



git & GitHub

Workshop

How we learned to stop worrying and love the git

Who are we?



Assistant Professor, Research,
Health Data Science (HeaDS).

Data Scientists, SUND Data
Lab, Centre for Health Data
Science (HeaDS).



Post-doc, Computational Biology
Laboratory, Danish cancer society
Research Centre (DCRC).



Jonas
Sibbesen



Diana
Andrejeva



Thilde
Terkelsen

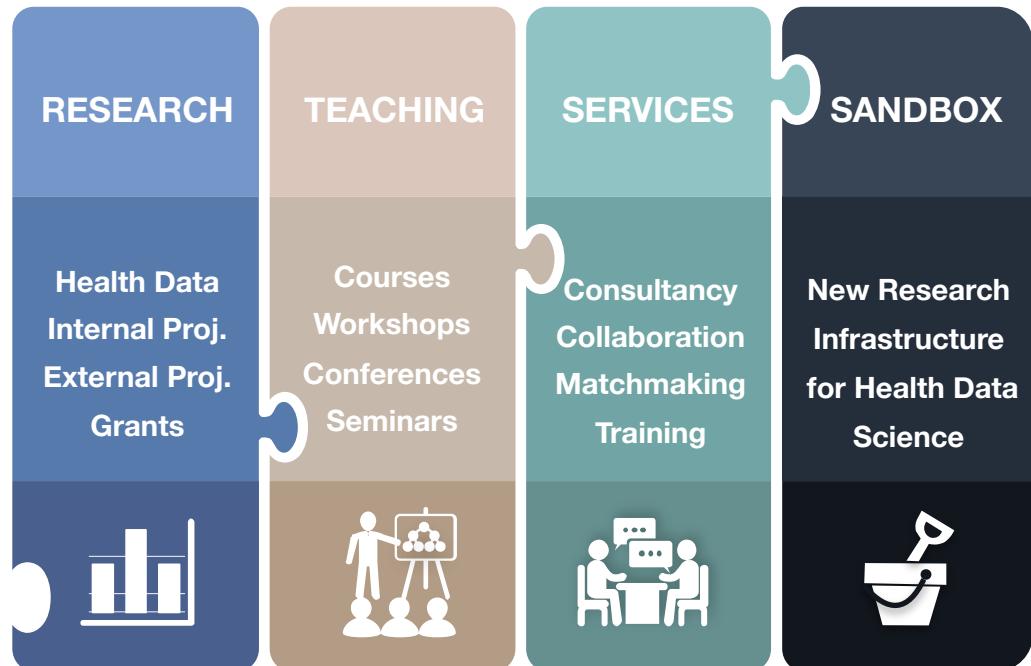


Matteo
Tiberti



Center for Health Data Science

- **Conduct Health Data Science research.**
- **Serve as the UCPH Data Lab.**
 - Be the hub for health data science research.
 - Provide SUND researchers with health data science services & training.
- **Develop National Health Data Science Sandbox for Training and Research**





SUND DATA LAB



Thilde Terkelsen
Data scientist



Henrike Zschach
Scientific Coordinator



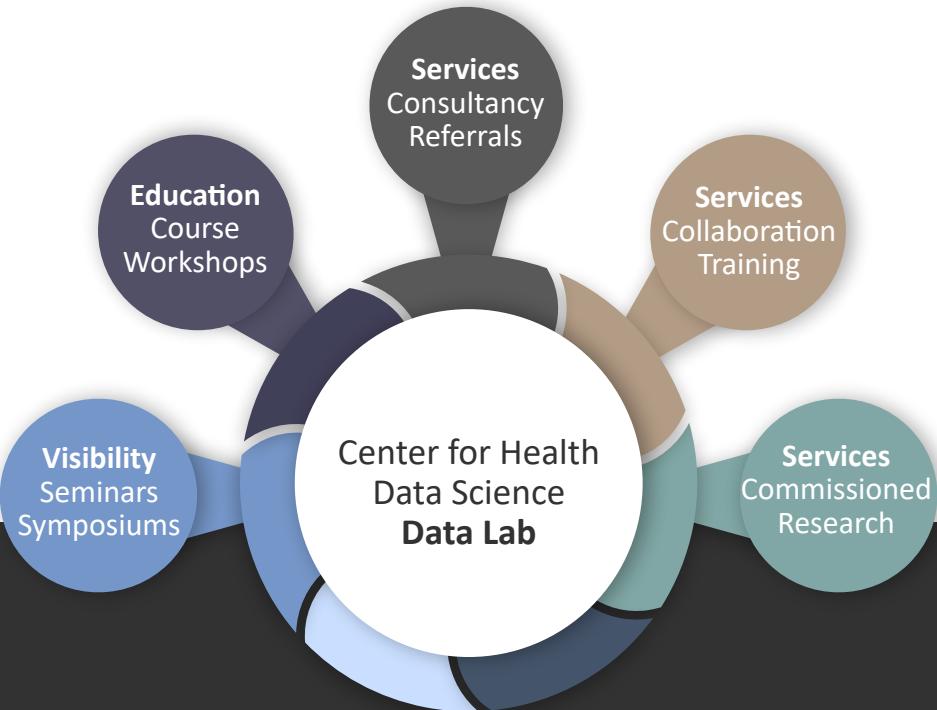
Diana Andrejeva
Data scientist



Marilena Hohmann
Admin Employee



Conor O'Hare
Admin Employee



Website - <https://heads.ku.dk>

Email - datalab@sund.ku.dk

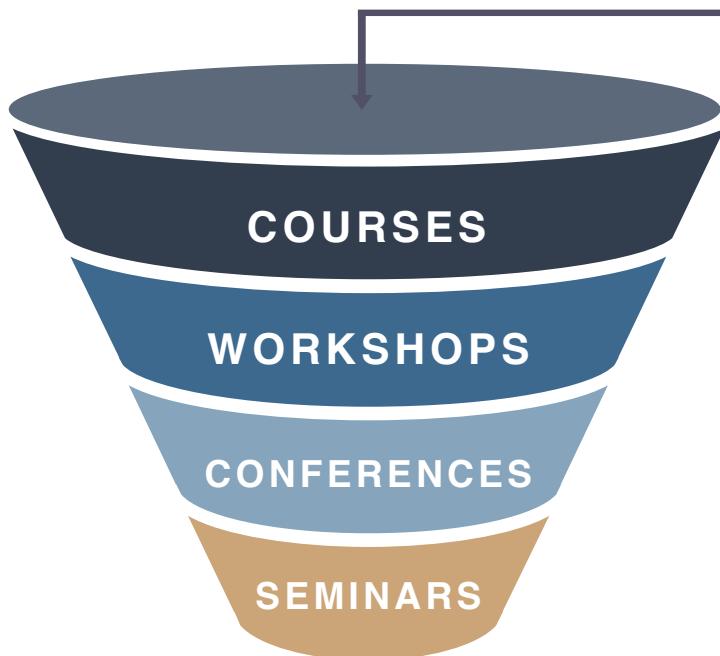
Follow us on **Twitter** at [@ucph_heads!](#)

Slack channel and **mailing list**

courses, conferences, research activities, job postings, etc. within the field of data science.



Center for Health Data Science



git/Github Workshop (Reproducible Science):
Today.



From Excel to R (module 1): March & June,
2022. More R modules in collaboration bio-
statistics.



Python Tsunami: May.



Computerome 2.0 Users Workshop:
May, 2022.
Collaboration Globe.



Introduction to RNA-seq analysis, June 2022.



Program

9.00-9.45: Theoretical introduction
9.45-9.55: First look at git and github, first commands
9.55-10.15: [Ex 1-3: GitHub repository, local copy, status](#)

10.15-10.25: Staging, committing, checking history
10.25-10.40: [Coffee Break](#)
10.40-11.00: [Ex 4-5: First commits](#)

11.00-11.10: Checkout and fix commits
11.10-11.30: [Ex 6: Checkout, reset, revert](#)

11.30-11.40: Branching and merging
11.40-12.00: [Ex 7: Branching and merging](#)

12.00-13.00: [Lunch break](#)

13.00-13.15: Q&A

13.15-13.25: Merging conflicts
13.25-13.45: [Ex 8: Creating a conflict and resolving it](#)

13.45-13.55: Interacting with a remote (pull, fetch and push)
13.55-14.15: [Ex 9: Interacting with a remote](#)

14.15-14.30 [Coffee Break](#)

14.30-15.00: [Ex 10: Contributing to our shared recipe repository - Issues and pull requests](#)

15:00-15:30: Q&A (and working on a repository for your own code)

Resources

- Git Pro Book:
<https://git-scm.com/book/en/v2>



- Introduction to git for bioinformaticians:
<http://ponderomatics.com/git.html>



- Get started with SourceTree:
<https://confluence.atlassian.com/get-started-with-sourcetree>



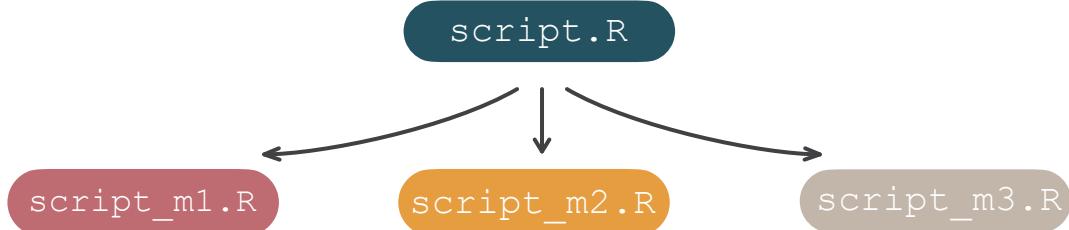
- CodeRefinery website:
<https://coderefinery.org/lessons/>



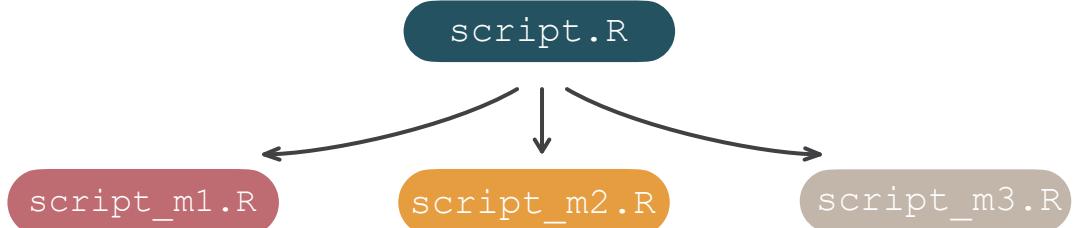
Justification

script.R

Justification

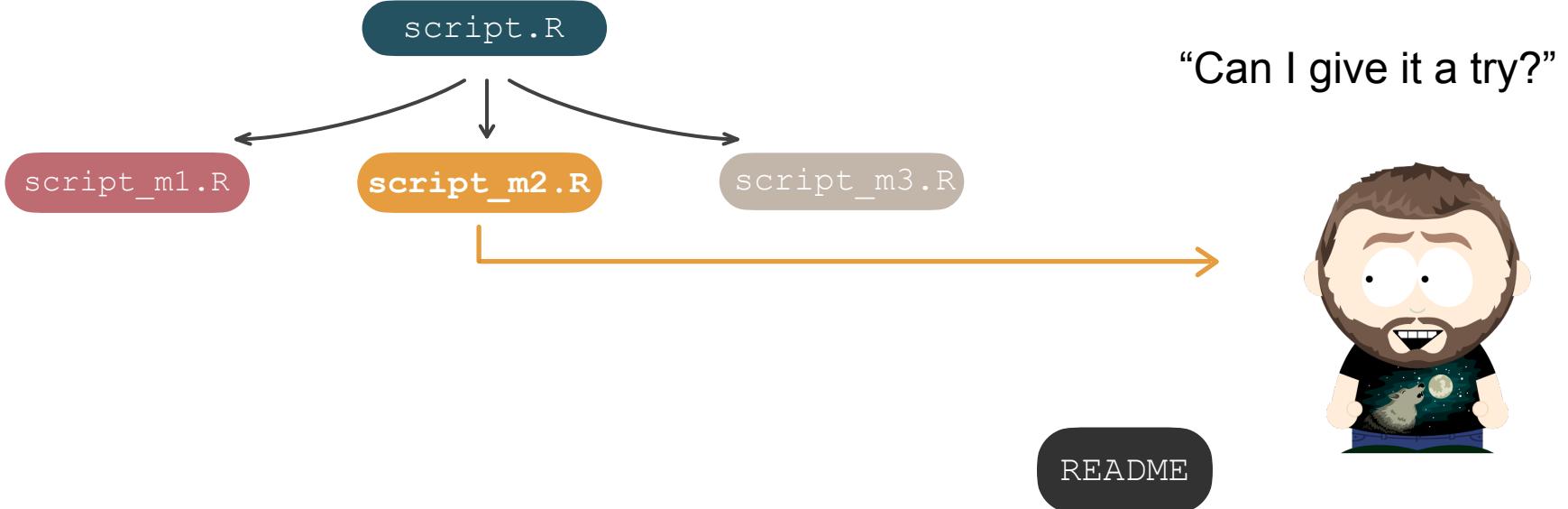


Justification

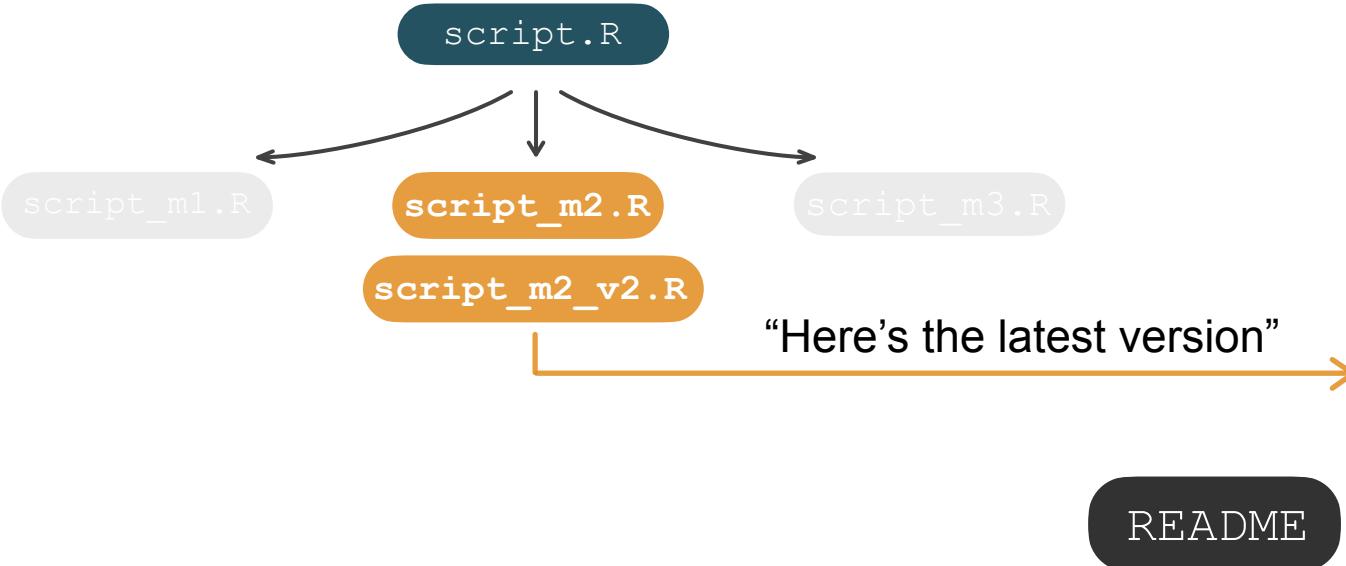


README

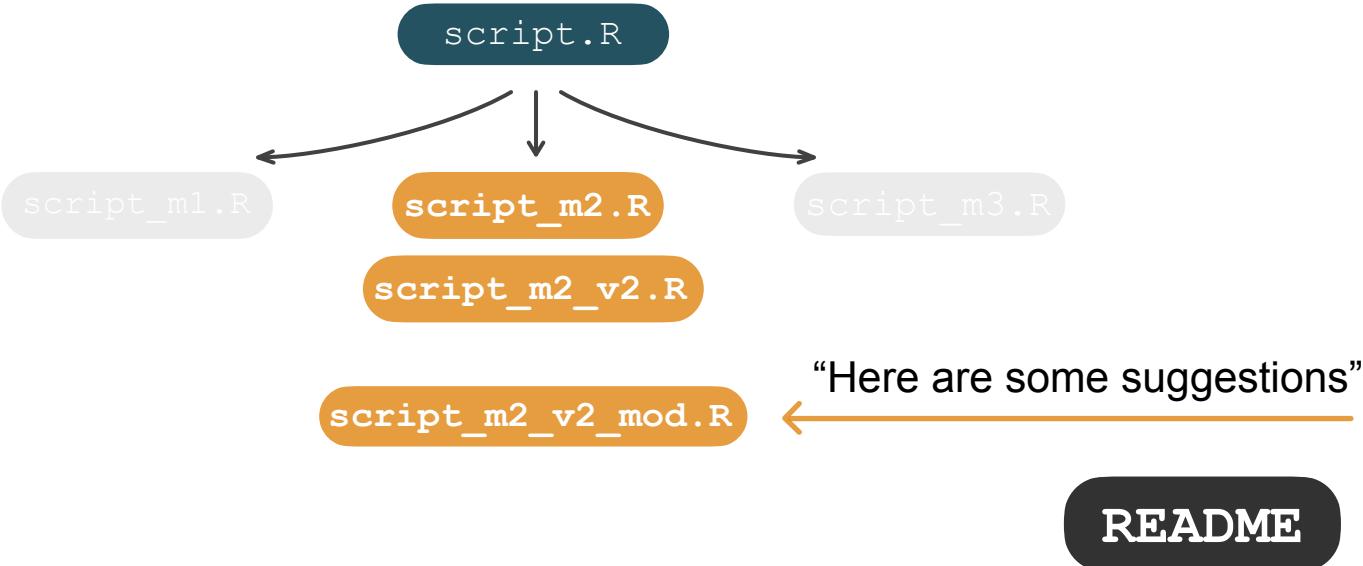
Justification



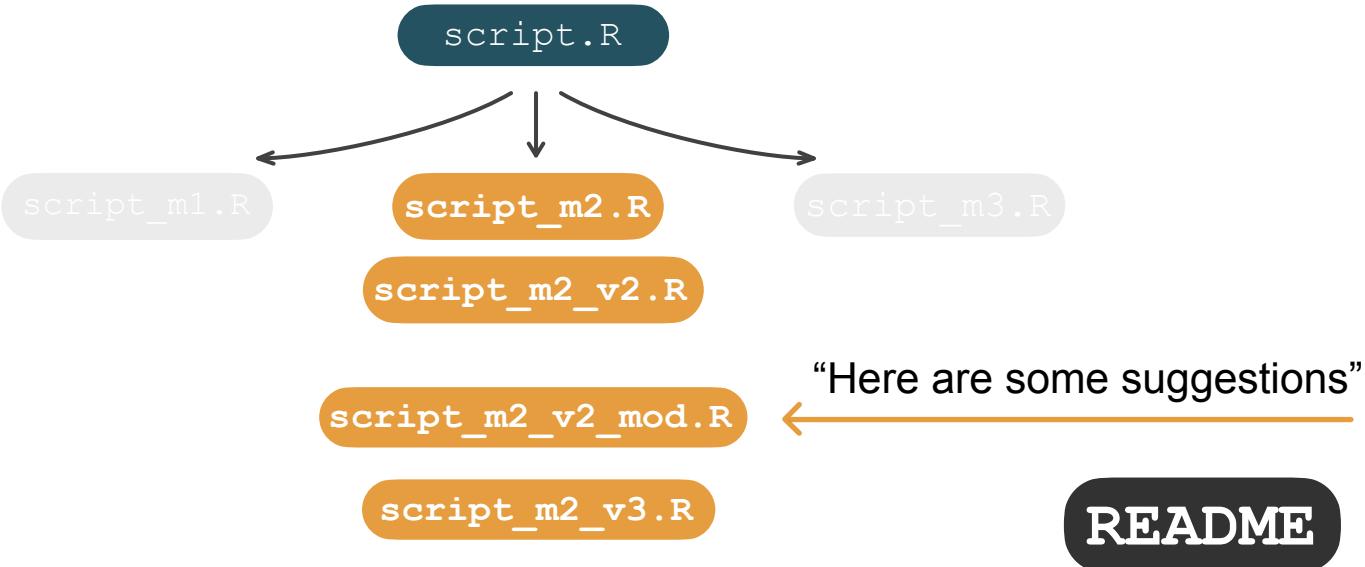
Justification



Justification



Justification



Justification

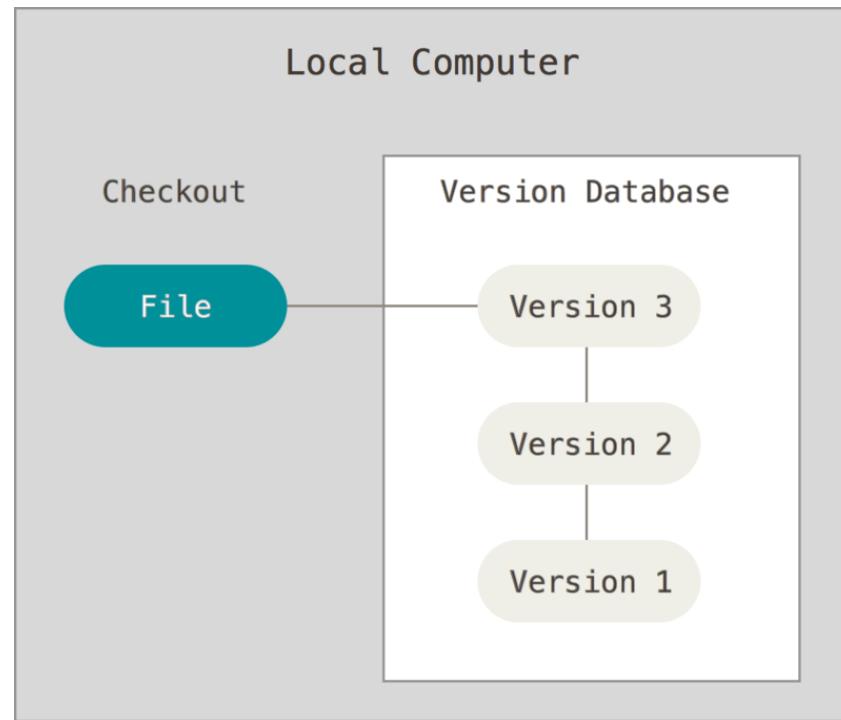
Keeping track of manually means...

- Significant overhead
 - Organization
 - Documentation
 - Communication
- Error-prone and time-consuming
- Makes collaboration difficult
- Six months from now...???



Version control systems

"Version control is a system that records changes to a file or set of files over time so that you can recall specific versions later (**history**)"



Version control systems

Referring to and tracking back to specific versions

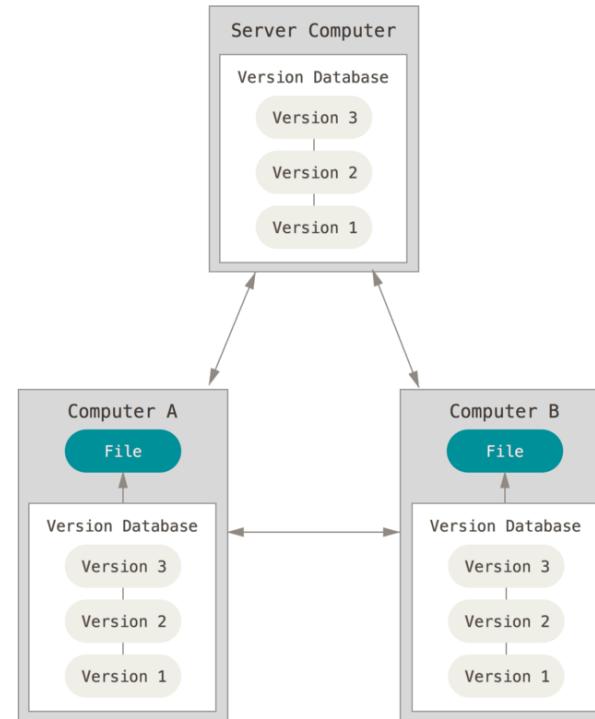
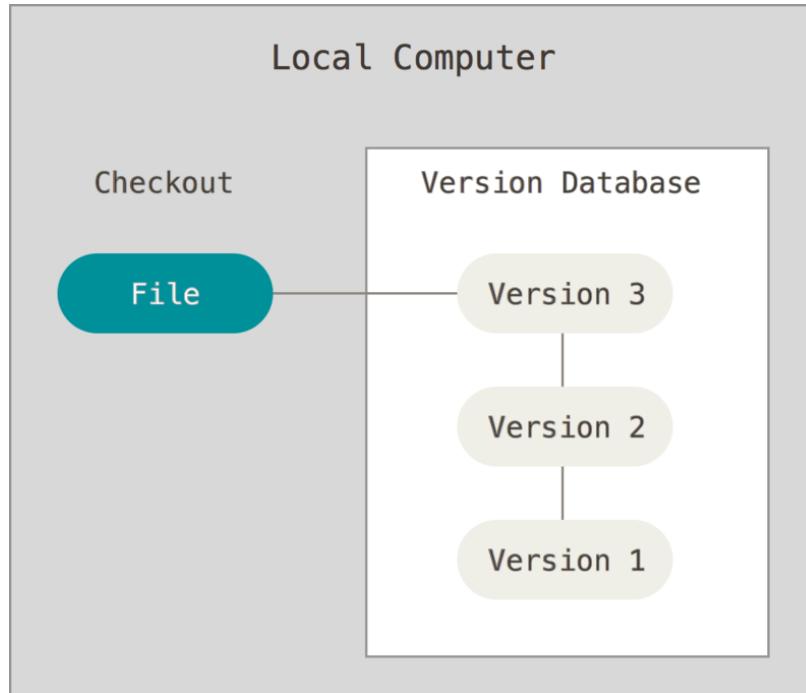
- When was “that” change introduced (backtracking)?
- Includes metadata (who, what, when, why)

Be organized and maintain long-term control over your codebase

Keep several versions of code at the same time, without clutter

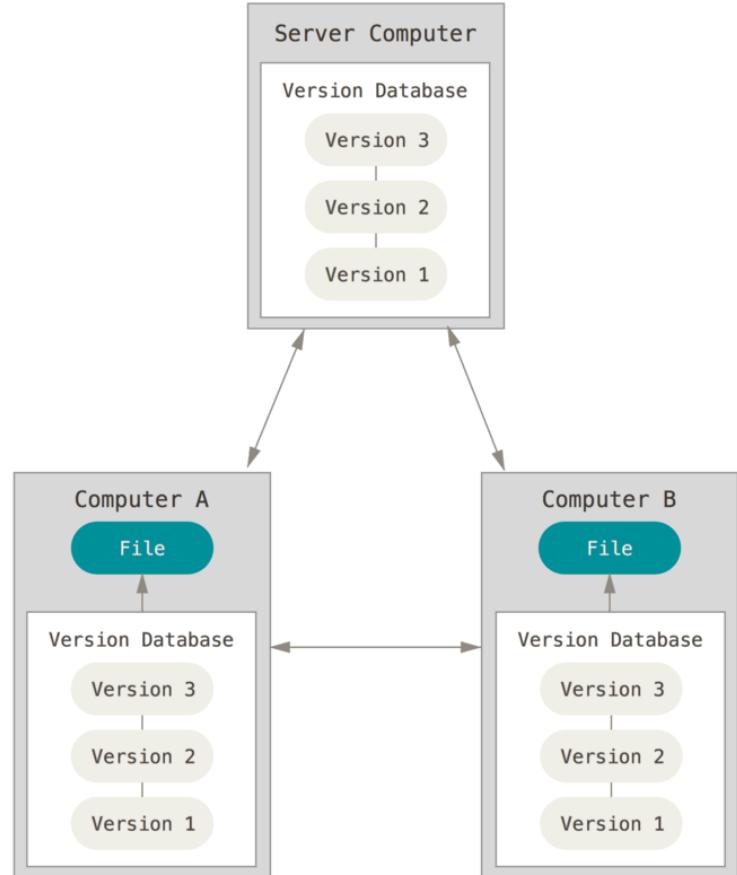
- Keeps known working versions safe
- Experimenting is easy and organized
- Experiments are self-contained
- Experiments can be kept, removed, or merged with the “main” codebase

Distributed version control systems



Distributed version control systems

- No single point of failure
- The system keeps everyone synchronized...
- ...but asynchronous work is possible
- Group-based model - shared access is default
- Shared responsibility of being up to date



git and GitHub

Git is a DVCS software,
created by Linus Torvalds
for the management of
the Linux kernel.

“git” is the default client;
other clients exist.

<https://git-scm.com>

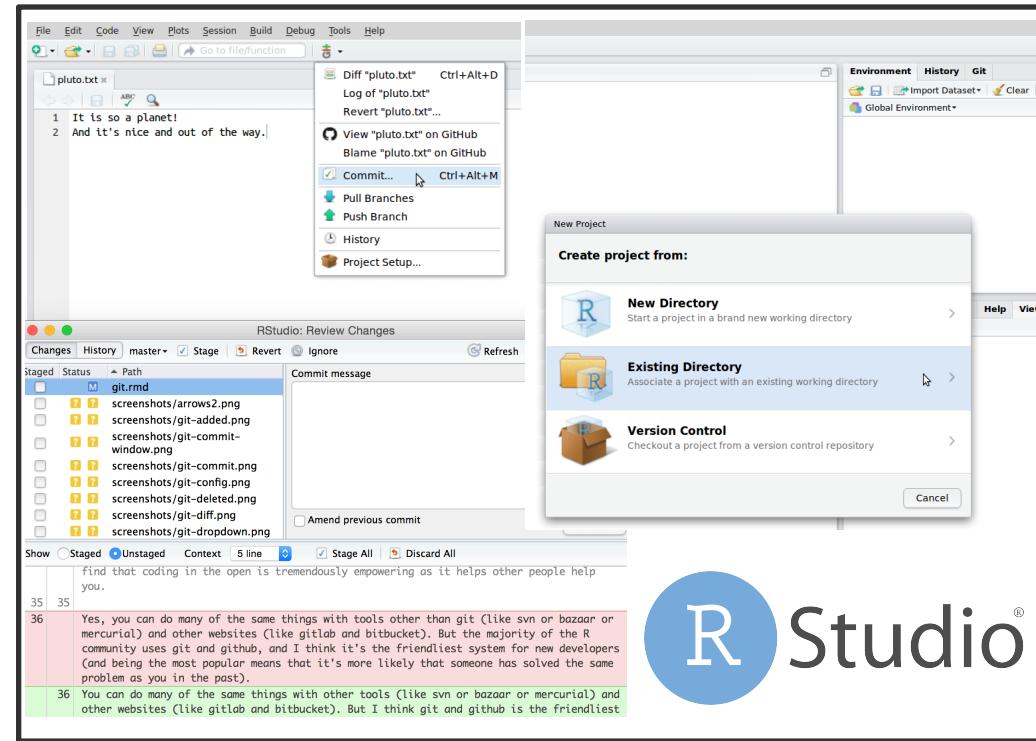


GitHub is a web-based
hosting service for version
control that uses git

Other services exist.

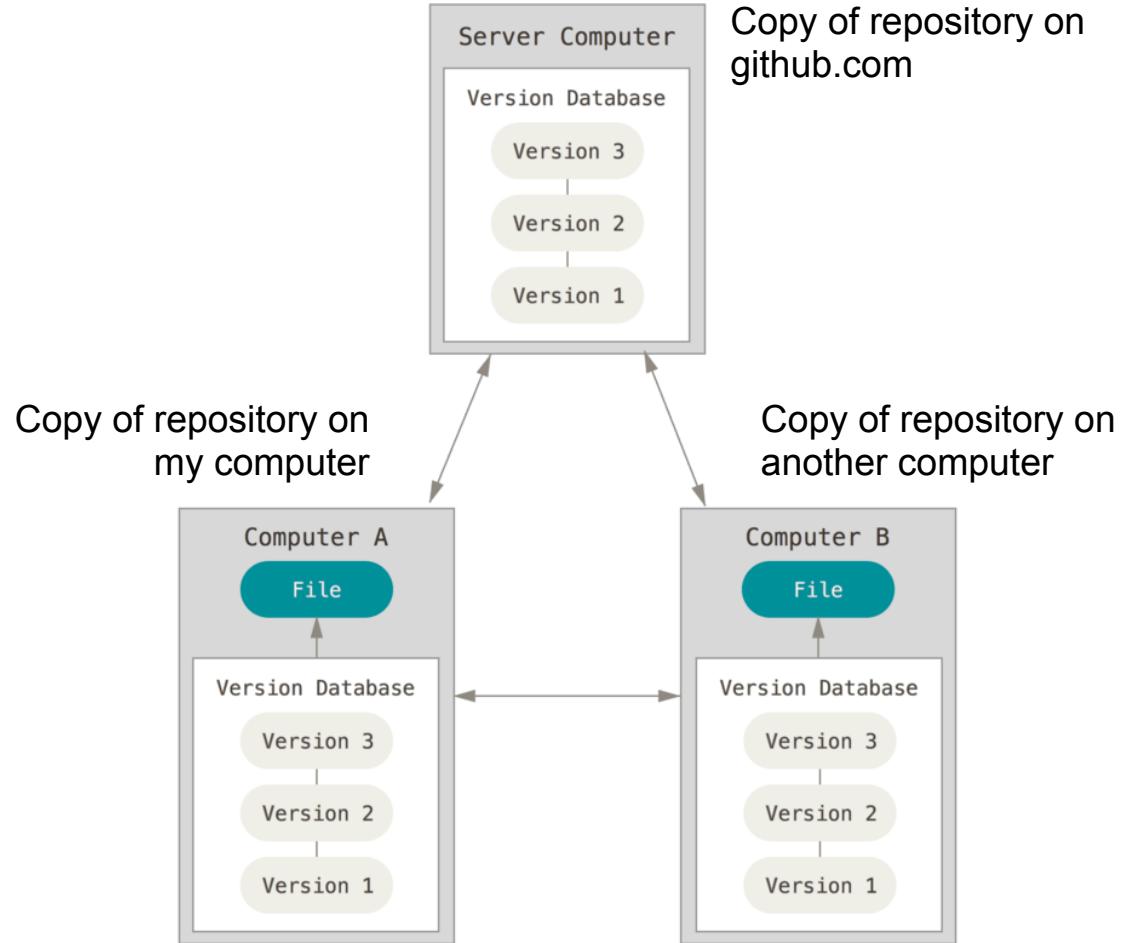
<https://github.com>

Git with R & Python Editors



- You can work with **git/GitHub** from within code-editors, including Rstudio (R), PyCharm, Visual Studio etc. (Python).
- Changes to scripts can be staged, committed, reverted, and pushed to remote (e.g. GitHub), just as from the command line.

git and GitHub



Why GitHub?



Helpful web interface:

- Visually browse and explore
- Community aspect (Issues, Wiki, references ...)
- Granular access control

Public space: Track record, visibility, transparency, reproducibility

Easy fork/merge system; easy contributing to projects

Remote repository; backup

Shared responsibility of being up to date

GitHub

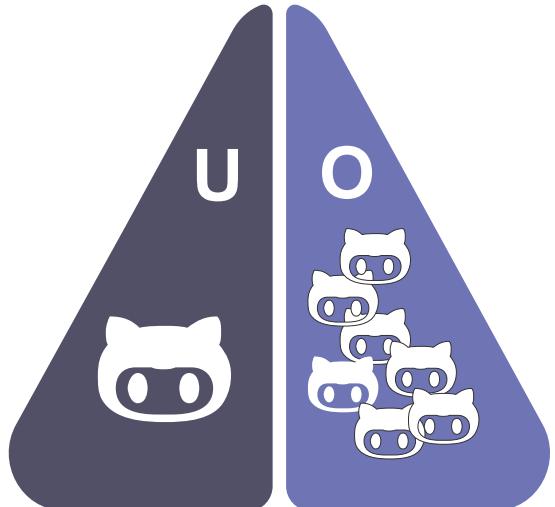
GitHub is organized in

U User accounts:

Personal repositories that have a single owner.

O Organizations:

- Designed to better accommodate the needs of a team (ex. lab)
- One or multiple owners and sophisticated access control systems to the repos.



GitHub

GitHub Repositories can be:

PUBLIC

- Accessible to everyone
- Usually released with an open source license
- Still possible to have control over how many people interact with the repo.

PRIVATE

- Not accessible to the public.
- Accessible only from allowed accounts – requires password.
- More fine-grained access.

NOTE: Organizations have further options to limit and organize access to repositories

GitHub

The screenshot shows the GitHub pricing page with three main plans: Free, Team, and Enterprise.

Free
The basics for individuals and organizations

- Unlimited public/private repositories
- 2,000 Actions minutes/month
Free for public repositories
- 500MB of Packages storage
Free for public repositories
- Community support

Team
Advanced collaboration for individuals and organizations

- Everything included in Free, plus...
- Protected branches
- Multiple reviewers in pull requests
- Draft pull requests
- Code owners
- Required reviewers
- Pages and Wikis
- 3,000 Actions minutes/month
Free for public repositories
- 2GB of Packages storage
Free for public repositories
- Web-based support

Enterprise
Security, compliance, and flexible deployment

- Everything included in Team, plus...
- Automatic security and version updates
- SAML single sign-on
- Advanced auditing
- Github Connect
- 50,000 Actions minutes/month
Free for public repositories
- 50GB of Packages storage
Free for public repositories

EXCLUSIVE OPTIONS

- Token, secret, and code scanning
- Premium support

Costs:

- Free:** \$0 per month
- Team:** \$4 per user/month
- Enterprise:** \$21 per user/month

[Create a free organization](#) [Continue with Team ▾](#) [Contact Sales](#) [Start a free trial](#)

**Academics get free
“Team” plan!**

Useful concepts

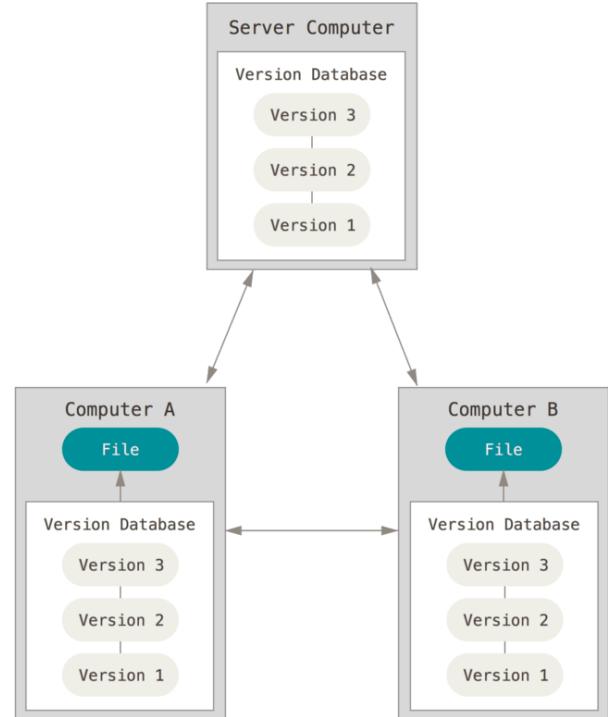
File tree:

All the files (organized in directories) that we want to keep track of, originating from a single directory.

Repository

Place in which changes to the file tree are recorded.
Can be local or remote.
Several copies can exist.

NOTE: We will be working on our local copy, meaning that there will be no changes on the repos on GitHub, until we decide to synchronize.



A look at git and GitHub

```
git-GitHub-workshop-2022 -- zsh -- 101x30
Last login: Mon Feb  7 10:29:21 on ttys000
[kgx936@SUN1007442 ~ % cd Desktop/git-GitHub-workshop-2022
[kgx936@SUN1007442 git-GitHub-workshop-2022 % ls
ChocolateCake README.md
[kgx936@SUN1007442 git-GitHub-workshop-2022 % git status ChocolateCake/ingredients.txt ]
```



I gang med Firefox Hjem - KUNet AdminJump EditJump

https://github.com/Center-for-Health-Data-Science/git-GitHub-workshop-2022

Search or jump to... Pull requests Issues Marketplace Explore

Center-for-Health-Data-Science / git-GitHub-workshop-2022 (Private)

Unwatch 2 Fork 0

Code Issues Pull requests Actions Projects Security Insights Settings

main 1 branch 0 tags Go to file Add file Code About

No description, website, or provided.

Readme 0 stars 2 watching 0 forks

5 commits

Thilde Bagger Terkelsen and Thilde Bagger Terkelsen more vanilla needed 6a4bdb5 14 seconds ago

ChocolateCake more vanilla needed 14 seconds ago

README.md Update README.md 7 minutes ago

README.md

git-GitHub-workshop-2022

This repository is used for the HeaDS git and GitHub workshop 2022. Workshop participants should clone the repo after which they can use it to complete workshop exercises associated. The shared repo is made for hosting cooking recipes which are made locally by participants and then pushed to remote for everyone to view.

HeaDS workshop contacts:

Releases

No releases published Create a new release

Packages

No packages published Publish your first package



Let's create a GitHub repo

The screenshot shows a GitHub user profile for "Jonas Andreas Sibbesen" (jonassibbesen). The profile includes a large circular profile picture, a bio, follower counts, achievements, and organization links. The main dashboard displays a list of "Popular repositories" and a "Contribution grid" showing activity over the last year. A red box highlights the "New repository" button in the top right corner of the header.

Popular repositories

- rpgv** Public
Method for inferring path posterior probabilities and abundances from pangenome graph read alignments
C++ ⭐ 12 2
- vg** Public
Forked from vgteam/vg
tools for working with genome variation graphs
C++
- vgrna-project-paper** Public
Bash scripts and data used in pantranscriptomic paper
Shell ⭐ 1
- BayesTyper** Public
Forked from bioinformatics-centre/BayesTyper
A method for variant graph genotyping based on exact alignment of k-mers
C++
- vgrna-project-scripts** Public
Scripts used for pantranscriptome analyses
R ⭐ 1
- xg** Public
Forked from vgteam/xg
xg0: a simpler xg index
C++

Achievements

Organizations

Contribution grid

330 contributions in the last year

Contribution settings ▾

Less More

Let's create a GitHub repo

Create a new repository

A repository contains all project files, including the revision history. Already have a project repository elsewhere? [Import a repository.](#)

Owner *  Center-for-Health-Data-Science /

Repository name *

Great repository names are short and memorable. Need inspiration? How about [refactored-sniffle?](#)

Description (optional)

 Public
Anyone on the internet can see this repository. You choose who can commit.

 Private
You choose who can see and commit to this repository.

Initialize this repository with:

Skip this step if you're importing an existing repository.

Add a README file
This is where you can write a long description for your project. [Learn more.](#)

Add .gitignore
Choose which files not to track from a list of templates. [Learn more.](#)

Choose a license
A license tells others what they can and can't do with your code. [Learn more.](#)

README file

File shown by default when someone visits the repository – good for an introduction to what the repository is about. Git markdown format.

.gitignore

Hidden file containing specifications of files/types that should be ignored at all times by git. There are some default choices.

LICENSE

Creates a LICENSE file that contains the license of the content of your repository.

<https://choosealicense.com>

Choose an open source license

An open source license protects contributors and users. Businesses and savvy developers won't touch a project without this protection.

{ Which of the following best describes your situation? }



I need to work in a community.

Use the [license preferred by the community](#) you're contributing to or depending on. Your project will fit right in.

If you have a dependency that doesn't have a license, ask its maintainers to [add a license](#).



I want it simple and permissive.

The [MIT License](#) is short and to the point. It lets people do almost anything they want with your project, like making and distributing closed source versions.

[Babel](#), [.NET Core](#), and [Rails](#) use the MIT License.



I care about sharing improvements.

The [GNU GPLv3](#) also lets people do almost anything they want with your project, except distributing closed source versions.

[Ansible](#), [Bash](#), and [GIMP](#) use the GNU GPLv3.

Personal Access Token (PAT)

Personal access token to use with the command line.

Token is used to “communicate” between local repo and remote GitHub repo.



Advantage of PAT over password:

- **Unique:** Can be generated per use or per device.
- **Revokable:** Can revoke access to each one at any time.
- **Secure:** Random strings of characters that cannot be attacked by brute force i.e. less hackable than a password.
- **Quantity:** Any number of access tokens can be created, compared to only one password per user.

git Syntax

We will use the terminal command git. Syntax:

```
git <command> [<args>] [<options>]
```

Args are usually names or files or directories.

Individual commands have help pages:

```
git <command> --help
```

Examples:

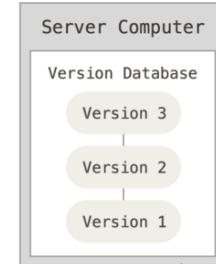
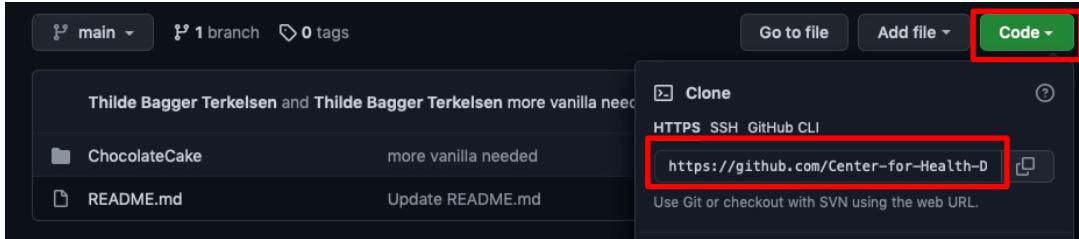
```
git add file.txt
```

```
git commit -a
```

```
git commit -m "changes were done"
```

Cloning a GitHub repository

We need a local copy of our repository :

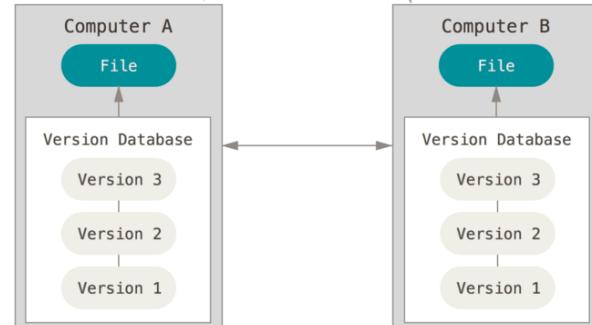


```
git clone [GitHub link]
```

Username: [your user]

Password/Token: [your PAT]

```
cd [your repo]
```



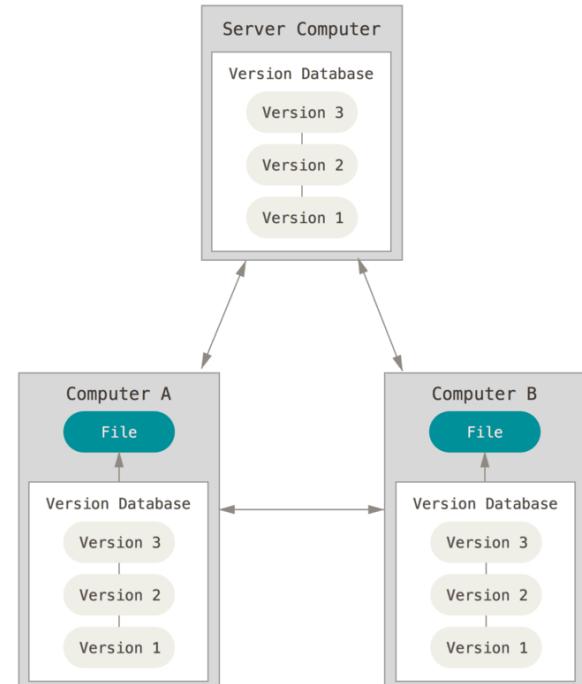
Creating a git repository

You could create it from scratch as well:

```
mkdir my-repo; cd my-repo  
git init
```

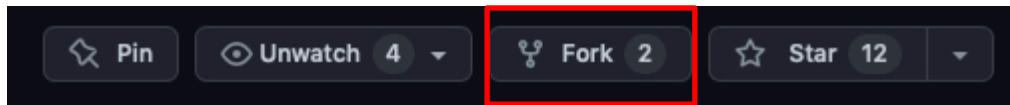
N.B: that in this case we would not have a remote! Creating a repository on GitHub and cloning it ensures that:

- We have a remote repository
- Remote and local copy are linked



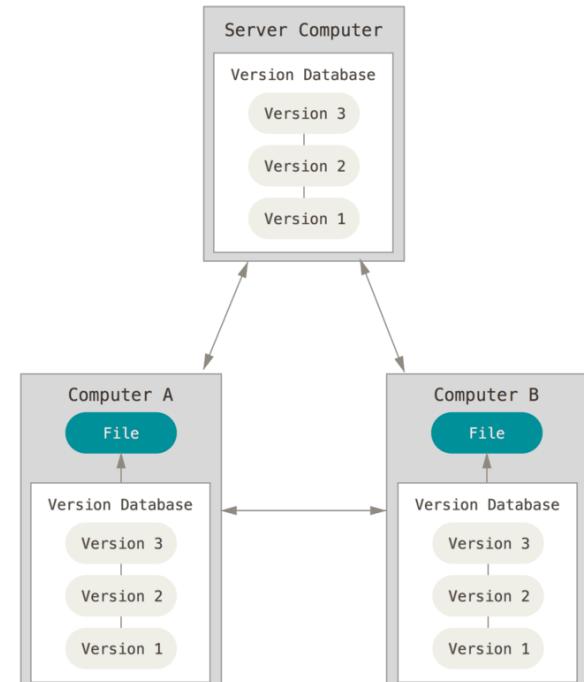
Forking a GitHub repository

Create a you own copy of someone else's repository



Forks are most commonly used to:

- Propose changes to another persons repository
- Use another persons repository as a starting point for own project



Checking status of a Github repo

- Check the current state of the repository:

```
git status
```

- See the name and location of the remote repository:

```
git remote -v
```

Pre-Exercise

Exercise

0

Go to your GitHub account and set up your personal access token. Follow the small step-by-step below:

<https://docs.github.com/en/authentication/keeping-your-account-and-data-secure/creating-a-personal-access-token>

Important: Copy your access token and note your GitHub username as you will need both for Exercise 2.

Exercises 1-3

Exercise

1

Create a new public repository on GitHub to hold your favorite cooking recipes.

Exercise

2

Create a local copy of your GitHub repository by cloning it in a folder on your computer. Make note of the location of the directory that you choose to host your local copy.

Exercise

3

Move to local repository. Check the status of this repository (current state). Check name and location of the remote repository.

Useful concepts

Commit:

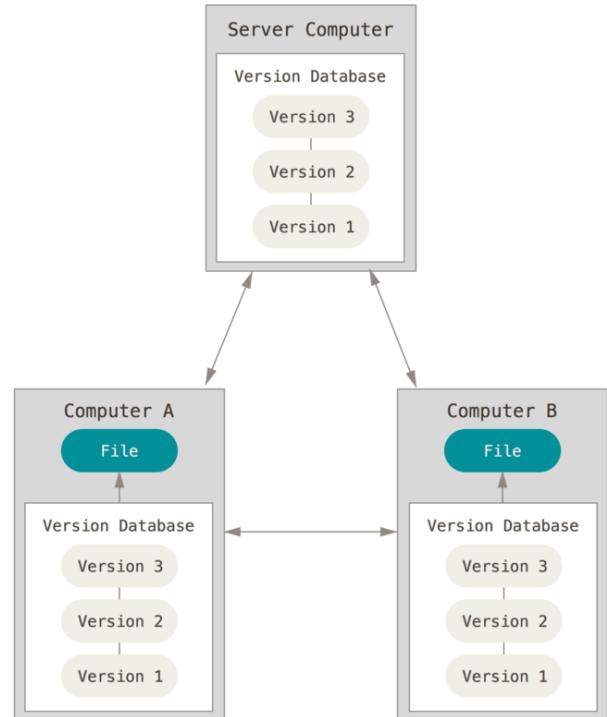
Snapshot of a particular state of a file tree.

Stage:

Selection of changes made on a repository to be added to a commit.

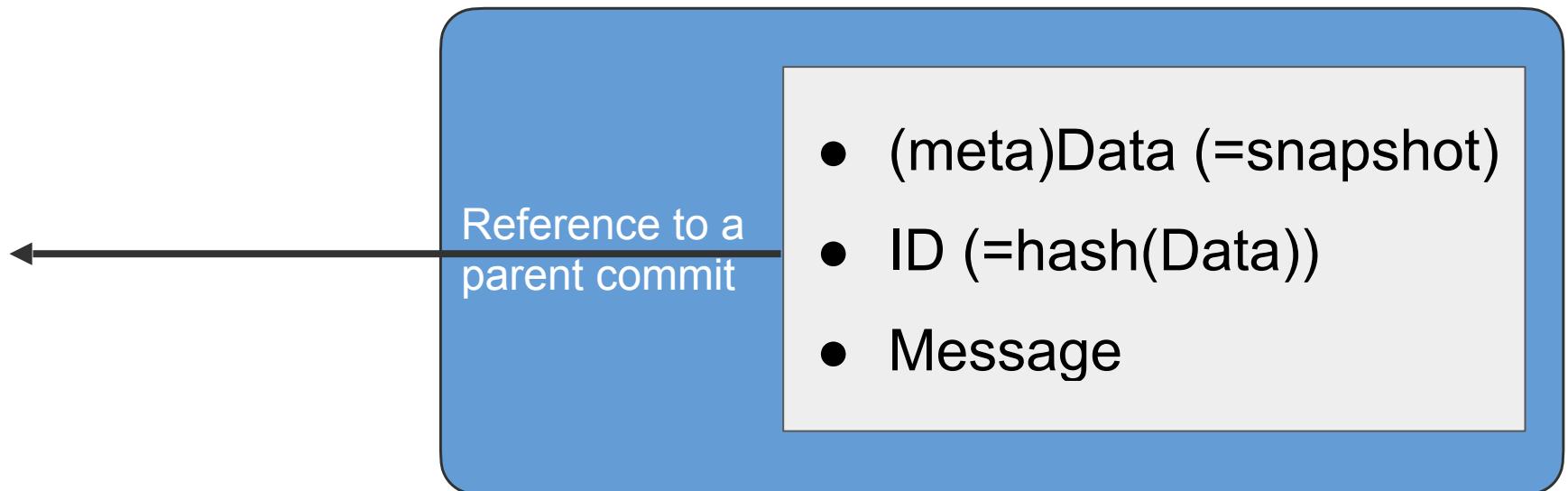
Head:

Reference (“pointer”) to a particular commit.



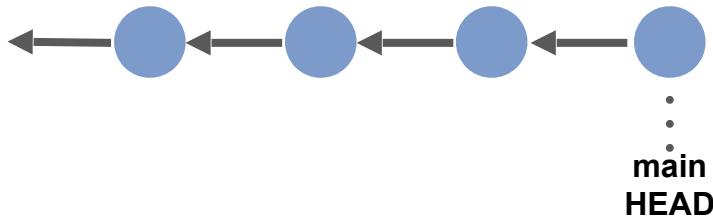
Useful concepts

Anatomy of a commit



Useful concepts

Anatomy of a commit



origin = original remote repository

main = main branch (local and remote)

HEAD = current commit you are viewing

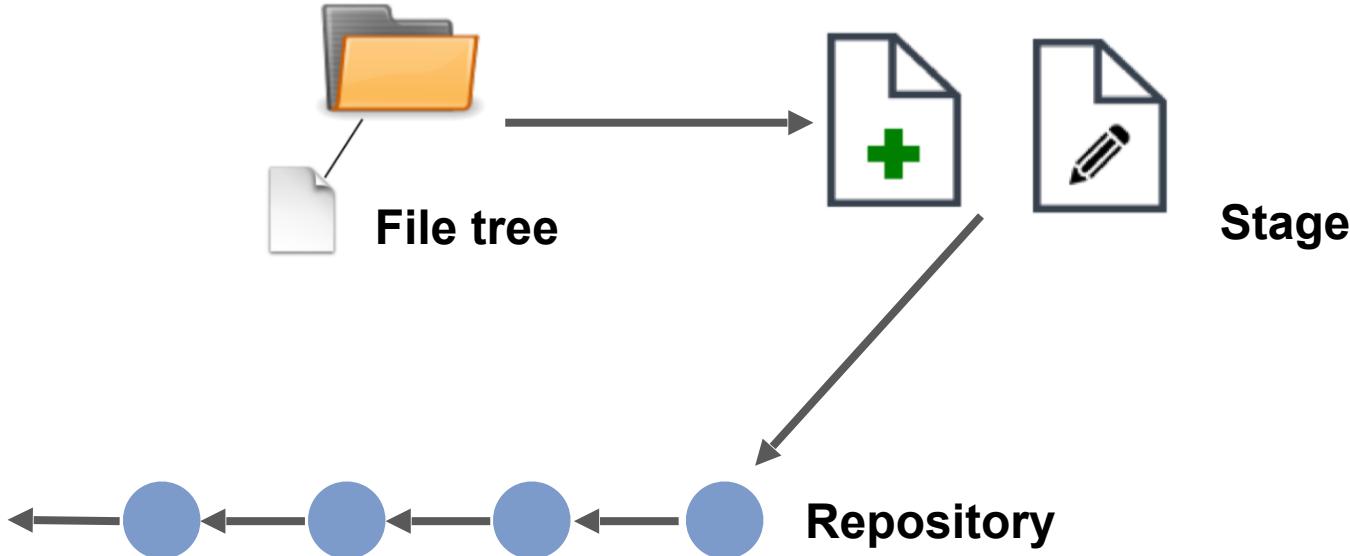
Be aware of the “**HEAD**” head!

It is the head referring to the commit currently checked out in the file tree

master = previous name for remote main (changed in 2020)

Useful concepts

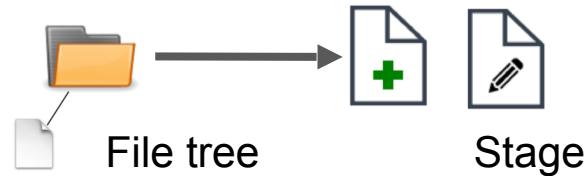
Workflow of a commit



Adding files to stage

Files are added to stage using the command **add**

```
git add filename
```



- Allows to stage files or even directories (if they contain files!)
- Option -A (--all) stages all changes if no arguments are given
- More than one filename are allowed including wildcards

```
git rm filename
```

```
git mv filename
```

```
git add -u filename
```

When you're happy with your changes and have add all the files to stage the next step is to commit the changes:

```
git commit
```

```
git commit -m "Commit Message"
```

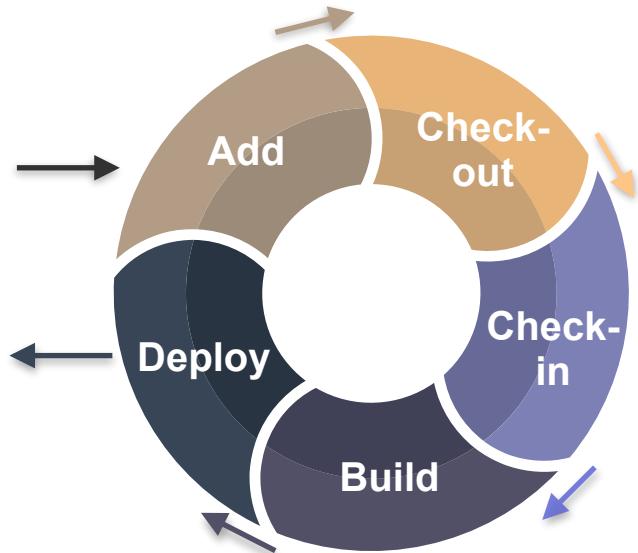
- Use -a (-all) to automatically stage files that have been modified and deleted. **New files you have not told Git about are not affected.**

```
git commit -a -m "Commit Message"
```

First Commit

Good Practices

- **Commits** should be:
 - Atomic and self-contained (or WIP), but not excessively pedantic
 - Done often (try not to have gigantic blob commits)
- **Commit messages** should:
 - Always have a short descriptive comment (no “bugfix”, “save”, etc.)
 - Written to be understandable by someone else >1 year down the line, including you :)



Checking history

To check the history of a repository:

```
git log
```

A few useful options:

- To see only the commits of a certain author

```
git log --author="SomeAuthor"
```

- To see a very compressed log where each commit is one line

```
git log --oneline
```

- To see a more complete history in a graph form:

```
git log --all --decorate --graph --oneline
```

Checking differences

Check differences

- since the last commit:

```
git diff
```

- between two commits:

```
git diff <ID1> <ID2>
```

- between last two commit:

```
git diff ^HEAD HEAD
```

Exercises 4

Exercise

4

- Add a recipe to your repository by creating an *ingredients.txt* and a *recipes.txt* file (can contain anything you would like) in the repository folder.
- Check the status of the repository before each of the following steps. Stage the new files using **add** and **commit** them.
- Create a directory with the recipe name and move your files to it; create a commit with your changes.
- Add or remove one step in *recipes.txt*; create a commit with your changes.
- Keep experimenting with staging and committing.

Exercises 5

Exercise

5

- Check the commit history. Can you identify the author, ID, time and date of your commits?
- Try experimenting with the different ways of showing the history.
- Check the difference between different commits. How should the **diff** output be interpreted?

Back to the past

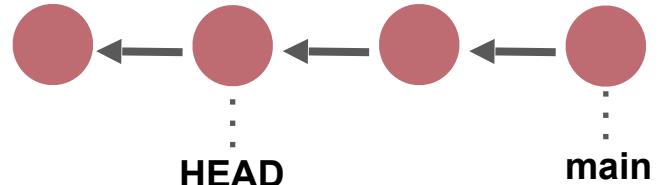
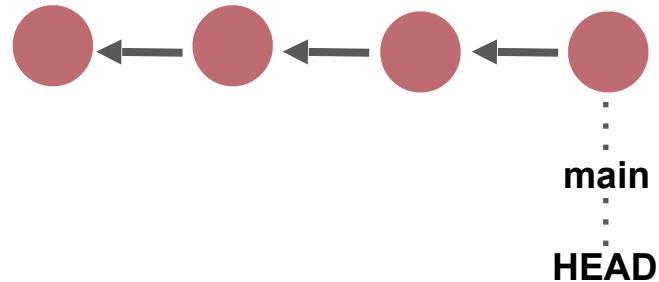
We can move around the repository using the command **checkout**

```
git checkout <identifier>
```

Identifier can be:

- A commit **ID**
- A branch **Name**

Changes the local content of the file tree to that of the reference - which means, moves **HEAD** to identifier.



Back to the past

Rewriting history is (usually) a bad idea

Every change you do in git is done with a forward in time perspective - the past should be changed only in some specific occasions!

- Changes (even to something done a long time ago) need to be done in commits added to the HEAD
- There are other mechanisms to re-start from an earlier commit (i.e. branching/merging)

I've botched staging or commit!

How to fix the last commit message:

```
git commit --amend -m "new message"
```



I've botched staging or commit!

reset is useful to “undo” some of the changes:

`git reset`

- Removes all staged changes.

`git reset <filename>`

- Removes file from staged area.

`git reset --hard <ID>`

- Moves head to that commit (can be HEAD) and resets the working directory to match that commit.



Note that these are potentially **destructive operations! Only on local branches!**

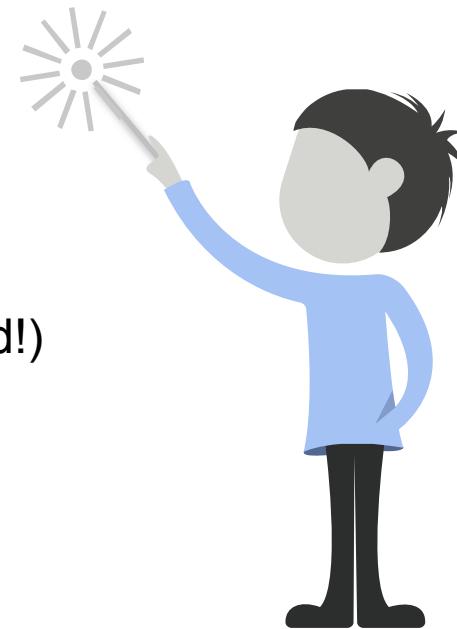
I've botched staging or commit!

revert is used to add commits that “reverse” the changes done by older commits:

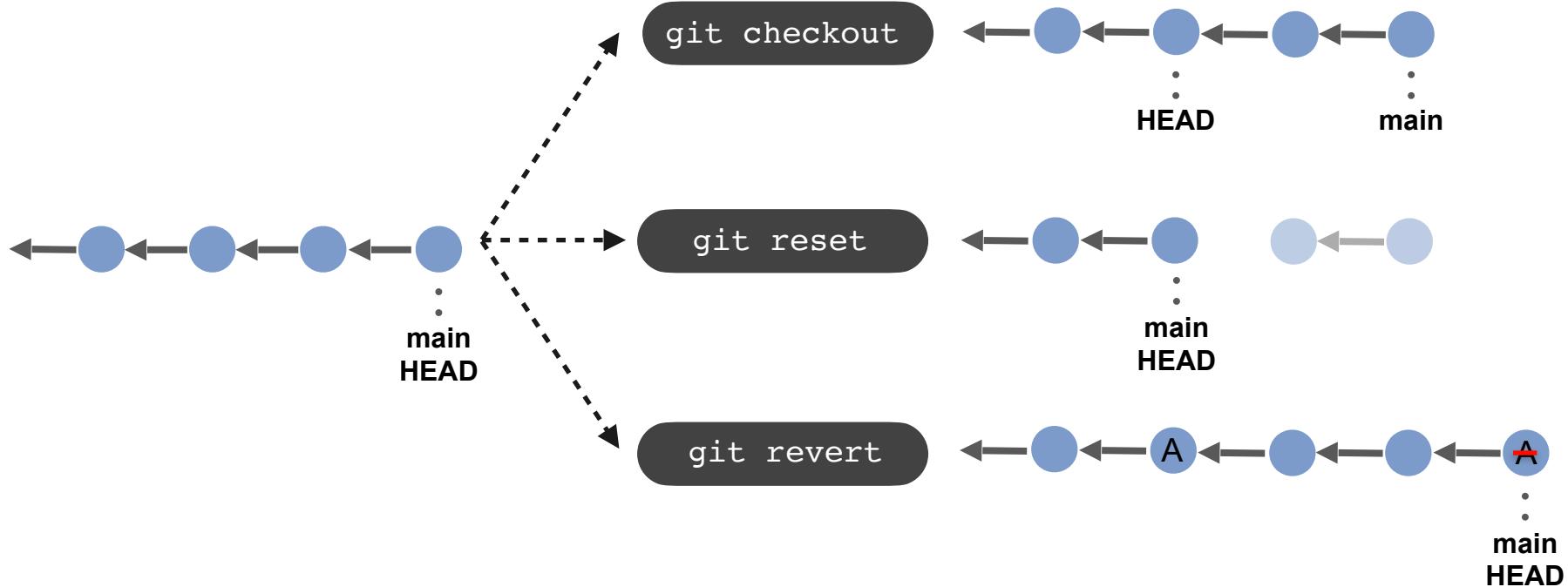
```
git revert <ID>
```

```
git revert <ID1>..<ID2>
```

- Non-destructive operation (history is maintained!)
- Here “ID” is the commit that you want to revert.
- History is polluted with commits that just revert
 - not the cleanest option
- **Better than reset for shared repositories**



Git checkout, reset & revert



Exercise 6

Exercise

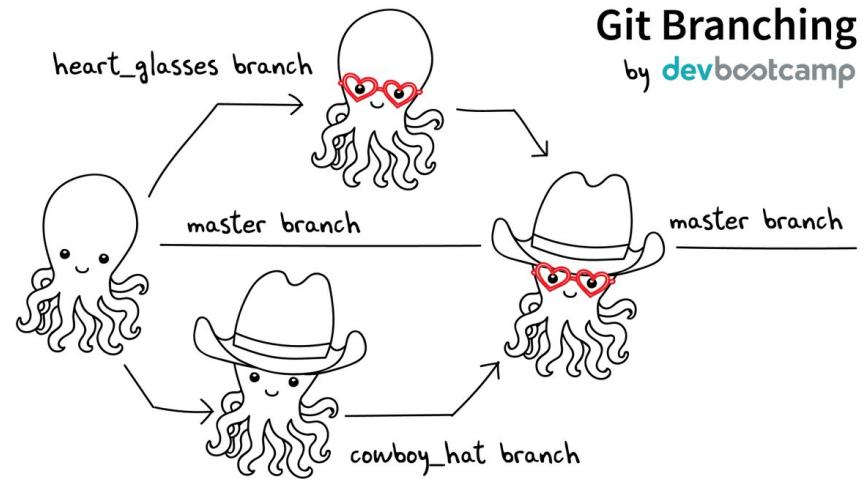
6

- Change the last commit message.
- Checkout an earlier commit. Check the content of the files. Check the history and status of the repository (do not commit). What do you notice?
- Checkout the last commit (use **main** as identifier).
- Add a step in *recipes.txt* and **add** the changes to stage, but **do not commit**. Check the status. Do a **hard reset** of **HEAD** and check the files and status. What do you notice?
- Add a new ingredient to *ingredients.txt* and commit the changes. Add a new step to *recipes.txt* and commit the changes.
- Revert the first of the two new commits using **revert** (it will ask you to write a commit message). Check the files and history. What do you notice?

Branching

A **branch** represents an independent line/track of work on your repository.

- Keep a branch that is in working order (main branch).
- Isolate experiments from the main branch.
- Work on more than one feature at the same time, independently.
- Merge changes we like into the “main” branch.



- List of all the branches in your repo

```
git branch synonymous to
```

```
git branch --list
```

- Create a branch named <branch>

```
git branch <branch>
```

- Switch to a branch

```
git checkout <branch>
```

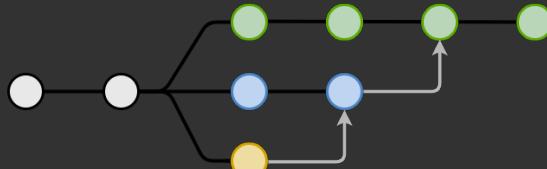
- Safe deletion: prevents from deleting
the branch if it has unmerged changes

```
git branch -d <branch>
```

- Force delete

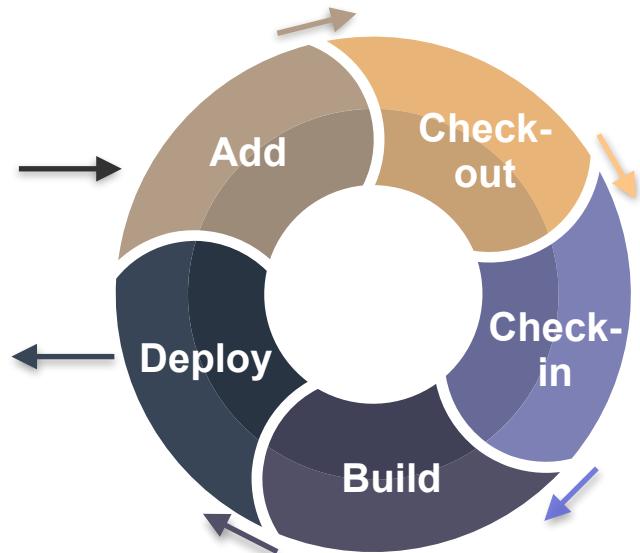
```
git branch -D <branch>
```

Branching



Good Practices

- Branches should:
 - Have descriptive names.
 - Done every time you want to experiment or add a new feature, bugfix etc.
 - Have a single purpose (one feature, one bug, one change).
 - Derived from a sensible commit (often the latest commit in the main branch)



Merging

Two main cases for merging



We want to integrate a feature we were working on in a branch, into main.



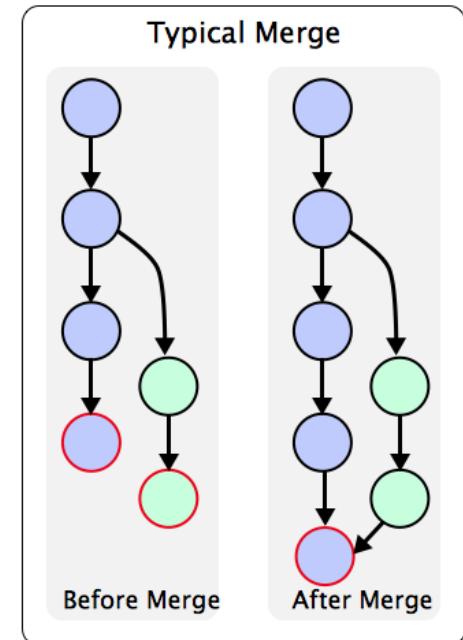
Main has diverged enough from our branch that we want to integrate the new commits in it before merging our feature – so we merge main into our feature branch.

Merging

Merging incorporates changes made in another commit/branch **into the current/active branch.**

- **Switch** to the branch you want to change (NOT the one you want to merge!)
- **merge** incorporates the changes made by the other branch **into the current/active branch.**

```
git checkout <active branch>  
git merge <branch to merge>
```



Exercise 7

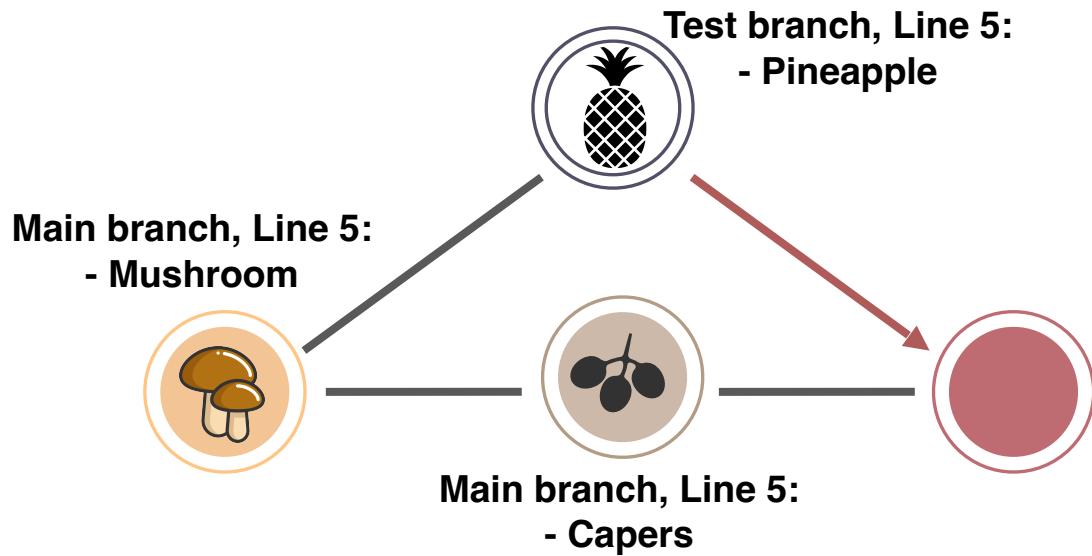
Exercise 7

- Checkout the last commit of your **main** branch
- Create an **experimental** branch and move to it. Change an ingredient in *ingredients.txt* and store the change as a commit.
- Go back to your **main** branch and add a step in *recipes.txt* and store the change as a commit.
- Merge your **experimental** branch into your **main** branch (it will ask you to write a commit message). Check the history (try using the graph mode).

Conflicts

A merge **conflict** happens when trying to merge branches that have changes in the same files and in the same lines

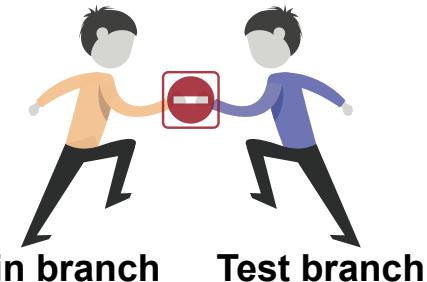
Merge test into main: which version should we keep?



Conflicts

```
(base) Matteos-MacBook-Pro-2:test matteotiberti$ git merge test
Auto-merging recipe.txt
CONFLICT (content): Merge conflict in recipe.txt
Automatic merge failed; fix conflicts and then commit the result.
```

- Check which file(s) have conflicts
- Modify files by hand to achieve the desired result.
- Add all files once they are ready and commit.
This solves the merge in a commit.
- **Conflict markers!** Remember to remove all markers and change your code in the final version you want.



```
- tomato
- mozzarella
- flour
- water
<<<<< HEAD
- capers
=====
- pineapple
>>>>> test
```

Exercise 8

Exercise

8

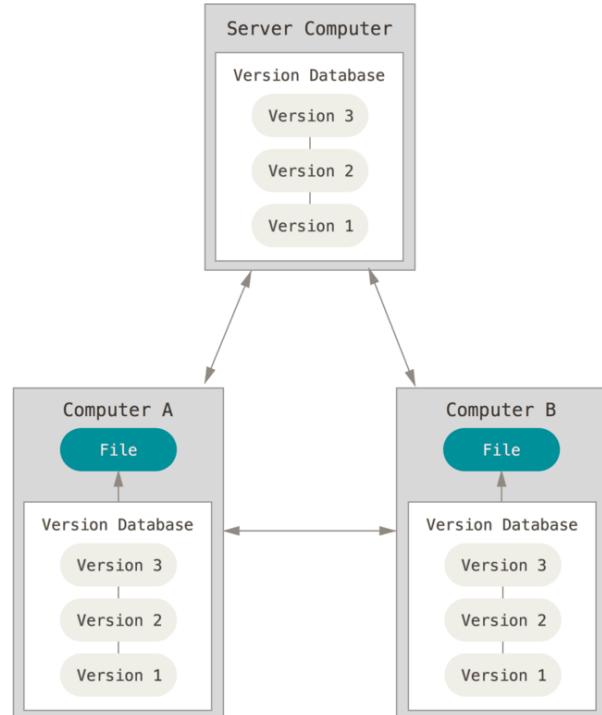
- Switch to your **experimental** branch and change the first line in one of your files, and commit.
- Switch to your **main** branch and change the first line of the same file in a different way, and commit.
- Try to merge your **experimental** branch into your **main** branch; you should get a conflict.
- Edit the conflicting file and solve the conflict. Stage and commit to fix it.

Interacting with a remote

A **remote** is a repository that is linked to our local (or in our case, our local repository started out as a copy of a remote repository).

We can create a local copy of our repository, make our changes as commit, and submit those to remote

We should take into account the changes that happened in the meanwhile on remote (other people's)



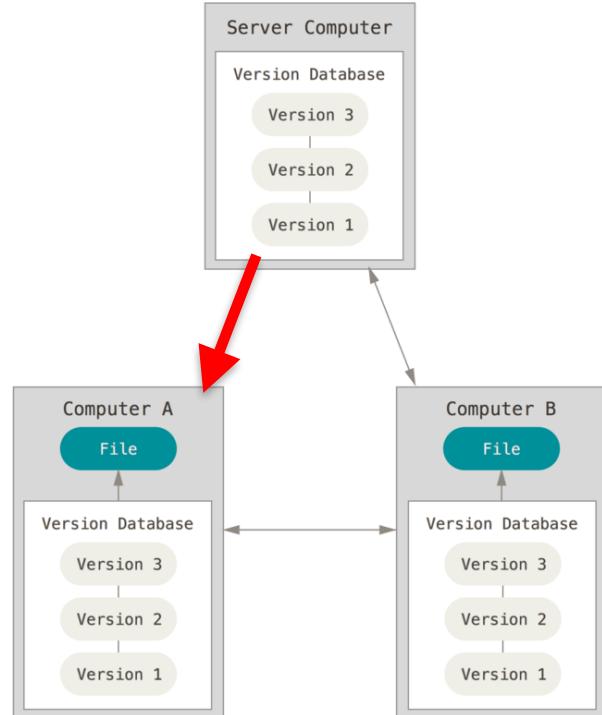
Interacting with a remote

- Use **pull** to download and apply the changes that were done in remote to your local repository (i.e. apply commits by other people):

```
git pull <remote> <branch>
```

- Use the **fetch** to update the info about the state of the remote repository (does not call merge)

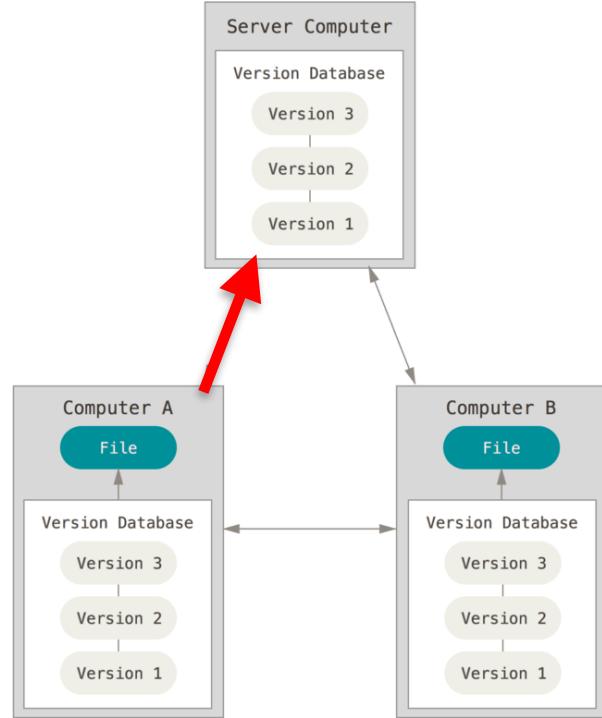
```
git fetch <remote>
```



Interacting with a remote

- Use **push** to upload local repository content to remote (i.e. export commits to remote branches)

```
git pull <remote> <branch>
```



Exercise 9

Interacting with a remote

Exercise

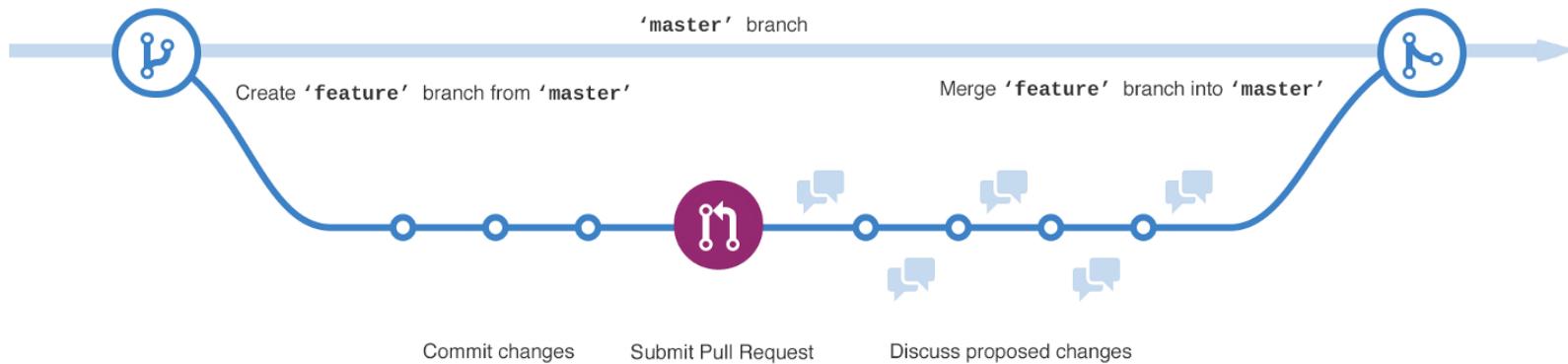
9

- Push your changes to the remote repository for your **main** branch. Visit your remote repository on github.com. Check if your changes are there.
- Create a new branch from the latest commit in **main**. Add a couple of commits. Push this new branch to your repository. Check the changes on GitHub. What do you notice?
- Merge your new branch into **main**. Push your changes and check them on GitHub. What do you notice?

A deeper look at GitHub

Contributing and interacting with other users: Issues and Pull requests

- Projects on GitHub often follow a pattern of development and communication.
- The main branch is considered the “development” branch and is not changeable directly - only through merges and pull requests.
- Contributions happen in branches that are merged into the master.
- Releases happens once in a while from the main branch.

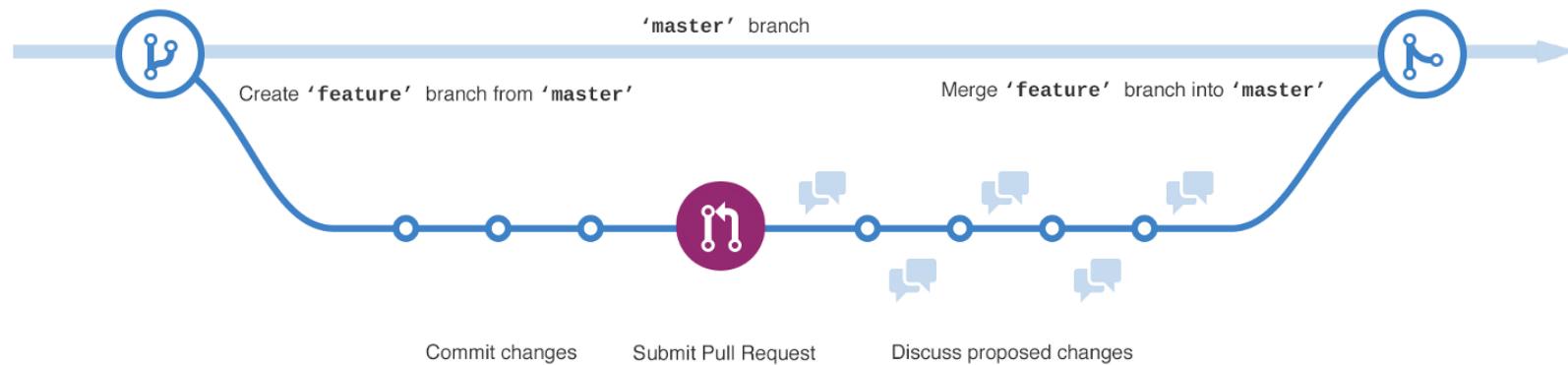


A deeper look at GitHub

Interacting with other users: Issues and Pull requests



Read the documentation of the project you want to contribute to.



A deeper look at GitHub

Interacting with other users: Issues and Pull requests



Check `/issues` if you have a problem or question to see if others have already asked the same. If needed, open a new Issue.

The screenshot shows the GitHub Issues page for the repository `ELELAB/mutateX`. The page has 11 issues listed:

- #98: Wild type residues types should be checked when using a position list (enhancement)
- #95: Mutation runs are getting terminated before completing
- #93: Add individual data points in histogram and box plots
- #92: Unrecognised residues from FoldX (enhancement)

At the top of the page, there is a modal dialog titled "Label issues and pull requests for new contributors". It contains the text: "Now, GitHub will help potential first-time contributors discover issues labeled with good first issue". A "Go to Labels" button is present in the modal. Below the modal, there are search filters and sorting options.

A deeper look at GitHub

Interacting with other users: Issues and Pull requests



Create a local copy of the repository:

- **Clone** if you have write access to the repository (direct access as *collaborator* or part of the repo *organization*).
- **Fork** if you have no affiliation to the repository.



Create a **new branch** from the main development branch. Add changes as commits. Push them so they are present on the remote (GitHub).

A deeper look at GitHub

Interacting with other users: Issues and Pull requests



Once ready, create a *Pull Request*. Your code might be subject to code review. If so, the maintainers will decide if/when your code is good enough to be merged.

A screenshot of the GitHub interface. At the top, there is a navigation bar with tabs: Code, Issues, Pull requests (which is highlighted with an orange underline), Actions, Projects, Security, Insights, and Settings. Below the navigation bar are several buttons: Filters (with a dropdown arrow), a search bar containing 'is:pr is:open', a 'Labels 9' button, a 'Milestones 0' button, and a green 'New pull request' button. The main content area is a large, empty rectangular box with a light gray border. In the center of this box is a small, faint icon of two people shaking hands. Below the icon, the text 'Welcome to pull requests!' is displayed in a dark font.

Exercise 10

A deeper look at GitHub

Exercise

10

- Go to the web page of the shared-recipes repository for which you have become a collaborator.
- Open an issue about adding your own recipe.
- **Clone** your local copy of this shared repository. Create a new branch. Add your recipe. Commit and push your changes. Try to pull before pushing.
- Go back to the repository webpage and open a **Pull request (PR)**. You might need to re-merge main because of the changes.
- Wait for one of us to approve the PR. Pull from the repo and check our recipe book.



Thank you for today

See you at HeaDS