Introduction to version control with Git

Day 1: Concepts and a basic workflow

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Who am I?

> Scientific programmer @ theoretical ecology group

Who are you?

Aims of the workshop

Git is a huge topic and Git is very powerful.

Learn simple Git workflows in **theory and practice** that you can immediately apply to your research projects.

Enough time to for practice and questions.

Topics

Today

- Introduction to Git concepts
- Simple Git workflow for your own projects

Tomorrow

- Collaborate using Git and Github

Next Monday

- Q&A
- Advanced topics
- Until then: work with Git on your own projects

Organization

- Today and tomorrow: 🕑 2.30 - 4 p.m.
- Next Monday: 🕑 2.30 - 3.30 p.m.
- Material is all online

Before we start

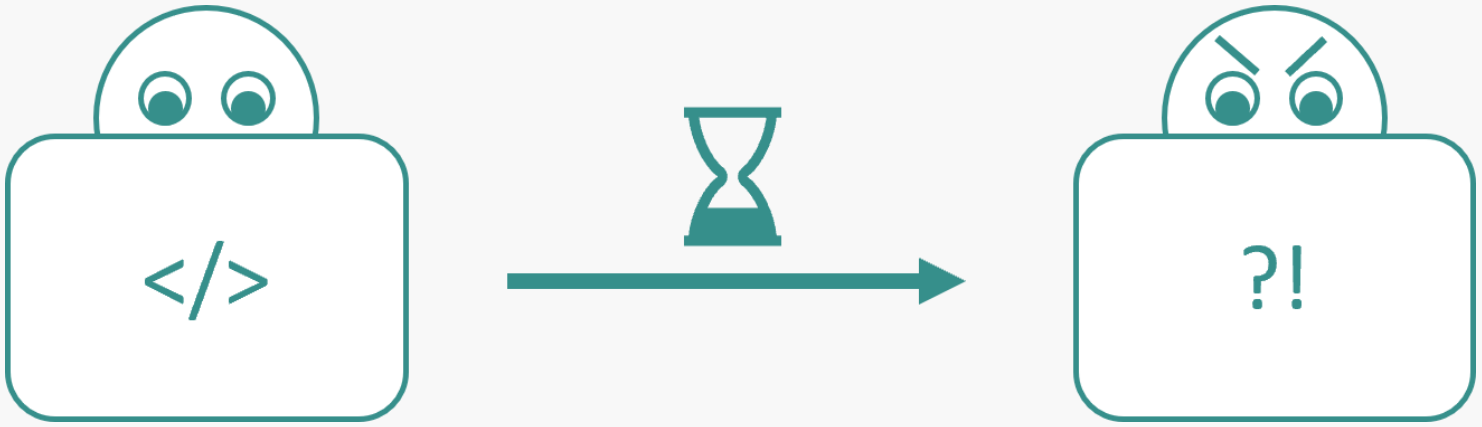
Did anyone have problems with the workshop preparation?

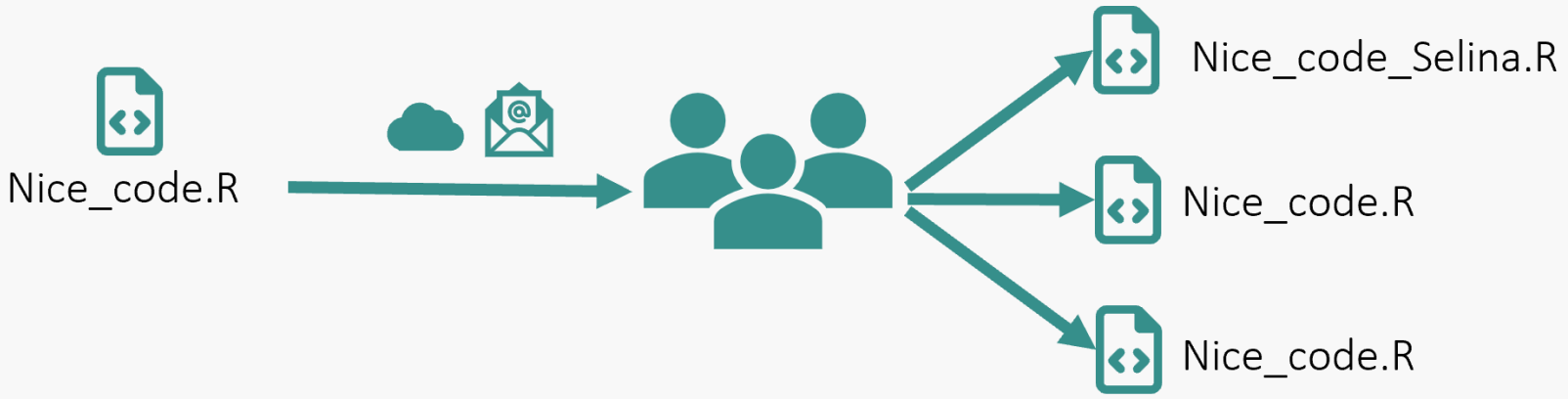
- Install Git
- Install Github Desktop
- Get a Github account and connect it with Github Desktop

Let’s get started

Why version control?

Two examples in which proper version control can be a time/stress saver



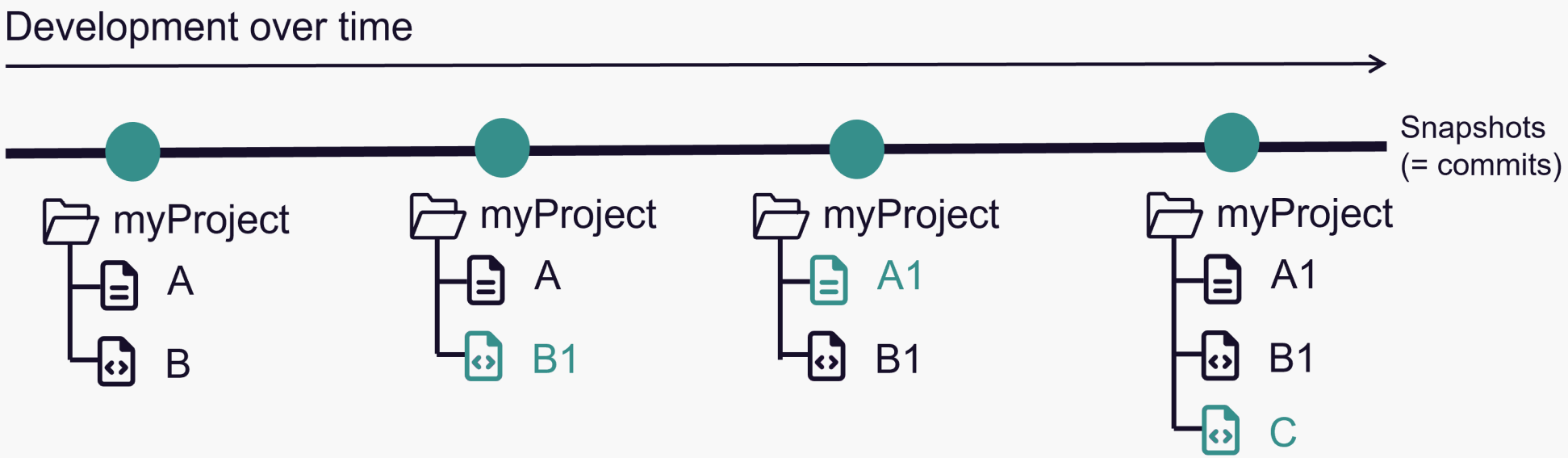


Version control with Git

- **Complete** and **long-term** history of every file in your project
- **Open source and free** to use version control software
- Quasi **standard** for software development
- A whole universe of **other software and services** around it

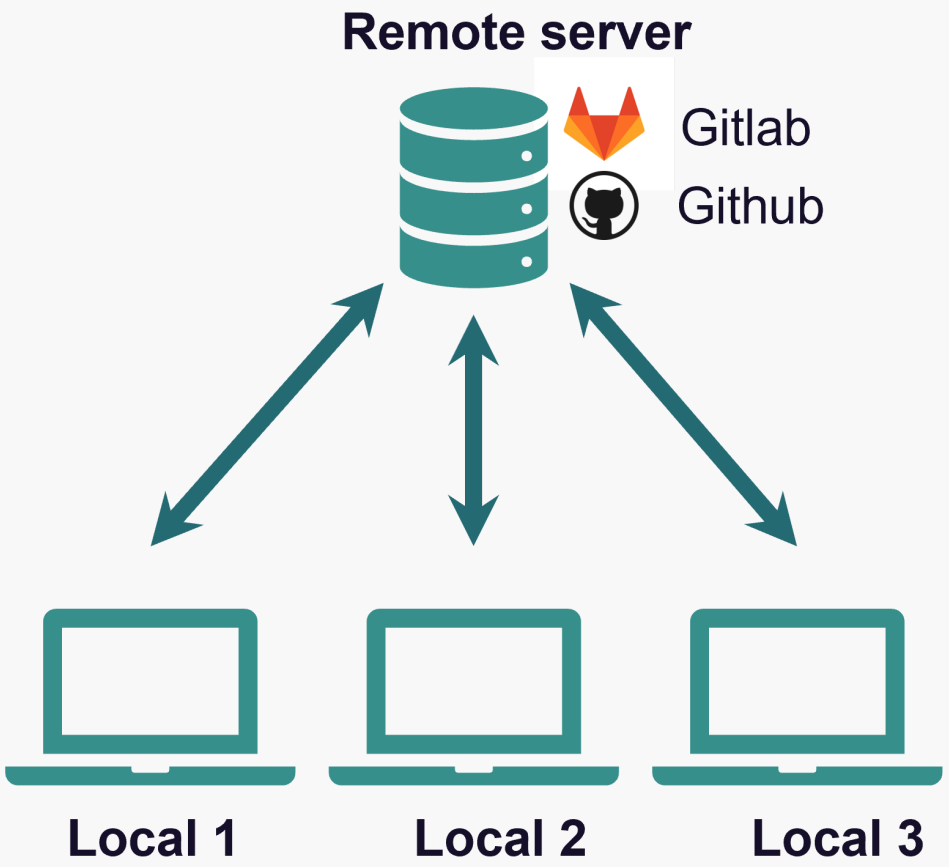
Version control with Git

- For projects with mainly text files (e.g. code, markdown files, …)
- Basic idea: Take snapshots (**commits**) of your project over time
- A project version controlled with Git is a Git **repository** (**repo**)



Version control with Git

Git is a **distributed version control system**



- Idea: many *local* repositories synced via one *remote* repo
- Everyone has a complete copy of the repo

How to use Git

After you installed it there are different ways to interact with the software.

How to use Git - Terminal

Using Git from the terminal

```
Selina_User@DESKTOP-G0RM7MS MINGW64 ~/Files_Selina
$ cd Repos/02_workshops/first_git_project/

Selina_User@DESKTOP-G0RM7MS MINGW64 ~/Files_Selina/Repos/02_workshops/first_git_
project
$ git init
Initialized empty Git repository in C:/Users/Selina_User/Files_Selina/Repos/02_w
orkshops/first_git_project/.git/

Selina_User@DESKTOP-G0RM7MS MINGW64 ~/Files_Selina/Repos/02_workshops/first_git_
project (master)
$
```

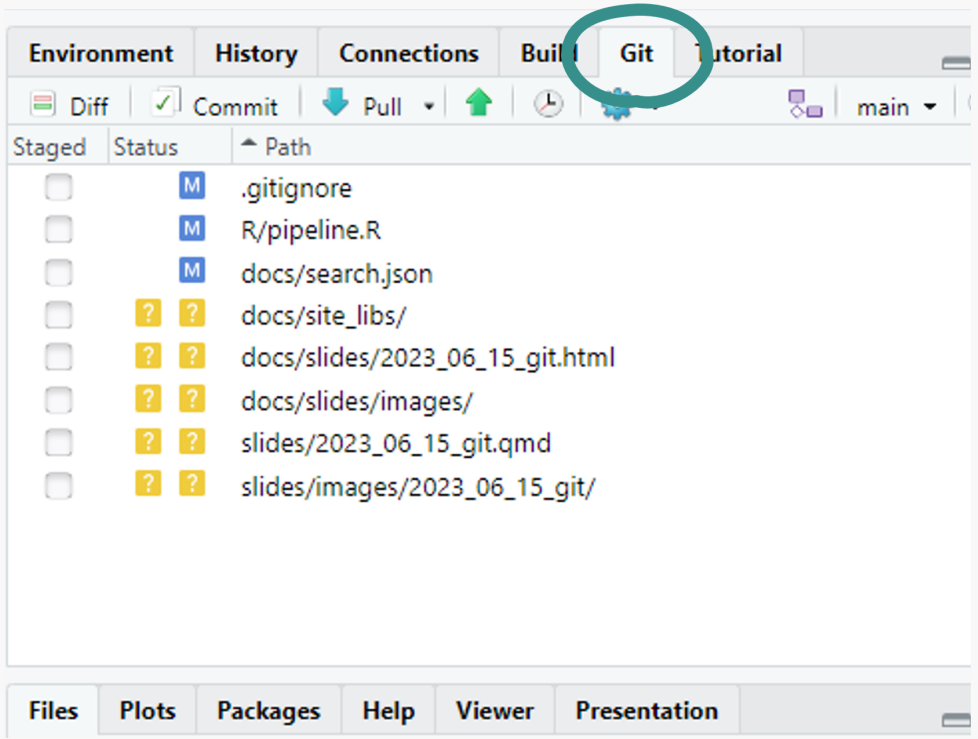
➕ Most control

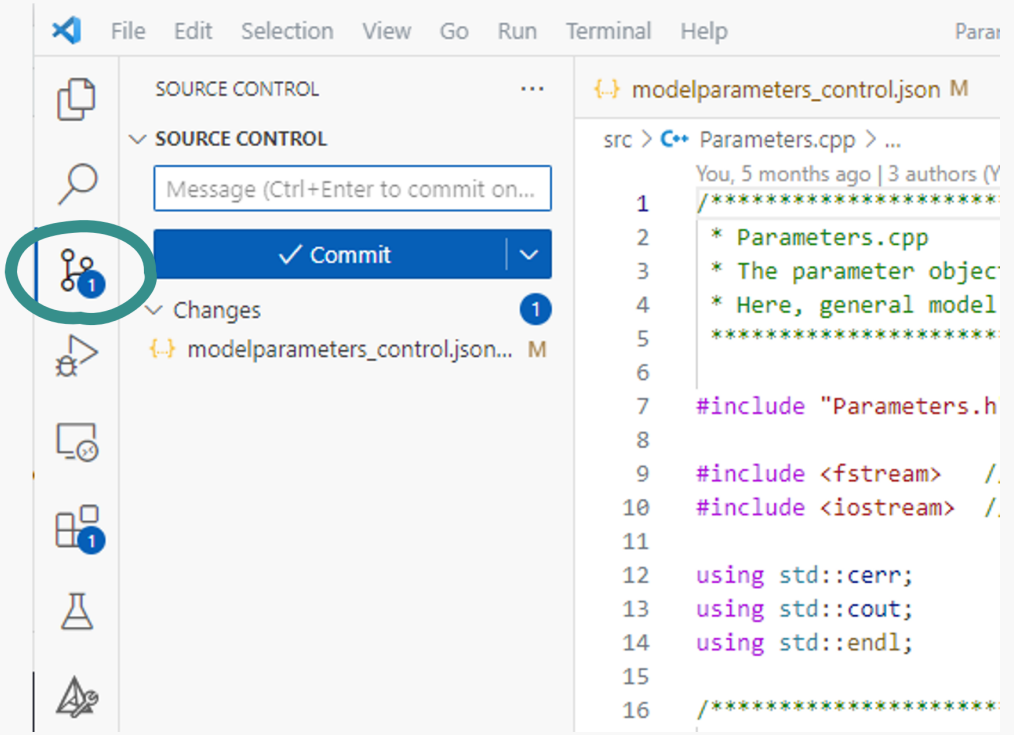
➕ A lot of help/answers online

➖ You need to use terminal 😱

How to use Git - Integrated GUIs

A Git GUI is integrated in most (all?) IDEs, e.g. R Studio, VS Code





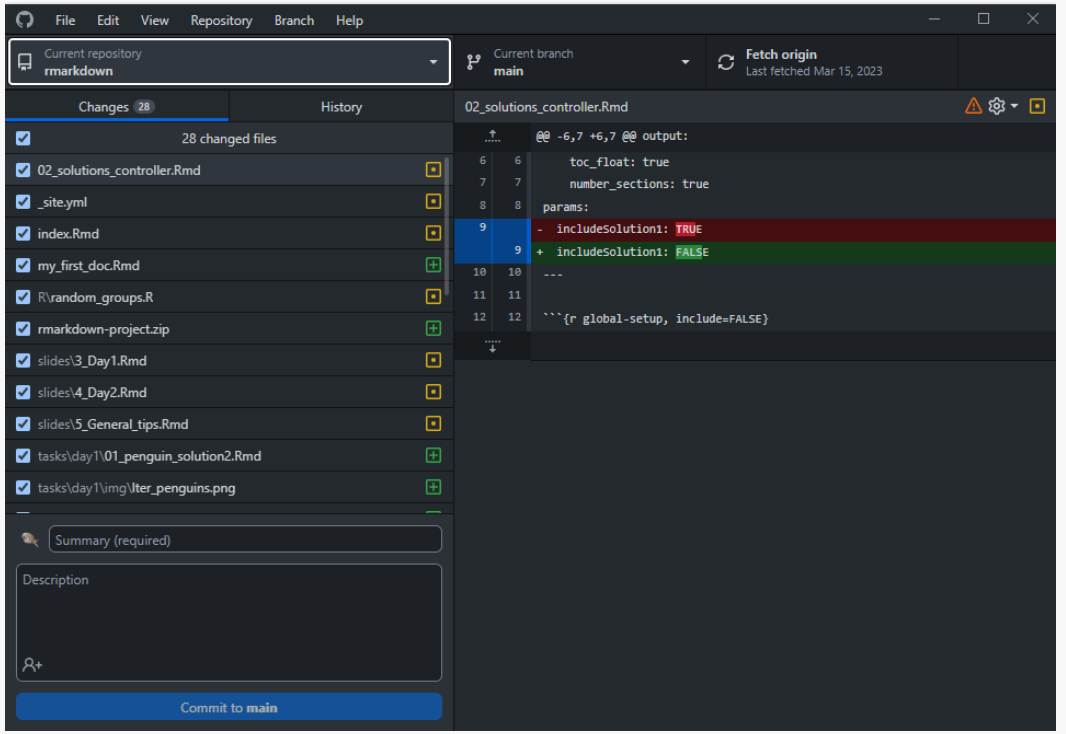
➕ Easy and intuitive

➕ Stay inside IDE

➖ Different for every program

How to use Git - Standalone GUIs

Standalone Git GUI software, e.g. Github Desktop, Source Tree, ...



➕ Easy and intuitive

➕ Nice integration with Github

➖ Switch programs to use Git

How to use Git

Which one to choose?

- Depends on experience and taste
- You can mix methods because they are all interfaces to the same Git

- We will use Github Desktop
  - Beginner-friendly and intuitive
  - Very convenient
  - Nice integration with Github

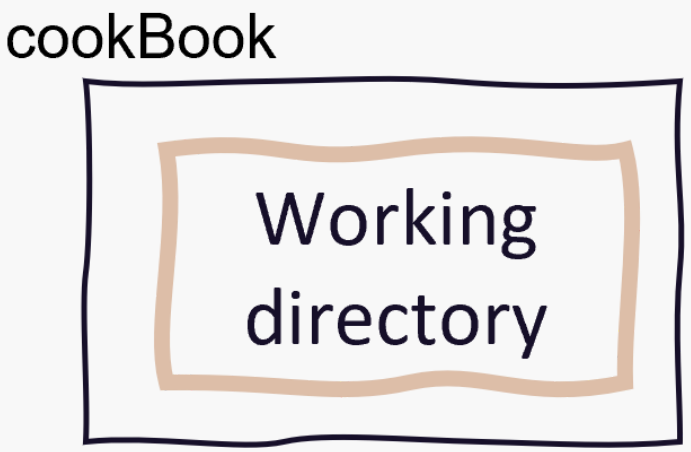
> **Tip**
>
> Have a look at the website where you find **How-To guides for the other methods** as well.

The basic Git workflow

> `git init`, `git add`, `git commit`, `git push`

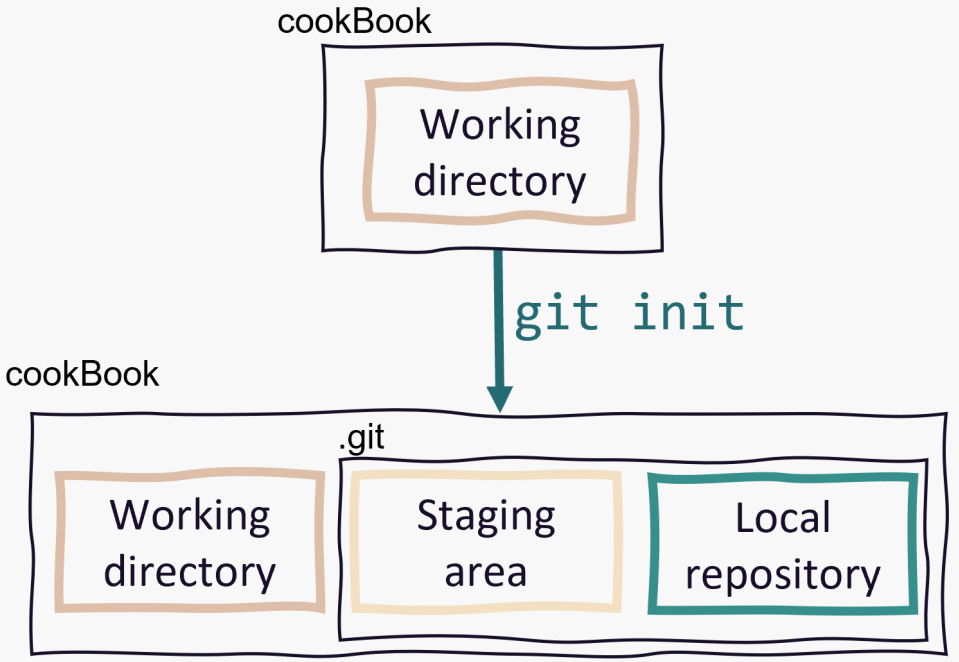
Step 0: An empty project

Example: A cookBook project to collect all our favorite recipes



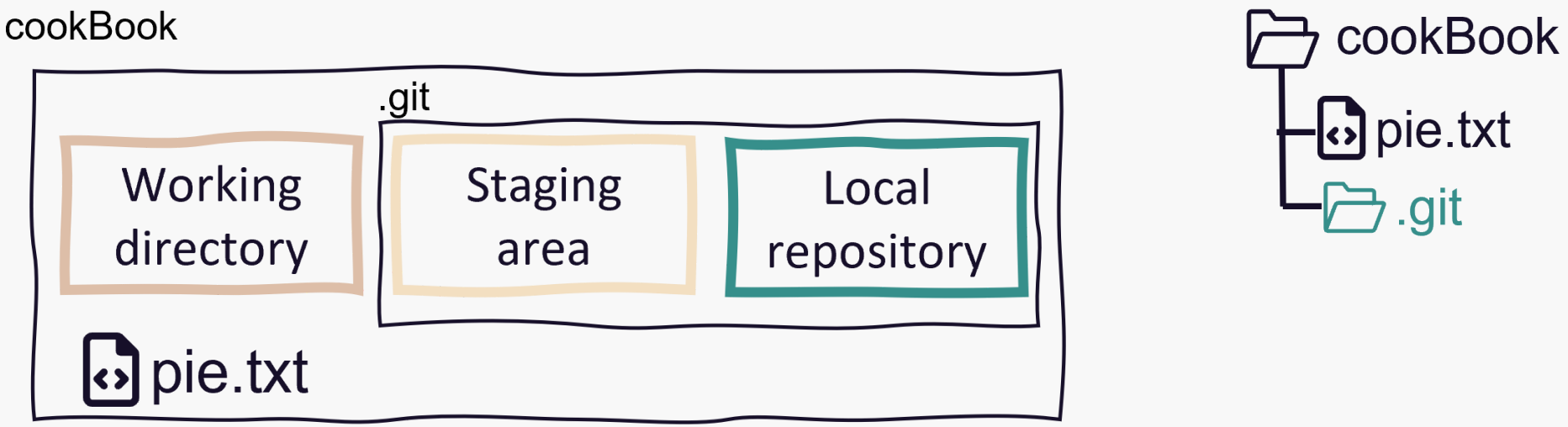
Step 1: Initialize a Git repository

- Adds a (hidden) `.git` folder to your project
  - You don't need to interact with this folder directly



Step 2: Modify files and stage changes

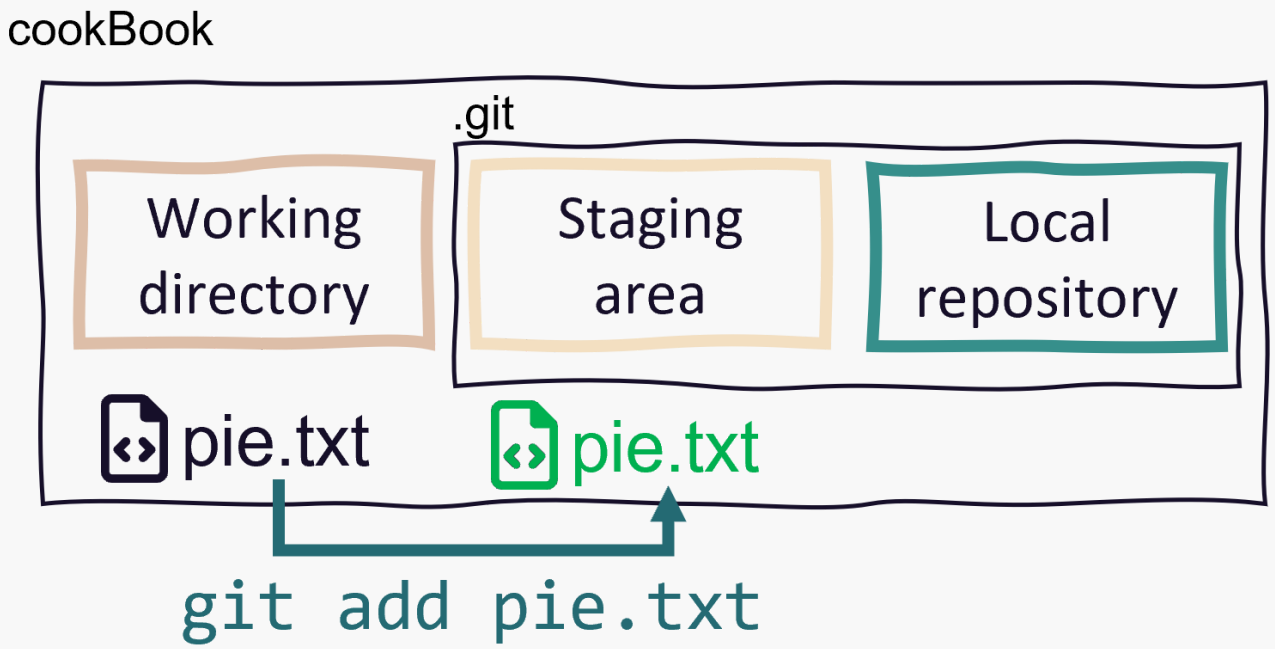
Git detects any changes in the working directory

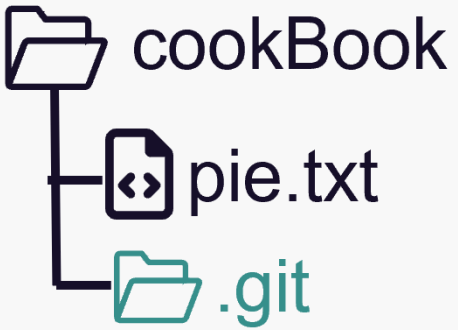


Step 2: Modify files and stage changes

Stage file to be part of the next commit (snapshot)

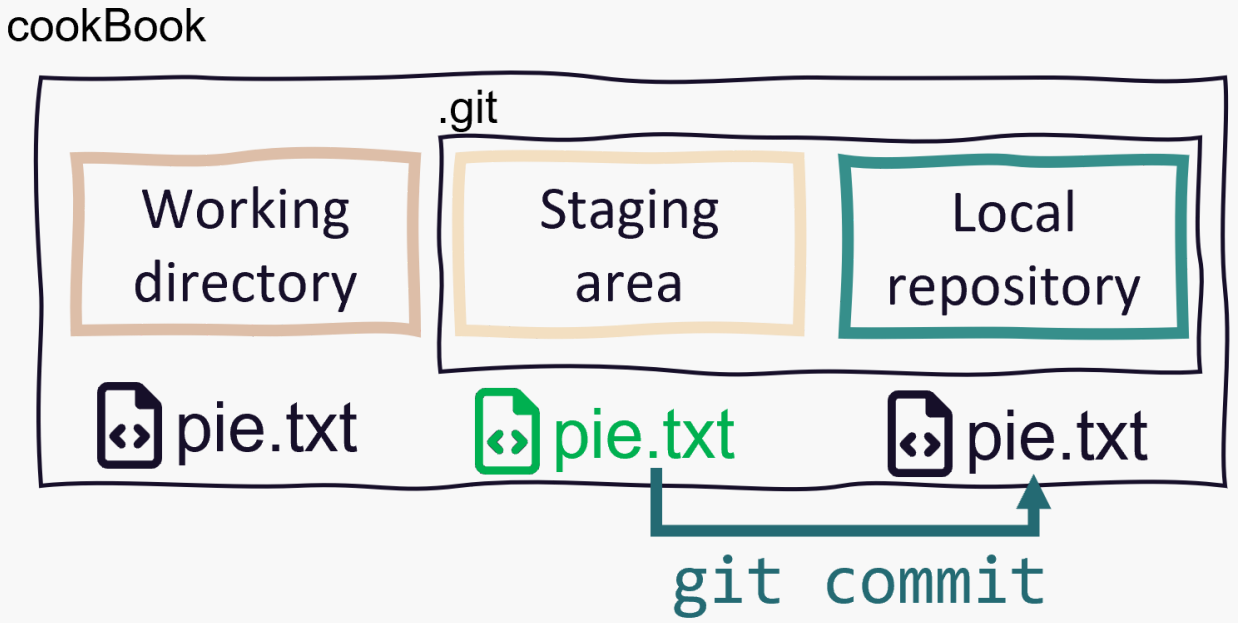
- In the terminal use `git add`
- In GUIs just a check box

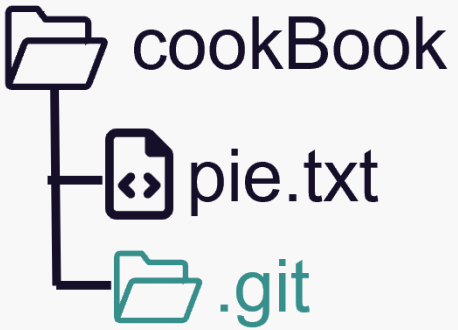




Step 3: Commit changes

- Commits are the snapshots of your project state

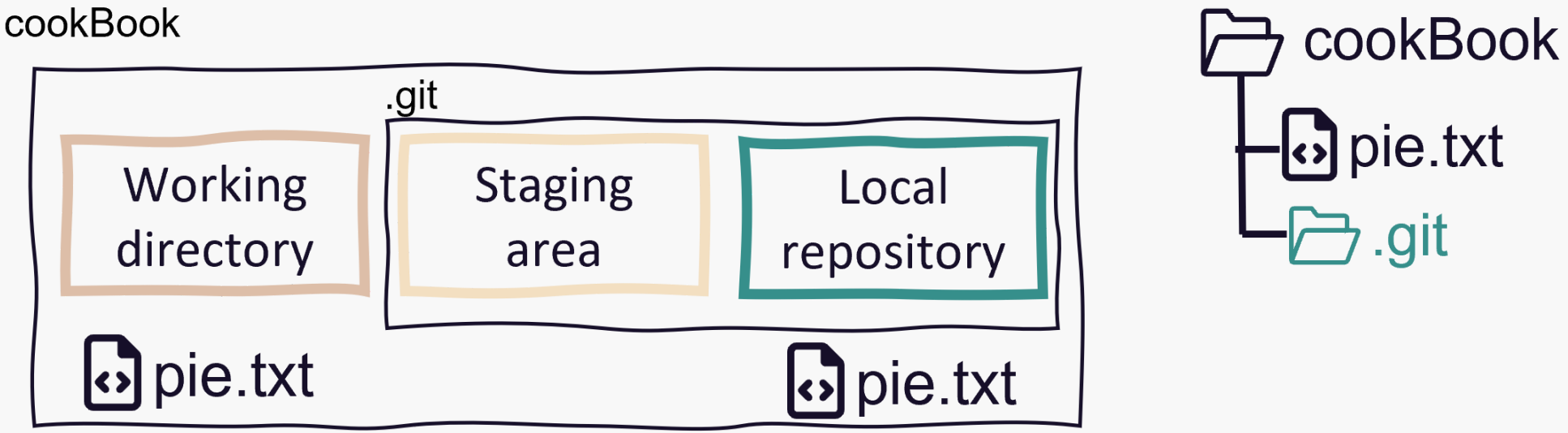




- Collect meaningful bundles of changes in the staging area, then commit

Step 3: Commit changes

- After a commit, the staging area is clear again
- Changes are now part of the project's Git history



Now you

> Start your own cook book Complete task 1 “Local repo” (10 min)

Stay in the meeting for the task.
Ask questions if you are stuck.
Turn down/off volume if you are disturbed.

How to write good commit messages?

xkcd on commit messages

How to write good commit messages?

See here for more details but some general rules:

1. Limit summary line to 50 characters
2. Capitalize summary line
3. Do not end summary line with period
4. Use imperative mood in the subject line
5. Use the *Description* to explain **what** and **why**, not **how**

How to write good commit messages?

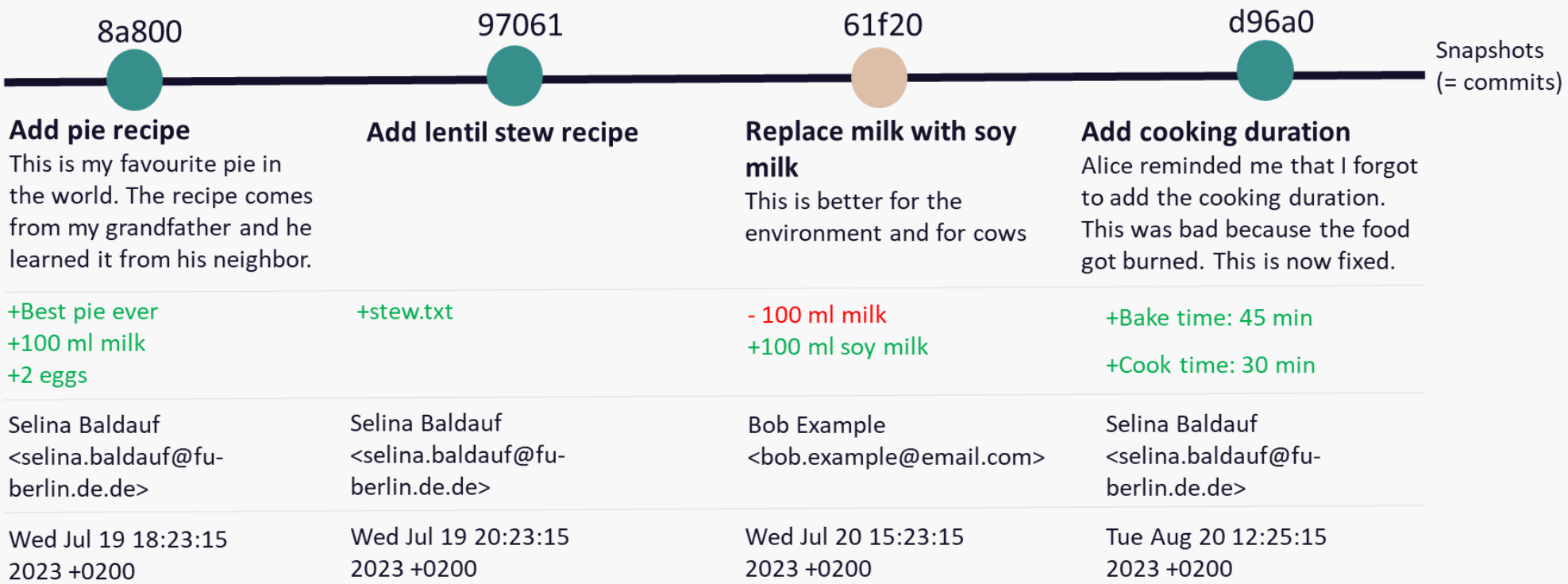
```
Add pie recipe

This is my favorite pie in the world.
The recipe comes from my grandfather and
he learned it from his neighbor.
```

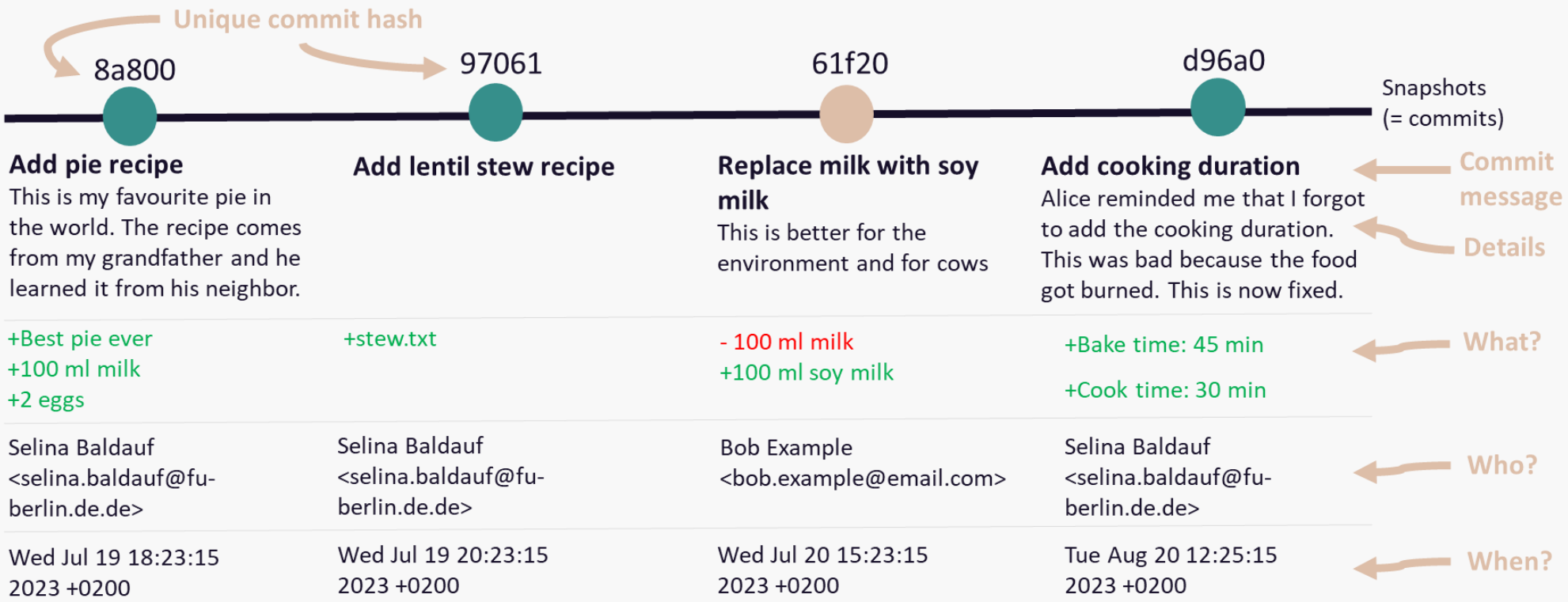
```
added a file.

This is a a really good recipe that I li
```

The commit history



The commit history



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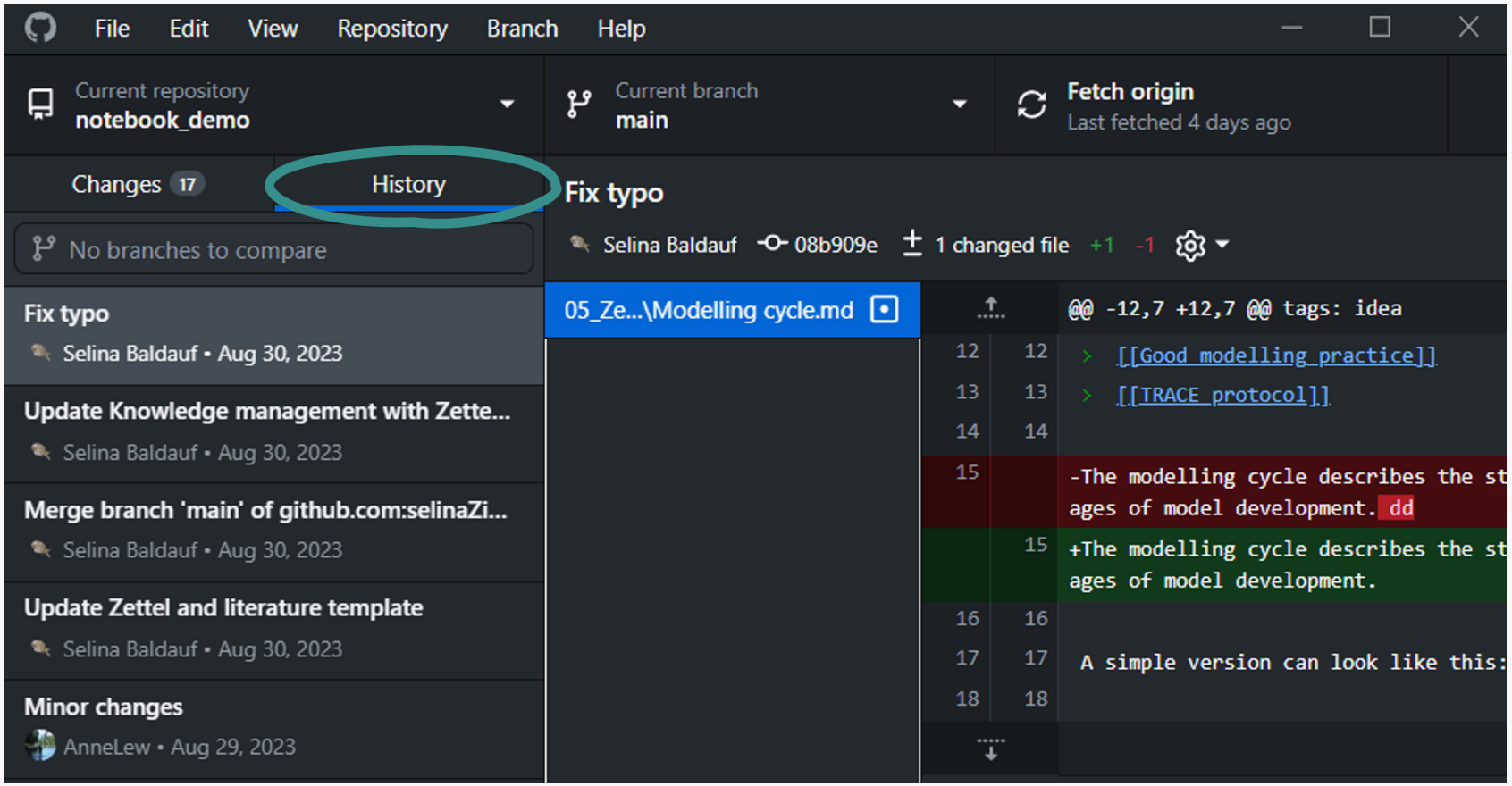
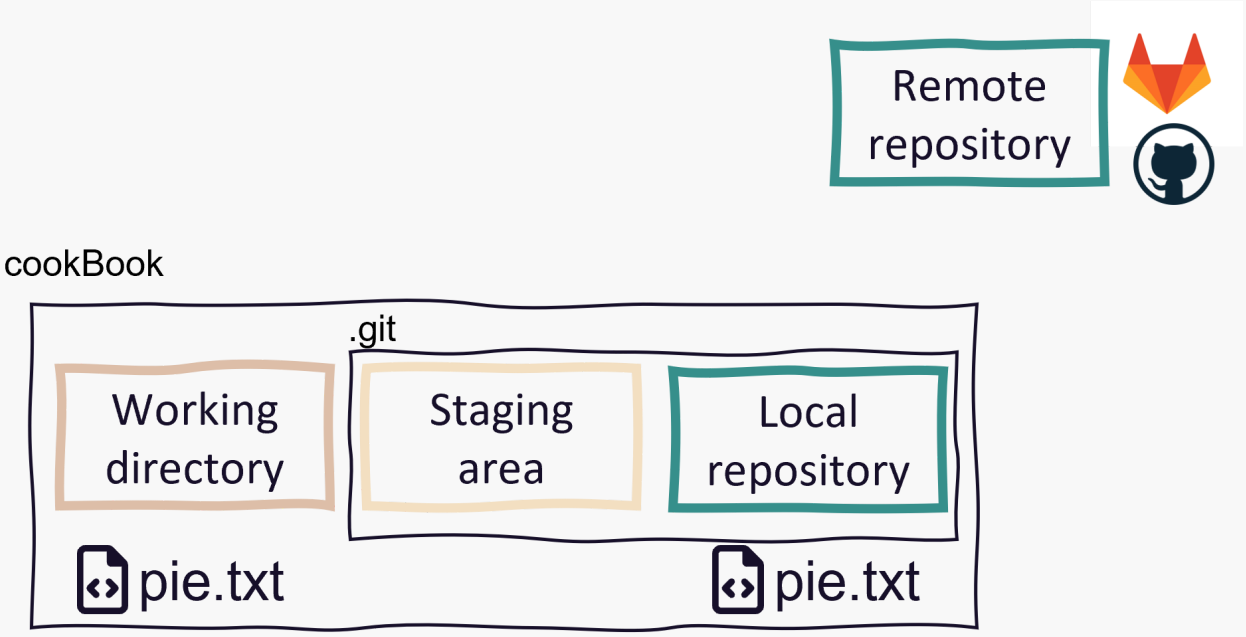


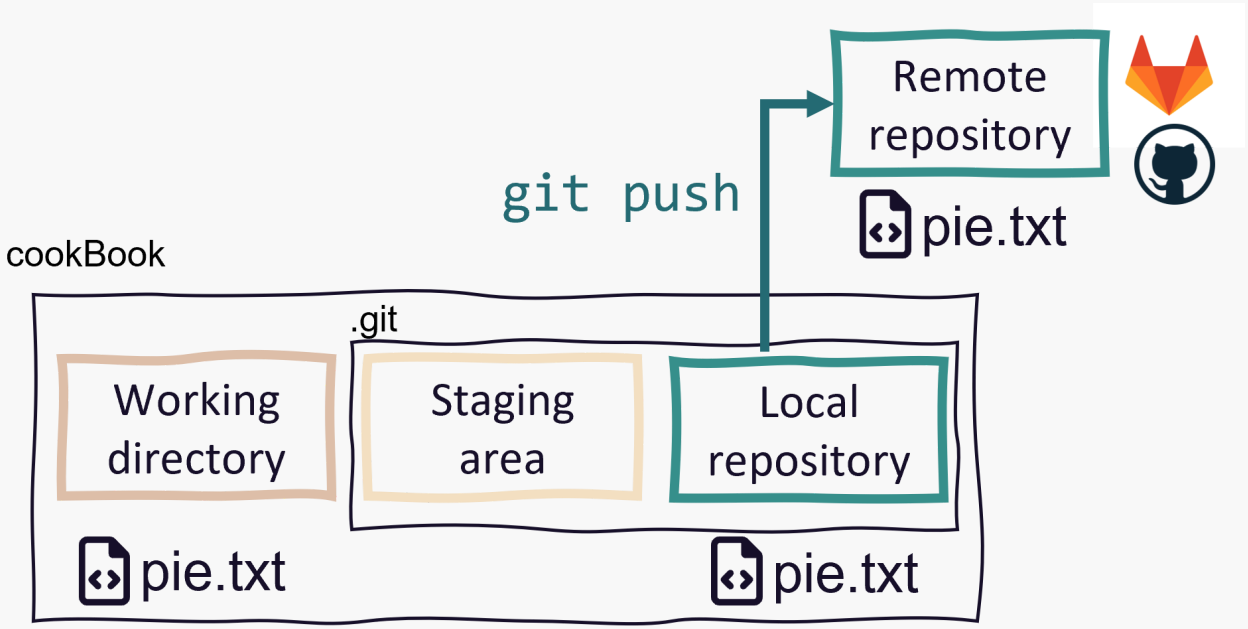
Step 4: Create and connect a remote repo

- Use remote repos (on a server) to *synchronize*, *share* and *collaborate*
- Remote repos can be *private* (you + collaborators) or *public* (visible to anyone)



Step 5: Share changes with the remote repo

- Push your local changes to the remote with `git push`



Now you

> Publish your cook book on Github Complete task 2 “Github” (5 min)

A word on remote repositories

- There are **commercial** and **self-hosted** options for your remote repositories
  - Commercial: Github, Gitlab, Bitbucket, …
  - Self-hosted: Gitlab (maybe at your institution?)
- Please be aware of your institutional guidelines
  - Servers outside EU
  - Privacy rules might apply

Summary of the basic steps

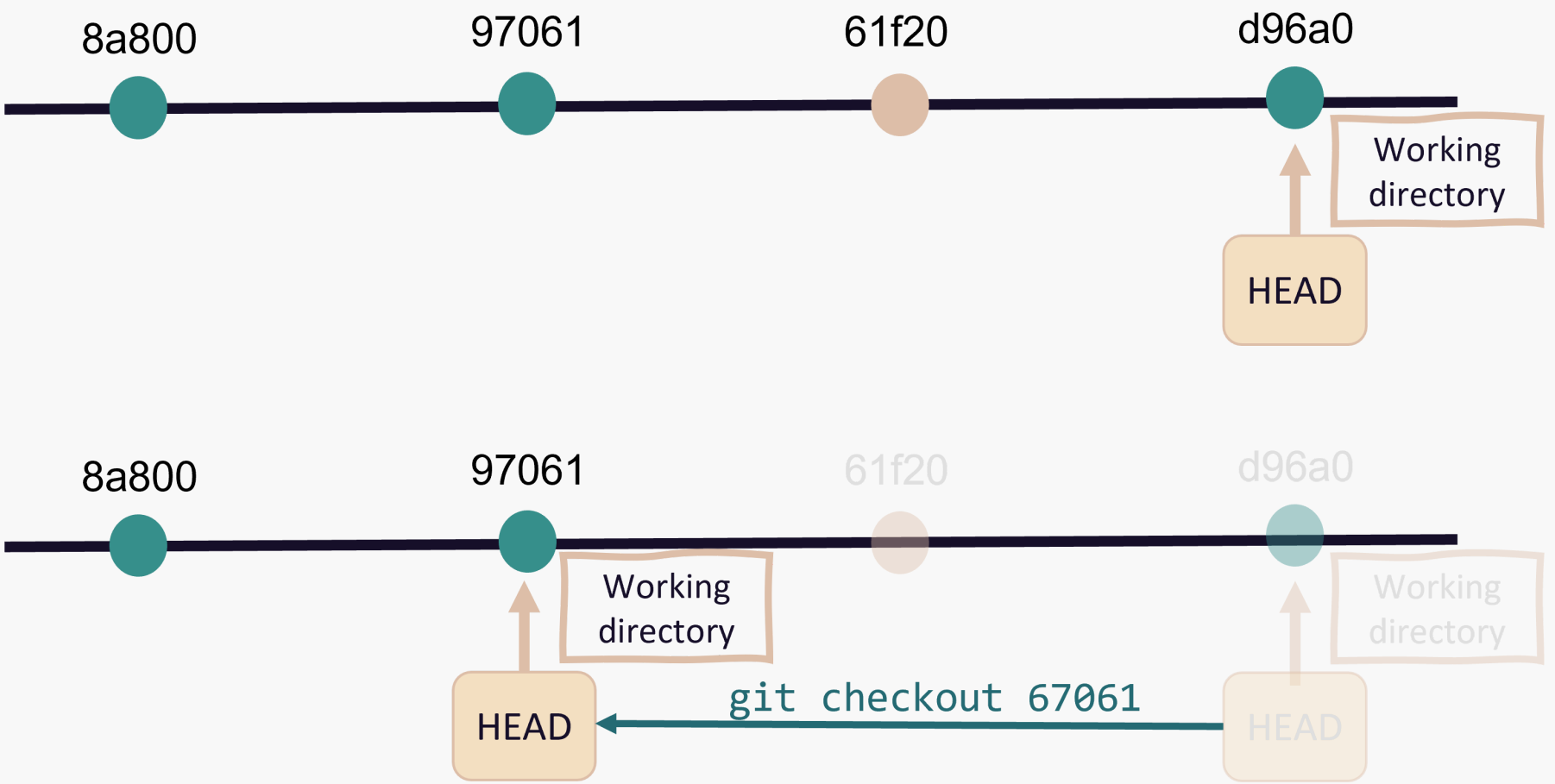
- `git init`: Initialize a git repository
  - Adds a `.git` folder to your working directory
- `git add`: Add files to the staging area
  - This marks the files as being part of the next commit
- `git commit`: Take a snapshot of your current project version
  - Includes time stamp, commit message and information on the person who did the commit
- `git push`: Push new commits to the remote repository
  - Sync your local project version with the remote e.g. on Github

Go back in time with Git

> git checkout, git revert

Checkout a previous commit

- Bring your work space back in time temporarily with `git checkout`



Revert changes

- Use `git revert` to revert specific commits
- This does not delete the commit, it creates a **new commit that undoes a previous commit**
  - It's a safe way to undo commited changes

Now you

> Revert a part of your recipe Complete the task 3 “Time travel” (5 min)

Publish your repositories

Publish your repositories

Github/Gitlab are a good way to publish and share your work.

Advantages of publishing your code

- Others can build on your work
- Citations
- Reproducibility
- Get feedback

Publish your repositories

You can increase the quality/complexity of your repo by

- Adding a nice README.md file
- Connecting the repo with Zenodo to get a DOI
- Create a Github pages website alongside your repo
- Encourage people to write issues if they find problems
- ...

Ignoring files

Ignore files with `.gitignore`

- Create a file with the name `.gitignore` in working directory
- Add all files and directories you want to ignore to the `.gitignore` file

- Useful to ignore e.g.
  - Compiled code and build directories
  - Log files
  - Hidden system files
  - Personal IDE config files
  - …

Ignore files with `.gitignore`

- Create a file with the name `.gitignore` in working directory
- Add all files and directories you want to ignore to the `.gitignore` file

Example

```
*.html    # ignore all .html files
*.pdf     # ignore all .pdf files

debug.log # ignore the file debug.log

build/    # ignore all files in subdirectory build
```

See here for more ignore patterns that you can use.

Thanks for your attention

> Questions?

Preparation for tomorrow

- Tomorrow we collaborate on our cookbooks in teams of 2
  - Enter your Github Account Name and the link to your repo here
- Look for the Github Name of your partner and add them as a collaborator to your repository
- Accept the invitation of your partner to their repository
  - You will get an Email or you can do it on Github

Basic Git workflow