

PART I · FOUNDATIONS

FREE SAMPLE · PART I

The Linux Testament

Everything, Updated. Your Way to Heaven.

Part I — Foundations, complete and unabridged: what Linux actually is, getting it running, the filesystem mapped, the Unix philosophy, how Linux boots, package managers explained, and your first real session. The full book continues from Part II through containers, security, the distro landscape, and the kernel itself.

- ✓ Step-by-step and practical
- 📖 Every distro, one map
- 🐳 Docker & containers, start to finish
- 🛡 Security, done right
- ⚙ Kernel internals, demystified
- 📄 Full quick-reference cheat sheet

I	VIII	74
PART HERE	PARTS TOTAL	CHAPTERS TOTAL



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This sample contains Part I (Foundations), complete and unabridged — 7 chapters. Parts II-VIII, the Lighter Side interlude, and the full back matter (grayed out above) are in the full book — get it at SplitZrate.com.

10 Commands

Not a chapter — a one-page spread, before this book gets any more serious than it's about to.

I

Thou shalt not run all things as root.

Root is allocated, not owed. Use only what the task requires.

III

Thou shalt not pipe a stranger's script into
`sudo bash` unread.

Do not invoke root in vain, or on faith alone.

V

Honour thy parent process, lest thy children become zombies.

Unix invented this metaphor for us. We're just using it correctly.

VII

Thou shalt not rewrite public history.

A force-push over another's commits is the closest git comes to betrayal.

IX

Thou shalt not silence thy errors, that thy logs may bear true witness.

`2>/dev/null` is a lie your system tells itself.

II

Thou shalt not trust a symlink as though it were the file itself.

It points to the sacred. It is not the sacred.

IV

Remember thy cron jobs, and keep them holy.

Maintenance observed on a schedule beats maintenance remembered by accident.

VI

Thou shalt not `kill -9` without just cause.

SIGTERM asks. SIGKILL doesn't.

VIII

Thou shalt not take thy neighbour's code without honouring the license.

Free does not mean unconditional.

X

Thou shalt not covet thy neighbour's root.

Unauthorized access is unauthorized access, whichever testament you check it against.

No commandment above is a joke at scripture's expense. Each one is also, independently, correct advice.

1 What Linux Actually Is

Not a history lesson — that book already exists, and it's better at this than a chapter squeezed into a reference manual could ever be. This one just makes sure the ground under your feet is solid before you start walking on it: what the word "Linux" technically refers to, what a kernel actually does all day, why there isn't just one Linux, and one idea that explains more of this book than any other sentence in it, without ever calling attention to itself.

1.1 What This Book Means by "Linux"

Strictly speaking, Linux is a kernel — one program, first written by one person, that talks directly to your hardware and decides which piece of software gets to use the processor next. That's it. The desktop, the package manager, the terminal you're picturing right now — none of that is the kernel itself. The shell, the file manager, the login screen, the fact that installing software is one command instead of a wizard with a progress bar: all of it is software that someone else wrote, bundled together, and shipped alongside that kernel. That bundle is called a **distribution**, or distro, and there are, at a conservative count, hundreds of them.

In practice, almost nobody honors this distinction in conversation, including here. "I'm running Linux" is a perfectly reasonable thing to say, and insisting on technical precision every time would make for exhausting reading. But it's worth knowing the line exists, because a surprising number of arguments you'll encounter online — deadly serious ones, fought by otherwise reasonable adults — turn out to be about exactly this: whether "Linux" means the kernel alone, or the kernel plus everything a particular group of people chose to wrap around it.

DID YOU KNOW

That disagreement has an official name — the GNU/Linux naming dispute — and it's been running, with real feeling on both sides, since the early 1990s. The short version: much of the software people install alongside the kernel came from the GNU Project, which started nearly a decade before Linux existed and would like a little credit for it. The longer version, with more plot than you'd expect from a licensing disagreement, is told properly in **The Kernel's Children**, Chapter 28 — "The Slash That Split a Community."

1.2 The Kernel's Only Job

A kernel's responsibilities sound modest listed out and turn out to be everything, once you notice that literally every other program depends on them. It decides which process runs on which CPU core, and for how long, dozens of times a second, so that your browser and your music player and forty background services all appear to run at once on hardware that can genuinely only do a handful of things simultaneously. It manages memory, handing out chunks of RAM to processes and taking them back when a program closes, so that one misbehaving application can't casually overwrite another's data. It talks to hardware through drivers, so that the program you wrote doesn't need to personally understand your specific model of SSD. And it enforces the boundary between what a normal program is allowed to do on its own and what it has to formally request — a **system call** — which is most of what stands between "an app crashed" and "an app took the rest of your system down with it."

You can see a sliver of this for yourself without installing anything:

```
# which kernel version you're actually running right now
uname -r

# the kernel's own account of itself, plus who built it and when
cat /proc/version
```

Neither command changes anything. That's deliberate, and it previews something worth knowing early: a large amount of what the kernel is doing at any given moment is available to read, not hidden — a theme the next section leans on directly.

NOTE

This chapter stays deliberately shallow on kernel internals — enough to be useful, not enough to be a systems course. The full anatomy (process scheduling in depth, memory management, writing a kernel module) gets its own chapter later, in Part VIII, once you've got a few hundred pages of practical footing under you first.

1.3 Why There Isn't Just "Linux"

If the kernel is the one non-negotiable ingredient, a distro is everyone else's opinion about what should surround it: which package manager installs your software, which init system starts your services at boot, which desktop (if any) greets you at login, and a thousand smaller defaults — what's already installed, what's deliberately left out, how aggressively the whole thing gets updated. Two distros can run the exact same kernel version and still feel like different operating systems, because almost everything you touch day to day is the distro's choice, not the kernel's.

This is also, not coincidentally, why "which distro is best" is a uniquely bad question to ask a room full of Linux users and expect a short answer. It isn't one decision. It's dozens of small ones, bundled by someone else, and "best" depends entirely on which of those small decisions you

happen to agree with. Part VII of this book — The Distro Landscape — is dedicated entirely to making those differences legible instead of mysterious: package managers side by side, init systems compared directly, and a practical answer to the question this section deliberately isn't going to fully settle yet.

1.4 Everything Is a File (Almost)

One design choice explains an unreasonable amount of why Linux feels the way it does once you're comfortable in it: as much as possible is represented as a file, even things that obviously aren't documents. A running process's live information lives under `/proc`. Hardware devices show up under `/dev`. A running kernel's tunable settings live under `/sys`. None of these are ordinary files, but because they behave like files, every tool that already knows how to read, write, and pipe files works on them too, without anyone having to invent a special case.

```
# how long this machine has been running, as a file you can just read
cat /proc/uptime

# every device the kernel currently knows about
ls /dev
```

It's not literally true — sockets and a handful of other things bend the rule — which is why the heading above says "almost." But as a working idea it holds up better than most engineering slogans do fifty years on, and it's the reason a huge fraction of this book's later chapters — on shell scripting, on containers, on debugging a system that's misbehaving — keep coming back to the same small set of tools instead of needing a different one for every occasion.

In short

- "Linux" strictly means the kernel; everyday usage — including here — means the kernel plus everything a distro bundles around it.
- The kernel's job is scheduling, memory, hardware access, and enforcing system calls — nothing more, nothing less.
- Distro's differ because almost everything *except* the kernel is a choice someone else made on your behalf.
- "Everything is a file" is why the same small toolset keeps working across wildly different tasks throughout this book.

Commands from this chapter

<code>uname -r</code>	Show the running kernel version
<code>cat /proc/version</code>	Kernel build details — compiler, date, builder
<code>cat /proc/uptime</code>	How long the system has been running, read as a file
<code>ls /dev</code>	Every device the kernel currently knows about

Where next: Want the kernel's full internals — scheduler, memory management, a kernel module walkthrough? That's Part VIII. Want the human history behind everything in this chapter, penguin bite included? That's **The Kernel's Children**, free, start to finish. Ready to get an actual Linux system in front of you to try any of this on? Chapter 2 walks through installing one, or just trying one without installing anything at all.

2 Getting Linux Running: Try It, Install It, or Both

The previous chapter was all concept. This chapter is the bridge to having an actual Linux system in front of you — without necessarily touching your existing setup at all. Trying Linux commits you to nothing; installing it is a separate, later decision, and this chapter is honest about exactly where that line is.

2.1 Two Ways In: Try It, or Install It

There are two genuinely different things people mean by "using Linux," and conflating them is where a lot of first-timers talk themselves out of even trying. **Trying** Linux means running it temporarily — from a USB stick, or inside a virtual machine — without changing anything on your existing computer. Close it, and your system is exactly as it was. **Installing** Linux means putting it permanently onto a disk, either alongside your current operating system (dual-boot) or in place of it. This chapter covers both, deliberately in that order, because trying first is the lower-stakes way to find out whether you actually like it before committing to anything.

2.2 Getting the Media Ready: ISOs, Checksums & Bootable USB Sticks

A distro is distributed as a single file called an **ISO** — a complete, self-contained snapshot of everything needed to boot and run it, named after the ISO 9660 disc format it originally borrowed its structure from. Download it directly from the distro's official site, not a mirror or a random link — and once it's downloaded, most official sites publish a **checksum**, a short fingerprint of the exact, untampered file, that you can compare against what you actually downloaded:

```
# generate a checksum of the file you downloaded
sha256sum ubuntu-24.04-desktop-amd64.iso

# compare it against the value published on the distro's download page — they
should match exactly
```

An ISO by itself won't boot your computer — it needs to be written to a USB stick in a way that makes the stick itself bootable, not just a stick that happens to contain a copy of the file. Purpose-built tools handle this correctly: **Rufus** and **Ventoy** on Windows, **balenaEtcher** on any platform, or `dd` directly on Linux or macOS for anyone already comfortable at the command line.

WARNING

Writing an ISO to a USB stick overwrites *everything* already on the target device, with no undo. The risk isn't the tool — it's picking the wrong device from a list that, on a desktop with multiple drives, might show your actual hard disk right next to the USB stick you meant to select. If you're using `dd` directly, confirm the correct device with `lsblk` immediately beforehand, and double-check its size against the USB stick you're holding before running anything. This is exactly the kind of moment worth slowing down for.

2.3 Trying Before Installing: Live Sessions

Boot a computer from that USB stick — usually by pressing a key like F12, F2, or Esc during startup to reach a one-time boot menu, which varies by manufacturer — and most distros drop you into a **live session**: a fully working Linux desktop, running entirely from the USB stick and your computer's memory, that hasn't touched your internal disk at all. You can browse the web, open a terminal, poke around the filesystem from Chapter 3 once you've read it, and get a real feel for a distro, and when you're done, reboot and remove the stick — your computer is untouched. Some distros also support **persistence**, a way to save changes back to the USB stick itself between sessions, which is worth knowing exists but isn't necessary just to try things out.

2.4 The Easiest On-Ramp: A Virtual Machine on Windows

If rebooting into a live session feels like more commitment than you want yet, a **virtual machine** runs Linux as a program inside Windows instead — in its own window, on its own simulated hardware, with zero effect on the host system either way. **VirtualBox** is the simplest free option: install it, create a new virtual machine, point it at the ISO from section 2.2 as its virtual optical drive, and start it — the distro's installer boots up exactly as it would on real hardware, just inside a window you can close at any time.

Worth knowing the terrain doesn't stop there: Hyper-V is Windows' own, more advanced built-in virtualization option, and **WSL2** (Windows Subsystem for Linux) offers a real Linux environment tightly integrated into Windows itself — genuinely useful for development work, but a different tool for a different job, since it doesn't give you a full graphical desktop the way a proper virtual machine does. For a first look at Linux as an actual operating system, a VM running a real desktop distro is the more representative experience.

NOTE

There's something to be said for this route beyond convenience: a virtual machine puts you back in full, direct control of a computer you fully understand, top to bottom — no dependency you didn't choose, no behavior you can't inspect. For some people, especially those coming from operating systems that don't always feel like they answer to the user, that alone is worth an afternoon.

2.5 Picking a Distro (and an Architecture) to Start With

You don't need Part VII's full comparison to make a reasonable first choice. **Ubuntu**, **Linux Mint**, and **Fedora** are the three most commonly recommended starting points, precisely because they prioritize working correctly out of the box over configurability — the argument for the alternatives usually starts making more sense once you already know what you're comparing them against, which is exactly what this book builds toward.

One more decision worth knowing about, even as a beginner: almost everything above assumes an **x86-64** machine, which covers the overwhelming majority of desktops and laptops. But Linux also runs natively on **ARM** hardware — the same processor family behind most phones and, increasingly, some genuinely power-efficient laptops — and an ARM build of a distro can mean meaningfully better battery life on hardware that supports it. The trade-off is real: ARM Linux's software and driver ecosystem is smaller and less uniformly polished than x86-64's, so it rewards checking compatibility for your specific machine first rather than assuming it'll just work. Part VIII's chapter on unusual hardware covers this in proper depth; for a first try, x86-64 remains the path with the fewest surprises.

2.6 Actually Installing, When You're Ready

Every mainstream distro's installer follows roughly the same shape: choose a language and keyboard layout, connect to a network if you want updates during setup, decide where it goes on disk, and confirm. That third step — disk setup — is the one place in this entire chapter where "roughly the same shape" stops being reassuring and starts requiring your full attention.

WARNING

Most installers offer an "erase disk and install" option alongside a manual partitioning option — and on a machine with more than one disk, or an existing Windows installation you meant to keep, picking the wrong target erases it completely, with no confirmation beyond the one you already clicked past. Before starting an install: know which physical disk you actually want to use, and if you're dual-booting, use manual partitioning rather than the automatic option so you can see and confirm exactly what's about to happen to each disk before committing. Chapter 3 covers what a partition actually is in more depth, and its own warning on this exact risk — read this section again alongside that one if anything here feels unfamiliar.

CHAPTER 2 — QUICK RECAP

In short

- Trying Linux (live USB or a VM) changes nothing on your computer; installing it is a separate, later decision.
- Always verify a downloaded ISO's checksum, and always double-check the target device before writing a USB stick — both are places where the wrong click has real consequences.
- A virtual machine on Windows (VirtualBox) is the lowest-commitment way to see a full Linux desktop.
- Ubuntu, Linux Mint, and Fedora are reasonable starting points; ARM Linux can mean better laptop battery life but with a smaller compatibility net.

Commands from this chapter

<code>sha256sum <file></code>	Generate a checksum to verify a downloaded ISO
-------------------------------------	--

<code>lsblk</code>	Confirm the correct device before writing a USB stick
--------------------	---

Where next: Whatever you booted in this chapter, Chapter 3 gives you the map for finding your way around it. Curious about the deeper differences between the distros mentioned here? That's Part VII. Want the full unusual-hardware treatment, ARM included? Part VIII.

3 The Filesystem, Mapped

Ask someone who's been using Linux for years where a particular config file lives, and they'll usually just know — not because they memorized a manual, but because the layout stops being arbitrary once you've seen it enough times. This chapter is the shortcut past that waiting period: one mental map of the filesystem, built before you need it rather than pieced together the hard way while something's broken.

3.1 One Tree, No Drive Letters

If your first computer ran Windows, part of this will need unlearning before it clicks. There is no `C:\`, no separate drive letter for every disk that happens to be plugged in. Linux has exactly one filesystem tree, starting at a single root directory written as `/`, and every single thing the system can read or write — every file, every directory, every other disk you attach — lives somewhere underneath that one root. A second hard drive doesn't get a new letter; it gets grafted onto the existing tree at a directory of your choosing, and once it's grafted on, nothing about how you access its files looks any different from a file that was always local. Section 3.4 covers exactly how that grafting works. For now, the idea to sit with is simpler: on Linux, "where is it" always has the same kind of answer — a path down from `/` — no matter what physical disk the file actually happens to live on.

This isn't just a cosmetic difference. It's the reason a command like `/usr/bin/python3` means the same thing on every Linux machine on earth, regardless of how many disks that particular machine has or how they're partitioned — which turns out to matter constantly, in scripts, in documentation, and in the muscle memory this book is trying to help you build.

3.2 The Layout, Guided Tour

You don't need to memorize this table. You need to have seen it once, so that the next time a path scrolls past in a terminal, some part of it looks familiar instead of arbitrary.

Path	What actually lives there
/bin, /sbin	Core commands the system needs to boot and run at all — increasingly just links into <code>/usr</code> ; see 2.3.
/usr	The bulk of installed software and its supporting files. This is the biggest branch of the tree by far.
/etc	System-wide configuration, almost all of it plain text. If you're editing a setting, it's probably here.
/var	Data that changes constantly while the system runs — logs, caches, mail queues, databases.
/home	Every regular user's personal files, one subdirectory per user. Yours is almost certainly where you spend your time.
/root	The <i>root user's</i> home directory — not the filesystem root. A one-letter naming collision that confuses everyone exactly once.
/opt	Self-contained third-party software that would rather not spread itself across <code>/usr</code> .
/tmp	Temporary files, cleared on reboot on most distros. Treat anything here as disposable, because the system already does.
/mnt, /media	Conventional attachment points for other filesystems — <code>/media</code> for removable media, <code>/mnt</code> for anything you're mounting by hand. More on this in 3.4.

A quick refresher, since Chapter 1 introduced these but didn't dwell on them: `/proc`, `/sys`, and `/dev` live at the root too, but they're not really storage in the sense everything above is — they're the kernel presenting live process information, tunable settings, and hardware devices as though they were files, exactly as described back in section 1.4. Worth knowing where they sit in the tree; not worth confusing with the directories in the table above.

DID YOU KNOW

Not every distro agrees with the layout in the table above. GoboLinux, an experimental distro dating back to the early 2000s, rejects the traditional Unix filesystem hierarchy entirely — every application gets its own self-contained directory under `/Programs`, versioned by name, with the familiar `/usr`-style paths recreated afterward purely as compatibility symlinks for software that expects them. It never went mainstream, but it's a genuinely useful reminder that this layout is a strong convention, not a law of physics. Part VII's look at filesystem quirks across distros picks this thread back up in more detail.

NOTE

This chapter deliberately stops short of file permissions — who's allowed to read, write, or execute what, and how ownership works. That's a substantial topic in its own right, and it gets a proper chapter later, in Part IV, once you're managing a real system rather than just finding your way around one.

3.3 The Quiet Merge of `/usr`

One historical wrinkle worth flagging, mostly so it doesn't confuse you later: for decades, `/bin` and `/usr/bin` were genuinely separate directories, holding different commands, for a reason rooted in disks from the 1970s being too small to hold everything in one place. Most modern distros have since folded them together — `/bin` is now typically just a symlink pointing into `/usr/bin`, and the same goes for `/sbin` and `/lib`. The historical reason stopped applying long before most of today's users started, but the old paths were left in place as links rather than removed, so that nothing depending on them would break unexpectedly. You'll still see both forms in scripts, in documentation, and in muscle memory that predates the merge — both work, and now you know why both exist.

3.4 Mount Points, and Why `/home` Might Live Somewhere Else

"Grafting a disk onto the tree," from section 3.1, has a name: **mounting**. Mounting takes a filesystem — a second hard drive, a USB stick, a network share, even a file containing a whole filesystem image — and attaches it at a chosen directory, called a **mount point**. From that moment on, everything inside that directory is actually stored on the mounted filesystem, transparently. You can check what's currently mounted, and how much room is left, without changing anything:

```
# every mounted filesystem, in human-readable sizes
df -h

# every block device the kernel can see, mounted or not
lsblk

# the full list of active mounts, in more detail than df
mount
```

A common, genuinely useful pattern is giving `/home` its own partition or even its own physical disk, separate from the rest of the system. Do that, and reinstalling or upgrading the operating system underneath it becomes far less nerve-wracking — the installer can be told to leave that partition alone entirely, and your files simply outlive whatever happens to the system around them. It's the kind of decision that costs nothing when made up front and saves a genuinely bad evening later.

WARNING

A quick reminder rather than new ground: the previous chapter already covered exactly how wrong this can go — a mis-clicked disk during install, or a wrong device during partitioning, can erase an existing operating system with no confirmation dialog standing between you and the mistake. Nothing about understanding mount points changes that risk; if you're about to repartition a real disk, that chapter's warning still applies in full, not just as a formality.

In short

- Linux has one filesystem tree rooted at `/` — no drive letters; other disks attach onto that same tree instead of getting their own.
- `/etc` for configuration, `/var` for data that changes constantly, `/home` for your own files, `/usr` for the bulk of installed software.
- On most modern distros, `/bin` and `/sbin` are now just symlinks into `/usr` — a leftover of a 1970s disk-space problem that no longer applies.
- Attaching a filesystem to a directory is called mounting; a separate `/home` partition is a small decision now that pays off the next time you reinstall.

Commands from this chapter

<code>df -h</code>	Mounted filesystems and free space, human-readable
<code>lsblk</code>	Every block device the kernel sees, mounted or not
<code>mount</code>	The full active mount list, in detail
<code>pwd</code>	Print exactly where in the tree you currently are
<code>ls /</code>	See the top-level layout from this chapter for yourself

Where next: Now that you know where everything lives, Part IV covers who's allowed to touch it — permissions and ownership, done properly. Curious how this layout bends or breaks across different distros, GoboLinux included? That's Part VII. Ready for the ideas behind why the terminal works the way it does? Chapter 4 is next.

4 The Unix Philosophy

One more idea before the typing starts, and arguably the most load-bearing one in this entire book: a design philosophy older than Linux itself, inherited wholesale from Unix, that explains — more than most people realize — why the command line works the way it does — why there are hundreds of small tools instead of one large one, and why that turns out to be a feature.

4.1 Do One Thing, and Do It Well

In the early 1970s, the small team building the first Unix systems at Bell Labs settled on a rule that has outlasted almost everything else from that era of computing: a program should do one job, do it well, and leave everything else to other programs. `grep` searches text. It does not sort it, count it, or format it — other tools already do those things, and do them well. This sounds almost too obvious to state as a principle, but it was a genuine departure from the alternative: large, do-everything applications where every feature lived inside one sprawling program, understood in full by fewer and fewer people as it grew.

The payoff isn't philosophical, it's practical. A tool that does one thing is easier to write correctly, easier to test, easier to replace when something better comes along, and — this is the part that matters most for how you'll actually use Linux — easier to combine with other tools in ways its original author never anticipated. `grep` has no idea it might one day be fed the output of a command that didn't exist when it was written. It doesn't need to know. That's the next section's subject.

4.2 Everything Talks Through Text

The mechanism that makes small tools composable is almost aggressively simple: by convention, Unix programs read plain text in and write plain text out. Every command you run has an input stream (**stdin**), a normal output stream (**stdout**), and a separate stream just for errors (**stderr**) — three plain, text-shaped channels that any other program can also read from or write to, without needing to understand anything about where that text came from. A tool built in 1975 and a tool built last month can work together perfectly, as long as both speak the same universal format: text.

That's also why Chapter 1's "everything is a file" idea and this chapter's philosophy are really the same idea wearing two names — files, devices, and streams all present themselves as things you can read and write as text, so the same small vocabulary of operations keeps applying no matter what's actually on the other end.

4.3 The Pipe: Composing Instead of Building

The single character that turns a pile of small tools into something more than the sum of its parts is `|`, the pipe. It takes the standard output of one command and feeds it directly into the standard input of the next, with nothing in between — no temporary file, no manual copy-paste, no waiting for the first command to finish writing to disk before the second one can start reading.

```
# three small tools, chained: list files, keep the ones mentioning "conf", count
them
ls /etc | grep conf | wc -l

# the same idea with running processes instead of files
ps aux | grep firefox
```

Neither `ls` nor `grep` nor `wc` was written with the other two in mind. None of them needed to be. That's the entire philosophy compressed into one punctuation mark: small, well-defined pieces, combined on demand, in combinations their authors never had to predict.

NOTE

You don't need to memorize pipe syntax to get through this book — it comes up constantly and becomes automatic fast. Part II builds real fluency with it, one practical example at a time; this chapter is only asking you to understand why it exists.

4.4 Where the Philosophy Bends

Worth saying plainly, since this book would rather be accurate than tidy: the Unix philosophy is a strong default, not a religion, and Linux itself doesn't follow it uniformly. `systemd`, which starts and supervises services on most modern distros, is deliberately more integrated and less single-purpose than the philosophy above would suggest — a genuine, still-ongoing disagreement among people who care about this, not a settled question this book is going to pretend was never asked. Part IV covers `systemd` on its own terms, including why it was built the way it was, without relitigating that argument here.

The honest summary: "do one thing well, and let text tie it together" got Unix and Linux further than almost any other design idea in computing's history, and it's still the right default lens for reading a command line you don't recognize. It just isn't the only idea Linux runs on anymore, and a book that claims otherwise wouldn't be doing you any favors.

CHAPTER 4 — QUICK RECAP

In short

- Unix programs are meant to do one job well, rather than many jobs adequately.
- Programs communicate through plain text — stdin, stdout, and stderr — so any tool can feed any other tool.
- The pipe (`|`) chains commands directly, without a temporary file in between.
- The philosophy is a strong default, not a rule Linux follows everywhere — systemd is the clearest counterexample, and that's fine.

Commands from this chapter

<code>ls /etc grep conf</code>	Pipe one command's output into another's input
<code>ps aux grep <name></code>	Same pattern, applied to running processes
<code>command wc -l</code>	Count the lines a previous command produced

Where next: Ready to see where this actually comes from and where the system hands off to it? Chapter 5 covers how Linux boots. Want real pipe fluency, not just the idea? Part II is built around exactly that.

5 From Power Button to Prompt: How Linux Boots

A conceptual walk from a cold power button to a working login prompt — enough to understand what actually happens, and roughly when, without turning into the deep systemd chapter that's still to come in Part IV. Understanding this sequence once makes a genuinely broken boot far less frightening later.

5.1 Before Linux Is Even Involved

The first few seconds after you press the power button have nothing to do with Linux at all. Your motherboard's firmware — **BIOS** on older hardware, **UEFI** on essentially everything made in the last decade — runs first, checks that the basic hardware is present and functioning (the brief flash of diagnostic text or a manufacturer logo you may have seen and ignored a thousand times), and then looks for something to hand control to. That something is a small program stored on one of your disks, called a **bootloader**. Linux itself hasn't been asked to do anything yet.

5.2 The Bootloader's One Job

On most Linux systems that bootloader is **GRUB** (short for GRand Unified Bootloader), and its entire purpose is narrow: find a Linux kernel on disk, load it into memory, and pass control to it — along with a short list of instructions, called kernel parameters, that tell the kernel a few things about how to start up. If your machine dual-boots into more than one operating system, this is also the moment that choice happens: GRUB's menu is what's actually letting you pick, before either OS has properly started.

You can see GRUB's own configuration without touching anything risky:

```
# GRUB's generated configuration — long, and not meant to be hand-edited directly
cat /boot/grub/grub.cfg | head -30

# the kernel parameters your currently-running system actually booted with
cat /proc/cmdline
```

5.3 The Kernel Takes Over

Once GRUB hands off, the kernel from Chapters 1–2 initializes itself: it sets up memory management, brings up the CPU cores, and starts loading drivers for the hardware it can detect. A surprising amount of that early hardware support doesn't live inside the kernel file itself but in a separate, temporary filesystem called the **initramfs** — loaded into memory alongside the kernel specifically to provide just enough drivers to reach the real root filesystem from Chapter 3 and mount it properly. Once that mount succeeds, the **initramfs** has done its job and gets discarded.

NOTE

None of this requires memorizing **initramfs** internals to use Linux day to day — it's here because "why does my system show an emergency shell instead of booting" almost always traces back to this exact stage, and recognizing the stage is most of the diagnosis.

5.4 **init**: The Kernel's First Program

With the real root filesystem mounted, the kernel does one last thing before stepping back: it starts a single program, always assigned process ID 1, conventionally called **init**. Everything else that runs on your system afterward — every service, every login shell, every program you'll ever open — exists as a descendant of that one process, directly or indirectly. On most modern distros, that first program is **systemd**, which takes over from here: starting services in the right order, bringing up networking, and eventually presenting you with a login screen or prompt.

This chapter stops right there, deliberately. What **systemd** actually does with that responsibility — units, targets, dependency ordering, and how to work with all of it directly — is substantial enough to earn its own chapter, and gets one, in Part IV.

CHAPTER 5 — QUICK RECAP

In short

- Firmware (BIOS/UEFI) runs first and hands off to a bootloader — Linux isn't involved yet.
- The bootloader (usually GRUB) finds and loads the kernel, plus any dual-boot menu.
- The kernel initializes hardware, using a temporary initramfs to reach the real root filesystem.
- The kernel starts exactly one program, PID 1 — usually systemd — which everything else descends from.

Commands from this chapter

<code>cat /proc/cmdline</code>	Kernel parameters the running system actually booted with
--------------------------------	---

<code>cat /boot/grub/grub.cfg</code>	GRUB's generated configuration
--------------------------------------	--------------------------------

Where next: Curious what systemd does with PID 1 once it has it? Part IV, in full. Ready for the next foundational idea — how software actually gets onto this system in the first place? Chapter 6 is next.

6 Package Managers, Conceptually

Not yet a comparison of `apt` versus `dnf` versus `pacman` — that's a whole part of this book on its own, later. This chapter is smaller and more durable than any single command: what a package manager actually is, and what problem it's solving, in a way that holds up no matter which one you end up using.

6.1 The Problem, Before the Solution Existed

Installing software sounds simple until you consider what a piece of software usually needs to run: not just its own code, but often a specific version of some shared library, which in turn might need another library, which might conflict with a version something else on your system already depends on. Handle this by hand across dozens of installed programs, and you get what older Linux users still only half-jokingly call **dependency hell** — a tangle of version mismatches that's exactly as unpleasant to debug as the name suggests.

A package manager exists to make that entire problem someone else's job, solved once and correctly for everyone using the same distro — instead of separately and imperfectly on every machine that installs the software.

6.2 What's Actually Inside a Package

A package is a single file bundling three things: the software itself, metadata describing exactly what it needs to run (its dependencies), and instructions for where its pieces belong once installed — which files go into `/usr/bin`, which config template belongs in `/etc`, and so on, tying directly back to the map from Chapter 3. When you install a package, you're not copying one file — you're asking the package manager to place dozens or hundreds of files in exactly the right spots, and to remember all of them, so that removing the software later is just as clean as installing it was.

6.3 Repositories: Where Packages Actually Come From

Packages don't materialize locally — they're downloaded from a **repository**, a server (or mirror of servers) maintained by your distro, or by a trusted third party, holding tested, version-tracked packages. This is also what makes updating software across an entire system a single command instead of a hundred separate downloads: the package manager already knows exactly what's installed, checks the repository for newer versions of each thing, and resolves the whole dependency puzzle from section 6.1 automatically, every time.

WARNING

Adding a third-party repository extends real trust to whoever maintains it — from that point on, your package manager will happily install and auto-update whatever they publish, with the same privileges as anything from your distro's official repository. Only add repositories you actually trust, and prefer ones your distro's own documentation points you toward over ones found in a random forum post.

6.4 One Concept, Many Implementations

Every major distro has its own package manager — Debian and Ubuntu use `apt`, Fedora and RHEL use `dnf`, Arch uses `pacman`, and there are several more — and at first glance their commands look nothing alike. Underneath, they're all solving section 6.1's exact problem, the same way, in spirit: track what's installed, resolve dependencies automatically, fetch from a trusted repository, keep the system consistent. Once that idea is solid, learning a second distro's package manager is mostly a vocabulary problem, not a conceptual one — which is precisely what Part VII's side-by-side comparison is built to make painless.

CHAPTER 6 — QUICK RECAP

In short

- A package manager exists to solve dependency hell once, centrally, instead of by hand on every machine.
- A package bundles the software, its dependency metadata, and exact install locations.
- Packages come from repositories — trusted servers your package manager checks for installs and updates.
- Different distros use different package managers, but almost always to solve the same problem the same way.

Where next: Want the actual command-by-command comparison across distros? That's Part VII. Ready to put everything from Part I so far to use? Chapter 7 is the hands-on checkpoint that closes out this Part.

7 Getting Comfortable: Your First Real Session

Everything so far has been concepts — worth having, but not yet something you could sit down and use. This chapter closes out Part I with the opposite: a small, deliberately minimal set of commands and habits that make a terminal feel less like a test you might fail and more like a tool you already know how to reach for.

7.1 Asking the System Instead of the Internet

The single most useful habit to build early is checking what a command does before searching for it elsewhere — because the answer is almost always already installed on your machine. `man` opens a command's full manual page; `--help`, appended to almost any command, prints a shorter summary of its options directly; and `apropos` searches manual page descriptions when you know roughly what you want to do but not which command does it.

```
# the full manual for a command
man ls

# a quick options summary, works for most commands
ls --help

# search for commands related to a word, when you don't know the exact name
apropos "copy files"
```

7.2 Let the Shell Remember and Finish Things For You

Two habits do more for day-to-day comfort than any individual command: tab completion and command history. Pressing `Tab` mid-command finishes a file name, directory, or command for you — press it twice when there's more than one match, and the shell lists every option instead of guessing. Pressing the up arrow recalls your previous command, repeatedly, and `Ctrl+R` searches backward through everything you've typed before, which is usually faster than retyping a long command from scratch.

7.3 A Small, Deliberately Minimal Survival Kit

You don't need dozens of commands memorized to be functional — you need a handful, used confidently. This is intentionally the shortest command list in the book so far:

Command	What it's for
<code>pwd</code>	Where am I right now, in the tree from Chapter 3
<code>ls</code>	What's in this directory
<code>cd</code>	Move to a different directory
<code>cat</code>	Print a file's contents to the screen
<code>nano</code>	A simple, beginner-friendly text editor — on-screen key hints included
<code>sudo</code>	Run one command with elevated privileges — see the warning below

WARNING

`sudo` runs exactly the one command that follows it as the root user, bypassing the normal protections covered in Part IV — it isn't a mode you turn on, and it doesn't excuse skipping the rest of this book's warnings just because a command finally worked. If a command you don't fully understand suggests prefixing it with `sudo`, that's the moment to slow down and read it carefully, not speed up.

7.4 What Part I Actually Bought You

Six chapters in, you now have a working mental model of what Linux is, where everything lives, why small tools compose instead of colliding, how the system reaches a login prompt at all, and how software gets onto it in the first place — plus enough hands-on comfort to not feel lost getting there. None of it makes you fast yet. That's what Part II is actually for: real fluency with the terminal, one deliberate chapter at a time, built on a foundation that's now genuinely solid instead of assumed.

CHAPTER 7 — QUICK RECAP

In short

- `man` , `--help` , and `apropos` answer most "how do I" questions without leaving the terminal.
- Tab completion and command history (up arrow, `Ctrl+R`) do a large share of the typing for you.
- A small survival kit — `pwd` , `ls` , `cd` , `cat` , `nano` , `sudo` — is enough to be functional.
- `sudo` elevates exactly one command at a time — never a reason to stop reading a command before running it.

Commands from this chapter

<code>man <command></code>	Open a command's full manual page
<code><command> --help</code>	Quick options summary for most commands
<code>apropos "task"</code>	Find a command by describing what you want to do
<code>pwd / ls / cd / cat</code>	The core four for finding and viewing your way around
<code>nano <file></code>	A beginner-friendly text editor to start with

Where next: Part I is complete. Part II starts immediately with real fluency — navigating and managing files properly, the first of eleven chapters that turn everything you've just learned into actual speed.

That's all of Part I.

Seven more Parts pick up right where this sample leaves off — from the terminal and shell mastery through desktop use, running a real server, containers, security, the distro landscape, and the kernel itself, closing with a full quick-reference cheat sheet, index, and glossary.

STILL IN THE FULL BOOK

- **PART II.** The Terminal & Shell Mastery
- **PART III.** Desktop, Gaming & Everyday Use
- **PART IV.** Running a Real System
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