC USAGE

```
bash

rm file.txt
```

Deletes file **permanently** (no recycle bin).

INTERMEDIATE OPTIONS

```
bash

rm -i file
```

Ask before deleting.

```
bash

rm -v file
```

Verbose deletion.

```bash
rm -r dir
```

Recursive delete (directory).

```bash
rm -f file
```

Force delete (no prompts, no errors).

ADVANCED / DANGEROUS COMBINATIONS ⚠️

Delete directory tree:

```bash
rm -rf dir
```

Delete everything EXCEPT one file:

```bash
rm -rf * !important.txt
```

Clean build artifacts:

```bash
rm -rf build/ dist/
```

ABSOLUTE WARNINGS

❌ **`rm -rf /`**
❌ **`rm -rf *`** in wrong directory

Pros always do:

```bash
pwd
ls
rm ...
```

⭐ 14) `find` — Search Files (MOST POWERFUL)

BASIC USAGE

```bash
find .
```

List everything recursively.

```bash
find /path
```

INTERMEDIATE SEARCH OPTIONS

By name:

```bash
find . -name file.txt
```

Case-insensitive:

```bash
find . -iname "*.log"
```

By type:

```bash
find . -type f
find . -type d
```

By size:

```bash
find . -size +100M
```

By time:

```bash
find . -mtime -7
```

ADVANCED / REAL POWER

Delete found files:

```bash
find . -name "*.tmp" -delete
```

Execute command on results:

```bash
find . -name "*.log" -exec rm {} \;
```

Count files:

```bash
find . -type f | wc -l
```

Find large files:

```bash
find / -type f -size +1G 2>/dev/null
```

PRO TIP

`find` + `xargs` + `awk` = automation weapon

⭐ 15) `help` — Shell Built-in Help

BASIC USAGE

```bash
help
```

Lists **shell built-in commands**.

```bash
help cd
```

Explains built-in behavior.

INTERMEDIATE DETAILS

Only works for:

- **cd**

- **`alias`**
- **`exit`**
- **`history`**

❌ Does NOT work for external commands (**`ls`**, **`cat`**)

ADVANCED USE

Quick syntax reminder:

```
bash

help for
help if
```

⭐ 16) `man` — Manual Pages

BASIC USAGE

```
bash

man ls
```

INTERMEDIATE SECTIONS

```
bash

man 1 ls
man 5 passwd
man 8 mount
```

Sections:

- 1 → user commands
- 5 → config files
- 8 → admin commands

NAVIGATION

- **`/word`** search
- **`n`** next
- **`q`** quit

ADVANCED USE

Search manuals:

```bash
man -k copy
```

Open specific option:

```bash
man bash
```

⭐ 17) `whatis` — One-Line Command Description

BASIC USAGE

```bash
whatis ls
```

Output:

```text
ls (1) - list directory contents
```

INTERMEDIATE USE

Multiple commands:

```bash
whatis ls cp mv
```

Uses manual database.

FIXING EMPTY RESULTS

```bash
sudo mandb
```

WHEN TO USE

- Fast recall
- Exams
- Interviews

⭐ 18) `alias` — Command Shortcuts

BASIC USAGE

```bash
alias ll='ls -lh'
```

INTERMEDIATE OPTIONS

List aliases:

```bash
alias
```

Remove alias:

```bash
unalias ll
```

ADVANCED / PRO USAGE

Safety alias:

```bash
alias rm='rm -i'
```

Persistent alias:

```bash
echo "alias ll='ls -lh'" >> ~/.bashrc
```

Temporary debugging:

```bash
alias grep='grep --color=auto'
```

GOTCHAS

❌ Aliases don’t work in scripts
(use functions instead)

⭐ 19) `exit` — Leave Shell / Script

BASIC USAGE

```bash
exit
```

INTERMEDIATE OPTIONS

```bash
exit 0
```

Success.

```bash
exit 1
```

Failure.

ADVANCED / SCRIPTING

```bash
command || exit 1
```

CI/CD pipelines:

```bash
exit 255
```

Exit codes:

- `0` → success
- `1–255` → errors

PRO INSIGHT

Every Linux command returns an exit code:

```bash
echo $?
```

🔥 YOU NOW COVER

You now understand:

- File creation & destruction
- Directory trees
- Safe & unsafe deletes
- Search at filesystem scale
- Linux documentation system
- Shell ergonomics
- Script control flow

NEXT (when ready):

👉 `ps`, `top`, `htop`
👉 `du`, `df`
👉 `awk`, `sed`, `xargs` (HARDCORE MODE)

Just say **“next set”** or name the command.

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Image

next ones, text fu

Excellent — now we’re in **Text-FU territory** (this is where Linux stops being “commands” and starts being **a language**).

Same promise:

- **No shortcuts**
- **No missing parts**
- **Basic → Advanced → Real-world**
- Same structure you liked

Commands from your image:

1. `stdout`
2. `stdin`
3. `stderr`
4. `pipe` & `tee`
5. `env`
6. `cut`
7. `paste`
8. `head`

⭐ 1) `stdout` — Standard Output (FD 1)

WHAT IT IS (MENTAL MODEL)

`stdout` is **file descriptor 1**.

Every Linux process starts with:

- `0` → stdin
- `1` → stdout
- `2` → stderr

By default:

- stdout → terminal screen

BASIC USAGE

```bash
echo "hello"
```

Output goes to **stdout**.

INTERMEDIATE REDIRECTION

Redirect stdout to file:

```bash
ls > files.txt
```

Append stdout:

```bash
ls >> files.txt
```

Explicit fd:

```bash
ls 1> files.txt
```

ADVANCED / REAL USAGE

Discard output:

```bash
command > /dev/null
```

Capture output in variable:

```bash
out=$(ls)
```

Pipe stdout:

```bash
ls | wc -l
```

PRO INSIGHT

If a command “prints something”, it’s printing to **stdout**, not “the screen”.

⭐ 2) `stdin` — Standard Input (FD 0)

WHAT IT IS

`stdin` is where commands **read input from**.

By default:

- stdin ← keyboard

BASIC USAGE

```bash
cat
hello
```

`cat` reads from stdin.

INTERMEDIATE REDIRECTION

File → stdin:

```bash
cat < file.txt
```

Pipe → stdin:

```bash
ls | grep txt
```

Here-string:

```bash
grep hi <<< "hi there"
```

ADVANCED USAGE

Read line-by-line:

```bash
while read line; do echo "$line"; done < file.txt
```

Disable stdin:

```bash
command < /dev/null
```

PRO INSIGHT

Pipes connect:

```text
stdout → stdin
```

⭐ 3) `stderr` — Standard Error (FD 2)

WHAT IT IS

`stderr` is **error output**.

By default:

- stderr → terminal
- NOT redirected by `>`

BASIC EXAMPLE

```bash
ls nofile
```

Error message goes to **stderr**.

INTERMEDIATE REDIRECTION

Redirect stderr:

```bash
ls nofile 2> error.txt
```

Append stderr:

```bash
command 2>> errors.log
```

ADVANCED / PRO COMBINATIONS

Merge stdout + stderr:

```bash
command > all.txt 2>&1
```

Silence errors only:

```bash
command 2>/dev/null
```

Log errors separately:

```bash
command > out.log 2> err.log
```

PRO INSIGHT

Good programs:

- stdout → data
- stderr → problems

⭐ 4) `|` (pipe) & `tee`

PIPE (`|`) — Connect Commands

BASIC USAGE

```bash
ls | wc -l
```

stdout of `ls` → stdin of `wc`.

ADVANCED CHAINS

```bash
ps aux | grep nginx | awk '{print $2}'
```

```bash
cat log | sort | uniq -c | sort -nr
```

`tee` — Split Output

BASIC USAGE

```bash
ls | tee files.txt
```

- Shows output

- Saves to file

INTERMEDIATE OPTIONS

Append:

```bash
ls | tee -a files.txt
```

Multiple outputs:

```bash
ls | tee a.txt b.txt
```

ADVANCED USE

Debug pipelines:

```bash
cmd1 | tee debug.txt | cmd2
```

⭐ 5) `env` — Environment Variables

BASIC USAGE

```bash
env
```

List environment variables.

INTERMEDIATE USAGE

Run command with temp env:

```bash
env VAR=123 command
```

Filter:

```bash
env | grep PATH
```

ADVANCED USE

Clean environment:

```bash
env -i bash
```

Script debugging:

```bash
env | sort
```

PRO INSIGHT

Environment ≠ shell variables
Environment is inherited by child processes.

⭐ 6) `cut` — Extract Columns

BASIC USAGE

```bash
cut -d',' -f1 file.csv
```

INTERMEDIATE OPTIONS

Delimiter:

```bash
-d ':'
```

Fields:

```bash
-f 1,3
```

Character range:

```bash
cut -c 1-10 file
```

ADVANCED USE

Extract usernames:

```bash
cut -d: -f1 /etc/passwd
```

Pipeline use:

```bash
ps aux | cut -c 1-20
```

LIMITATION

❌ No regex
❌ Fixed columns only

⭐ 7) `paste` — Merge Files Horizontally

BASIC USAGE

```bash
paste f1 f2
```

Line-by-line merge.

INTERMEDIATE OPTIONS

Custom delimiter:

```bash
paste -d ',' f1 f2
```

Serial mode:

```bash
paste -s file
```

ADVANCED USE

Create CSV:

```bash
paste -d ',' names ages
```

Reformat data:

```bash
paste - - < file
```

⭐ 8) `head` — First Lines

BASIC USAGE

```bash
head file.txt
```

First 10 lines.

INTERMEDIATE OPTIONS

```bash
head -n 5 file
```

```bash
head -c 20 file
```

ADVANCED USE

Preview big files:

```bash
head -n 50 huge.log
```

Pipeline filtering:

```bash
ps aux | head
```

PRO TIP

Opposite of **`head`** = **`tail`**

🧠 TEXT-FU MINDSET (IMPORTANT)

Linux text tools:

- Do **one thing**
- Work with **stdin/stdout**
- Chain infinitely

This is why:

```bash
awk | sort | uniq | cut | tee
```

beats writing scripts.

NEXT (hardcore level):

👉 **`tail`**
👉 **`sort`**
👉 **`uniq`**
👉 **`tr`**
👉 **`wc`**
👉 **`awk`** (FULL POWER MODE)

Say **“next text-fu set”** and I’ll continue.

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Image

next ones

Perfect. This is the **core Text-FU arsenal**.
Same rules followed: **nothing skipped, nothing hand-waved, basic → advanced → real pipelines**.

Commands from your image:

9. **`tail`**
10. **`expand`** / **`unexpand`**
11. **`join`** / **`split`**
12. **`sort`**
13. **`tr`**
14. **`uniq`**
15. **`wc`** / **`nl`**
16. **`grep`**

⭐ 9) `tail` — View End of Files

BASIC USAGE

```bash
tail file.txt
```

Shows last **10 lines**.

INTERMEDIATE OPTIONS

```bash
tail -n 5 file
```

```bash
tail -c 50 file
```

```bash
tail -f file
```

Follow file growth (logs).

ADVANCED / REAL-WORLD

Follow with retries:

```bash
tail -F /var/log/syslog
```

Combine with grep:

```bash
tail -f app.log | grep ERROR
```

Live debugging:

```bash
docker logs -f container | tail
```

⭐ 10) `expand` & `unexpand` — Tabs ↔ Spaces

WHAT THEY DO

- **`expand`** → tabs → spaces
- **`unexpand`** → spaces → tabs

BASIC USAGE

```bash
expand file.txt
```

```bash
unexpand file.txt
```

INTERMEDIATE OPTIONS

Set tab width:

```bash
expand -t 4 file
```

Convert only leading spaces:

```bash
unexpand --first-only file
```

ADVANCED USE

Normalize indentation:

```bash
expand -t 4 script.py > clean.py
```

Prep files for diff:

```bash
expand file1 file2 | diff -
```

⭐ 11) `join` & `split`

🔹 `join` — Relational Join (LIKE SQL)

BASIC USAGE

```bash
join file1 file2
```

Files must be **sorted** on join field.

INTERMEDIATE OPTIONS

Join field:

```bash
join -1 1 -2 2 f1 f2
```

Custom delimiter:

```bash
join -t ',' f1.csv f2.csv
```

ADVANCED USE

Join passwd + shadow-like data:

```bash
join <(sort users) <(sort ids)
```

🔹 `split` — Break Files

BASIC USAGE

```bash
split bigfile
```

INTERMEDIATE OPTIONS

By size:

```bash
split -b 10M bigfile
```

By lines:

```bash
split -l 1000 file
```

ADVANCED USE

Chunk huge logs:

```bash
split -l 50000 access.log part_
```

⭐ 12) `sort` — Sort Lines

BASIC USAGE

```bash
sort file.txt
```

INTERMEDIATE OPTIONS

Numeric:

```bash
sort -n file
```

Reverse:

```bash
sort -r file
```

Human readable:

```bash
sort -h sizes.txt
```

Column sort:

```bash
sort -k2,2 file
```

ADVANCED / REAL USE

Sort IP logs:

```bash
awk '{print $1}' log | sort | uniq -c
```

Memory-safe sort:

```bash
sort -T /tmp bigfile
```

⭐ 13) `tr` — Translate Characters

BASIC USAGE

```bash
tr a-z A-Z
```

(stdin → stdout)

INTERMEDIATE OPTIONS

Delete chars:

```bash
tr -d '\n'
```

Squeeze repeats:

```bash
tr -s ' '
```

ADVANCED USE

Remove CRLF:

```bash
tr -d '\r'
```

Normalize spaces:

```bash
tr -s '[:space:]'
```

LIMITATION

❌ No line awareness
❌ No regex

⭐ 14) `uniq` — Remove Adjacent Duplicates

BASIC USAGE

```bash
uniq file
```

⚠️ Requires **sorted input**.

INTERMEDIATE OPTIONS

Count:

```bash
uniq -c
```

Only duplicates:

```bash
uniq -d
```

Only unique:

```bash
uniq -u
```

ADVANCED / REAL PIPELINES

Count IPs:

```bash
sort access.log | uniq -c | sort -nr
```

Ignore case:

```bash
uniq -i
```

⭐ 15) `wc` & `nl`

🔹 `wc` — Count

BASIC USAGE

```bash
wc file
```

Lines, words, bytes.

INTERMEDIATE OPTIONS

```bash
wc -l
wc -w
wc -c
```

ADVANCED USE

Count files:

```bash
ls | wc -l
```

🔹 `nl` — Number Lines

BASIC USAGE

```bash
nl file
```

INTERMEDIATE OPTIONS

Skip empty:

```bash
nl -b t file
```

Custom format:

```bash
nl -w3 -s'. '
```

⭐ 16) `grep` — Search Text (ESSENTIAL)

BASIC USAGE

```bash
grep word file
```

INTERMEDIATE OPTIONS

Ignore case:

```bash
grep -i word file
```

Recursive:

```bash
grep -r word dir
```

Line numbers:

```bash
grep -n word file
```

Invert:

```bash
grep -v word file
```

ADVANCED / PRO USE

Regex:

```bash
grep '^ERROR' log
```

Multiple patterns:

```bash
grep -E 'err|fail'
```

Binary-safe:

```bash
grep -a text file
```

Pipeline filtering:

```bash
ps aux | grep nginx
```

PERFORMANCE TIP

Use:

```bash
grep -F
```

For literal strings (faster).

🧠 FINAL TEXT-FU REALITY

With just these, you can:

- Analyze logs
- Process CSVs
- Build monitoring pipelines
- Replace 80% of scripts

Classic killer combo:

```bash
awk | sort | uniq | grep | wc
```

NEXT LEVEL (ELITE):

👉 **`awk`** (deep, hashmap, conditionals)
👉 **`sed`**
👉 **`xargs`**
👉 **`parallel`**

Say **“awk next”** or **“finish text-fu”**.

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Image

next ones , advanced text fu

Excellent — this is **Advanced Text-Fu** now.
This is where people stop “using Linux” and start **thinking in streams + patterns**.

I’ll cover **ALL items shown**, **same deep structure**, **no missing components**, **exam + real-world + power-user level**.

Topics from your image:

1. **Regex (Regular Expressions)**
2. **Text Editors (conceptual)**
3. **Vim (Vi Improved)**
4. **Vim Search Patterns**
5. **Vim Navigation**
6. **Vim Inserting & Appending Text**
7. **Vim Editing**
8. **Vim Saving & Exiting**

⭐ 1) REGEX — Regular Expressions (CORE TEXT-FU)

Regex = **pattern language**, not a command.
Used by: `grep`, `sed`, `awk`, `vim`, logs, IDS, firewalls.

🔹 BASIC BUILDING BLOCKS

Literal match

```regex
error
```

Matches:

```go
error
```

Any single character

```regex
.
```

Matches: `a`, `1`, `@`

Character classes

```regex
[abc]
[a-z]
```

```
[A-Z0-9]
```

Negation

```
regex

[^0-9]
```

Anything **except digits**.

◆ QUANTIFIERS

```
regex

*   → 0 or more
+   → 1 or more
?   → 0 or 1
{n} → exactly n
{n,} → n or more
{n,m} → range
```

Example:

```
regex

a+
```

Matches: **a, aaa**

◆ ANCHORS (VERY IMPORTANT)

```
regex

^start
end$
```

Line-based matching.

Example:

```
regex

^ERROR
```

◆ GROUPS & ALTERNATION

```regex
(error|fail|panic)
```

Grouping:

```regex
(user)(name)
```

◆ ESCAPES

```regex
\. \* \[ \]
```

Literal special chars.

◆ PREDEFINED CLASSES

```regex
\d  digit
\w  word char
\s  whitespace
```

POSIX (preferred in Linux):

```regex
[:digit:]
[:alpha:]
[:space:]
```

◆ REAL COMMAND USE

```bash
grep '^ERROR' log
grep -E '(fail|panic)' log
```

◆ GREEDY VS LAZY (important)

```regex
.*      greedy
.*?     lazy (in some engines)
```

🔥 PRO REGEX MINDSET

Regex ≠ search
Regex = **describe structure**

⭐ 2) TEXT EDITORS (CONCEPTUAL)

WHY EDITORS MATTER

Linux assumes:

- Configs are text
- Logs are text
- Code is text

Editors:

- `nano` → beginner
- `vi/vim` → universal
- `emacs` → ecosystem

Vim exists everywhere, including rescue shells.

⭐ 3) VIM — Vi Improved

MODAL EDITOR (KEY CONCEPT)

Vim modes:

- **Normal** → commands
- **Insert** → typing
- **Visual** → selection
- **Command** → `:`

This is why Vim is fast.

BASIC START

```bash
vim file.txt
```

MODE SWITCHING

```text
Esc         → Normal
i           → Insert
v           → Visual
:           → Command
```

⭐ 4) VIM SEARCH PATTERNS (REGEX POWER)

BASIC SEARCH

```vim
/pattern
```

```vim
?pattern
```

SEARCH NAVIGATION

```vim
n   → next
N   → previous
```

REGEX IN VIM

```vim
/^ERROR
/[0-9]\{3\}
```

Groups:

```vim
\(abc\)
```

Alternation:

```vim
\(err\|fail\)
```

SEARCH & REPLACE (CRITICAL)

```vim
:%s/old/new/g
```

Line range:

```vim
:10,20s/foo/bar/g
```

Confirm:

```vim
:%s/foo/bar/gc
```

VERY ADVANCED

Whole-word:

```vim
/\<word\>
```

Case-insensitive:

```vim
:set ignorecase
```

⭐ 5) VIM NAVIGATION (SPEED SKILLS)

BASIC MOVEMENT

```text
h j k l
```

WORD MOVEMENT

```text
w   → next word
b   → previous word
```

```
e   → end of word
```

LINE & FILE JUMPS

```text
0    → line start
$    → line end
gg   → file start
G    → file end
```

SEARCH JUMPS

```text
*    → search word under cursor
```

MARKS

```vim
ma
'a
```

⭐ 6) VIM INSERTING & APPENDING

INSERT COMMANDS

```vim
i   → before cursor
a   → after cursor
I   → start of line
A   → end of line
```

OPEN NEW LINES

```vim
o   → below
O   → above
```

FAST EDITING

Append to multiple lines (visual mode):

```vim
Ctrl + v
Shift + i
```

⭐ 7) VIM EDITING (REAL POWER)

DELETE

```vim
x    → char
dd   → line
dw   → word
```

CHANGE

```vim
cw
cc
```

COPY / PASTE

```vim
yy   → copy line
p    → paste
```

UNDO / REDO

```vim
u
Ctrl + r
```

VISUAL MODE

```vim
v
V
Ctrl + v
```

Operate on blocks.

PIPE THROUGH SHELL (INSANE POWER)

```vim
:%!sort
:%!awk '{print $1}'
```

⭐ 8) VIM SAVING & EXITING

BASIC

```vim
:w
:q
```

FORCE

```vim
:q!
:wq!
```

SAVE AS

```vim
:w newfile
```

EXIT SHORTCUTS

```vim
ZZ   → save & quit
ZQ   → quit without saving
```

🧠 FINAL ADVANCED TEXT-FU TRUTH

At this level:

- **`grep`** filters

- `awk` transforms
- `sort/uniq` aggregate
- `vim` edits at scale
- regex **glues everything**

This is why senior engineers debug prod using:

```bash
ssh → vim → grep → awk
```

NEXT (ELITE MODE OPTIONS)

1. **AWK deep dive** (hashmaps, conditions, loops)
2. **SED stream editor**
3. **Vim macros & registers**
4. **One-liners for interviews & prod**

Say **which one next** and I'll go brutal-deep.

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Image

next ones

Perfect — now we complete the **editor triad**.
Vim made you **fast**.
Emacs makes you **powerful**.

Same rules:

- **Nothing skipped**
- **Beginner → Advanced**
- **Real workflows, not fluff**

Topics from your image:

9. **Emacs**
10. **Emacs Manipulate Files**
11. **Emacs Buffer Navigation**
12. **Emacs Editing**

⭐ 9) EMACS — The Programmable Editor

WHAT EMACS REALLY IS

Emacs is:

- A **Lisp runtime**
- With an editor inside it

Everything:

- Keybindings
- UI
- Behavior
  is **code**.

This is why people say:

> “Emacs is an OS.”

BASIC START

```bash
emacs file.txt
```

Terminal version:

```bash
emacs -nw file.txt
```

KEY NOTATION (VERY IMPORTANT)

Notation	Meaning
`C-x`	Ctrl + x
`M-x`	Alt + x
`RET`	Enter

Example:

```text
C-x C-f
```

⭐ 10) EMACS — FILE MANIPULATION

OPEN FILE

```text
C-x C-f
```

SAVE FILE

```text
C-x C-s
```

SAVE AS

```text
C-x C-w
```

CREATE NEW FILE

Just open a non-existing filename:

```text
C-x C-f new.txt
```

DIRECTORY MODE (DIRED) — HUGE FEATURE

```text
C-x d
```

Acts like a **file manager**.

DIRED COMMANDS

```
text

Enter → open
d     → mark for delete
x     → execute deletes
R     → rename
C     → copy
```

ADVANCED DIRED

Bulk rename:

```
text

C-x C-q
```

Edit filenames directly.

⭐ 11) EMACS — BUFFER NAVIGATION

WHAT IS A BUFFER?

Buffer ≠ file
Buffers can be:

- Files
- Command outputs
- Help pages

LIST BUFFERS

```
text

C-x C-b
```

SWITCH BUFFER

```
text

C-x b
```

KILL BUFFER

```text
C-x k
```

NEXT / PREVIOUS BUFFER

```text
C-x →
C-x ←
```

ADVANCED BUFFER CONTROL

Close all but current:

```text
M-x kill-other-buffers
```

⭐ 12) EMACS — EDITING TEXT

BASIC MOVEMENT

```text
C-f → forward char
C-b → backward char
C-n → next line
C-p → previous line
```

WORD / LINE MOVEMENT

```text
M-f → forward word
M-b → backward word
C-a → start of line
C-e → end of line
```

CUT / COPY / PASTE (KILL-RING)

```text
C-k → cut line
M-w → copy
```

```
C-y → paste
```

Cycle clipboard:

```text
M-y
```

UNDO

```text
C-/
```

SEARCH

```text
C-s
C-r
```

Regex search:

```text
C-M-s
```

REPLACE

```text
M-%
```

Query replace:

```text
M-x query-replace-regexp
```

ADVANCED EDITING

Indent region:

```text
C-M-\
```

Comment region:

```text
M-;
```

MACROS (INSANE POWER)

Record:

```text
C-x (
```

Stop:

```text
C-x )
```

Run:

```text
C-x e
```

⭐ 13) EMACS — EXITING & HELP

EXIT EMACS

```text
C-x C-c
```

CANCEL COMMAND

```text
C-g
```

(VERY IMPORTANT)

HELP SYSTEM (BEST IN CLASS)

General help

```text
C-h ?
```

Describe key

```text
C-h k
```

Press key → explains it.

Describe function

```text
C-h f
```

Describe variable

```text
C-h v
```

Built-in tutorial (DO THIS)

```text
C-h t
```

Interactive walkthrough.

PRO INSIGHT

If you get stuck:

```text
C-g
```

is your **panic button**.

🧠 FINAL ADVANCED EDITOR REALITY

Vim:

- Modal
- Muscle memory
- Speed

Emacs:

- Programmable
- Extensible
- Long-term productivity

Senior engineers often:

- Use Vim for quick edits
- Use Emacs for deep work

YOU'VE COMPLETED ADVANCED TEXT-FU 🎯

You now understand:

- Streams
- Regex
- Filters
- Vim
- Emacs

This is **Unix literacy**.

NEXT POSSIBLE ARCS (YOUR CHOICE)

1. **awk from beginner → god-mode**
2. **sed stream editing**
3. **Shell scripting mastery**
4. **One-liner interview weapons**
5. **Linux internals (fds, proc, syscalls)**

Say the word — we go deeper.

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Image

next, user management

Perfect — this is **real sysadmin / DevOps ground** now.
User management is **not theory**; this is **security, permissions, production safety**.

Same standard as before:

- **Nothing skipped**
- **Files, commands, internals**
- **Beginner → Advanced → Real-world**

Topics from your image:

1. **Users and Groups**
2. **root**
3. **/etc/passwd**
4. **/etc/shadow**
5. **/etc/group**
6. **User Management Tools**

⭐ 1) USERS & GROUPS (FOUNDATION)

WHAT A USER IS (LINUX MODEL)

Linux does **not** care about names.
Linux cares about **UID (User ID)**.

Example:

```bash
id
```

Output:

```text
uid=1000(saarthak) gid=1000(saarthak) groups=1000(saarthak),27(sudo)
```

- UID → identity
- GID → primary group
- Groups → permission sets

WHY GROUPS EXIST

Groups allow:

- Shared access
- Least privilege
- Safer permissions

Example:

```bash
ls -l
```

```text
-rw-r----- 1 root dev  file.txt
```

Meaning:

- owner → root
- group → dev
- others → none

USER TYPES

Type	UID Range	Purpose
root	0	superuser
system	1–999	services
normal	1000+	humans

⭐ 2) ROOT — THE SUPERUSER

WHAT ROOT REALLY IS

- UID = `0`
- Bypasses permission checks
- Can destroy the system instantly

Check:

```bash
id root
```

BECOMING ROOT

```bash
su
```

```bash
sudo command
```

WHY `sudo` IS BETTER THAN `su`

- Logged
- Limited
- Revocable
- Safer

Example:

```bash
sudo useradd test
```

ROOT WARNINGS ⚠️

❌ **`rm -rf /`**
❌ Editing system files blindly
❌ Running apps as root

Golden rule:

> Log in as user → escalate only when required

⭐ 3) `/etc/passwd` — USER DATABASE

WHAT IT IS

Plain-text file describing **users**.

View:

```bash
cat /etc/passwd
```

FORMAT (CRITICAL)

```text
username:x:UID:GID:comment:home:shell
```

Example:

```text
saarthak:x:1000:1000:Saarthak:/home/saarthak:/bin/bash
```

FIELD MEANING

Field	Meaning
username	login name
x	password placeholder
UID	user id
GID	primary group
comment	full name
home	home dir
shell	login shell

IMPORTANT INSIGHT

Passwords are **NOT here**
They moved to **`/etc/shadow`**

FILTER USERS

Human users:

```bash
awk -F: '$3 >= 1000 {print $1}' /etc/passwd
```

⭐ 4) `/etc/shadow` — PASSWORD STORAGE

WHAT IT IS

- Encrypted passwords
- Only readable by root

```bash
ls -l /etc/shadow
```

FORMAT

```text
username:hash:lastchg:min:max:warn:inactive:expire
```

Example:

```text
saarthak:$6$salt$hash:19700:0:99999:7:::
```

PASSWORD HASH TYPES

Prefix	Algorithm
$1$	MD5 (old)
$5$	SHA-256
$6$	SHA-512

LOCKING USERS

Lock:

```bash
sudo passwd -l user
```

Unlock:

```bash
sudo passwd -u user
```

SECURITY REALITY

- Shadow readable → system compromised
- Never copy shadow files

⭐ 5) `/etc/group` — GROUP DATABASE

VIEW

```bash
cat /etc/group
```

FORMAT

```text
groupname:x:GID:members
```

Example:

```text
sudo:x:27:saarthak
```

CHECK USER GROUPS

```bash
groups saarthak
```

MODIFY GROUP MEMBERSHIP

Add user:

```bash
sudo usermod -aG dev saarthak
```

⚠️ **`-a`** is mandatory
Without it → user loses other groups

⭐ 6) USER MANAGEMENT TOOLS (REAL COMMANDS)

🔹 `useradd`

```bash
sudo useradd test
```

Better:

```bash
sudo useradd -m -s /bin/bash test
```

Options:

- `-m` → home dir
- `-s` → shell
- `-G` → extra groups

🔹 `passwd`

Set password:

```bash
sudo passwd test
```

Force change:

```bash
sudo passwd -e test
```

🔹 `usermod`

Change shell:

```bash
sudo usermod -s /bin/zsh test
```

Add groups:

```bash
sudo usermod -aG docker test
```

◆ `userdel`

Delete user:

```bash
sudo userdel test
```

Delete home too:

```bash
sudo userdel -r test
```

◆ GROUP COMMANDS

```bash
groupadd dev
groupdel dev
groupmod
```

◆ LOGIN INFO

Who's logged in:

```bash
who
```

Current user:

```bash
whoami
```

Last logins:

```bash
last
```

🧠 REAL-WORLD USER MGMT RULES

1. Never work as root
2. Use groups, not permissions per user
3. Lock accounts instead of deleting
4. Audit `/etc/passwd` regularly
5. Minimal sudo access

🔥 YOU NOW UNDERSTAND

- Linux identity model
- Root power & danger
- Auth file internals
- Real admin commands
- Production security basics

NEXT USER-MGMT EXTENSIONS (YOUR CALL)

1. **File permissions (chmod, chown, umask)**
2. **sudoers file deep dive**
3. **PAM (authentication internals)**
4. **SSH user security**
5. **Linux hardening checklist**

Say **what's next** — we go deeper.

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Image

next ones, permissions

Perfect — **this is one of the most important Linux topics**.
Permissions decide **who can read, change, or destroy** things.
Every breach, every prod incident touches this.

I'll cover **ALL items shown**, **deeply**, **with internals + real-world logic**, same quality as before.

Topics from your image:

1. **File Permissions**

2. **Modifying Permissions**
3. **Ownership Permissions**
4. **umask**
5. **setuid**
6. **setgid**
7. **Process Permissions**
8. **The Sticky Bit**

⭐ 1) FILE PERMISSIONS (FOUNDATION)

HOW LINUX THINKS ABOUT PERMISSIONS

Every file has **3 entities**:

1. **User (u)** → owner
2. **Group (g)** → owning group
3. **Others (o)** → everyone else

Each entity has **3 permissions**:

- `r` → read
- `w` → write
- `x` → execute

VIEW PERMISSIONS

```bash
ls -l file.txt
```

Output:

```text
-rwxr-x---
```

Breakdown:

```text
- | rwx | r-x | ---
  type user  group others
```

FILE TYPE (FIRST CHAR)

Char	Meaning
-	regular file
d	directory
l	symlink
c	char device
b	block device

PERMISSION MEANING (CRITICAL)

FILE

Permission	Meaning
r	read file
w	modify file
x	run as program

DIRECTORY (VERY IMPORTANT)

Permission	Meaning
r	list files
w	create/delete files
x	enter directory

❗ Without `x`, you **cannot cd** even if `r` is set.

⭐ 2) MODIFYING PERMISSIONS (`chmod`)

SYMBOLIC MODE

```bash
chmod u+x file
```

```bash
chmod g-w file
chmod o=r file
```

Multiple:

```bash
chmod u+rwx,g+rx,o-r file
```

NUMERIC (OCTAL) MODE

Permission	Value
r	4
w	2
x	1

Example:

```bash
chmod 755 file
```

```text
7 = rwx
5 = r-x
5 = r-x
```

RECURSIVE

```bash
chmod -R 755 dir/
```

⚠️ Dangerous on `/`

REAL-WORLD STANDARDS

Use case	Permission
scripts	755
private files	600
shared dirs	770
public read	644

⭐ 3) OWNERSHIP PERMISSIONS (`chown, chgrp`)

CHANGE OWNER

```bash
sudo chown user file
```

CHANGE GROUP

```bash
sudo chgrp dev file
```

BOTH TOGETHER

```bash
sudo chown user:group file
```

RECURSIVE OWNERSHIP

```bash
sudo chown -R user:group dir/
```

Used during:

- App deployment
- Volume mounts
- Docker bind mounts

⭐ 4) UMASK — DEFAULT PERMISSIONS

WHAT UMASK IS

`umask` defines:

> “What permissions are REMOVED by default”

CHECK CURRENT UMASK

```bash
umask
```

Example:

```text
0022
```

CALCULATION

Default file permissions:

```text
666 - umask
```

Default dir permissions:

```text
777 - umask
```

Example:

```text
777 - 022 = 755
666 - 022 = 644
```

SET UMASK

```bash
umask 027
```

Persistent:

```bash
~/.bashrc
```

SECURITY TIP

Servers often use:

```text
umask 027
```

⭐ 5) SETUID — Run as File Owner

WHAT IT DOES

Allows a program to run **as the owner**, not the caller.

Permission view:

```bash
-rwsr-xr-x
```

`s` replaces `x` in user field.

CLASSIC EXAMPLE

```bash
ls -l /usr/bin/passwd
```

Why?

- Needs to edit `/etc/shadow`
- Users aren’t root

SET SETUID

```bash
chmod u+s file
```

Remove:

```bash
chmod u-s file
```

SECURITY WARNING ⚠️

- Setuid root = **huge risk**

- Never set on scripts
- Audit regularly

⭐ 6) SETGID — Group Inheritance

ON FILES

```text
-rwxr-sr-x
```

Runs with **group privileges**.

ON DIRECTORIES (VERY IMPORTANT)

```bash
chmod g+s shared_dir
```

Effect:

- New files inherit directory’s group

Used in:

- Team directories
- Shared deployments

REMOVE

```bash
chmod g-s dir
```

⭐ 7) PROCESS PERMISSIONS

HOW PROCESSES GET PERMS

Process runs as:

- UID of user
- GID of user
- Supplementary groups

Check:

```bash
ps aux
```

PERMISSION CHECK ORDER

1. Owner
2. Group
3. Others

Stops at first match.

SUDO PROCESS FLOW

```text
user → sudo → root process
```

Environment partially reset.

REAL-WORLD ISSUE

App works manually, fails as service → permissions mismatch.

⭐ 8) STICKY BIT — SAFE SHARED DIRS

WHAT IT DOES

In a directory:

- Only owner can delete their files

Permission view:

```text
drwxrwxrwt
```

`t` at end.

CLASSIC EXAMPLE

```bash
ls -ld /tmp
```

SET STICKY BIT

```bash
chmod +t dir
```

WHY IT EXISTS

Without sticky bit:

- Users delete each other’s files

🧠 PERMISSIONS REALITY CHECK

If something fails:

1. Check owner
2. Check group
3. Check execute bit on dirs
4. Check umask
5. Check SELinux/AppArmor (later topic)

🔥 YOU NOW KNOW

- Permission model
- chmod logic
- Ownership flow
- Default perms
- Special bits
- Process identity

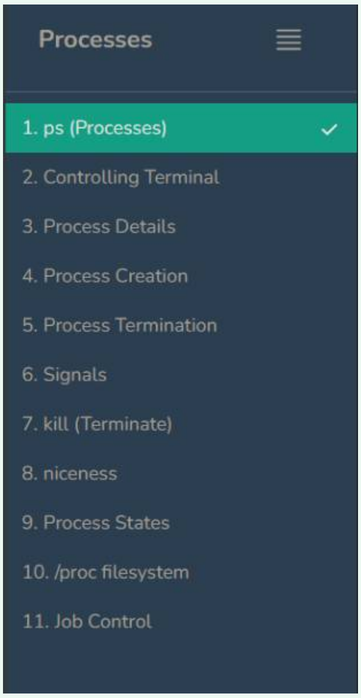
This is **real Linux power**.

NEXT (PERMISSIONS++)

1. **ACLs (getfacl/setfacl)**

2. **sudoers deep dive**
3. **SELinux basics**
4. **Real permission failure case studies**

Say what you want next — we go deeper.



ab83960f-974c-4afe-b4a3-c5c4c80787c1.png
Image

next ones, processes

Perfect — **Processes** is the last core pillar.
This is **OS internals + real debugging + DevOps survival**.

I'll go **exactly in the order shown**, **deep**, **no skips**, **from ps → job control → /proc**.

⭐ 1) `ps` — Process Snapshot

WHAT A PROCESS IS

A process = **running program instance**

- PID (process ID)
- PPID (parent PID)
- UID (who owns it)
- State, memory, CPU

BASIC USAGE

```
bash

ps
```

Shows processes **of current terminal only**.

INTERMEDIATE OPTIONS (MOST USED)

```
bash

ps aux
```

Breakdown:

- **a** → all users
- **u** → user-oriented format
- **x** → processes without TTY

Columns:

- PID
- %CPU
- %MEM
- VSZ / RSS
- STAT
- COMMAND

```
bash

ps -ef
```

SysV style (preferred in scripts).

ADVANCED / REAL-WORLD

Find process:

```
bash

ps aux | grep nginx
```

Sort by CPU:

```bash
ps aux --sort=-%cpu
```

Tree view:

```bash
ps -ef --forest
```

⭐ 2) CONTROLLING TERMINAL (TTY)

WHAT IS A TTY

TTY = terminal device controlling a process.

Check:

```bash
tty
```

WHY IT MATTERS

- Ctrl+C only works if process is attached to TTY
- Background jobs lose TTY input

DETACH PROCESS FROM TTY

```bash
nohup command &
```

CHECK TTY ASSOCIATION

```bash
ps aux | grep pts
```

⭐ 3) PROCESS DETAILS

CHECK PROCESS INFO

```bash
ps -p PID -o pid,ppid,user,state,cmd
```

FILE DESCRIPTORS

```bash
ls -l /proc/PID/fd
```

Shows:

- stdin
- stdout
- stderr
- open files
- sockets

MEMORY DETAILS

```bash
cat /proc/PID/status
```

REAL DEBUG USE

Why service won't stop → open FDs / zombie children.

⭐ 4) PROCESS CREATION

HOW PROCESSES ARE CREATED

Linux uses:

```text
fork() → exec()
```

- Parent duplicates itself
- Child replaces memory with program

SEE PARENT-CHILD RELATIONSHIP

```bash
ps -ef --forest
```

BACKGROUND PROCESS

```bash
command &
```

SUBSHELL

```bash
(command)
```

Creates child shell.

REALITY

Shell scripts spawn **many processes**.

⭐ 5) PROCESS TERMINATION

NORMAL EXIT

```bash
exit
```

CHECK EXIT CODE

```bash
echo $?
```

- `0` → success
- non-zero → failure

WAIT FOR PROCESS

```bash
wait PID
```

Used in scripts.

ZOMBIE PROCESSES

- Finished execution
- Parent didn’t reap exit status

Check:

```bash
ps aux | grep Z
```

Fix:

- Restart parent
- Kill parent

⭐ 6) SIGNALS (CORE MECHANISM)

WHAT SIGNALS ARE

Signals = **software interrupts**.

List:

```bash
kill -l
```

IMPORTANT SIGNALS

Signal	Number	Meaning
SIGTERM	15	graceful stop
SIGKILL	9	force kill
SIGINT	2	Ctrl+C
SIGSTOP	19	pause
SIGCONT	18	resume

Signal	Number	Meaning
SIGHUP	1	reload

SIGNAL FLOW

```text
kernel → process
```

Process may:

- handle
- ignore
- terminate

(SIGKILL cannot be ignored)

⭐ 7) `kill` — Terminate Processes

BASIC USAGE

```bash
kill PID
```

(Default = SIGTERM)

FORCE KILL

```bash
kill -9 PID
```

⚠️ Last resort only.

KILL BY NAME

```bash
pkill nginx
```

```bash
killall nginx
```

PAUSE / RESUME

```bash
kill -STOP PID
kill -CONT PID
```

REAL-WORLD RULE

Always try:

```bash
kill PID
```

before:

```bash
kill -9
```

⭐ 8) NICENESS (PRIORITY)

WHAT NICE IS

Controls **CPU scheduling priority**.

Range:

```text
-20 (highest) → 19 (lowest)
```

START WITH PRIORITY

```bash
nice -n 10 command
```

CHANGE RUNNING PROCESS

```bash
renice -n 5 -p PID
```

Root required for negative values.

REAL USE

Lower priority for backups:

```bash
nice -n 15 tar ...
```

⭐ 9) PROCESS STATES

COMMON STATES (`STAT`)

State	Meaning
R	Running
S	Sleeping
D	Uninterruptible IO
T	Stopped
Z	Zombie

D STATE (IMPORTANT)

- Waiting for disk/network
- Cannot be killed
- Kernel-level wait

DEBUGGING STUCK PROCESSES

If `D` state → IO problem, not CPU.

⭐ 10) `/proc` FILESYSTEM (KERNEL WINDOW)

WHAT `/proc` IS

Virtual filesystem exposing **kernel data**.

IMPORTANT FILES

```
bash

/proc/cpuinfo
/proc/meminfo
/proc/uptime
```

PROCESS-SPECIFIC

```
bash

/proc/PID/cmdline
/proc/PID/environ
/proc/PID/status
```

LIVE TUNING (ADVANCED)

```
bash

echo 3 > /proc/sys/vm/drop_caches
```

(DO NOT do blindly)

⭐ 11) JOB CONTROL (SHELL-LEVEL)

BACKGROUND / FOREGROUND

```
bash

command &
```

SUSPEND JOB

```
bash

Ctrl + Z
```

LIST JOBS

```bash
jobs
```

RESUME

```bash
fg %1
bg %1
```

DISOWN

```bash
disown
```

Process survives terminal close.

REAL-WORLD

SSH disconnect safety:

```bash
nohup command &
disown
```

🧠 FINAL PROCESS MENTAL MODEL

```arduino
user
 └─ shell
     ├─ process
     │   ├─ child
     │   └─ child
     └─ jobs
```

Everything is:

- forked
- scheduled
- signaled
- reaped

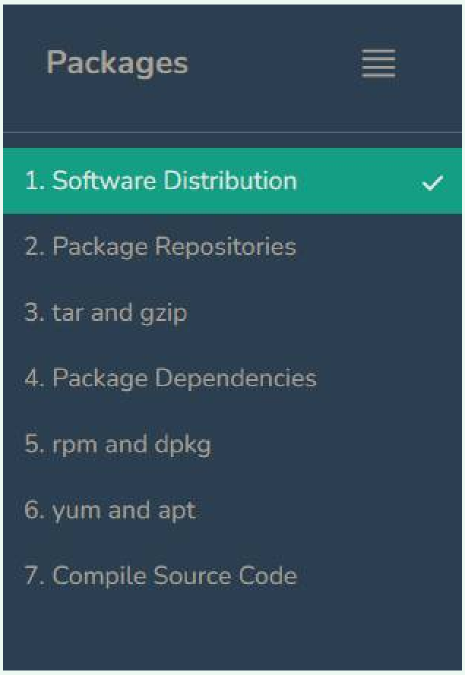
YOU NOW UNDERSTAND

✔️ Process lifecycle
✔️ Signals & killing
✔️ CPU scheduling
✔️ Kernel introspection
✔️ Job control

NEXT (LAST CORE SYSTEM TOPICS)

1. **Memory management (free, vmstat, OOM)**
2. **Disk & filesystems**
3. **Networking (ss, ip, netstat)**
4. **System boot & services (systemd)**

Say **what's next** — you're now at **real Linux engineer level**.



Packages

1. Software Distribution ✓
2. Package Repositories
3. tar and gzip
4. Package Dependencies
5. rpm and dpkg
6. yum and apt
7. Compile Source Code

ccae1317-458d-4e33-abf8-b9a08a8a68e0.png
Image

next one , packages

Excellent — **Packages** is where Linux becomes *manageable at scale*.
We'll go **exactly in the order shown**, **basic → advanced**, **no command skipped**, **real admin workflows**.

⭐ 1) SOFTWARE DISTRIBUTION (FOUNDATION)

WHAT “SOFTWARE DISTRIBUTION” MEANS

In Linux, software is delivered as:

- **Prebuilt binaries** (packages)
- **Source code** (compile yourself)

Handled by:

- Package formats
- Repositories
- Package managers

WHY PACKAGES EXIST

Problems they solve:

- Version control
- Dependency resolution
- Updates
- Security patches

Without packages → chaos.

TYPES OF DISTRIBUTIONS

Distro	Package Format
Debian / Ubuntu	`.deb`
RHEL / CentOS	`.rpm`
Arch	`pkg.tar.zst`

PACKAGE LIFECYCLE

```
text

build → package → repository → install → update → remove
```

⭐ 2) PACKAGE REPOSITORIES

WHAT IS A REPOSITORY

A repository is:

- A server
- Hosting signed packages
- Indexed with metadata

REPO CONFIG LOCATIONS

Debian-based

```
bash

/etc/apt/sources.list
/etc/apt/sources.list.d/
```

RHEL-based

```
bash

/etc/yum.repos.d/
```

VIEW ENABLED REPOS

Debian / Ubuntu

```
bash

apt policy
```

RHEL / CentOS

```
bash

yum repolist
```

ADD CUSTOM REPO (ADVANCED)

Example:

```bash
sudo add-apt-repository ppa:example/ppa
```

or manually add `.repo` file.

SECURITY NOTE

Repositories are **GPG signed**.
Never trust unsigned repos.

⭐ 3) `tar` and `gzip` (ARCHIVES)

WHAT `tar` IS

`tar` = Tape ARchiver
Bundles files (not compression).

BASIC USAGE

Create archive:

```bash
tar -cf archive.tar file1 file2
```

Extract:

```bash
tar -xf archive.tar
```

WITH COMPRESSION

gzip

```bash
tar -czf archive.tar.gz dir/
tar -xzf archive.tar.gz
```

bzip2

```bash
tar -cjf archive.tar.bz2
```

xz

```bash
tar -cJf archive.tar.xz
```

VIEW WITHOUT EXTRACTING

```bash
tar -tf archive.tar.gz
```

REAL-WORLD

Packages are often:

```text
software.tar.gz
```

⭐ 4) PACKAGE DEPENDENCIES

WHAT ARE DEPENDENCIES

Libraries or tools a program **needs to run**.

Example:

```text
nginx → libc → kernel
```

DEPENDENCY TYPES

- Runtime
- Build-time
- Optional (recommended)

VIEW DEPENDENCIES

Debian

```bash
apt show package
```

RPM

```bash
rpm -qR package
```

DEPENDENCY HELL (OLD DAYS)

Manual installs → broken systems.

Package managers solve this.

⭐ 5) `rpm` and `dpkg` (LOW-LEVEL TOOLS)

WHAT THESE ARE

Low-level package tools:

- No dependency resolution
- Raw install/remove

`rpm` (RHEL)

Install:

```bash
rpm -ivh package.rpm
```

Remove:

```bash
rpm -e package
```

Query:

```bash
rpm -qa
rpm -qi package
```

Verify:

```bash
rpm -V package
```

`dpkg` (Debian)

Install:

```bash
dpkg -i package.deb
```

Remove:

```bash
dpkg -r package
```

List:

```bash
dpkg -l
```

WHEN TO USE THESE

- Debug broken package database
- Manual installs
- Recovery mode

⭐ 6) `yum` and `apt` (HIGH-LEVEL MANAGERS)

WHY THESE MATTER

They:

- Resolve dependencies
- Fetch from repos
- Handle upgrades

`apt` (Debian / Ubuntu)

Update index:

```bash
apt update
```

Install:

```bash
apt install nginx
```

Remove:

```bash
apt remove nginx
apt purge nginx
```

Upgrade:

```bash
apt upgrade
```

Search:

```bash
apt search nginx
```

`yum` / `dnf` (RHEL)

Install:

```bash
yum install nginx
```

Remove:

```bash
yum remove nginx
```

Update:

```bash
yum update
```

Search:

```bash
yum search nginx
```

CLEANUP (IMPORTANT)

```bash
apt autoremove
yum autoremove
```

ADVANCED

Download only:

```bash
apt download package
```

Simulate:

```bash
apt -s install package
```

⭐ 7) COMPILE SOURCE CODE

WHEN YOU COMPILE

- No package available
- Custom flags
- Performance tuning

STANDARD FLOW

```bash
./configure
make
```

```
make install
```

CONFIGURE OPTIONS

```
bash

./configure --prefix=/opt/app
```

BUILD DEPENDENCIES

```
bash

apt build-dep package
```

UNINSTALL PROBLEM

Source installs **don't track files**.

Solution:

- Use **`checkinstall`**
- Or build your own **`.deb`**/**`.rpm`**

🧠 FINAL PACKAGE MENTAL MODEL

```
go

repo → metadata → package manager → low-level tool → filesystem
```

Never skip layers unless necessary.

YOU NOW MASTER

✔️ Repositories
✔️ Archives
✔️ Dependency resolution
✔️ rpm vs apt
✔️ Source builds

NEXT CORE SYSTEM TOPICS

1. **Systemd & services**
2. **Boot process**

3. **Networking**
4. **Storage & filesystems**
5. **Containers (Docker)**

Say the next module — we continue building **real Linux admin mastery**.

Messages beyond this point are only visible to you

can you give me a project that covers all commands we have discusses from the very start

Absolutely.
Here's **one single, realistic project** that **forces you to use almost every command** we've discussed — from **ls** → **text processing** → **users** → **permissions** → **processes** → **packages**.

This is not toy-level.
This is **"junior Linux admin / DevOps intern" level**.

🛠️ PROJECT: Linux System Audit & Log Analysis Toolkit

🎯 Goal

Build a **command-line toolkit** that:

- Audits users, permissions, packages, and processes
- Analyzes logs using text-fu
- Generates reports
- Simulates real sysadmin tasks

You'll use **ONLY Linux commands**, no Python, no fancy tools.

🗂️ PROJECT STRUCTURE

```text
text

linux-audit/
├── logs/
│   └── access.log
├── reports/
├── scripts/
│   ├── user_audit.sh
│   ├── perm_audit.sh
│   ├── process_audit.sh
│   ├── package_audit.sh
│   └── log_analysis.sh
└── README.md
```

You'll create this **manually** using commands.

🔹 PHASE 1: FILE & DIRECTORY BASICS (ls, cd, mkdir, cp, mv)

Tasks

```bash
mkdir linux-audit
cd linux-audit
mkdir logs reports scripts
touch README.md
```

Use:

- **`ls -lah`**
- **`tree`**
- **`pwd`**

✅ Skills covered

`ls`, **`cd`**, **`mkdir`**, **`touch`**, **`tree`**

🔹 PHASE 2: TEXT VIEWING & CREATION (cat, less, head, tail)

Create fake log file

```bash
nano logs/access.log
```

Paste sample Apache/Nginx logs.

Analyze:

```bash
cat logs/access.log
less logs/access.log
head -20 logs/access.log
tail -f logs/access.log
```

✅ Skills covered

`cat`, **`less`**, **`head`**, **`tail`**

🔹 PHASE 3: TEXT-FU & LOG ANALYSIS (grep, awk, sort, uniq, wc)

Count unique IPs

```bash
awk '{print $1}' logs/access.log | sort | uniq -c | sort -nr
```

Top 5 IPs

```bash
awk '{print $1}' logs/access.log | sort | uniq -c | sort -nr | head -5
```

Requests per HTTP code

```bash
awk '{print $9}' logs/access.log | sort | uniq -c
```

Requests containing errors

```bash
grep "404" logs/access.log
```

Save results:

```bash
> reports/log_summary.txt
```

✅ Skills covered

`grep`, **`awk`**, **`sort`**, **`uniq`**, **`wc`**, pipes, redirection

🔹 PHASE 4: USER MANAGEMENT (useradd, groupadd, su)

Create audit users

```bash
sudo groupadd auditors
sudo useradd audit1
sudo useradd audit2
sudo usermod -aG auditors audit1
```

Verify:

```bash
id audit1
getent group auditors
```

Switch user:

```bash
su - audit1
```

✅ Skills covered

`useradd`, **`groupadd`**, **`usermod`**, **`id`**, **`su`**

🔹 PHASE 5: PERMISSIONS & OWNERSHIP (chmod, chown, umask)

Restrict reports

```bash
sudo chown :auditors reports
sudo chmod 770 reports
```

Check:

```bash
ls -ld reports
```

Test access as different users.

Advanced:

```bash
chmod g+s reports
```

Set default perms:

```bash
umask
```

✅ Skills covered

`chmod`, **`chown`**, permissions, umask

🔹 PHASE 6: PROCESSES & JOB CONTROL (ps, top, kill, jobs)

Monitor system

```bash
ps aux
top
```

Find heavy process

```bash
ps aux --sort=-%cpu | head
```

Background job

```bash
sleep 500 &
jobs
fg
bg
kill %1
```

Kill by name

```bash
pkill sleep
```

Inspect process:

```bash
ls /proc/PID
```

✅ Skills covered

`ps`, **`top`**, **`kill`**, **`jobs`**, **`/proc`**, backgrounding

🔹 PHASE 7: PACKAGE MANAGEMENT (apt/yum, rpm/dpkg)

Install tool

```bash
sudo apt install tree
```

Verify:

```bash
which tree
dpkg -l | grep tree
```

Remove:

```bash
sudo apt remove tree
```

Inspect package:

```bash
apt show tree
```

Extract package files (advanced):

```
bash

dpkg -L tree
```

✅ Skills covered
`apt`, **`dpkg`**, packages, repositories

🔹 PHASE 8: ARCHIVES & BACKUPS (tar, gzip)

Backup reports

```
bash

tar -czf reports_backup.tar.gz reports/
```

Verify:

```
bash

tar -tf reports_backup.tar.gz
```

Restore:

```
bash

tar -xzf reports_backup.tar.gz
```

✅ Skills covered
`tar`, compression, backups

🔹 PHASE 9: SCRIPTING (combining everything)

Example: `scripts/log_analysis.sh`

```
bash

#!/bin/bash

LOG=../logs/access.log
OUT=../reports/log_report.txt

echo "Top IPs:" > $OUT
awk '{print $1}' $LOG | sort | uniq -c | sort -nr | head -5 >> $OUT

echo "HTTP Codes:" >> $OUT
awk '{print $9}' $LOG | sort | uniq -c >> $OUT
```

Make executable:

```bash
chmod +x scripts/log_analysis.sh
```

Run:

```bash
./scripts/log_analysis.sh
```

✅ Skills covered
shebang, execution, redirection, permissions

🧠 WHAT THIS PROJECT PROVES

By completing this, you can **honestly say**:

✔️ I can navigate Linux
✔️ I can analyze logs
✔️ I understand users & permissions
✔️ I manage processes
✔️ I handle packages
✔️ I automate tasks

This is **resume-grade**, not tutorial fluff.

🚀 NEXT LEVEL (OPTIONAL HARD MODE)

- Add cron job to run audits daily
- Use **`find`** to detect world-writable files
- Add **`sed`** to sanitize logs
- Use **`nice`** to lower script priority
- Store reports per-date

If you want, next I can:

- Turn this into **step-by-step lab checklist**
- Add **interview questions based on this project**
- Create **Linux admin mock scenario**
- Convert this into **GitHub-ready project**

Just say the word.