

Version control and data curation with Git and GitHub

Johannes Englisch
englisch@shh.mpg.de

Department of Linguistic and Cultural Evolution
Max Planck Institute for the Science of Human History

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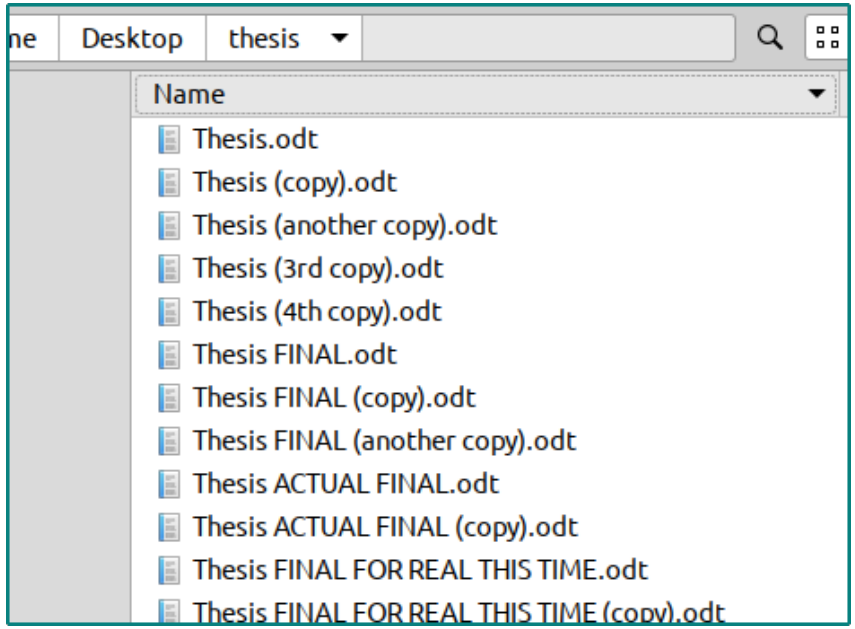
Doorway to Human History

What is Git?

Why?

- I don't like to lose work.
- I like it when people work together without getting in each other's way.
- I like to be able to make mistakes.



Short fact sheet

- Git is a Distributed Version Control System.
- Created in 2005 by Linus Torvalds (the creator of Linux).
- Free and Open-Source Software.
- Probably the most popular VCS out there.

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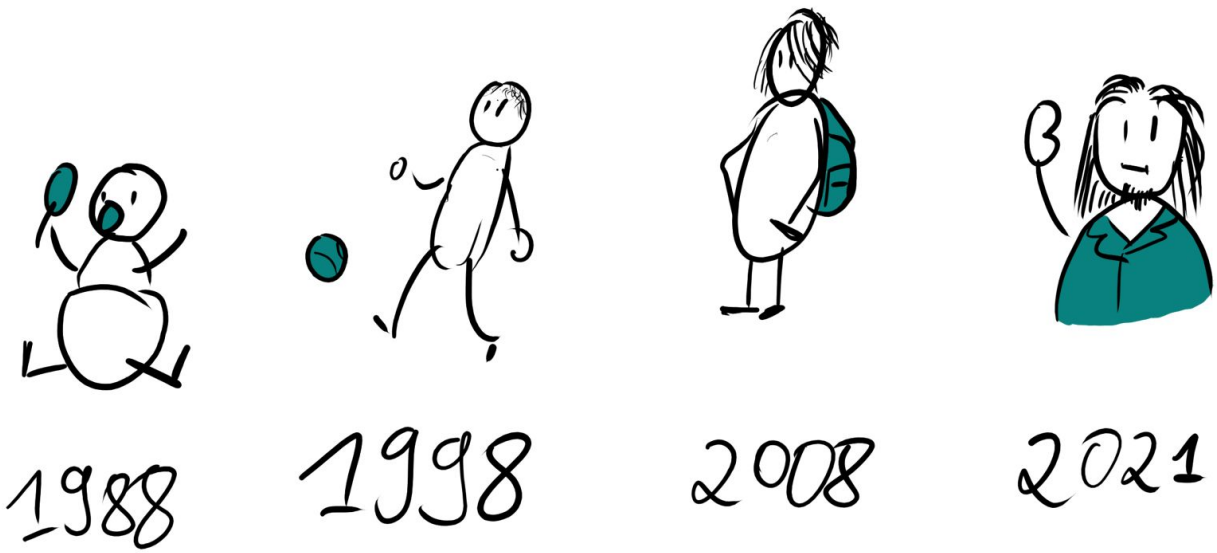
Version control

A Version Control System (VCS) keeps track of different versions of a project.

Two meanings of ‘version’

Meaning 1

‘Version’ as in the state of a project at a given point in time.
$\rightarrow$ i. e. ‘old version’ vs. ‘new version’



Two meanings of ‘version’ (ctd.)

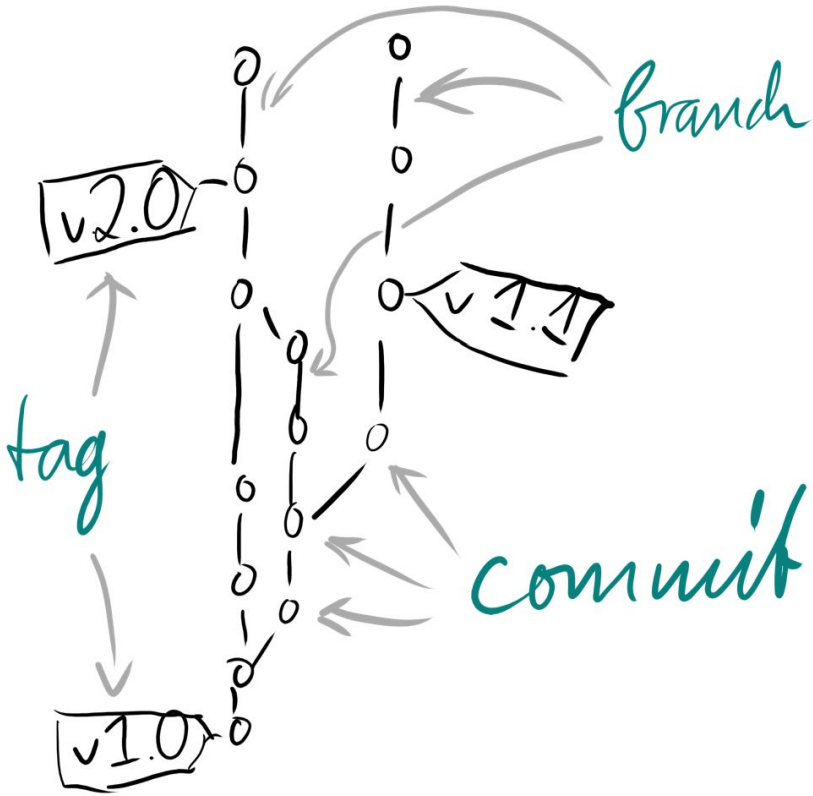
Meaning 2

‘Version’ as in different alternative editions of the same project, existing next to each other.

$\rightarrow$ ‘regular version’ vs. ‘evil alternate universe version’

Two meanings of ‘version’ (ctd.)

Version Control Systems do both!



What can VCS's be used for?

- Programming
- Configuration files
- Writing an article together in LaTeX, Markdown, etc.
- Reproducible and citable research data
  (we like that around here)
- Personal to-do lists, notes, etc.
- These slides ;)

Know your limits!

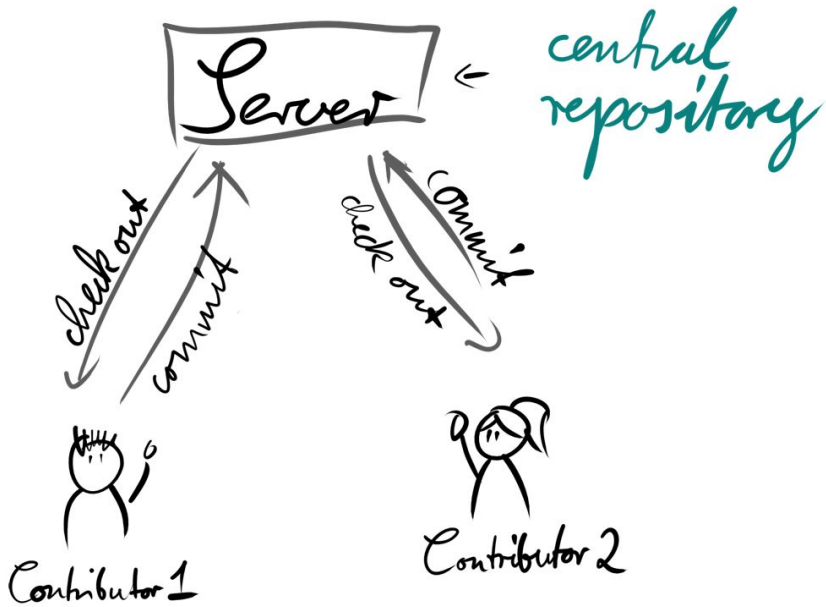
What are VCS's good at?

Text-based data (plain-text files, program code, XML/HTML, LaTeX, CSV tables, etc.)

What are (most) VCS's bad at?

Binary data (images, audio files, pdfs, zip archives, etc.)

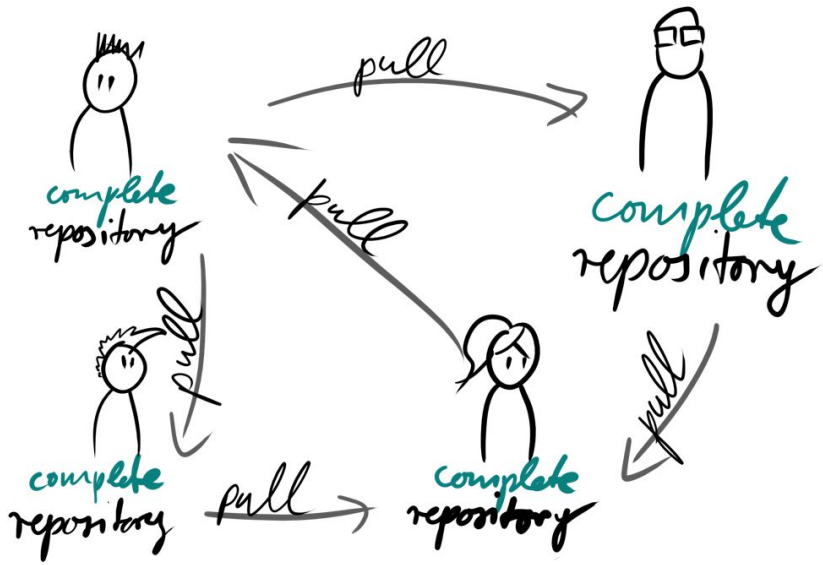
Centralised vs. Distributed VCS



Centralised VCS (e. g. CVS, subversion)

- Central repository on some server somewhere.
- People download the current state of the project to their computers.
- People upload any changes they made back onto the server.

Centralised vs. Distributed VCS (ctd.)



Distributed Version Control (e. g. git, mercurial)

- Everybody has a complete copy of the project (and all its history) on their hard drives.
- Changes are pushed and pulled between the different repositories.

Centralised vs. Distributed VCS (ctd.)

Note

In reality, people put a separate copy of the project on a server somewhere and pull/push their changes through that.

- Some project spin up their own git servers, e. g.:
  - Linux kernel$^{\hookrightarrow}$
  - GNU operating system$^{\hookrightarrow}$
- Others use third-party hosting sites:
  - Microsoft's Github$^{\hookrightarrow}$ (most popular)
  - Atlassian's Bitbucket$^{\hookrightarrow}$
  - Gitlab$^{\hookrightarrow}$

Know your limits! (ctd.)

Advantages of Distributed Version Control

- No need for a constant internet connection.
- Quick and comfy workflow (local branches are the best!).
- The massive redundancy reduces the chance of data loss.

Drawbacks

- Workflow of pulling/merging can be a bit finicky at times.
- Copies get out of sync with each other more easily, increasing the number of merge conflicts.
- Copying around the entire history wastes disk space and bandwidth, and also just takes longer.

Quick terminology note

What is a ‘repository’?

(coll.: repo or repos)

- General tech speak: online storage space
- Git speak: a copy of a version-controlled project folder

Getting git set up

Download/Installation

- GNU/Linux, *BSD: it's in the repos
- Windows: https://git-scm.com/downloads
- macOS:
  - Option 1: install the XCode command-line tools:
    ```
    $ xcode-select --install
    ```
  - Option 2: https://git-scm.com/downloads
  - Option 3: it's on homebrew

User interface

- Git uses a command-line interface
- There are graphical interfaces and editor plugins for common tasks, but at the end of the day the command-line is the preferred way to use git

```
$ git
usage: git [--version] [--help] [-C <path>] [-c <name>=<value>]
           [--exec-path[=<path>]] [--html-path] [--man-path] [--ir
           [-p | --paginate | -P | --no-pager] [--no-replace-objec
           [--git-dir=<path>] [--work-tree=<path>] [--namespace=<n
           <command> [<args>]

These are common Git commands used in various situations:
[...]
```


First setup

Tell git your name and email address

```
$ git config --global user.name "Johannes Englisch"
$ git config --global user.email "englisch@shh.mpg.de"
```

- The name and address will be attached to every commit you make.
- This is completely unrelated to any Github/Bitbucket/ etc. accounts you might have!

First setup (ctd.)

Tell git about your text editor

```
$ git config --global core.editor \
    "C:\Program Files\Notepad++\Notepad++.exe"
$ git config --global core.editor "/usr/bin/emacs"
$ ...
```

→ The official installer also allows to set the editor (at least on Windows).

First setup (ctd.)

Avoid potential headache regarding line endings

- Windows:

```
$ git config --global core.autocrlf true
```

- GNU/Linux, *BSD, macOS, etc.:

```
$ git config --global core.autocrlf input
```


First setup (ctd.)

Review your settings

```
$ git config -l
```


Exploring a git repo

Cloning an existing repo

```
$ git clone https://github.com/dictionaria/kalamang kalamang
Cloning into 'kalamang'...
remote: Enumerating objects: 155, done.
remote: Counting objects: 100% (155/155), done.
remote: Compressing objects: 100% (81/81), done.
remote: Total 155 (delta 81), reused 139 (delta 68), pack-reused 0
Receiving objects: 100% (155/155), 927.47 KiB | 7.73 MiB/s, done.
Resolving deltas: 100% (81/81), done.
```


Status report!

```
$ cd kalamang
$ git status
On branch main
Your branch is up-to-date with 'origin/main'.

nothing to commit, working tree clean
```


History lesson

```
$ git log
commit 5f28ae268e88d70e2f5f9ca2497a7e8fed257611 (HEAD -> main, tag
Author: Robert Forkel <...>
Date:   Fri Apr 9 13:27:29 2021 +0200

    re-compiled against Glottolog 4.3

commit 3d98441885adb1037afcbde9478d8ae4c0330567
Author: Johannes Englisch <englisch@shh.mpg.de>
Date:   Wed Apr 7 14:41:57 2021 +0200

    regen with current pydictionaria version
[...]
```


Branches, Tags

```
$ git branch
* main
$ git branch -a
* main
  remotes/origin/HEAD -> origin/main
  remotes/origin/link-to-concepticon
  remotes/origin/main
$ git tag
v1.0
v1.1
```


Time to time travel

```
$ git checkout v1.0
[...]
HEAD is now at 64ba30e release 1.0
$ git checkout link-to-concepticon
[...]
Switched to a new branch 'link-to-concepticon'
$ git checkout d1e45b9
[...]
HEAD is now at d1e45b9 metadata regen
```

$\rightarrow$ re. commits: you don't have to type all 40 digits – only enough to make it unique (usually like 7 or so digits)

Your very own git repo

Creating a new git repo

```
$ cd <folder>
$ git init
Initialised empty Git repository in <folder>/.git
```


Reviewing your changes

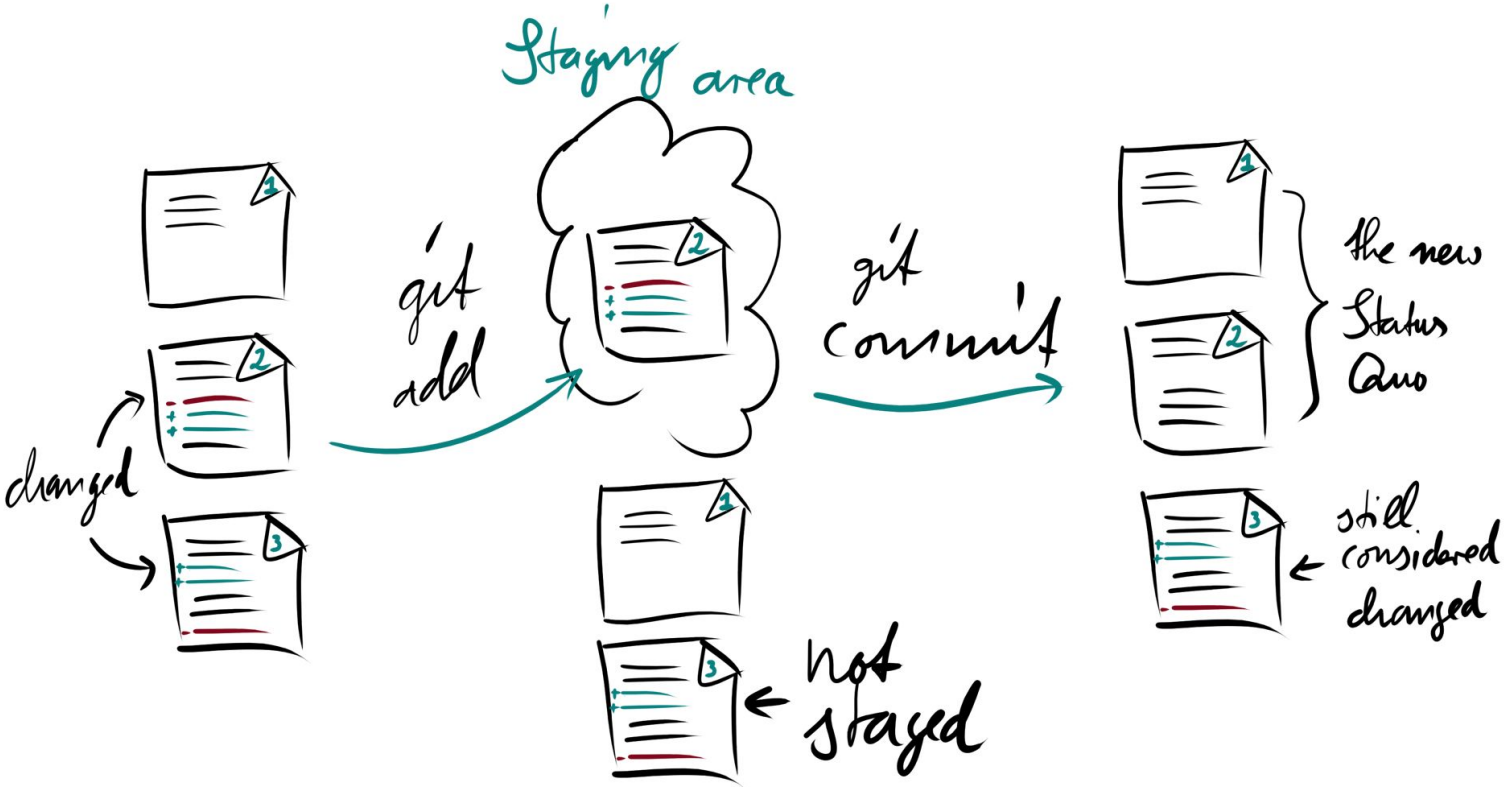
What files changed since the last commit?

```
$ git status
```

What lines changed since the last commit?

```
$ git diff
```


Making a commit is a two-step process



1. Add changes to the Staging Area.
2. Commit to these changes (and leave a commit message).

Adding changes to the staging area

```
$ git add file1 file2 [...]
```


Time for some commitment

Short version

```
$ git commit -m "short, yet helpful commit message :D"
```

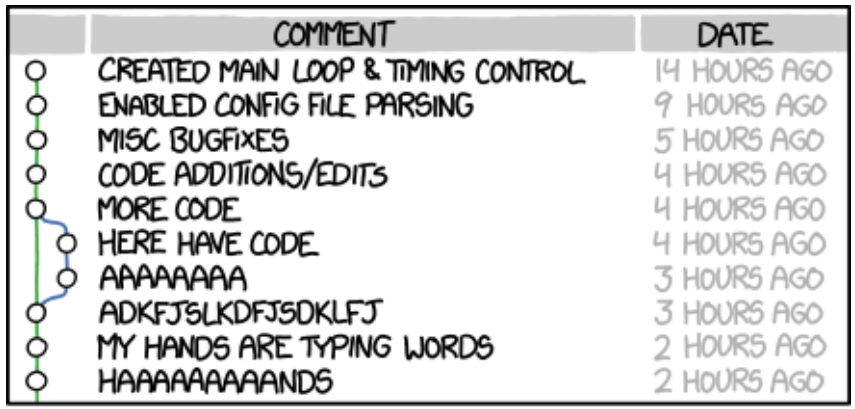
‘Proper’ version

```
$ git commit
```

The latter will open your text editor for your commit message:

- Save+quit to create the commit.
- Leave the message blank (or quit without saving) to abort the commit.

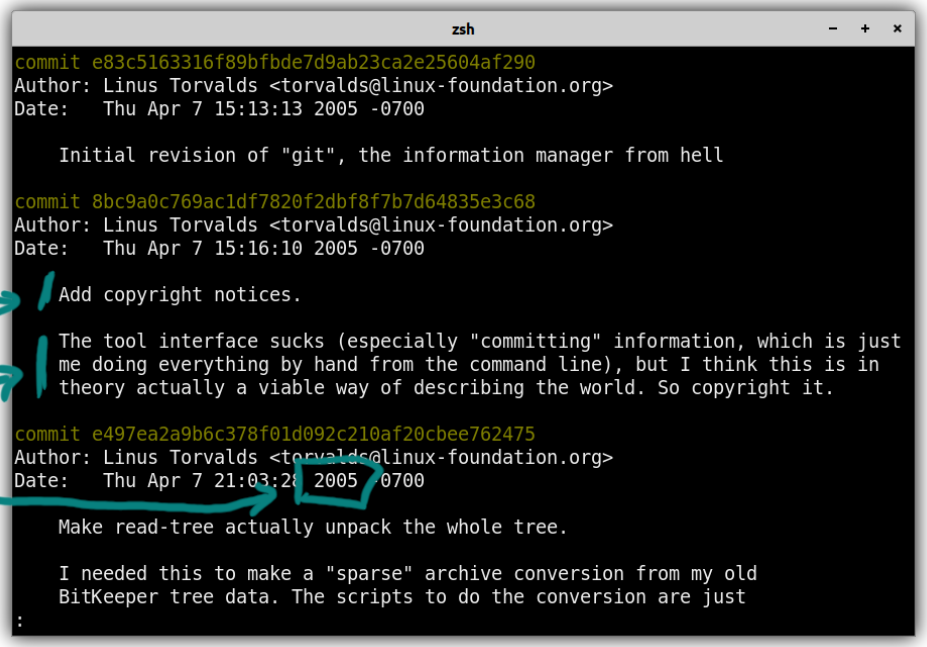
Good and helpful commit messages



by Randall Monroe (CC BY-NC 2.5), https://xkcd.com/1296/

Good and helpful commit messages (ctd.)

- One-line summary (max. 50 chars.)
- More detailed description of what changed and why
- Keep in mind that commit messages stick around for a long time



Good and helpful commit messages (ctd.)

Good one-liners

A good technique for a one-line commit message is to focus more on why a commit was made.

Example

don't: ~~`updated readme`~~

do: `forgot Steve in the author listing`

Changing your mind

I'm not ready to commit to this yet!

```
$ git reset file.txt
```

Note: This does not delete or change any files – it just removes them from the Staging Area.

Changing your mind (ctd.)

Crap, I messed around with the project and now everything is terrible! Let's just throw this away and start over...

```
$ git checkout file.txt
```

- This will undo any changes to `file.txt` that haven't been committed or staged, yet.
- This process is irreversible – tread with caution!
- Yes, `checkout` serves double-duty...

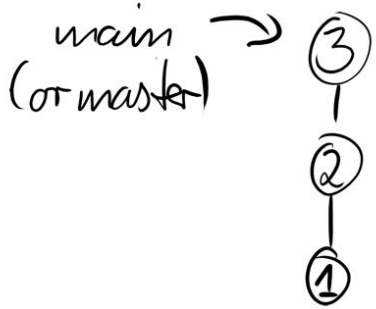
Ignore me

There are a bunch of (temp) files in my folder that I don't want to add to my git repo

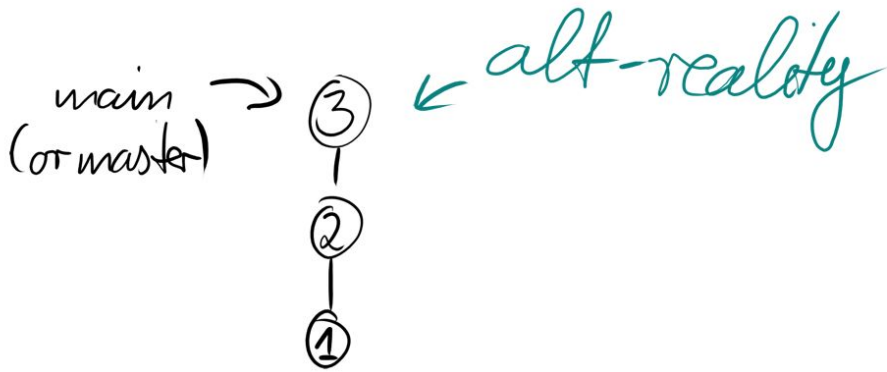
- Create a text file called `.gitignore` (nothing before the dot; no extension at the end).
- Add a new line for every file you want to ignore.
- The `.gitignore` file is just another file you can add/commit/etc. to your git repo.

Casually making parallel universes

How branches work



How branches work (ctd.)



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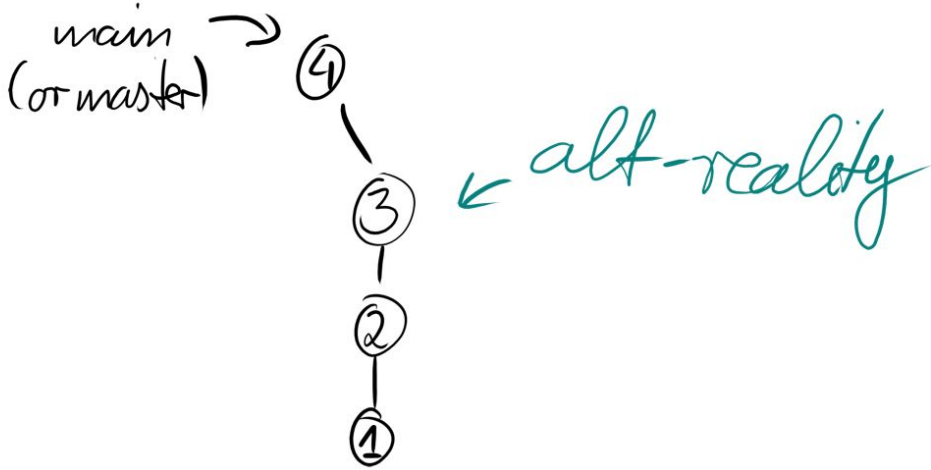

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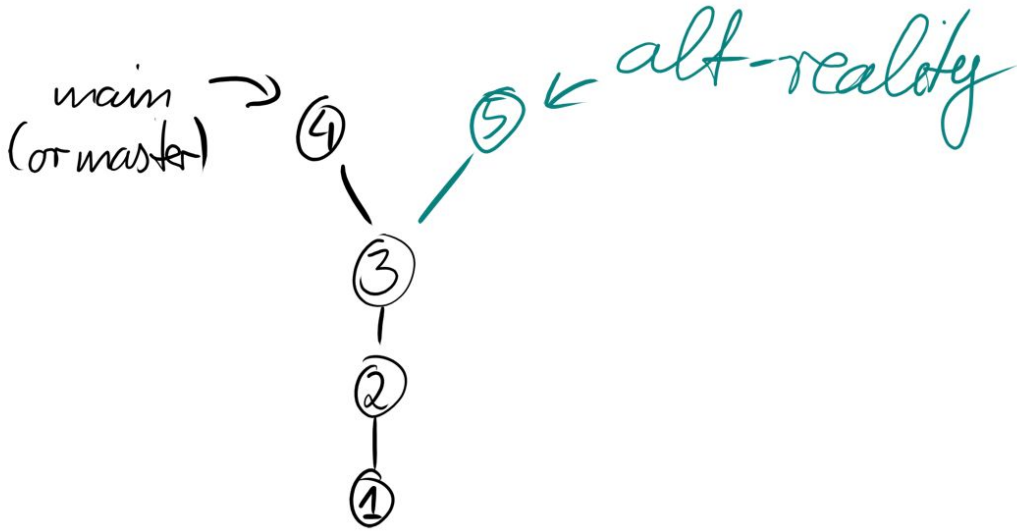

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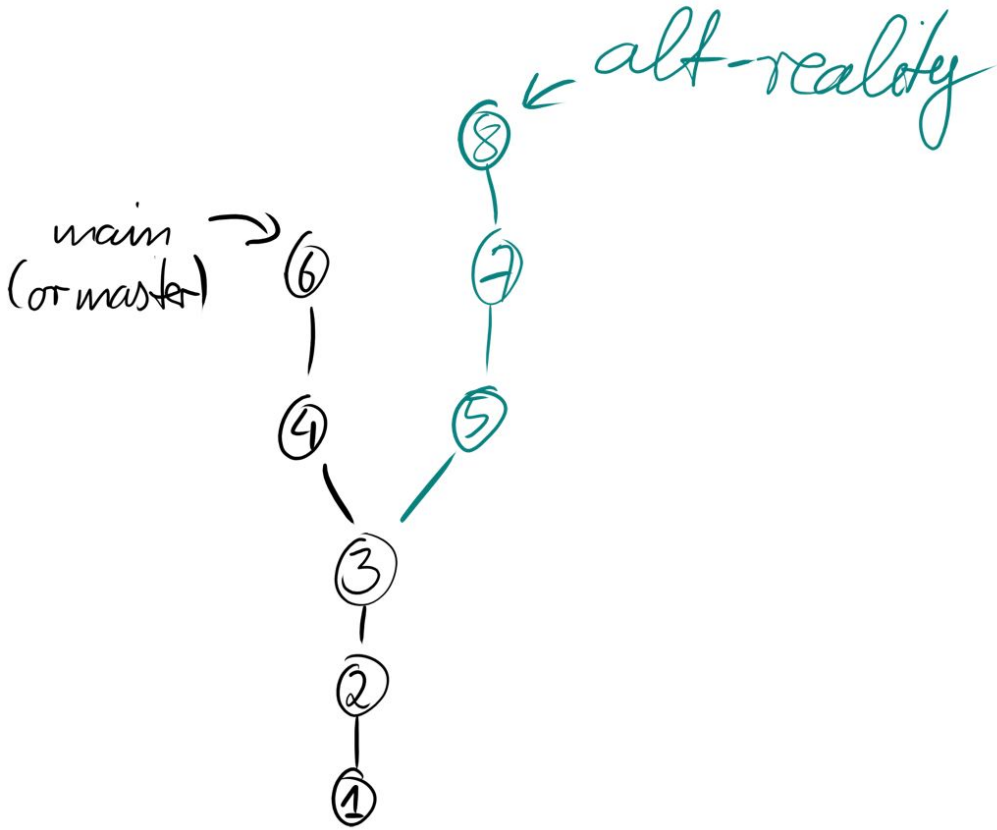

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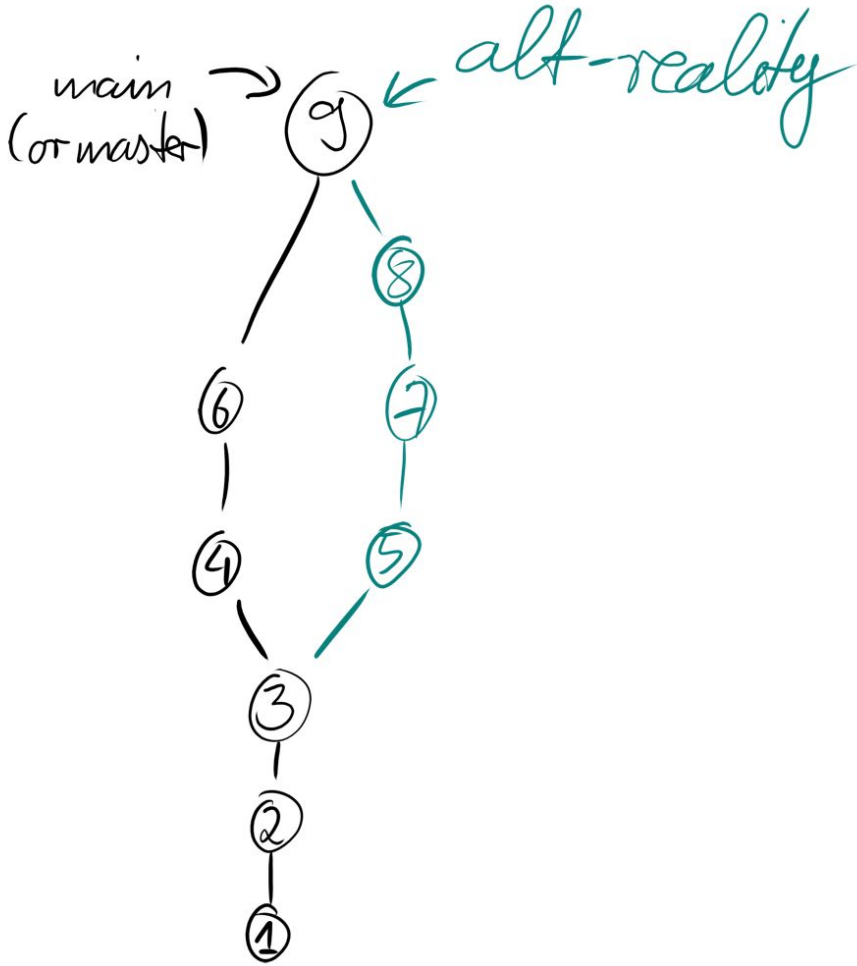

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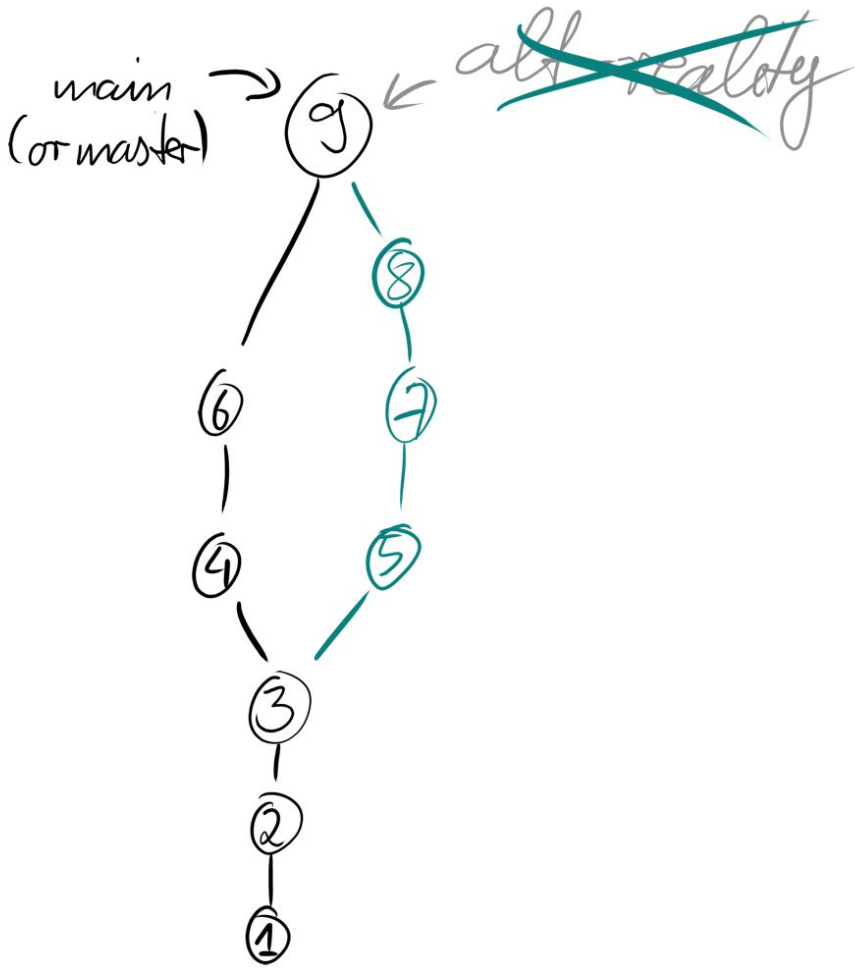


Relevant commands

Make new branch calles `alt-reality`

```
$ git branch alt-reality
```

Switch to branch

```
$ git checkout alt-reality
```


Relevant commands (ctd.)

Merge branches

```
$ git branch main
$ git merge alt-reality
```

Remove the merged branch

```
$ git branch -d alt-reality
```


How does merging work?

Best case scenario

Git applies all the changes made in both branches to the project and everybody is happy. `\(^^)/`

How does merging work? (ctd.)

More annoying scenario

```
$ git merge alt-reality
Auto-merging test
CONFLICT (content): Merge conflict in alt-reality
Automatic merge failed; fix conflicts and then commit the result.
```


How does merging work? (ctd.)

What to do?

- Look at `git status` to see which files are affected.
- Manually edit the relevant files.
- Especially look out for this pattern:

```
<<<<<<< HEAD
stuff in the base branch
=======
stuff in the merged branch
>>>>>>> alt-reality
```

- `add` and `commit`

Publish your work on Github

Basic idea

- Create an empty git repo on Github (or anywhere else).
- Tell your local git repo about it.
- Push your local history to the remote repo.

Alternative workflow for new projects

- Create an empty git repo on Github (or anywhere else).
- Clone the empty onto your computer.

Github does not know who you are

- You can only clone/pull from repos you have read access to.
- You can only push to repos you have write access to.
- Git needs to send some sort of ID or else Github will refuse to cooperate.
- Git cannot look into your browser, so being logged on to the Github website doesn't do anything...

Two methods

- Personal access token
  (not gonna cover that one here – check Github's documentation$^{\hookrightarrow}$ for details)
- Secure Shell (SSH)

Secure Shell (SSH)

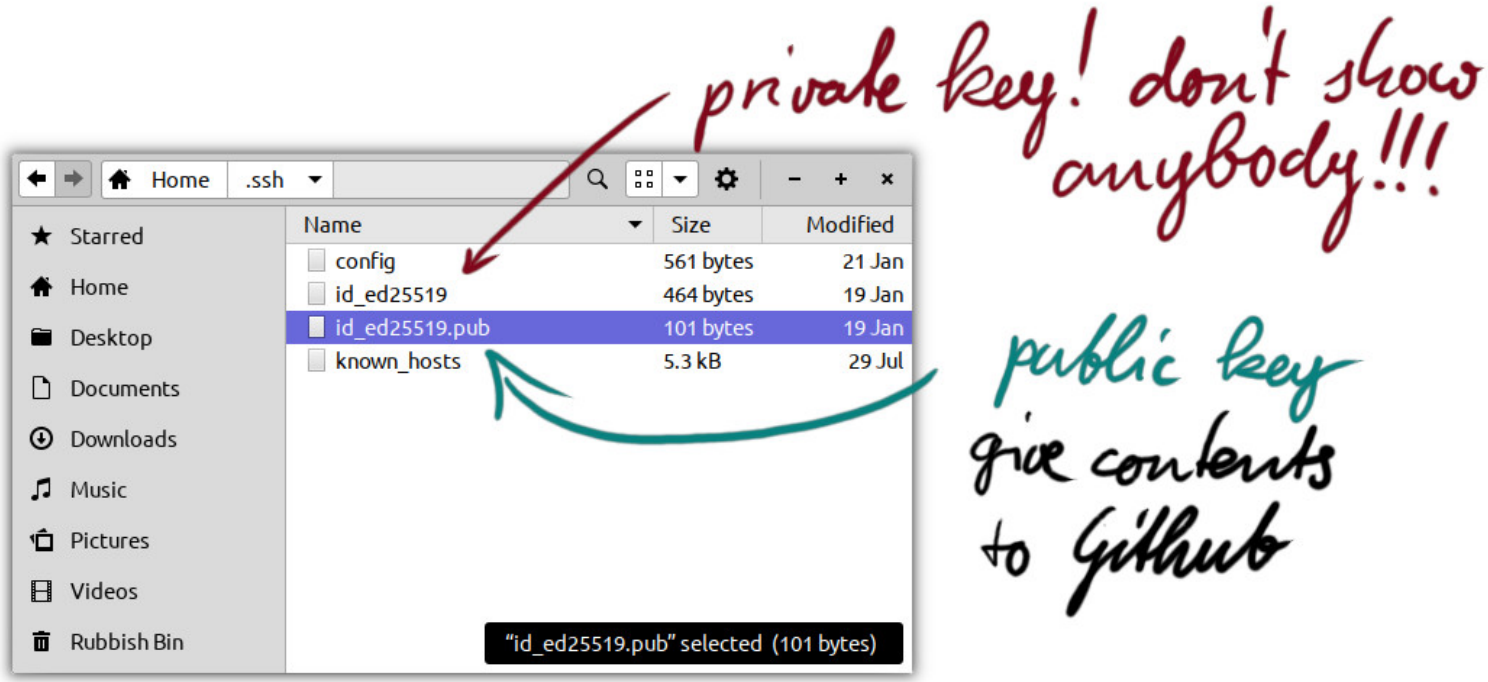
Create a key pair (if you don't have one yet)

```
$ ssh-keygen -t ed25519 -C "your_email@example.com"
```

→ see Github's documentation on creating an SSH key↪

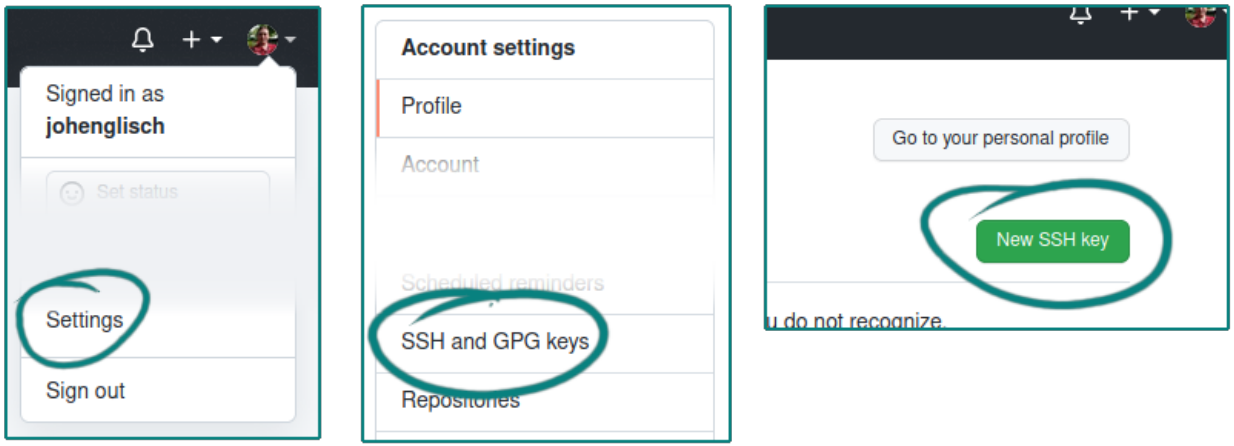
Secure Shell (ctd.)

Find your public key



Secure Shell (ctd.)

Give your public key to Github



- Copy the contents of your public key file into the text field.
- See Github's documentation on adding an SSH key

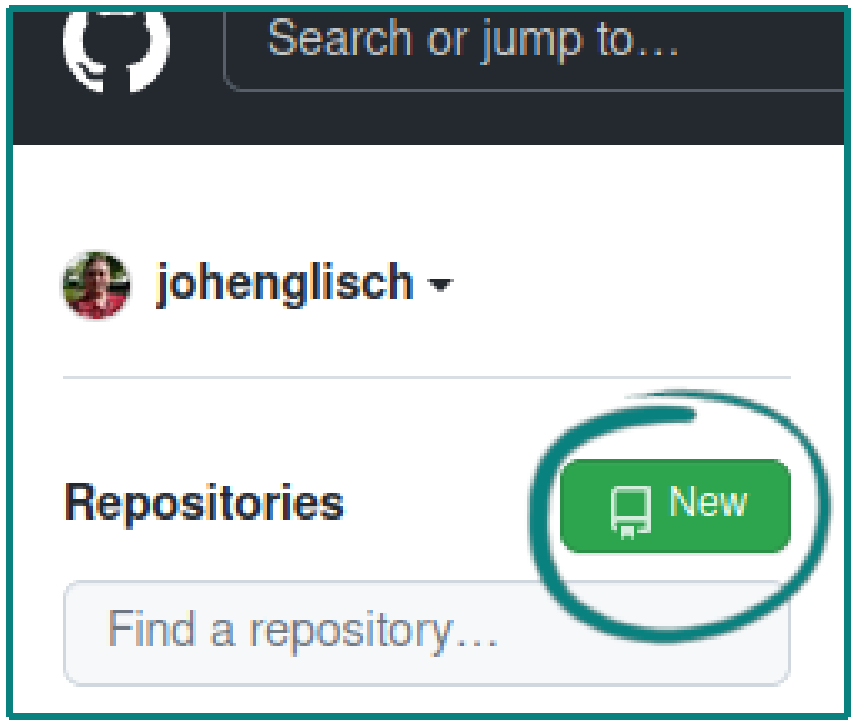
Cloning a git repo over SSH

- Cloning over SSH requires a different URL than regular cloning:

  `git@github.com:<user name>/<repo name>`

```
$ git clone git@github.com:johenglisch/git-intro-2021
```


Creating a new repo on Github



Hooking your local git repo up with Github

```
$ git remote add origin \
    git@github.com:johenglisch/git-intro-2021
```

- This connects your local git repo to a remote repo.
- Note that we are adding the SSH URL rather than the regular HTTPS one.

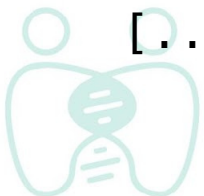
Keeping the repos in sync

Uploading for the first time

```
$ git push -u origin HEAD
```


Keeping the repos in sync (ctd.)

```
$ git pull
remote: Enumerating objects: 364, done.
remote: Counting objects: 100% (364/364), done.
remote: Compressing objects: 100% (197/197), done.
remote: Total 364 (delta 232), reused 256 (delta 127), pack-reused
Receiving objects: 100% (364/364), 85.43 KiB | 4.07 MiB/s, done.
Resolving deltas: 100% (232/232), completed with 19 local objects.
From https://github.com/cldf/pycldf
   61bfadd..275bb9f  master     -> origin/master
 * [new tag]         v1.20.0    -> v1.20.0
[...]
 * [new tag]         v1.23.0    -> v1.23.0
Updating 61bfadd..275bb9f
Fast-forward
 CHANGELOG.md                                       |  39 +
 CONTRIBUTING.md                                    |  10 +-
[...]
```



I am a dirty liar (<_<)"

Actually, `git pull` does two things:

1. `git fetch`: Sync all branches from the remote repository.
2. `git merge`: Merge the remote version of the current branch (e. g. `origin/main`) with the local version of the current branch (e. g. `main`)

Keeping the repos in sync (ctd.)

Upload new changes

```
$ git push
Enumerating objects: 11, done.
Counting objects: 100% (11/11), done.
Delta compression using up to 4 threads
Compressing objects: 100% (7/7), done.
Writing objects: 100% (7/7), 701 bytes | 350.00 KiB/s, done.
Total 7 (delta 5), reused 0 (delta 0)
remote: Resolving deltas: 100% (5/5), completed with 4 local objec
To github.com:johenglisch/git-intro-2021
   e96bea1..a27e261  master -> master
```


Finishing notes

Links

- Tutorial on the Git website:
  https://git-scm.com/docs/gittutorial
- Software carpentry lesson on git:
  https://swcarpentry.github.io/git-novice/