

Collaborative Programming


Kilian Lieret

Princeton University

Markdown-based slides available as  open source; contributions welcome!

Please open these slides on your laptop as we'll jump back and forth between the slides and the browser!

Structure of this lecture

1.  ****Collaboration in the browser****
 1. GitHub Gists
 2. Creating issues
 3. Forking a repository
 4. Creating commits
 5. Opening pull requests
 6. Handling merge conflicts
2. Working with a local repository
3. Learning to love git (showcase of advanced topics)

GitHub Gists

the easiest way to share code on GitHub

The "gist" interface works more like a pastebin (and is very easy to use!)

Use case:

- Embed code snippets in websites that don't natively support it properly (like medium)
- Quick sharing of simple code snippets

However: Gists are not meant for collaboration or larger pieces of work!

Tasks

1. Go to github.com and click the "+" symbol and select "Gist" or directly go to gist.github.com
2. Create a simple file and publish it

Let's explore the history of an open source repository

Tasks

1. Navigate to <https://github.com/klieret/collab-git-playground-codas-hep-23> ("playground repository")
2. Explore the history and find a hidden tiger 🐅!

Let's open an issue!

Tasks

1. Please navigate to the playground repository
2. Open an issue with a random feature request

Bonus tasks

- Edit the **title & description** of your issue
- Add a **comment** mentioning another participant
- Use an emoji **reaction**
- **Close & reopen** your issue
- Check for other issues and comment there

Advanced

- Install the gh command line tool
- Clone the repository
- Use the CL to open an issue

Forking & committing changes

Bonus tasks

While you can open issues, you do not have permissions to directly modify content.

Tasks


1. Click the **fork** button. This will create a "copy" of the whole repository

2. Open the ``content`` folder and click ``Add file`` > ``Create new file``

3. Call your file ``<your gh username>_first`` and add a few lines to it

4. Add a commit message and commit

5. Confirm that you see your file & a new commit

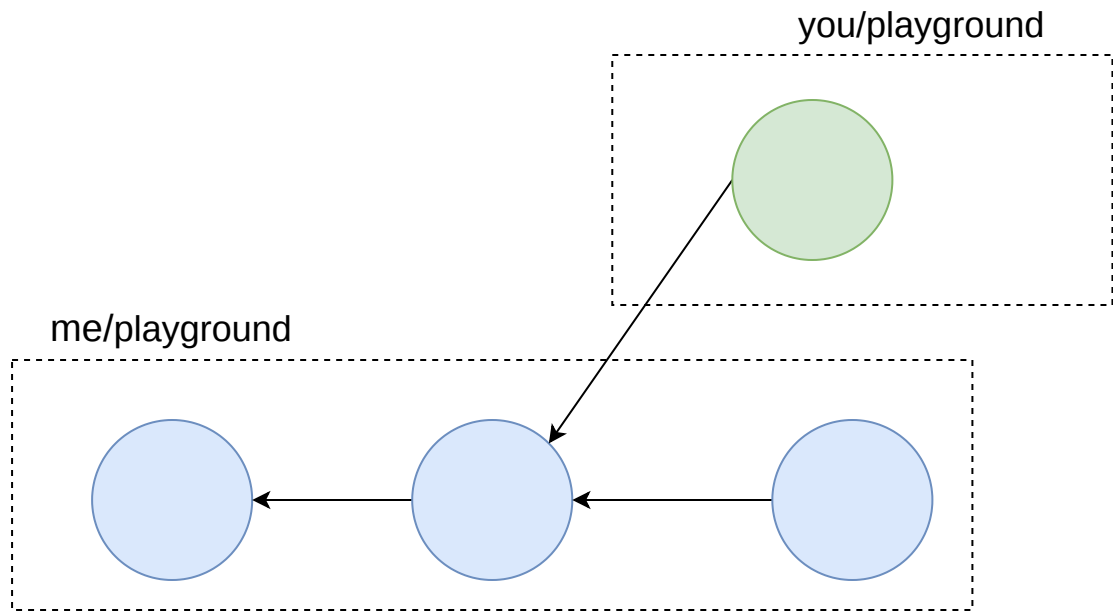
 Usually you always want to commit to a separate branch in this scenario (later!)

- Add a second file
- Open your previous file and make changes to the text

Advanced

Do the same with the gh CLI.

What did we do?



- Every node is a commit. Every commit points to a parent.
- Your fork "branched off" of the original repository: You're adding additional commits to a parallel reality
- Next step: Bringing your commits back to the original repository

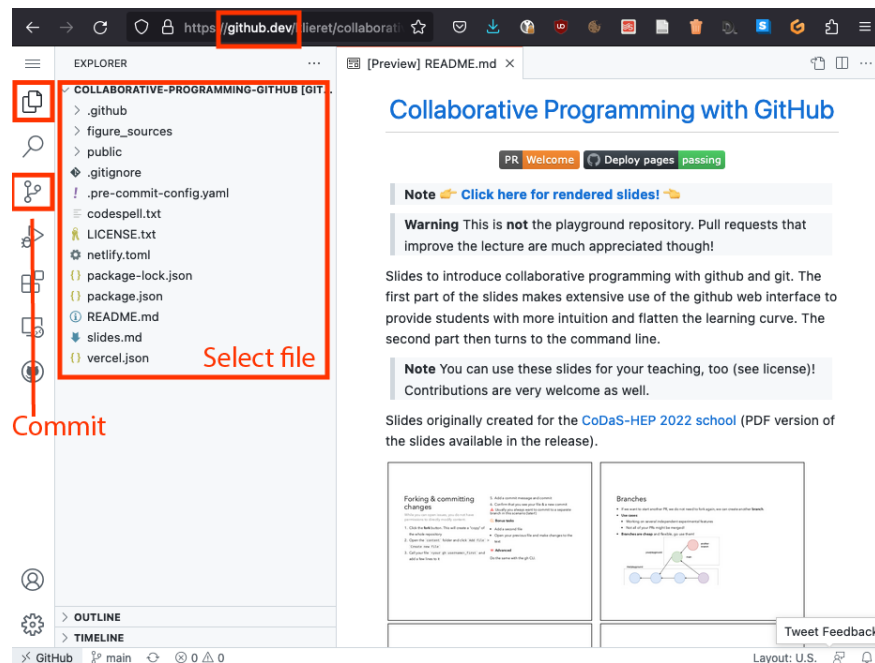
Advanced editing

Starting `VSCode` in the browser

✓ Tasks

1. Navigate to the playground repository
2. Do one of these:
 - Press `⌘ .` (opens in same tab),
 - Press `⌘ >` (opens in new tab)
 - change the URL from `github.com` to `github.dev`.
3. Make some additional changes
4. Commit by clicking on the git tab in the left menu, adding a message and pressing 'commit & push'

Change back to the previous view by changing from `github.dev` back to `github.com`.

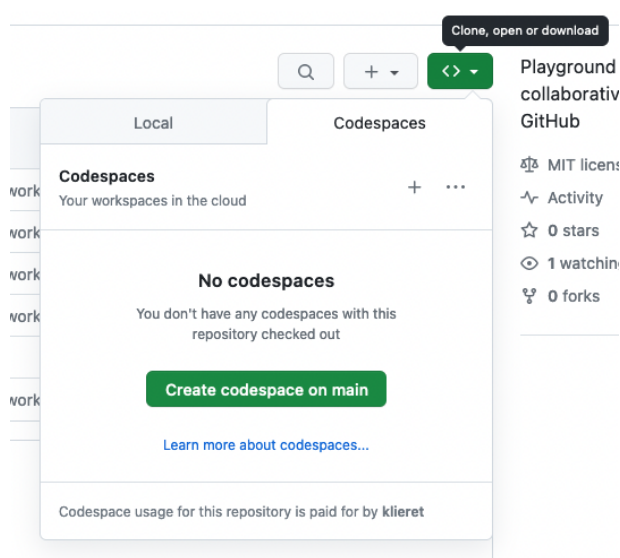


Advanced-er editing with GitHub Codespaces

A full development platform

✓ Tasks

1. Go back to the repository and open GitHub codespaces:




2. Type ``echo 'hello world'`` in the terminal
3. ✓+ Install stuff: ``sudo apt-get update && sudo apt-get install fortune &&`

Creating a PR

How to bring our changes back to the original repository

✓ Tasks

- If you create new commit on a fork, github will already offer you a button to open the PR. Click it!

 octo-repo had recent pushes less than a minute ago

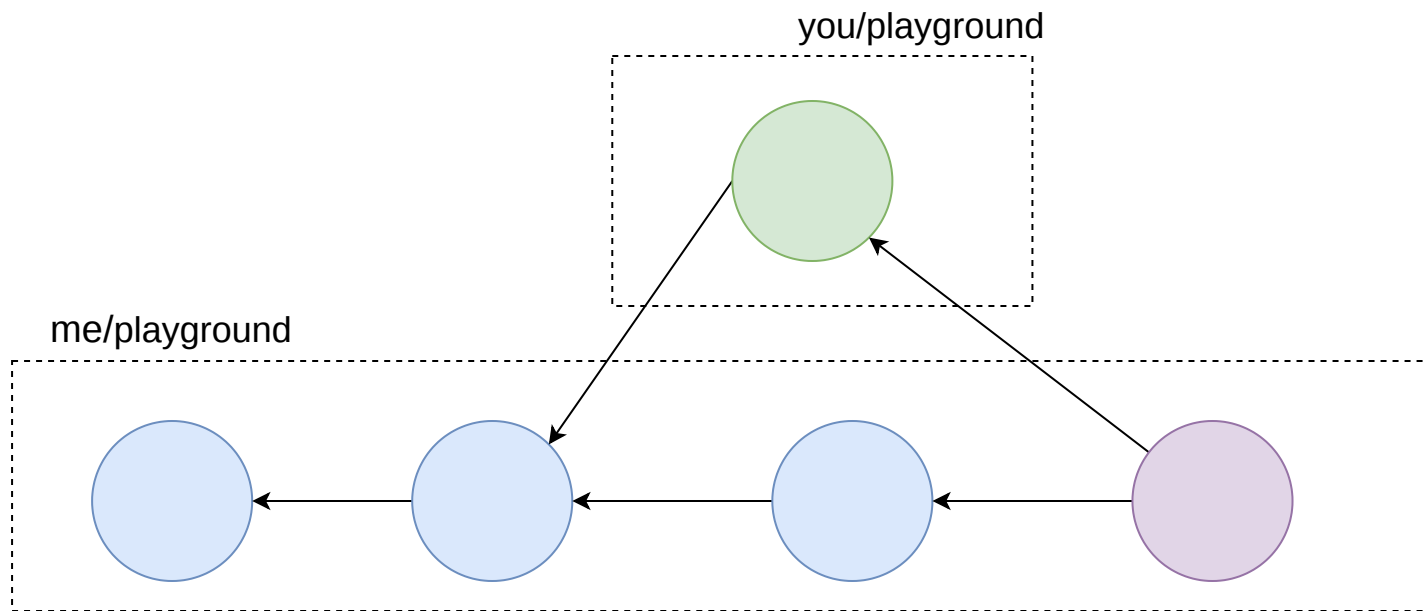
Compare & pull request

🔍+ Bonus tasks

- Mention one of your issues. If you write ``Closes #<number of your issue>`` and the PR is merged, the issue will automatically close.
- Check the differences that the PR will create
- Comment under one of the differences
- Mention another participant ``@<name>``

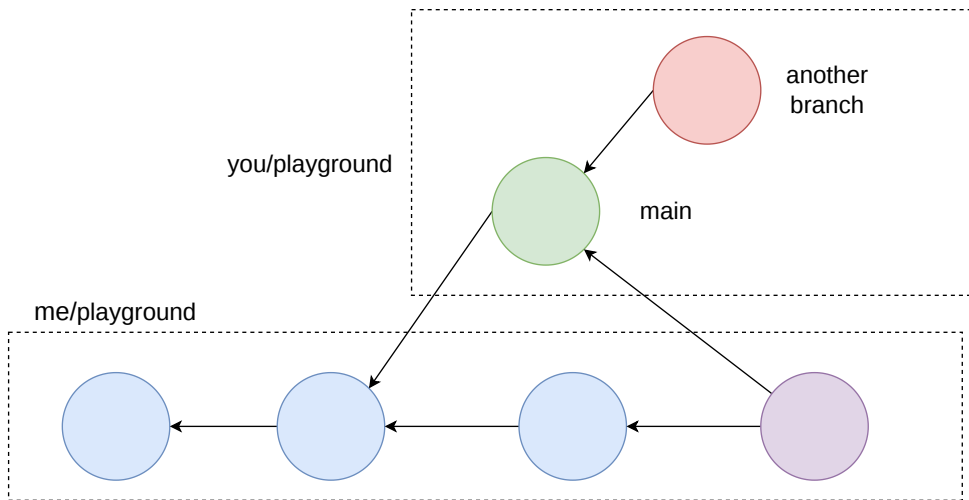
What did we do?

Someone just merged your pull request!



Branches




- If we want to start another PR, we do not need to fork again.
- This time however, we first create another **branch** in our fork.
- Use cases:
 - Working on several independent experimental features
 - Not all of your PRs might be merged!
- Branches are cheap and flexible, always use them!



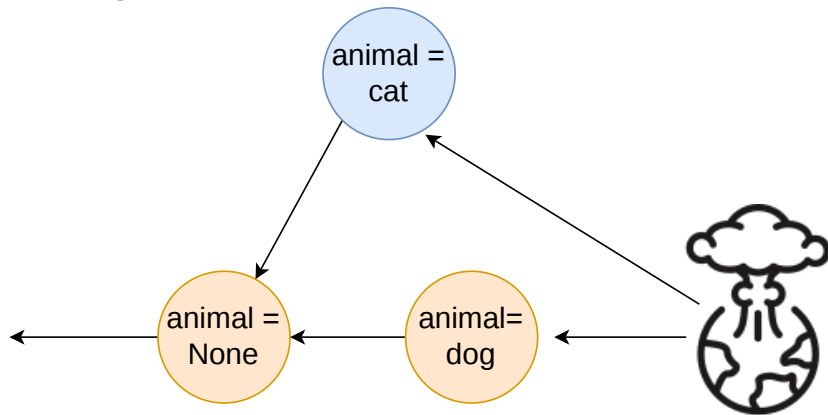
Forks vs Branches

- A *fork* copies the entire repository:
 - Similar to copying the entire local project folder (including your `.git` repository)
 - If the original repository is deleted, your fork persists
 - You *own* your fork and have every permission there
- A *branch* belongs to its repository and only tracks certain changes
- Branches are cheap and easy, forks are expensive
 - If you have write permissions for a repository you do not usually need/want to fork it
 - If you need to fork, fork once and then use branches

Branches

1. Add another file ``content/<your gh username>_second``
 2. Select ``Create a new branch for this commit and start a pull request``
 3. Give your branch a reasonable name (whitespace discouraged)
 4. Commit!
 5. Create another PR to either:
 - Your neighbor's ``main`` branch
 - The original repository (``klieret/ ...``)
 - Your own ``main`` branch
 6.  If you want to do the bonus exercises, mark your PR as ``draft``
 7. If you receive a PR, merge it (unless it's a draft)
-
-  **Bonus task: Adding additional commits to a PR**
 5. Go back to the default view of your repository and verify that you now have multiple branches
 6. Select your new branch
 7. Modify your just created file and create a new commit on the same branch
 8. Check that your PR has been updated by this new commit
 9. Remove ``draft`` status and ask repository owner to review + merge
-
-  **Bonus task: Go crazy!**
Commit to various branches, create PRs between your branches or to your neighbors branches.

Merge conflicts



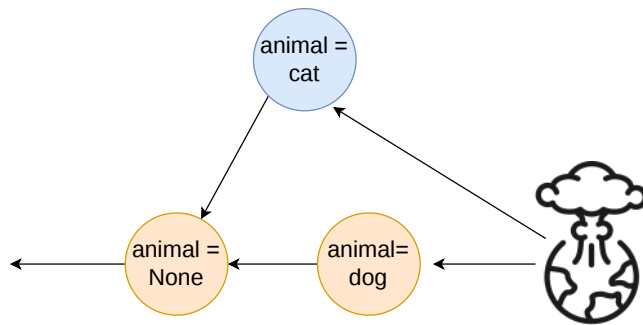
- source

Merge conflicts

⚠ Please follow these instructions *precisely!*

1. Go to your fork
2. Verify that you are on the ``main`` branch (yellow)
3. Change something in ``content/<your_gh_username>_first`` and commit to the branch (!)
``merge-conflict`` (blue)
4. Open a pull request to your own ``main`` branch. Do not merge the PR yet!
5. Change to your ``main`` branch again

6. Change the same (!) line to something different and commit (to ``main``)
7. Check back on your PR, it should warn you about a conflict
8. Resolve the conflict by determining how both changes should be reconciled
9. Commit the merge



🔧 **Bonus tasks:** Verify that if you change different lines with unchanged lines between them, git will do the merge automatically.

Part 2: The command line



Let's get you set up

Configure name, email and editor

If you run git for the first time,

```
git config --global user.name "John Doe"  
git config --global user.email johndoe@example.com  
# Choose your favorite editor, e.g., nano or vim  
git config --global core.editor nano  
# Requires git 2.28  
git config --global init.defaultBranch main
```

If you haven't done already, generate ssh keys for authentication to github

```
ssh-keygen  
# follow the instructions  
cat ~/.ssh/id_rsa.pub
```

and add the key to github. Then clone your repository:

```
git clone git@github.com:<your username>/collaborative-programming-github.git
```

Please raise your hand if you have any issues!

Your first commit

```
cd collaborative-programming-github
cd content
ls
# Get changes that were done on the remote, just in case
git pull
# show status of git repository
git status
# Create new file
touch <your gh handle>-third.txt
# Status is dirty now
git status
# Commit file
git commit <your gh handle>-third.txt -a -m "My third file"
# Clean again
git status
# View past commits (quit with q)
git log
# Push to the remote
git push
```

Bonus tasks:

- Create a few more commits (changing the file)
- Commit without the `-m`` option and enter your commit message manually

Changing multiple files in one commit

```
# change all three of your files
git status
# multiple files should now show "unstaged changes"
git add <your gh handle>-first.txt <your gh handle>-second.txt
git status
# two files "staged"
# Commit. Careful: Do not use the -a option
git commit -m "Committing changes to two files"
git status
# one file still showing unstaged changes
git add <your gh handle>-third.txt
git commit -m "Commit to one file"
# Bring changes to github again
git push
```

Hints:

- If you want to add everything to the stage: `git add .`` or use the `-a`` option for git commit
- If you want to remove a file from the staging area: `git reset <file>``
- If you want to unstage all files: `git reset``

Branches

```
git branch my-new-branch
git status
# still on branch 'main'
git switch my-new-branch # or: git checkout my-new-branch
git status

# Now use your previous knowledge to create some more commits

git status
# Make sure that everything is committed
git log
# Verify that you have added a view commits

git switch main
# Verify that the changes from the other branch are not present
git log
# Also our commits aren't present
```

Merging

Bring the commits from ``my-new-branch`` back to ``main``

👑 **Advanced:** Add more commits to main before merging to set yourself up for a merge conflict

```
# On branch main
git merge my-new-branch
# Should work directly unless you're doing the advanced exercise
```

👑 **Advanced:** Manually modify the files to resolve the conflict, then ``git commit -a``.

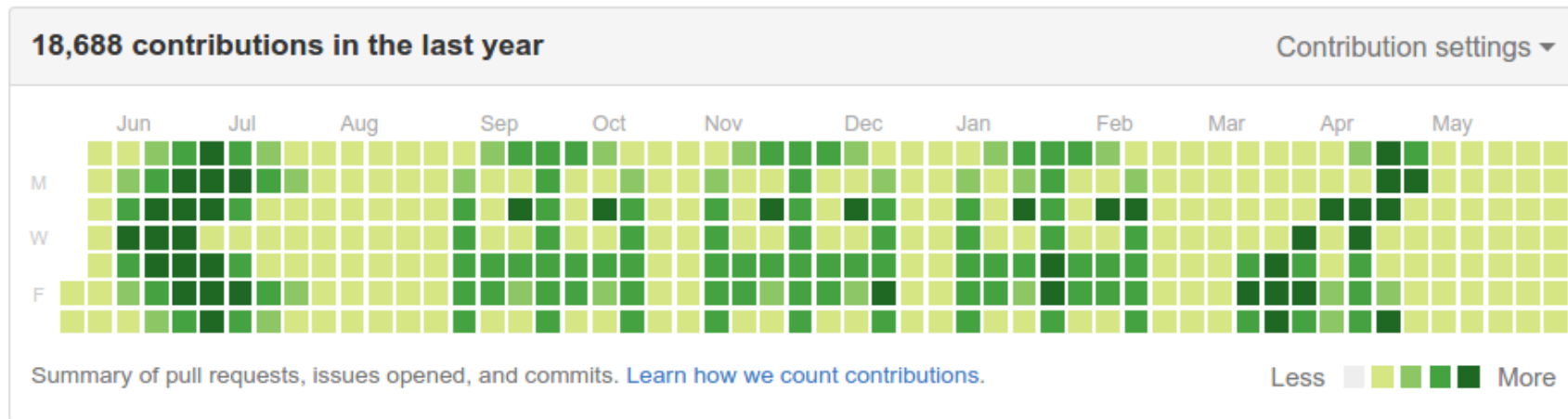
What we didn't tell you about today

... but what you should really know about

- `git show`: Show details about a commit
- `git diff`: Show differences
- `git stash`: Temporarily put changes aside
- `.gitignore` files: Avoid tracking irrelevant files
- `git revert`: Revert changes
- `git checkout`: Jump through history (or between branches)
- ...

Take a look at a cheat sheet like this one and make sure you understand all commands listed.

Part III: Learning to love git



source

- If you are developing software, you almost certainly will use git, no matter where.
- Learning to master git is perhaps THE most transferable skill you can hone.
- Git would not be so dominant if you could not learn to love it.

Your git config

- All repository specific settings live in `<your_repo>/.git/config`. Take a look!
- You can set global settings in `~/.git/config`. Take a look!

Rule of thumb: If you are unsure about the metadata of your repository or about commands that modify it, take a look at your `.git/config`.

Defining aliases

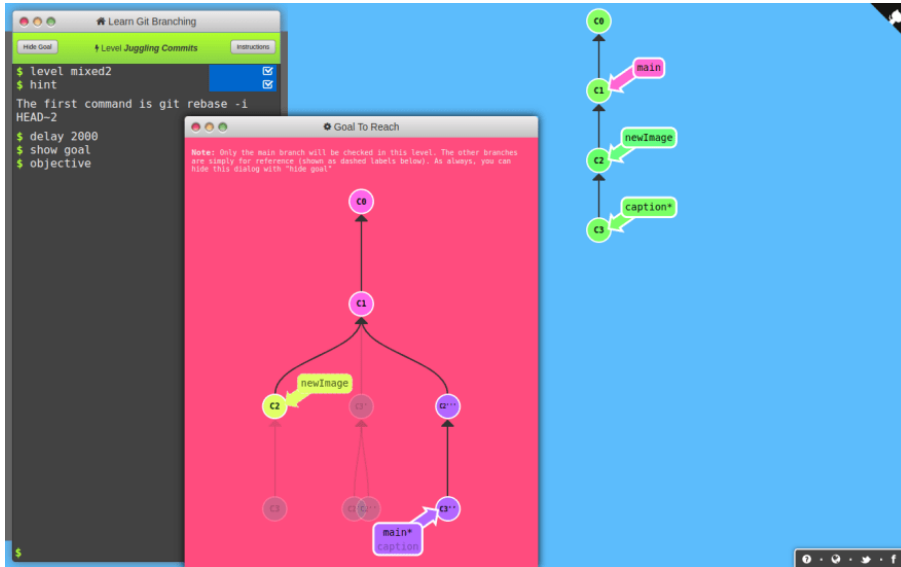
```
# Type `git c` instead of `git commit`
git config --global alias.c commit
git config --global alias.ca commit -a
# ...
# Use `g` instead of git
alias g="git"
# You need to put this definition in your bashrc (or other zshrc etc.) to make it last
```

Alternatively you can also directly write into your config file.

Practice, practice, practice

and then some more

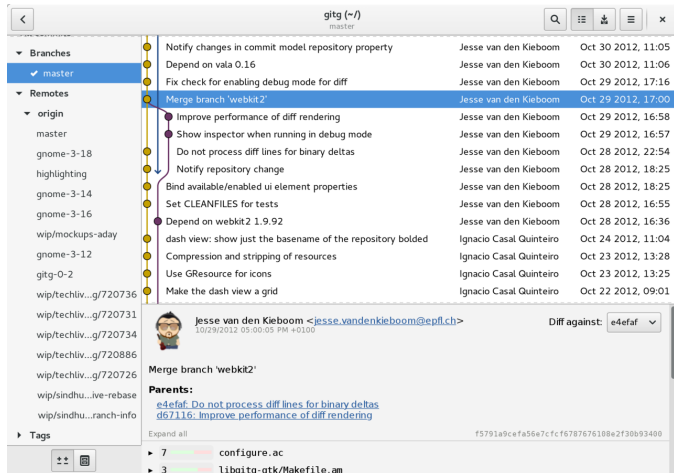
This page has very nice suggestions for different levels, all of them using **gamification** but increasing in realism.



Graphical tools

can give you more intuition

Go here for a curated list of them.



source

Best practices

Licensing Don't forget to add a license to your repository or nobody can use it! See for example the [GitHub docs](#) for more information.

GitHub actions You can automatically run unit tests or other automated tasks every time you commit (or perform other actions on GitHub). Take a look at [GitHub actions](#). For simple checks with almost no setup, also take a look at [pre-commit](#) and its [GitHub integration](#).

Thanks!

You can also practice by improving these very slides! Go to <https://github.com/klieret/collaborative-programming-github>. Issues, forks and PRs are very welcome! You only need to speak markdown to help.