Git as a Story

A Version Control Journey for Everyone

🧭 Why Version Control Matters

You already use version control informally:

- `report_final_v3_reallyfinal.xlsx`
- Multiple presentation drafts
- Document copies "just in case"

Sound familiar?

The Questions We Ask

When someone hands you a file, you want to know:

- **Who** made this?
- **Where** did the data come from?
- **Why** did they make these changes?
- **How** did it change over time?
- Does it have the **latest** updates?

What You Really Want

Like a lab notebook for your work:

- **Undo** mistakes
- **Go back in time** to see what changed
- **Audit trail** of edits
- **See which experiments** were run
- **Understand** what worked before

Git was designed to serve this need.

Building from Scratch

Let's design this system together.

Simple approach: Make a copy every time we like our work

- `report_v1` → `report_v2` → `report_v3`

Works ok for single files. But what about projects?
`report_v1` also depends on other files (images, spreadsheet, charts, other code files)

- It can get unmanageable quickly

Building from Scratch

Option 2:

Google Docs and Office 365 save automatically...

But what if:

- You step away mid-edit
- The snapshot catches a broken state
- You didn't mean to save yet

The Best of Both Worlds

Option 3:

Let's create a **COMMIT BUTTON** that:

- Takes a snapshot when **you** decide
- Saves the **entire folder**, not just one file
- Lets you add a **message** describing the change
- Doesn't create file explosion (`v1` , `v2` , `v3` ...)

Why save the whole folder?

Otherwise: `report_v20` + `spreadsheet_v3` + `image_v6` = chaos!

📸 Commit: Your Time Machine Control

Click COMMIT to:

1. Save a snapshot of your work
2. Write a message: "What changed and why?"
3. Create a known good state

Now you have a reliable history to fall back on.

2. Going Backwards and Forwards

If every commit has a message describing what changed...

We need a LOG BUTTON to see the list of changes over time.

We need a CHECKOUT BUTTON to jump to any point in history.

The Bookshelf Analogy

Every commit is like a book on a shelf:

- Each book is a complete snapshot of your work at that moment
- Want to see how things looked last month? Pick up that book
- **Checkout** = checking out a book from the library

3. The Problem with Linear History

Real work isn't linear:

- Scientists test multiple hypotheses
- Analysts try different formulas
- Writers explore alternate endings

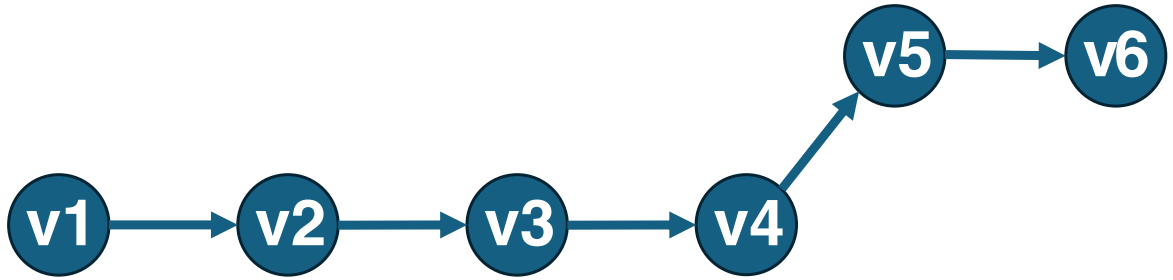
You need to experiment without breaking what works.

Real Example 1: The Dashboard Analyst

You're building a biomedical research dashboard:

- You have a **better formula** to try
- Want to **test it** without switching everyone
- Can't **stop working** while people test
- Still need the **current version** running

We need a way to do work without affecting the main.

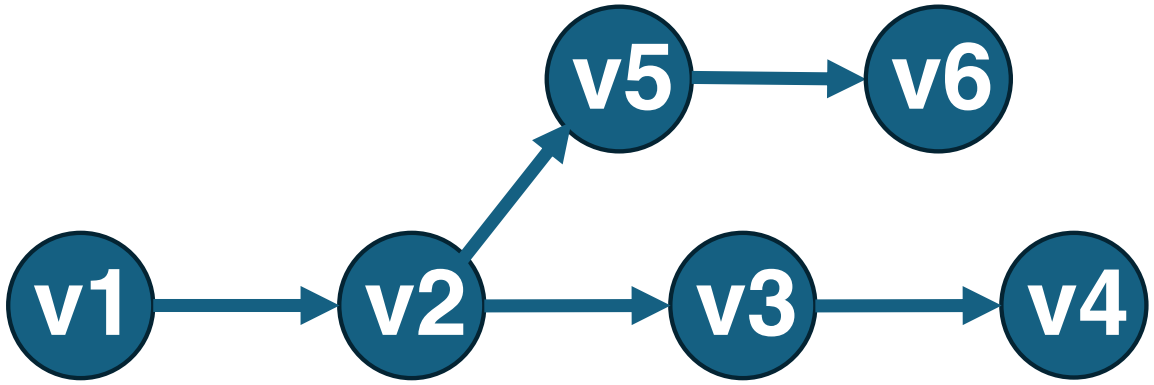


Real Example 2: The Emergency Bug Fix

Your live dashboard has a bug:

- Need to **fix it now**
- But you have **unfinished work** in progress
- Can't release half-done features

Solution: Branch from the released version, fix it there.



🌳 Introducing: BRANCHES

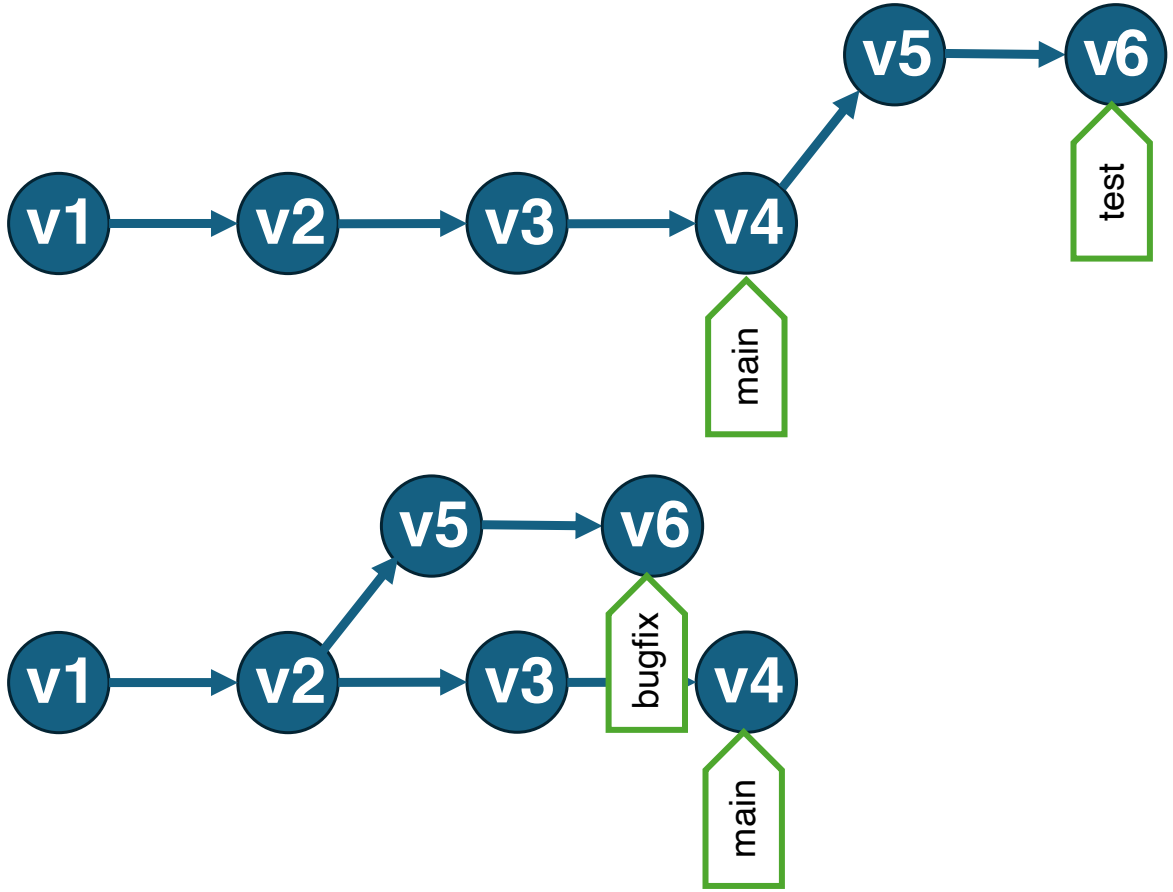
The **BRANCH BUTTON** lets you:

- Split off from main history
- Work on experiments safely
- Keep the main version stable
- Track the "tip" (latest commit) of each branch

Branch Visualization

Each branch explores a different direction.

Every commit still traces back to the beginning.



6. 🏷️ Tags: Milestones and Signposts

Sometimes you need to mark special versions:

- `v1.0` - First release
- `publication-draft` - Submitted to journal
- `final-report-2024` - Year-end version

TAG BUTTON: Label any commit for easy reference.

Quick Review: Your Personal Time Machine

So far, we've built a system for **individual work**:

- **COMMIT** - Save snapshots with messages
- **LOG** - See the history of changes
- **CHECKOUT** - Jump to any point in time
- **BRANCH** - Experiment without breaking things
- **TAG** - Mark important milestones

You can now work safely, experiment freely, and never lose your work.

7. Distributed Collaboration

Code (and analysis) is rarely done alone.

The problem:

- Can't have people overwriting each other
- Need coordination without chaos

The Solution: Everyone Gets a Copy

The **CLONE/FORK BUTTON** gives someone:

- The entire history
- All the branches
- Full ability to work independently
- No interference with your work

They have their own time machine!

8. 🔒 Hashes and Identity

New concern: What if someone edits the history?

- Sneaks in malicious changes
- Accidentally breaks something

Solution: Digital signatures (hashes)

How Hashes Work

Every commit gets a unique fingerprint:

```
24b9da6552252987aa493b52f8696cd6d3b00393
```

- Changes even with tiny edits
- Each commit includes the previous commit's hash
- **Any past change changes all future hashes**
- Makes tampering immediately obvious

9. Merges: Bringing Work Together

Now we have:

- ✓ Snapshots (commits)
- ✓ Independent work (branches)
- ✓ Complete history (log)
- ✓ Easy comparison (hashes)

How do we combine our work?

The MERGE BUTTON

Merging combines branches:

1. Find the most recent **common commit**
2. Combine the **differences** from both branches
3. Create a new commit with combined work

11. The Staging Area

Problem: Sometimes you make a bunch of unrelated edits.

Best practice: Package related changes together in one commit.

Challenge: What if you forgot to commit before making other changes?

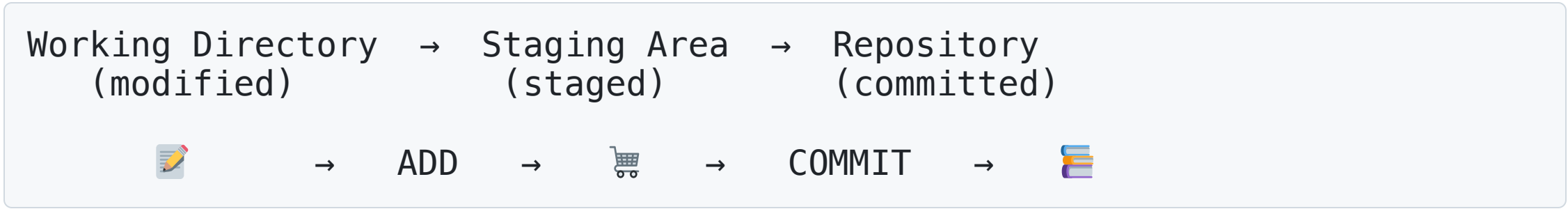
The ADD BUTTON

The **staging area** is like a shopping cart:

- **ADD** changes you want in the next commit
- Leave out changes that belong elsewhere
- **COMMIT** when your cart is ready

Workflow: Edit → Add → Commit

The Three States Visualized



14. Wrap-Up: Git as a Cognitive Model

Git isn't just a tool—it's a **way of thinking** about work:

- Work as **structured history**
- Changes as **navigable snapshots**
- Experiments as **parallel explorations**

Three Key Metaphors

1. 📸 **Snapshots** – Freeze moments in time
2. 🌳 **Branches** – Explore ideas in parallel
3. 🤝 **Merges** – Bring ideas together coherently by comparing *differences*

Review: The Story So Far

The Journey:

1. Started with messy file copies (`report_final_v3.xlsx`)
2. Built a system to take snapshots (**commit**)
3. Added ability to view history (**log**) and time travel (**checkout**)
4. Created parallel timelines for experiments (**branch**)
5. Marked important moments (**tag**)
6. Enabled collaboration by sharing complete copies (**clone/fork**)
7. Protected integrity with digital signatures (**hashes**)
8. Combined work from different branches (**merge**)
9. Organized changes before saving (**staging/add**)

The Buttons We've Created

- **COMMIT** - Save a snapshot
- **LOG** - View history
- **CHECKOUT** - Jump in time
- **BRANCH** - Split off to experiment
- **TAG** - Mark milestones
- **CLONE/FORK** - Share the entire history
- **MERGE** - Combine work
- **ADD** - Stage changes

You Now Understand Git

Everything else is just:

- Syntax and commands
- Tools and interfaces
- Best practices and workflows

The concepts? You've got them.

Questions?

```
$ git commit -m "Learning complete"
```

Thank You

Remember: Version control is about telling the story of your work.

Git just gives you the tools to tell it well.