Learning Linux Deeper Than Commands

Understand the system — not just the tools. Learn the 'why' behind every command. Once you know how Linux boots, manages files, and handles processes — every error message becomes a clue, not a problem.

Boot Process — From Power Button to Prompt

1. **BIOS/UEFI** — hardware check
2. **GRUB** — loads kernel options
3. **Kernel** — detects hardware, mounts root FS
4. **init/systemd** — starts essential services
   💡 *Tip:* If boot fails, use `recovery mode` or `journalctl -b -1` to inspect previous boot logs.

File Hierarchy — Your Filesystem Map

- `/` → Root directory
- `/etc` → Configuration files
- `/var` → Logs, mail, print spool
- `/usr` → User apps and binaries
- `/home` → User data
- `/tmp` → Temporary files
- `/proc` → Kernel and process info
  💡 *Deep Tip:* Check hardware without GUI using `cat /proc/cpuinfo` or `cat /proc/meminfo`.

Processes & Services — How Linux Runs

Every running command is a process. Each has a unique PID. Parent-child relationships form the process tree.

Commands:

```
ps aux          # view all processes
pstree          # visualize process hierarchy
systemctl       # manage services
journalctl      # view logs
```

Use `top` or `htop` to monitor CPU/memory usage in real time.

Networking — How Linux Talks to the Network

When you type `ping google.com`: 1. **ARP** — finds MAC address of gateway 2. **DNS** — resolves domain to IP 3. **ICMP** — sends echo requests 4. **Routing** — sends packet via interface

Useful tools:

```
ip addr
ss
ping
traceroute
tcpdump
```

Permissions & Ownership — Security Starts Here

File permissions are represented as **r (read)**, **w (write)**, **x (execute)**.

```
-rwxr-x---  root  admin  script.sh
```

Owner: read/write/execute
Group: read/execute
Others: no access

Commands:

```
chmod 755 file.txt
chown user:group file.txt
ls -l     # view permissions
```

Package Management — Installing Software

Different distros, different tools: - Debian/Ubuntu → `apt`, `dpkg` - RedHat/CentOS → `yum`, `dnf` - Arch → `pacman`

Examples:

```
sudo apt update && sudo apt upgrade
sudo dnf install nmap
dpkg -S /usr/bin/ls   # find package of command
```

System Monitoring — Keep an Eye on Your System

Logs:

```
journalctl -xe
cat /var/log/syslog
```

Monitoring:

```
top
htop
df -h
du -sh *
uptime
```

Automate monitoring using Bash + `cron`.

Example Commands & Tips

```
ls -lh              # list files with size
cat /etc/os-release  # check Linux version
uname -r            # show kernel version
whoami              # display current user
df -h               # check disk space
free -h             # check memory usage
```

💡 Always explore using `--help` with any command.

Mindset — Understand, Not Memorize

Don't just type commands — study their effects. Learn how Linux manages processes, memory, and files. Once you understand the logic, every error becomes a clue, not a problem.