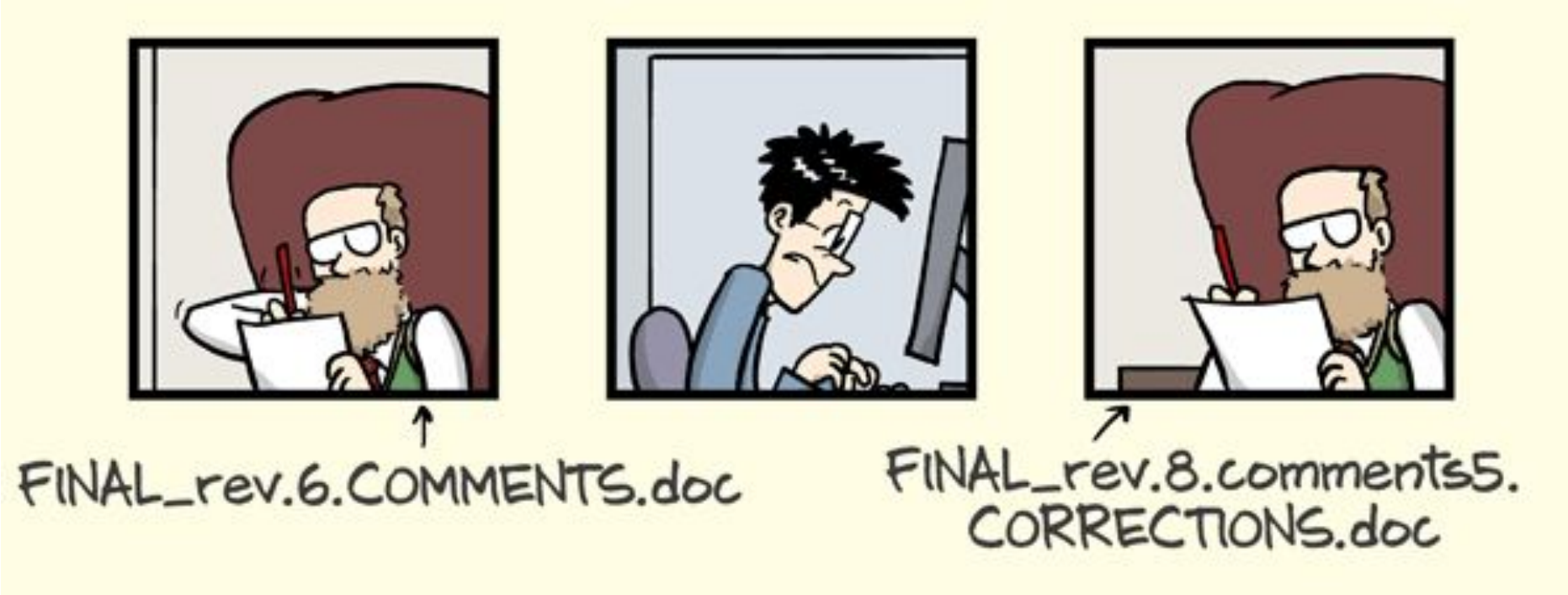
Git and GitHub

Anastazie Sedláková
Libor Mořkovský
Václav Janoušek

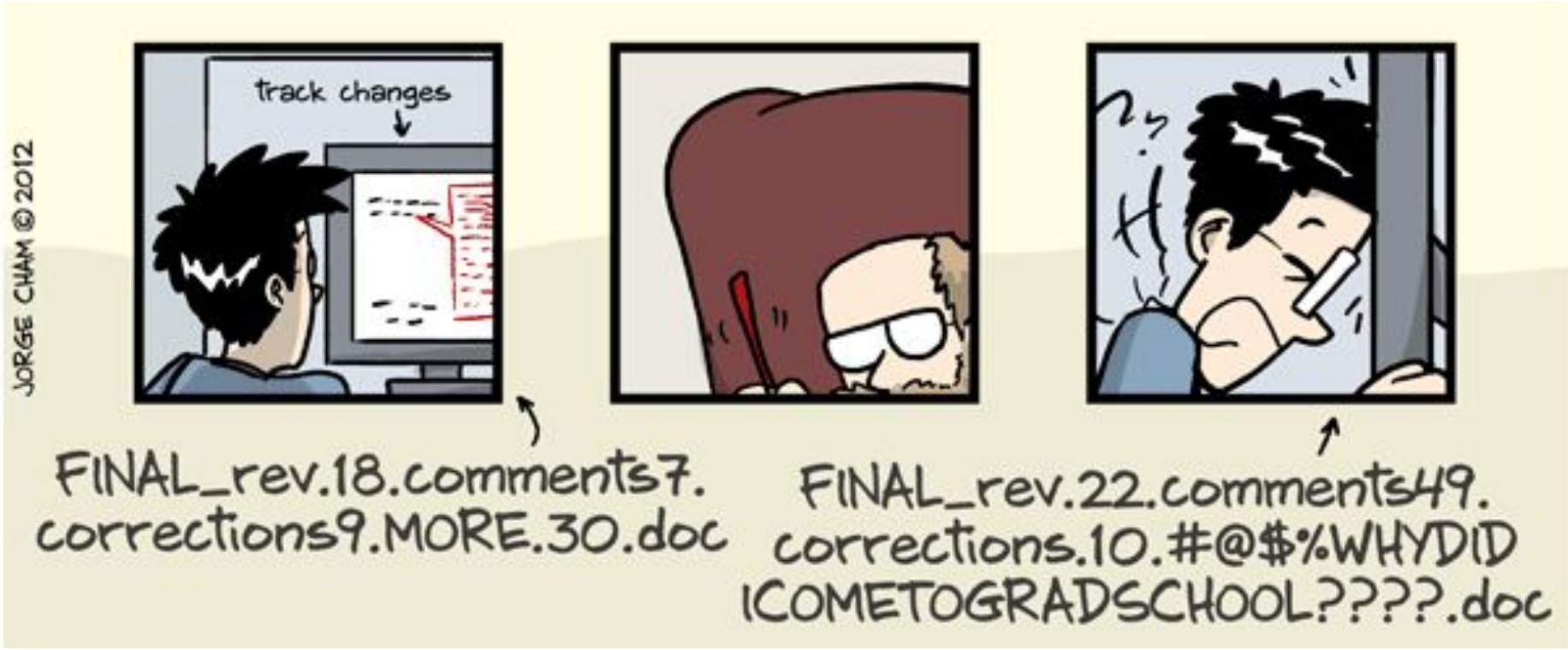
Versioning

http://phdcomics.com/comics/archive.php?comicid=1531

Versioning


FINAL_rev.6.COMMENTS.doc
FINAL_rev.8.comments5.
CORRECTIONS.doc

Versioning


track changes
JORGE CHAM © 2012
FINAL_rev.18.comments7.
corrections9.MORE.30.doc
FINAL_rev.22.comments49.
corrections.10.#@$%WHYDID
ICOMETOGRADSCHOOL????.doc

Git

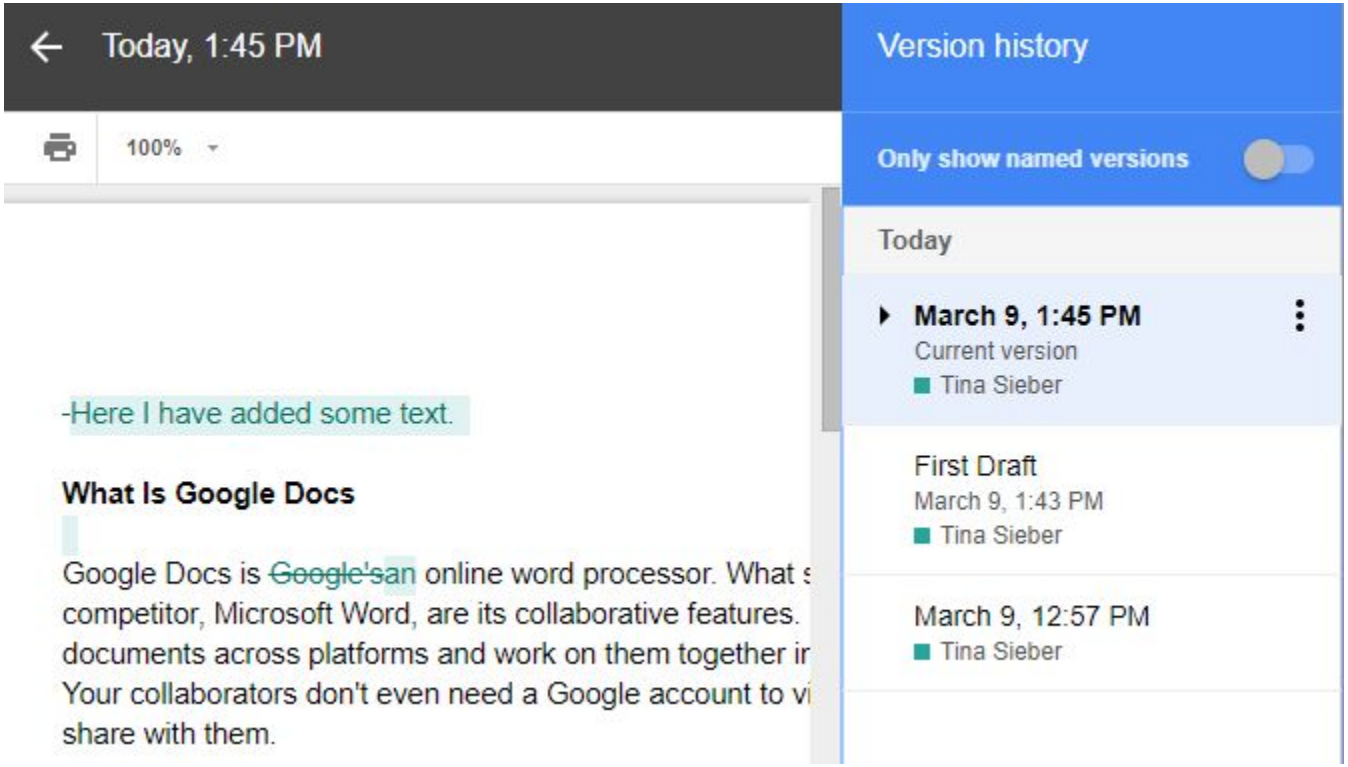
- System to keep track of changes that happen across the set of files
- A.K.A. version control tool

Github

- Online service to run Git in the cloud
- You version your files with Git and than share and store using github
- Versioned files are easily shared across multiple computers
- **Do not share data in Github**. It is not optimized to share data
  - Put data directory into .gitignore file
  - Create .gitignore file using nano in your project directory

Git vs Google Docs

	saves current state …	*keeps track of …*
Git	on request	directory tree (multiple files and their position)
Google Docs	automatically	single file



Git and Github: upsides

- collaboration
  - sharing
  - peer review
- backup
  - can go back to any version
  - simple and secure way to distribute to other machines

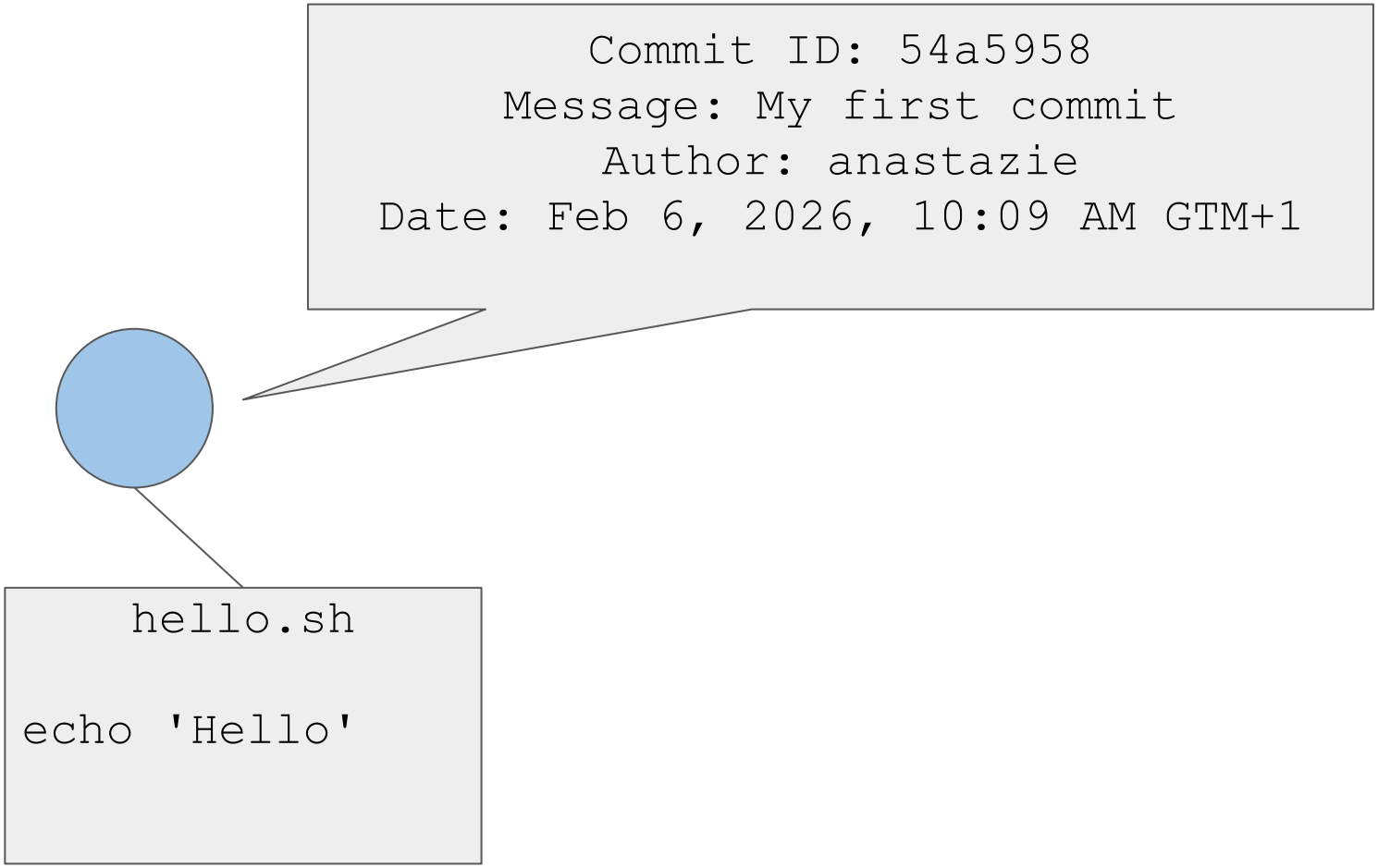
Git: downsides

https://xkcd.com/1597

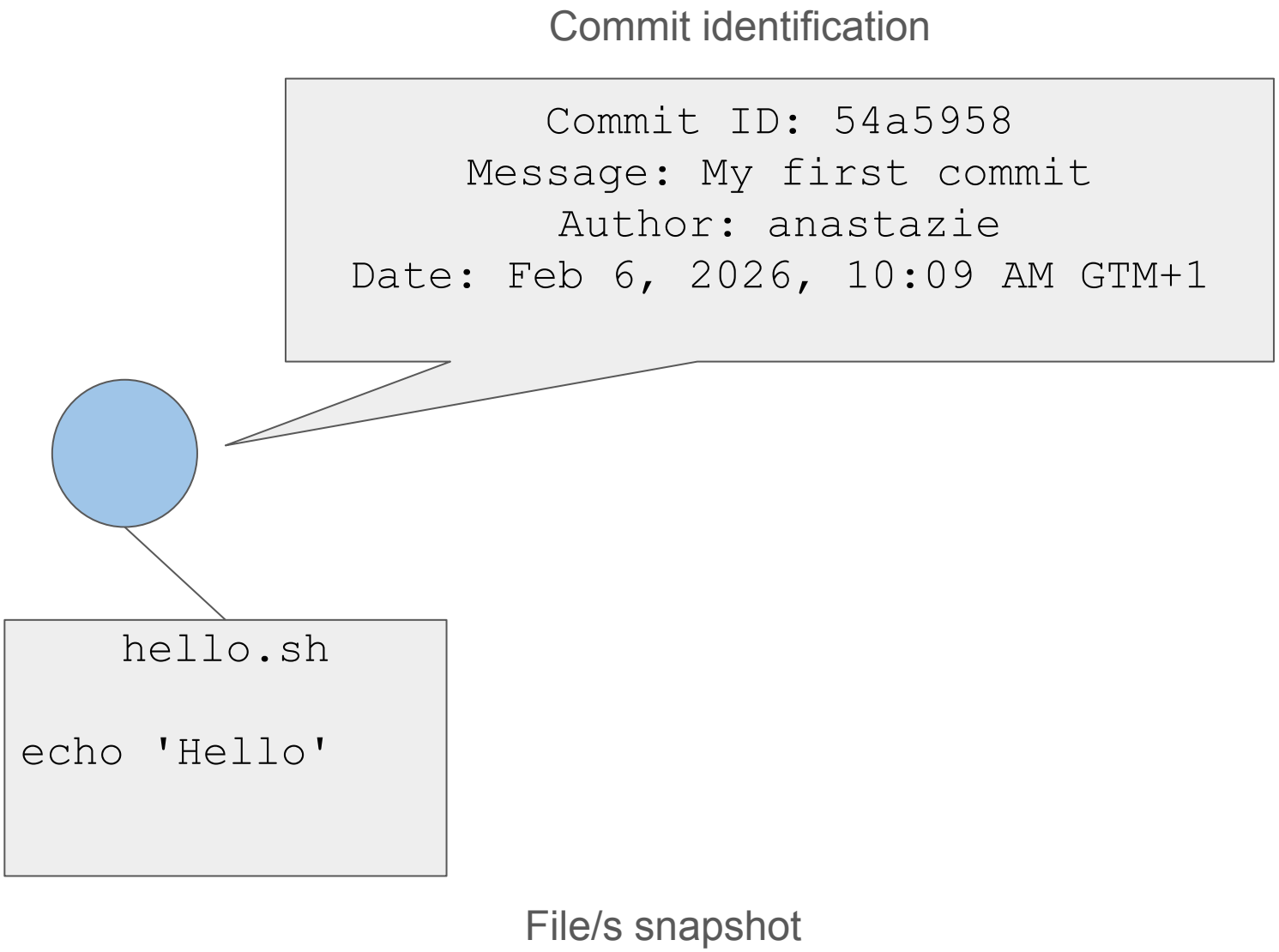
Vocabulary

- Repository
  - Project's folder
  - A repository contains all of the project files (including documentation), and stores each file's revision history
  - Repositories can have multiple collaborators and can be either public or private
- Commit
  - Records changes (snapshots) to one or more files
  - Core building block units of a Git project timeline
- Branch
  - A branch is a parallel version of a repository. It is contained within the repository, but does not affect the primary or main branch allowing you to work freely without disrupting the "live" version.
- More terms here

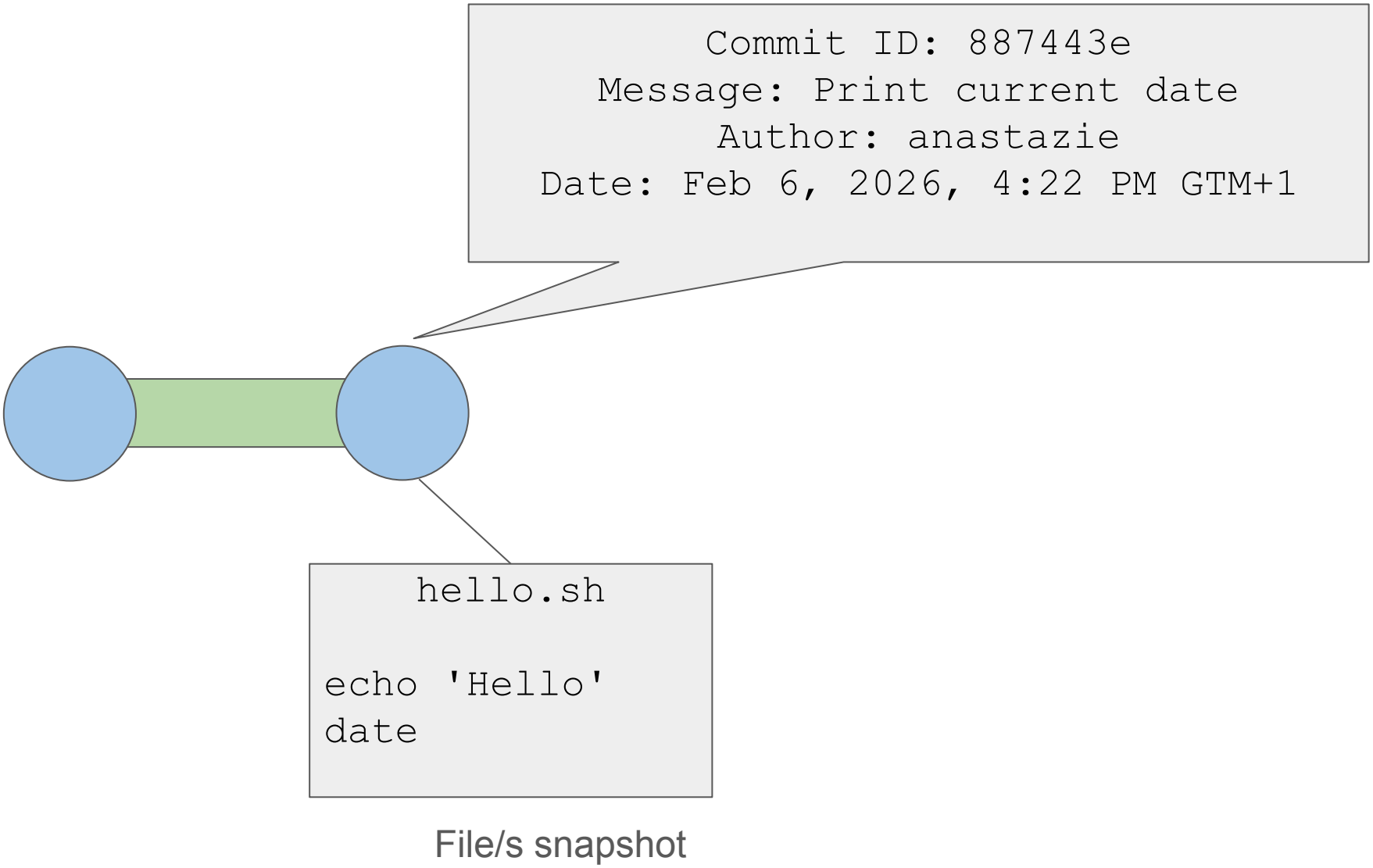
Commits


Commit ID: 54a5958
Message: My first commit
Author: anastazie
Date: Feb 6, 2026, 10:09 AM GTM+1
hello.sh
echo 'Hello'

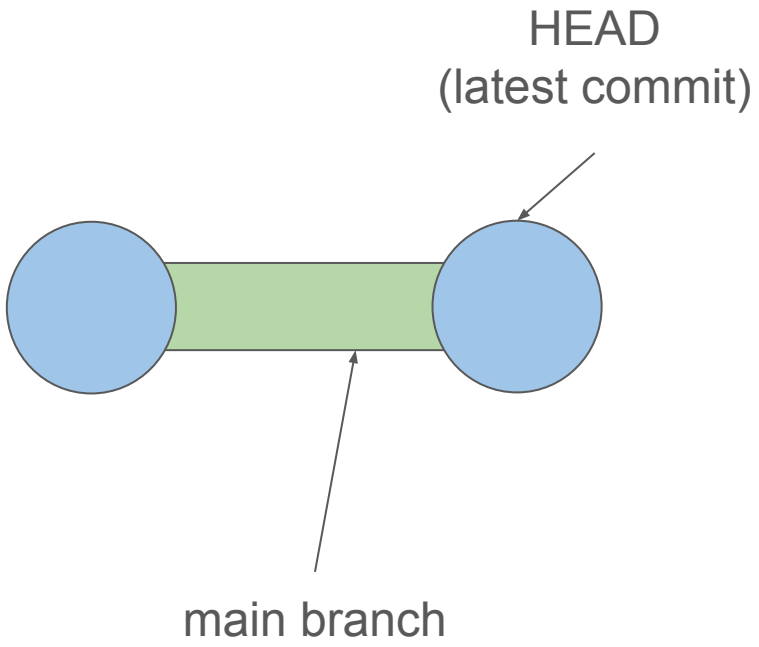
Commits


Commit identification
Commit ID: 54a5958
Message: My first commit
Author: anastazie
Date: Feb 6, 2026, 10:09 AM GTM+1
hello.sh
echo 'Hello'
File/s snapshot

Commits

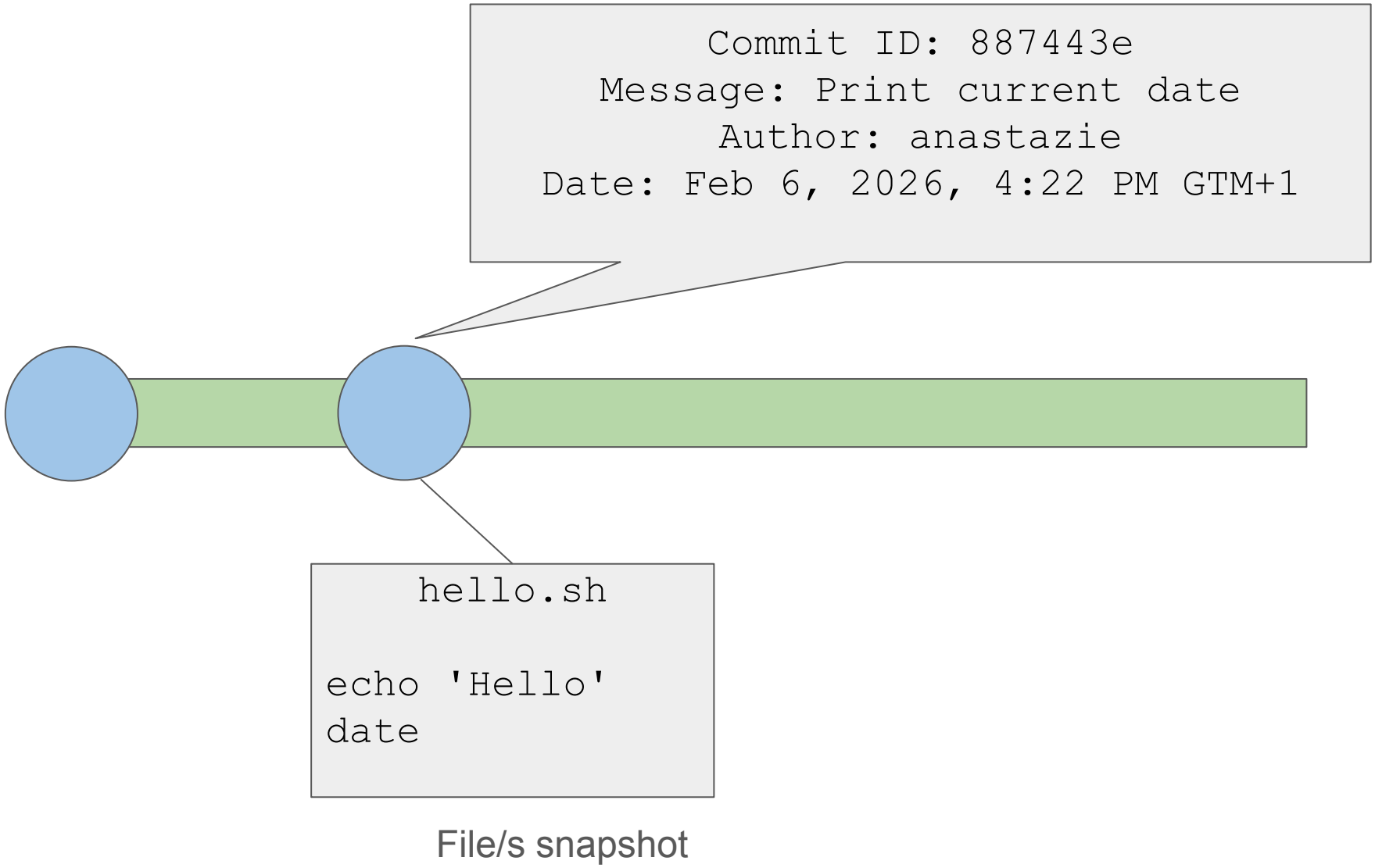

Commit ID: 887443e
Message: Print current date
Author: anastazie
Date: Feb 6, 2026, 4:22 PM GTM+1
hello.sh
echo 'Hello'
date
File/s snapshot

Commits



File/s snapshot

Commits


Commit ID: 887443e
Message: Print current date
Author: anastazie
Date: Feb 6, 2026, 4:22 PM GTM+1
hello.sh
echo 'Hello'
date
File/s snapshot

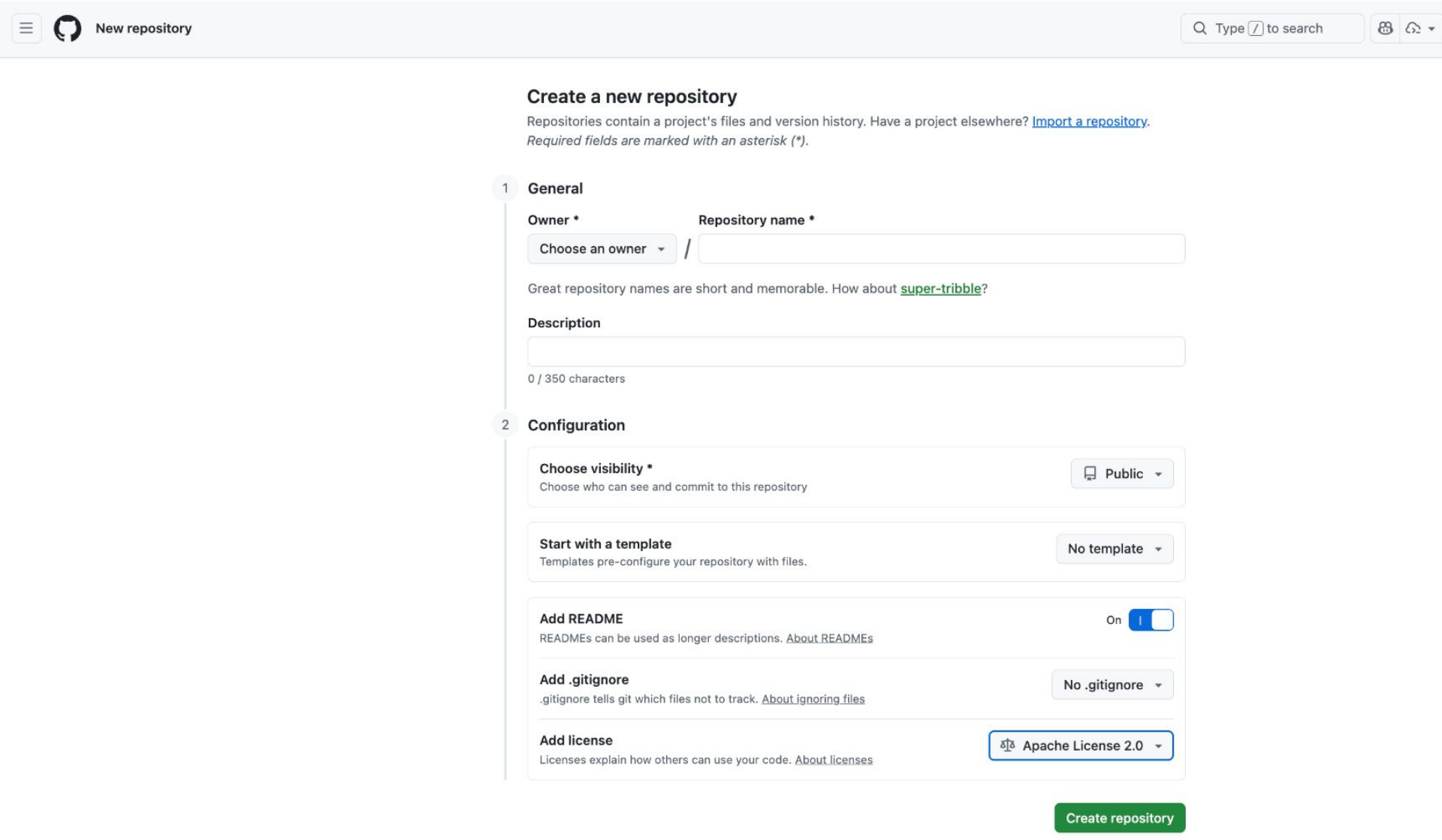
GitHub

“Social part of programming”

Exercise

- Register at https://github.com/
- Create repository (use + sign)
  - Visibility: Public
  - Add README On
  - Add license: Apache License 2.0. (or any other preferred)

Exercise


New repository
Type / to search
Create a new repository
Repositories contain a project's files and version history. Have a project elsewhere? Import a repository.
Required fields are marked with an asterisk (*).
1
General
Owner *
Repository name *
Choose an owner
/
Great repository names are short and memorable. How about super-tribble?
Description
0 / 350 characters
2
Configuration
Choose visibility *
Choose who can see and commit to this repository
Public
Start with a template
Templates pre-configure your repository with files.
No template
Add README
READMEs can be used as longer descriptions. About READMEs
On
Add .gitignore
.gitignore tells git which files not to track. About ignoring files
No .gitignore
Add license
Licenses explain how others can use your code. About licenses
Apache License 2.0
Create repository

Configuring git

- Specifying information about you to identify your commits

```
$ git config --global user.email
"ferda@mraveniste.cz"

$ git config --global user.name "Ferda
Mravenec"
```

Adding SSH keys to Github

- Github need to know who is making commits in repository
- You generate keys locally or on server. Your SSH key has private and public parts
- Keys are stored in ~/.ssh directory
- You then save public part in Github

Adding SSH keys to Github

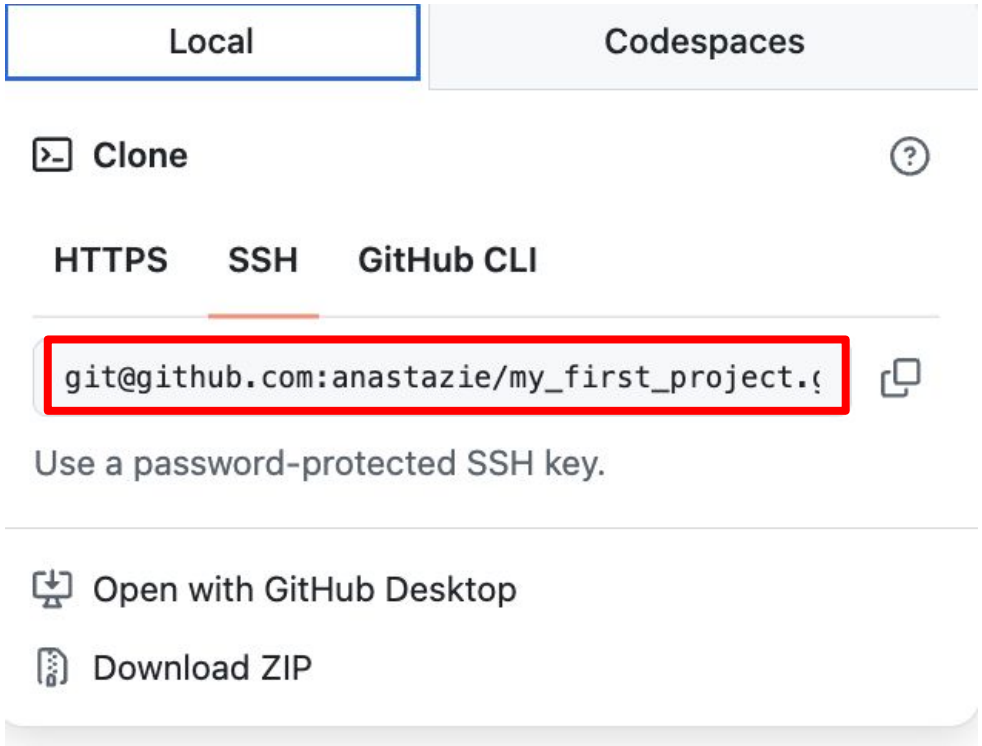
```
$ ssh-keygen -t ed25519
Generating public/private ed25519 key pair.
Enter file in which to save the key (/home/nasta/.ssh/id_ed25519):
Enter passphrase for "/home/nasta/.ssh/id_ed25519" (empty for no
passphrase):
Enter same passphrase again:
Your identification has been saved in /home/nasta/.ssh/id_ed25519
Your public key has been saved in /home/nasta/.ssh/id_ed25519.pub
The key fingerprint is:
SHA256:rx+tafZatRarelwb/w1QK01jiM6K7SwyhiA4nPiac5M nasta@ngs-course-2026
The key's randomart image is:
...

$ cat ~/.ssh/id_ed25519.pub
ssh-ed25519
XXXXC3NzaC1lZDI1NTE5XXXXXXXIGIxZEsut6N5WYdOu/80Qb1ykJ1T5khRWJSev9Igj1uc
nasta@ngs-course-2026
```

Adding SSH key on Github

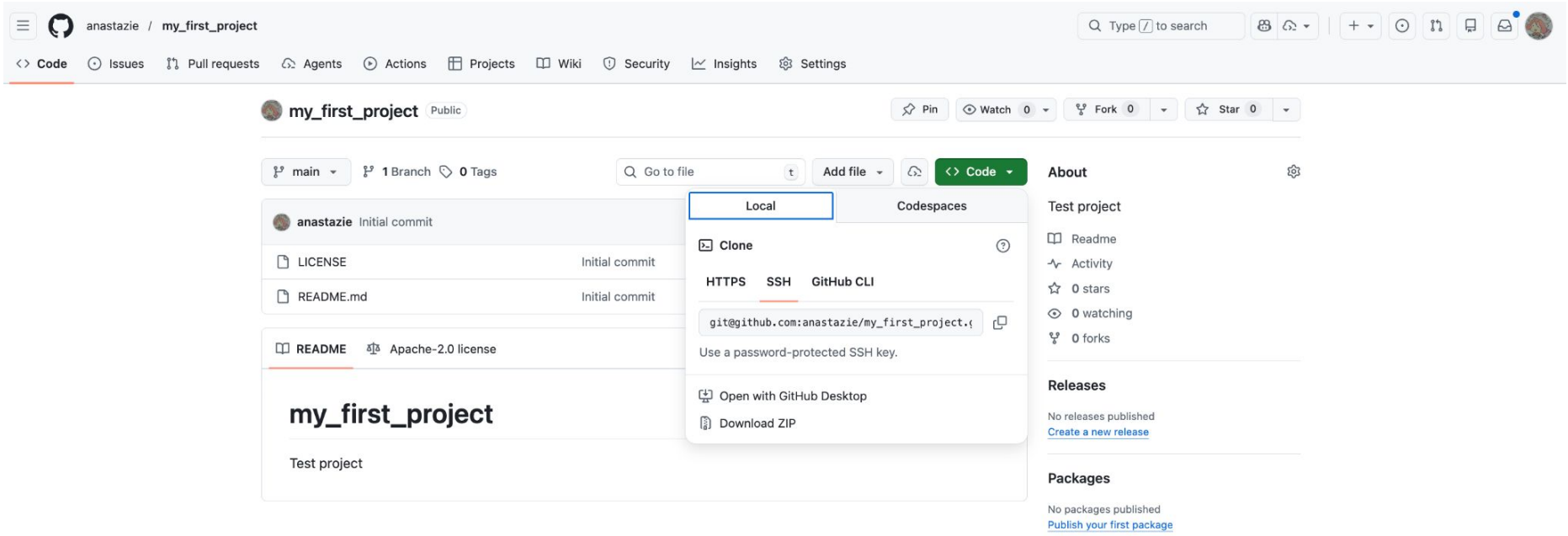
- In the upper-right corner of any page on GitHub, click your profile picture, then click Settings.
- In the "Access" section of the sidebar, click SSH and GPG keys.
- Click New SSH key or Add SSH key.
- In the "Title" field, add a descriptive label for the new key. For example, if you're using a personal laptop, you might call this key "Personal laptop".
- Select the type of key, either authentication or signing. For more information about commit signing, see About commit signature verification.
- In the "Key" field, paste your public key.
- Click Add SSH key.
- Instructions on Github

Cloning repository from remote

- Once you created repository on Github, you want to download it on your local machine or server
  - `git clone git@github.com:anastazie/my_first_project.git`
- Repository folder will appear in you working directory

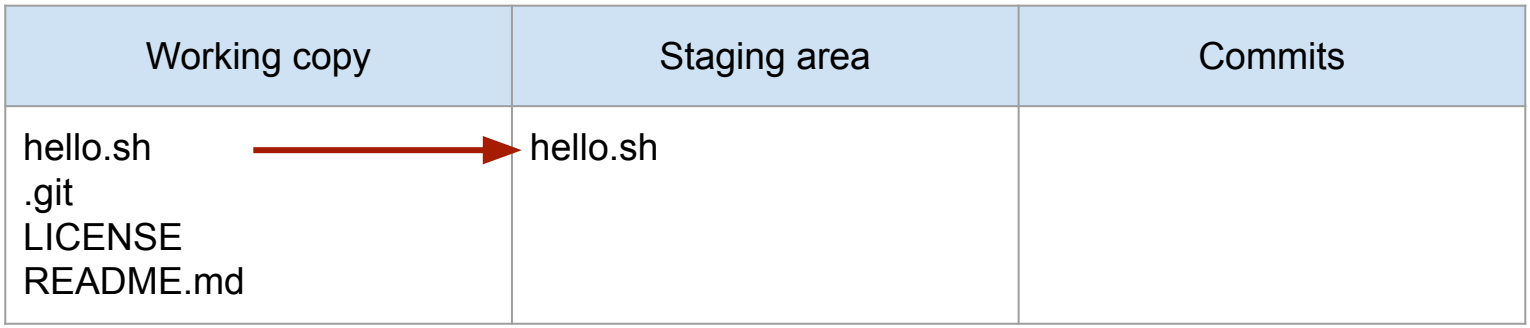


Cloning repository from remote



Commit changes

- Check what files are modified, added or deleted
  - `git status`
- add files to staging area (where you prepare the next commit)
  - `git add hello.sh`



```
$ git status
On branch main
Your branch is up to date with 'origin/main'.
Untracked files:
  (use "git add <file>..." to include in what will be committed)
    hello.sh
nothing added to commit but untracked files present (use "git add" to
track)
$ git add hello.sh
$ git status
On branch main
Your branch is up to date with 'origin/main'.
Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
    new file:   hello.sh
$ git commit -m 'print Hello'
[main 85074ac] print Hello
 1 file changed, 1 insertion(+)
 create mode 100644 hello.sh
```

Commit changes

- initialize a repository
  - `git init`
- add files to staging area (where you prepare the next commit)
  - `git add hello.sh`
- create a commit
  - `git commit -m 'print Hello'`

Working copy	Staging area	Commits
hello.sh .git LICENSE README.md		hello.sh 85074...

Navigating the commit history of a Git repository

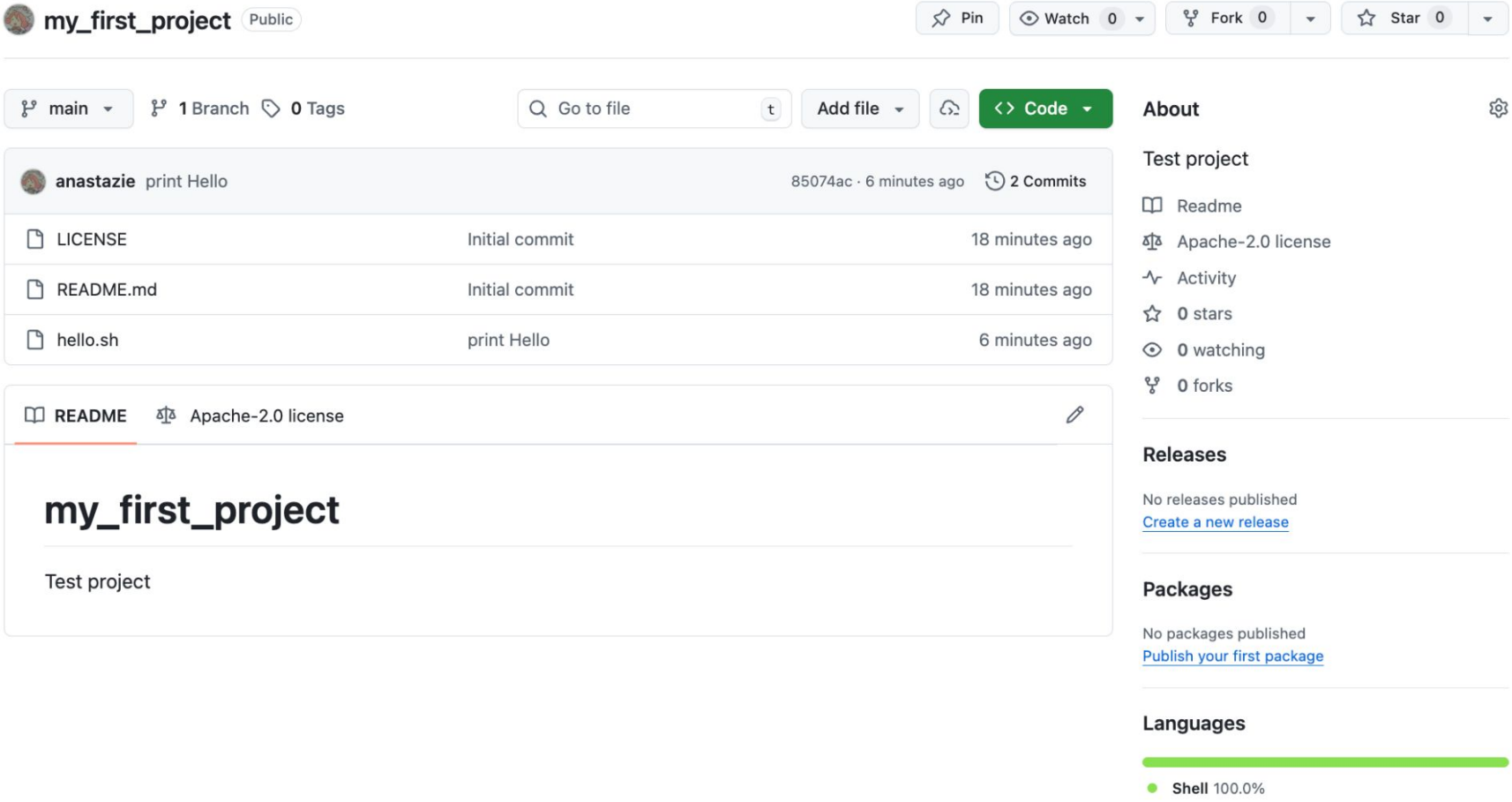
```
$ git log
commit 85074acd9a3f92371d2899d4e08ed1525d0bc170 (HEAD -> main)
Author: Anastazie Sedlakova <nasta@sedlakovi.org>
Date:   Sat Feb 7 14:55:44 2026 +0100

    print Hello

commit 2de4fcae4f6b3c15832bb83587b60b2a2dffd8f5 (origin/main,
origin/HEAD)
Author: Anastazie Sedlakova <anastazie@upheal.io>
Date:   Sat Feb 7 14:44:21 2026 +0100

    Initial commit
```

Transferring your changes to Github

- Use git push
- First time git push -u origin main
  - Establish a Connection: It links your local main branch to the main branch on the remote server (origin).
  - Set Up "Tracking": The -u flag sets the remote branch as the upstream for your local branch.
  - Convenience for Later: Once this link is created, you can just type git push or git pull in the future without having to specify origin main every single time.

Pushing to remote (Github)

```
$ git push -u origin main
Enumerating objects: 4, done.
Counting objects: 100% (4/4), done.
Delta compression using up to 10 threads
Compressing objects: 100% (2/2), done.
Writing objects: 100% (3/3), 327 bytes | 327.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
To github.com:anastazie/my_first_project.git
   2de4fca..85074ac  main -> main
```


my_first_project
Public
Pin
Watch 0
Fork 0
Star 0
main
1 Branch
0 Tags
Go to file
t
Add file
Code
anastazie print Hello
85074ac · 6 minutes ago
2 Commits
LICENSE
Initial commit
18 minutes ago
README.md
Initial commit
18 minutes ago
hello.sh
print Hello
6 minutes ago
README
Apache-2.0 license
my_first_project
Test project
About
Test project
Readme
Apache-2.0 license
Activity
0 stars
0 watching
0 forks
Releases
No releases published
Create a new release
Packages
No packages published
Publish your first package
Languages
Shell 100.0%

Initialize git repository locally

- In your project, initialize git
  - `git init`
- Commit changes
- Create a remote repository: Log in to GitHub and create a new, empty repository. Do not initialize it with a README or license
- Link the local and remote repositories: Copy the remote repository URL SSH
  - `git remote add origin <REMOTE_URL>`
- Push to the remote
  - The -u flag sets the "upstream" tracking, allowing you to simply use git push for future updates to this branch
  - `git push -u origin main`

Diff

A shorthand for “differences”. Usually between working copy and the last commit.

‘-’ means line removed
‘+’ means line added

A sample from course materials repo:

```
     ``pull`` will do a merge for you

-  ``git checkout --theirs``
+  ``git checkout --theirs {file path}``
     in conflict, choose the version from the remote branch
```

Pulling from a remote

- download commits and merge into working copy
  - `git pull`

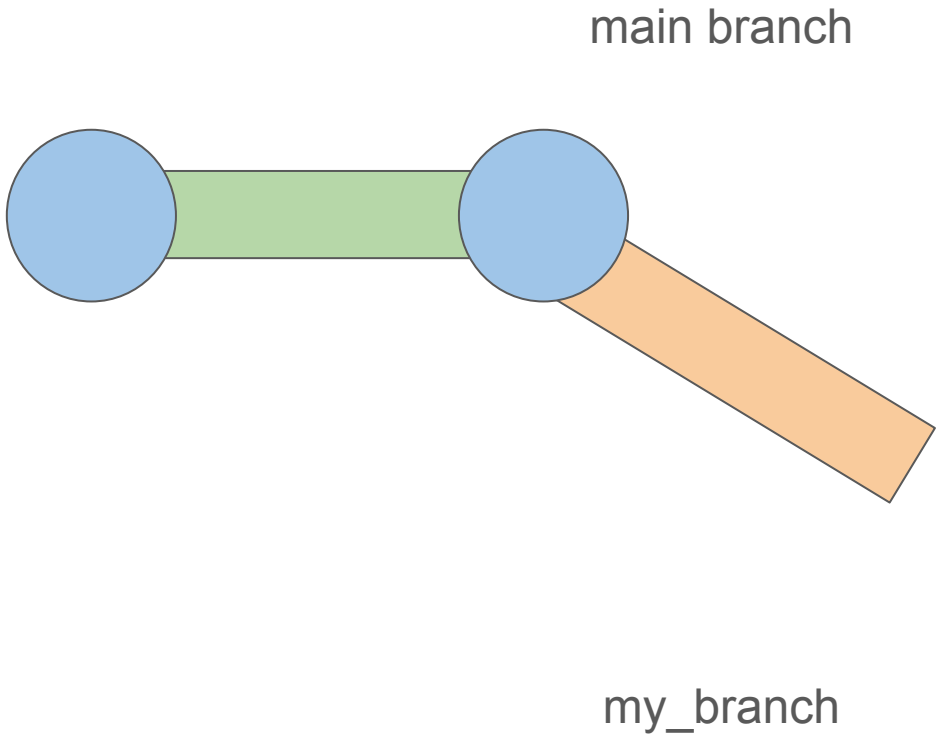
Exercise

- In your repository, create `hello.sh` file
- Commit changes
- Push changes to Github

Branches

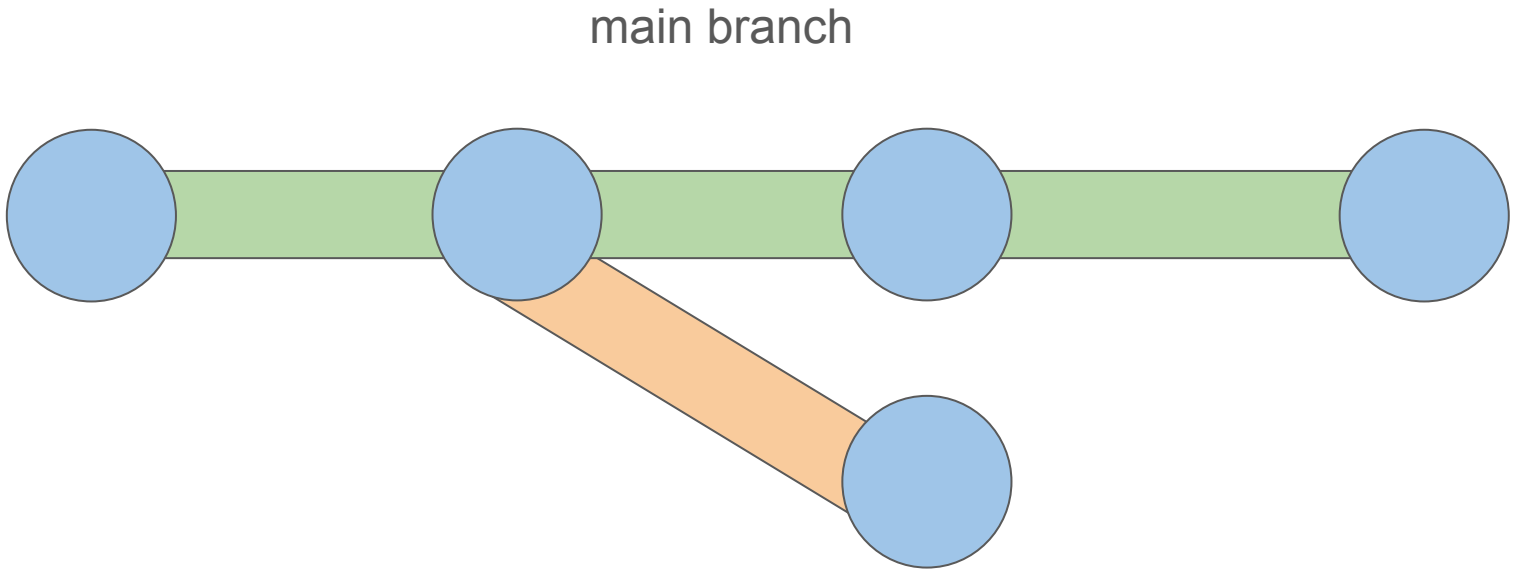
- branches help you manage multiple versions of your code
- important for programmers, but we can’t ignore it completely
- we’ll be using one local branch called **`main`**
- on a remote, there is a twin branch, **`origin/main`**

Commits



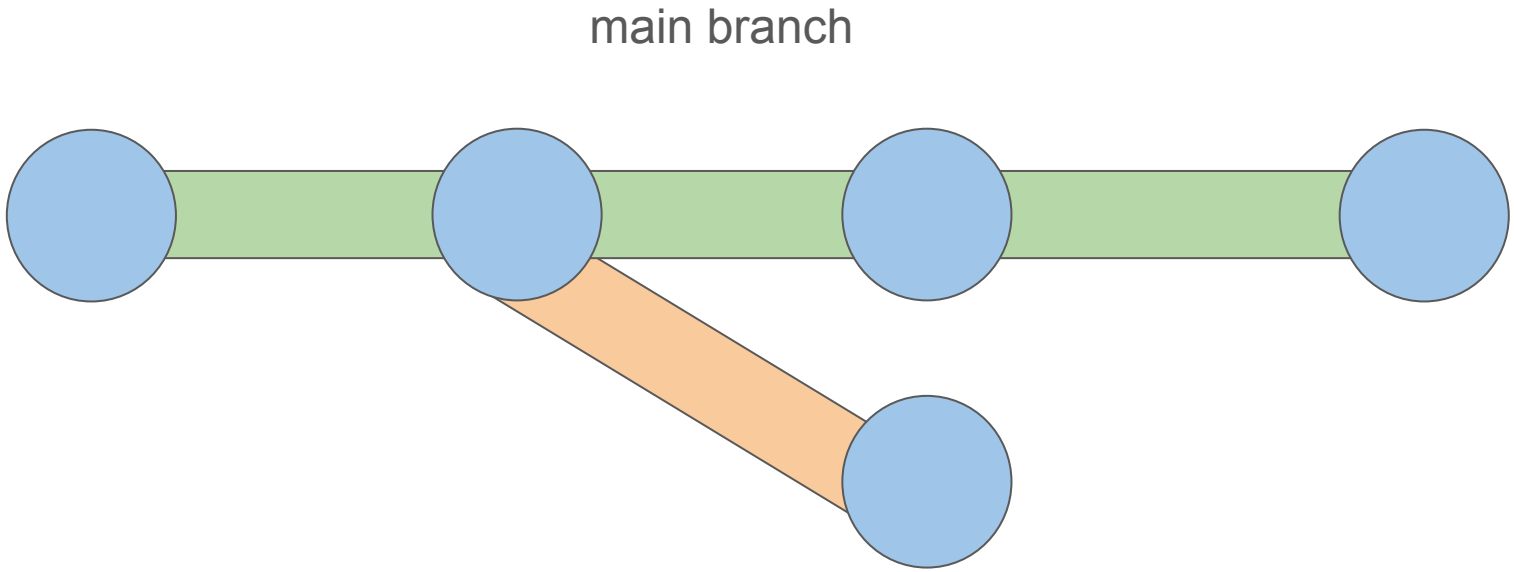
Commits

Working on your branch does not affect the main branch



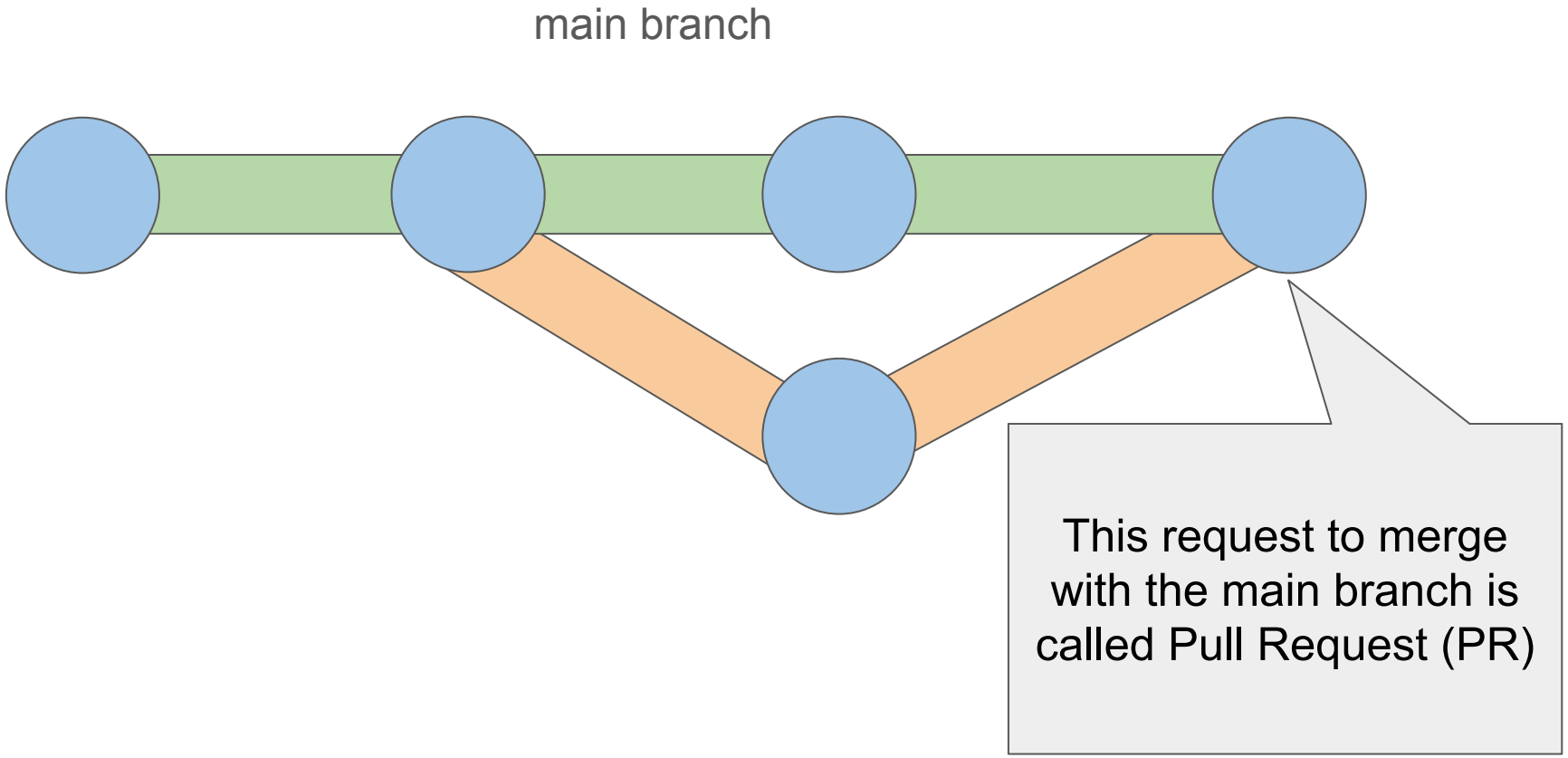
Commits

Working on your branch does not affect the main branch



Commits

Once you are done working on your branch you can merge it to the main branch



Working with branches

- Create branch
  - git checkout -b add-date
  - Alternatively use git switch -c add-date
  - You will be automatically moved to this branch
- Move to another branch
  - git checkout <branch name>
  - Alternatively git switch <branch name>

Working with branches

```
$ git checkout -b add-date
Switched to a new branch 'add-date'

$ git switch main
Switched to branch 'main'
Your branch is up to date with 'origin/main'.
```

Exercise

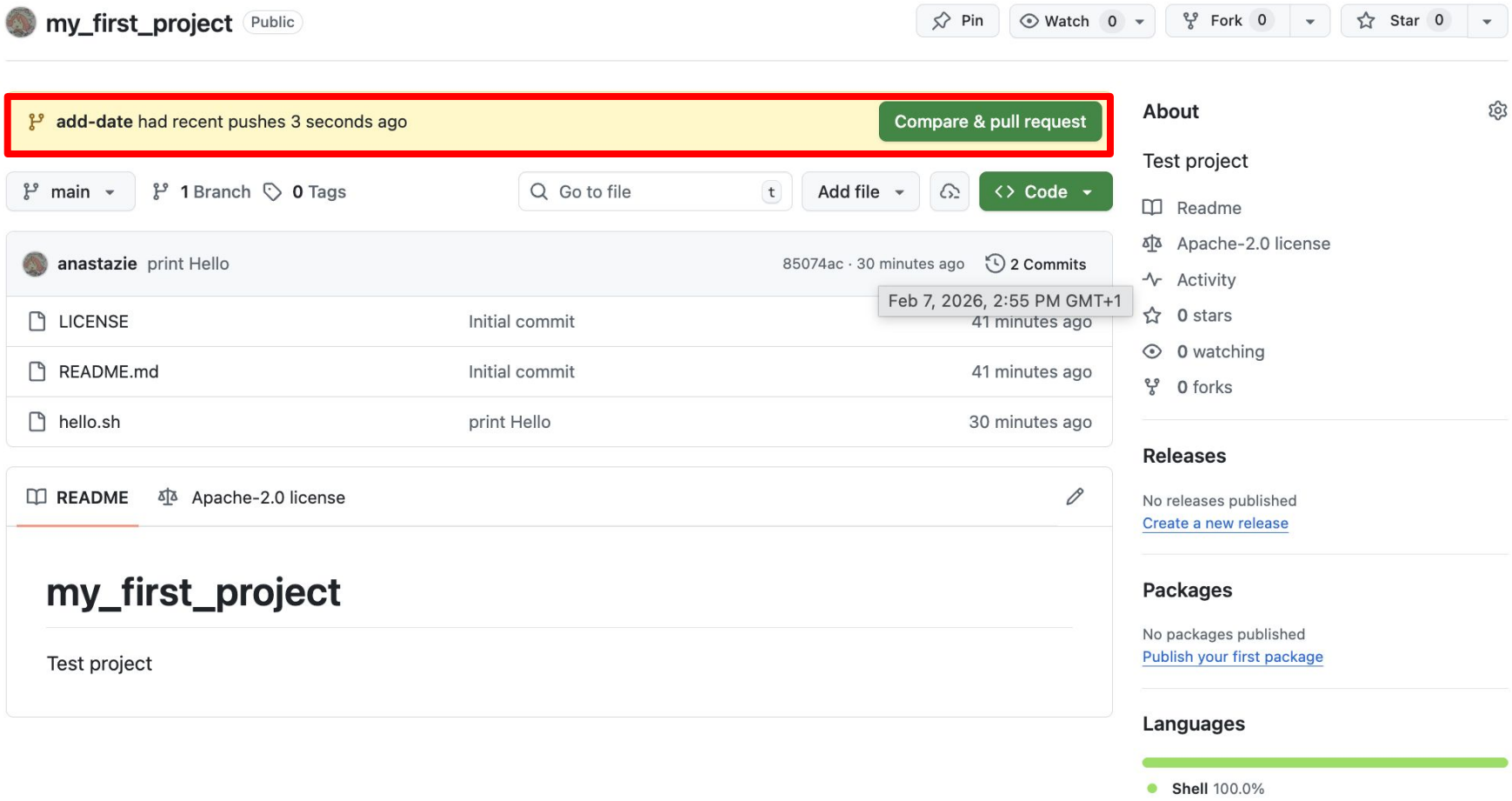
- Create new branch
- In that branch modify hello.sh
- Push your changes

Working with branches

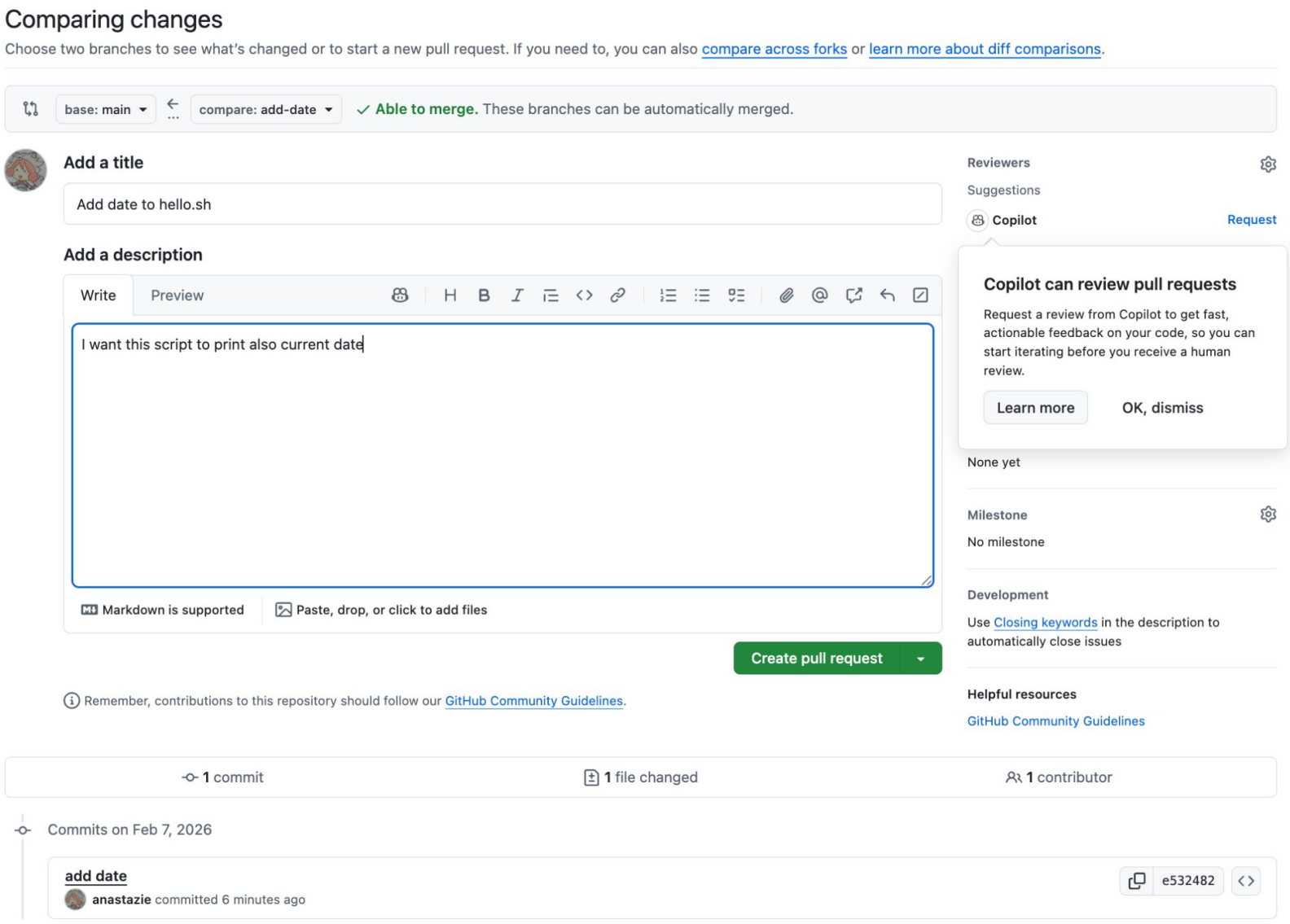
```
$ git add hello.sh
$ git commit -m 'add date'
[add-date e532482] add date
 1 file changed, 1 insertion(+)
$ git push -u origin add-date
Enumerating objects: 5, done.
Counting objects: 100% (5/5), done.
Delta compression using up to 10 threads
Compressing objects: 100% (2/2), done.
Writing objects: 100% (3/3), 270 bytes | 270.00 KiB/s, done.
Total 3 (delta 1), reused 0 (delta 0), pack-reused 0
remote: Resolving deltas: 100% (1/1), completed with 1 local object.
remote: Create a pull request for 'add-date' on GitHub by visiting:
     https://github.com/anastazie/my_first_project/pull/new/add-date
remote:
To github.com:anastazie/my_first_project.git
 * [new branch]      add-date -> add-date
branch 'add-date' set up to track 'origin/add-date'.
```

Creating pull request

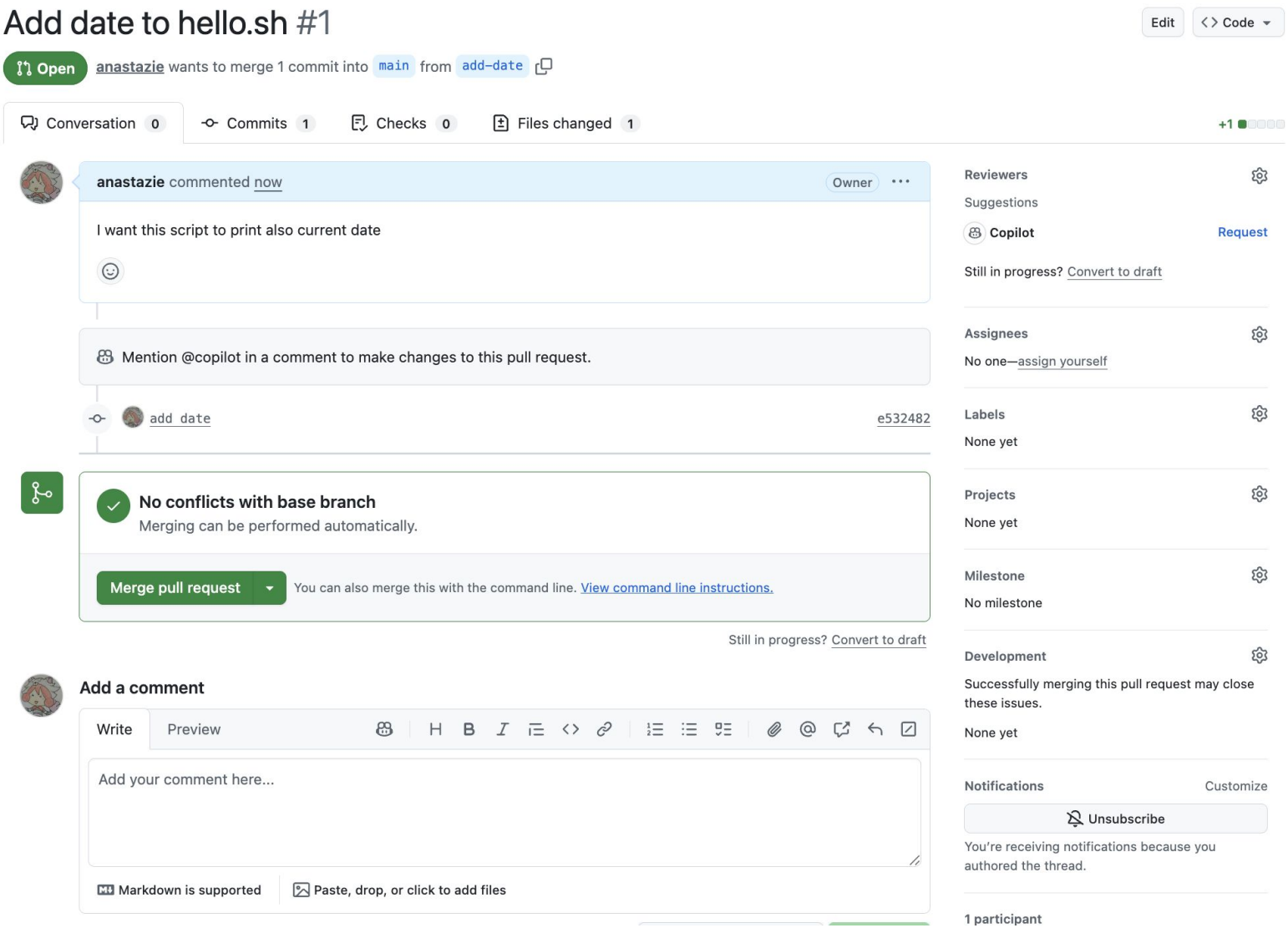
When I want changes in my branch to be in the main branch. Pull request can be then merged into main branch.



Creating pull request



Creating pull request



Exercise

- Create pull request

Pulling from a remote

- download commits and merge into working copy
  - `git pull`
- simple as that, unless there is a merge conflict

https://octodex.github.com/bear-cavalry/

Merge conflict

- Changes were made in the same place in the same file in your branch and main branch
- Git cannot decide on its own which version to keep
- You need to decide what to do
  - Use main branch version
  - Use your branch version
  - Combine both

Merge conflict

¯_(ツ)_/¯

hello.sh on my_branch

```
1 echo 'Hello'
2 date
3 ls -l ~ | wc -l
```

hello.sh on main

```
1 echo 'Hello'
2 cd ~
3 mkdir data
```

Resolving conflicts - text files

- check what's conflicted
  - `git status`
- text files need to be edited
  - `nano my-file.txt`
  - `git add my-file.txt`
- commit the resolution, without any message
  - `git commit`
  - recently available: `git merge --continue`

Resolving conflicts - binary files

- check what's conflicted
  - `git status`
- binary files are simple, choose either the incoming (theirs) or ours
  - `git checkout --ours binary-file.jpg`
  - `git add binary-file.jpg`
- commit the resolution, without any message
  - `git commit`
  - recently available: `git merge --continue`

Resolving conflicts

In text files, if both branches modify the same line, a conflict has to be resolved by deleting all the unwanted text (also the marks).

```
Here are lines that are either unchanged from the common ancestor,
or cleanly resolved because only one side changed,
or cleanly resolved because both sides changed the same way.
<<<<<<< yours:sample.txt
Conflict resolution is hard;
let's go shopping.
=======
Git makes conflict resolution easy.
>>>>>>> theirs:sample.txt
And here is another line that is cleanly resolved or unmodified.
```

What have we learned?

- We are using Git to have explicit versioning of directory tree
- Git makes snapshot of one or multiple files and saves them as a commit
- Repository is a project inside which git tracks changes
- You can use Github to share and store your repository. To do that you push your local branch to remote
- Branches allows multiple collaborators to work in the same repository without disrupting the main branch
- When you want your code to be in the main branch, you create pull request