GIT Tutorial For Beginners

Link

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FH Sustainable Computing Workshop

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Version-Controlled Documentation

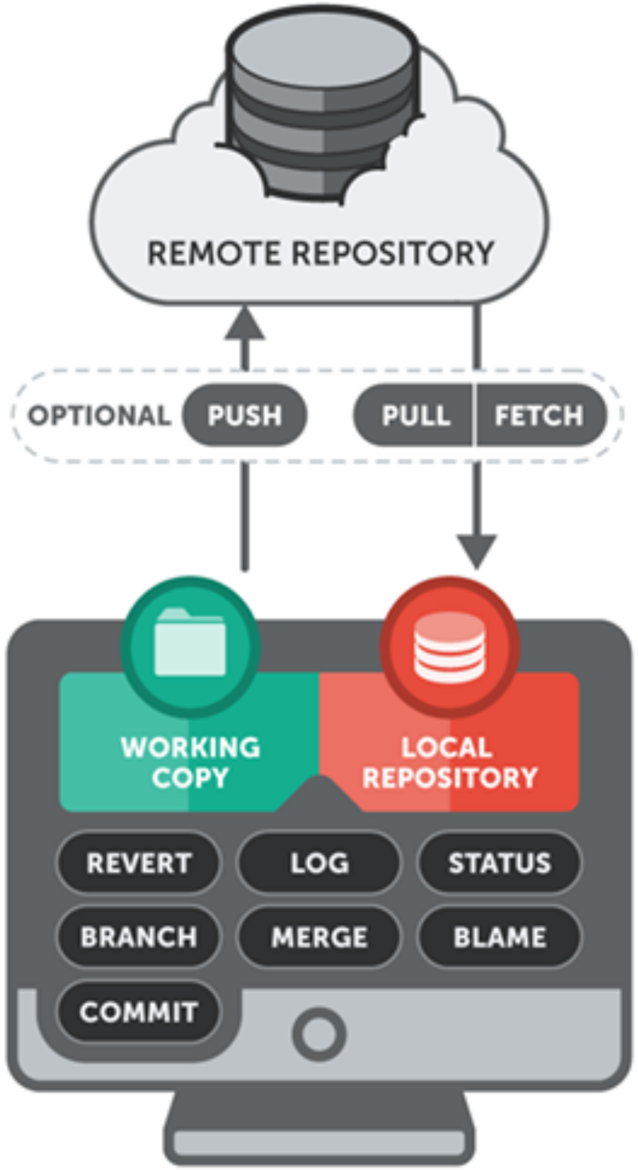
Why use version-controlled documentation, like GIT?

What is version control?

- Keep **history** of the code
    - Can revert if something goes wrong!
- **Collaborate** easily with other people
- **Automatically build or deploy** with every change (see CI tutorial!)

GIT is Distributed

- "**Distributed**": Each developer has (at least) one copy of the repository: **the local repository**
- Each developer interacts with one or multiple remote repository: **remotes**
- Online access needed only to share your work with others and obtain the changes introduced by others



GIT Basics

- **Initialise** a git repository: `git init`
- **Clone** a copy of a remote repo: `git clone <url> <local-folder>` Exercise 1
- main or master is the main branch of your repository
- **Make your changes available (steps to push to a remote):**
  - `git add <filename>` (add a file with all changes)
    - Another option: `git add -p` (cycle through changes and add one by one)
    - Never use: `git add *`
  - `git commit -m "My commit message”`
  - `git push <remote> <branch>`
- **Display** which **remote repositories** are known: `git remote`
- **Display the current status** of your working copy (and its relationship with remotes): `git status`
- **Check the history**: `git log`

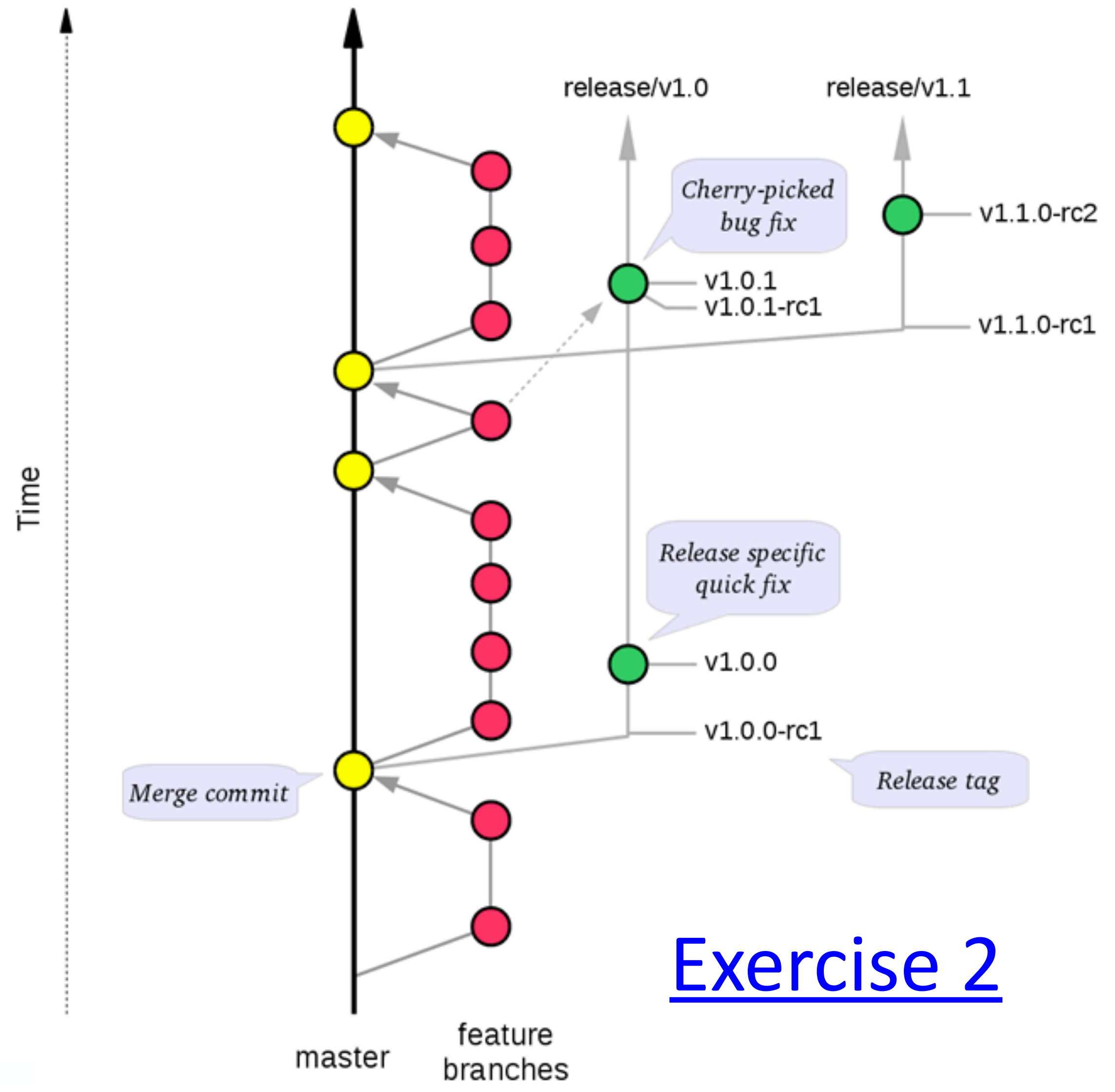
Organizing Your Work

Several options available to collaborate with others:

- Everyone pushes to the remote repository, OR
- Everyone make a fork of the repository   Exercise 1
  - Each person pushes to their fork
  - When ready, submit a pull/merge request to the main repository
  - Can set the main repository as an “upstream” remote repository

Organizing Your Work: One Repo

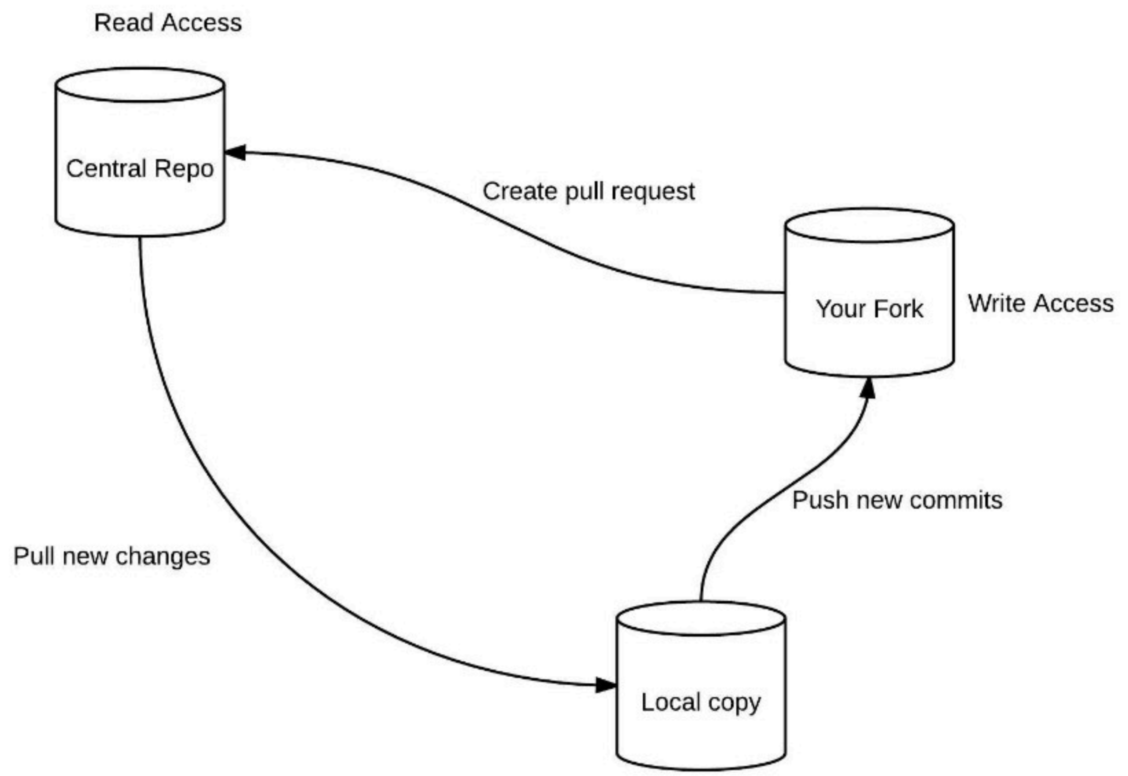
- One possible way to organize your work: everyone pushes to one repo
- main or master is the main branch of your repository
- Work on larger chunks in dedicated branches
  - `git checkout <branch>`
- Create tags to specify a state of your repository
  - `git tag <tag version>`



Exercise 2

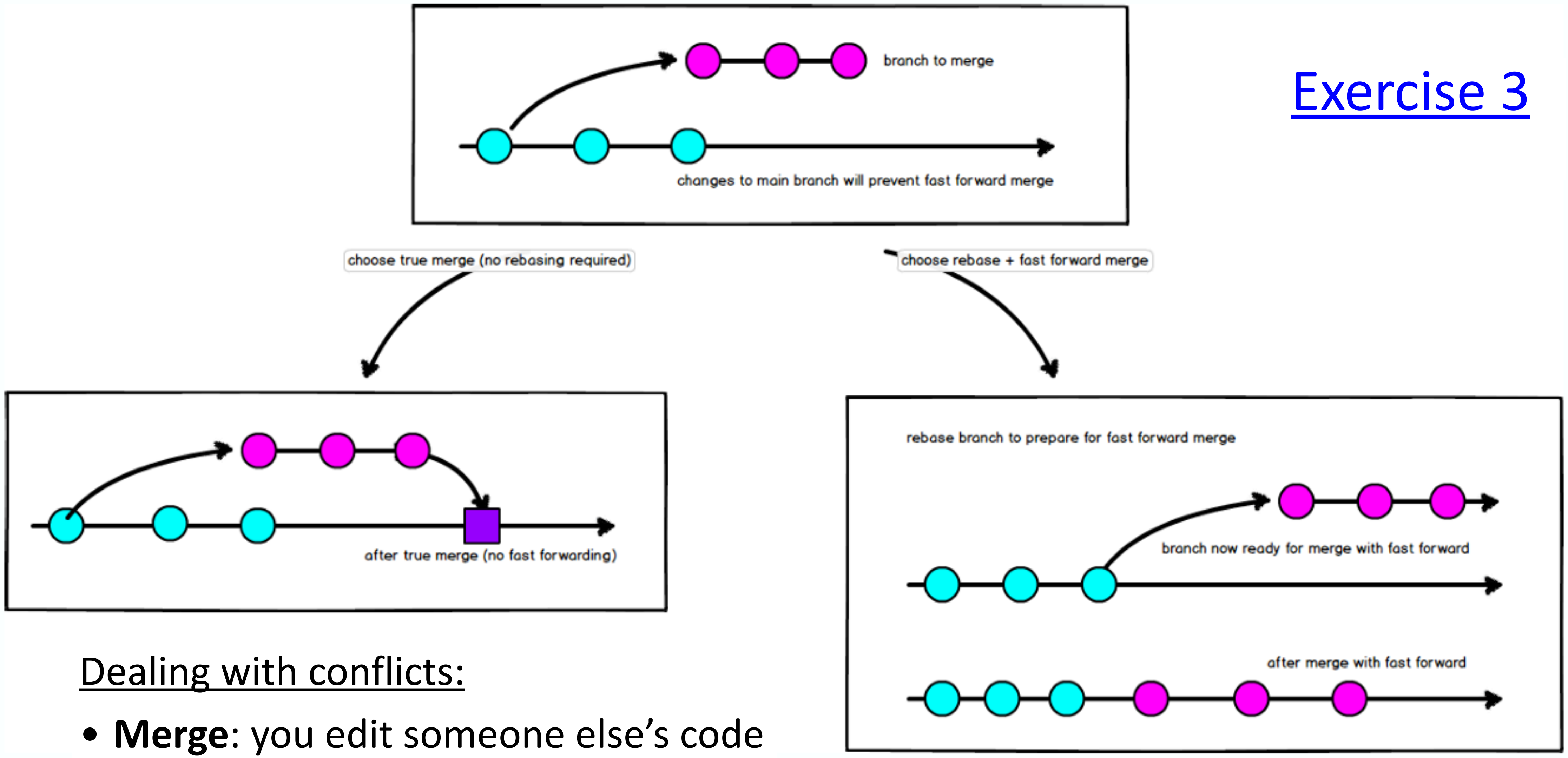
Organizing Your Work: Forks and Merge/Pull Requests

- Another way to organize your work, particularly if you are collaborating with several other people, is to use forks and merge/pull requests
- **Fork**: your own online copy of the repository
  - After you fork the original repository, you can clone your fork locally
  - You can push changes to your fork without affecting the original repository
- When you are ready, you can submit a merge/pull request to merge your changes from your fork back into the original repository



- Can add the original repo as an upstream remote repo
  - And get back the changes that occur in the upstream repository into your fork with merge or rebase

Merge vs Rebase


branch to merge
changes to main branch will prevent fast forward merge
choose true merge (no rebasing required)
choose rebase + fast forward merge
after true merge (no fast forwarding)
rebase branch to prepare for fast forward merge
branch now ready for merge with fast forward
after merge with fast forward

Exercise 3

Dealing with conflicts:

- **Merge**: you edit someone else's code
- **Rebase**: you edit your own code

Merge and Rebase Commands

Merge

- Always go to the branch you want to merge your changes to: `git checkout master`
- Merge the changes: `git merge super-new-feature`

Rebase

- Go to the branch you are working on: `git checkout super-new-feature`
- Rebase onto a branch (e.g. master): `git rebase master`
- Merge like usual

Providers

- Basically, you have GitLab and GitHub as online providers
- DESY provides an instance of GitLab: https://gitlab.desy.de
  - We will be using this today: 3 Git Exercises on DESY GitLab
- CERN also has an instance of GitLab
- GitHub is one of the other popular hosting providers

Some Technicalities

- The local repo is located under a folder named `.git` in your working copy
- Git uses 160-bit (SHA-1) hashes to point to a given state of your repository
- This hash is always **unique** (collision unlikely)
- It is hard to memorize and not very practical — we use **references**:
  - HEAD is a reference to the hash describing the current status
  - main or master is a **branch** (usually the main branch)
  - release/21.0.21 is a tag
- A given hash points to the same content, even if from different repositories, branches, tags, …
- For small repositories, 7 leading digits of the hash are (usually) enough
- For example, to show the contents of one commit: `git show e3153d7`

More Useful GIT Commands (~advanced)

- **Stash:**
    - Temporarily save and remove your local changes
    - Add to stash: `git stash save <name>`
    - List stashed: `git stash list`
    - Retrieve from stash
        - but do not remove it: `git apply <name>`
        - and remove it: `git pop <name>`
    - <name> is always optional
- **Cherry-pick:**
    - Take one hash and apply it to your current staging area:

```
git cherry-pick e3153d7
```

What If?

I've made a lot of changes but now I want to submit just some of them?

- Look at the log and decide what you want (`git log`)
- Make a new branch from upstream/master: `git checkout -b feature-a upstream/master`
- Cherry-pick commit(s) that you found in the log:
  - `git cherry-pick e3153d7`
  - `git cherry-pick f249a34`
- Push to the origin: `git push -u origin feature-a`

What If?

I’ve made a commit but I forgot a file?

- Add the file that is missing: `git add missing.txt`
- Update, that is, amend the commit: `git commit --amend`

What If?

I’ve added too much to the staging area/commit?

- If not committed yet, reset the file: `git reset my-file.txt`
- If have already committed, reset the state to the previous HEAD: `git reset --soft HEAD~1`

Summary

- Git helps you keep **track of the history** of your (nonbinary) files and **easily collaborate with others**
  - Code
  - Thesis (git works with overleaf…)
  - Recipes
- A lot of material covered today — **the goal should be to understand the philosophy**
- With the exercises, the goal is for you to **understand the basics** of how to do these things in practice
- **Useful links:**
  - https://training.github.com/downloads/github-git-cheat-sheet/
  - https://ohshitgit.com
- But in general, if you have a git problem, **google (ChatGPT) is your friend**
  - Countless people have screwed up like you just did before you