14 – Further Git features

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Scientific Programming in Python (2026)

https://atticlectures.net/scipro/python-2026/

Rename files

- **Rename a file** under version control:

```
git mv README README.txt
git status
On branch main
Changes to be committed:

renamed: README -> README.txt

git commit -m "Add .txt extension to readme file"
```

- Corresponding file in working directory will be renamed immediately
- The name change must be committed like any other change

Delete files

- **Delete (remove)** a file under version control

```
git rm unnecessary_file
git status
On branch main
Changes to be committed:

deleted:    unnecesary_file

git commit -m "Delete unnecessary file"
```

- Corresponding file in the working directory will be deleted immediately
- The removal must be committed like any other change
- The file will be not present in **future revisions**, but stays part of the previous commits!

Investigating changes

- Changes between **working copy and last checked in / staged version**

```
git diff README.txt
diff --git a/README.txt b/README.txt
index 8eab0a7..770eee5 100644
--- a/README.txt
+++ b/README.txt
@@ -1,6 +1,6 @@
-*********
-Linsolver
-*********
+**********
+Linsolvers
+**********
```

Lines removed

Lines added

- If no file name is specified, all changes in all version controlled files are shown

```
git diff
```

- Changes between **two committed revisions** using revision hashes

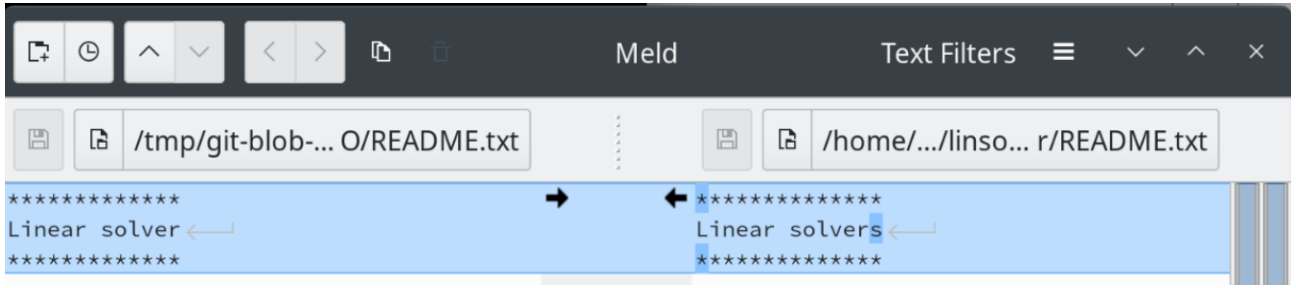
```
git diff 04d386 2a3186 -- README.txt
```

Optional, otherwise changes in all files shown

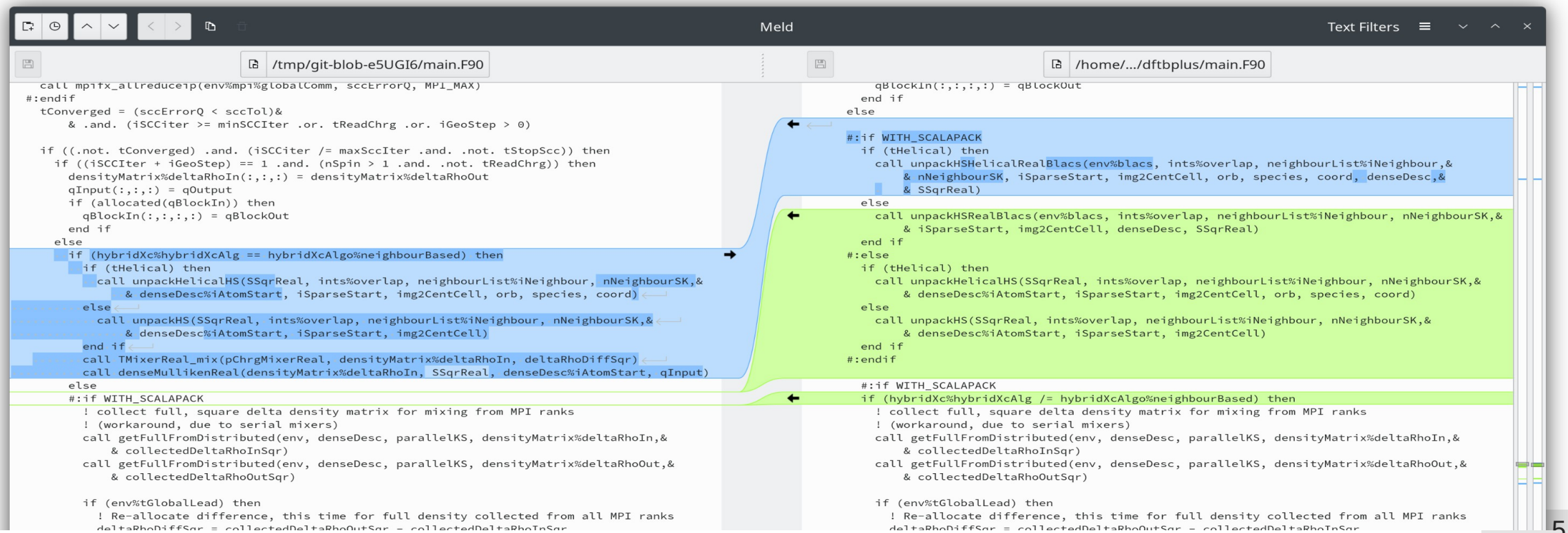
Investigating changes

- The **difftool** sub-command calls the default diff-viewer (kdiff3, meld) to **visualize changes**

```
git difftool
Viewing (1/1): 'README.txt'
Launch 'meld' [Y/n]?
```



A more complex example:



Discard changes in working copy

- **Set working directory back** to last committed / staged version:

```
git status
[...]

   modified:   README.txt

no changes added to commit (use "git add" and/or "git commit -a")

git restore README.txt
git status
[...]
nothing to commit, working tree clean
```

Overwrites working copy!

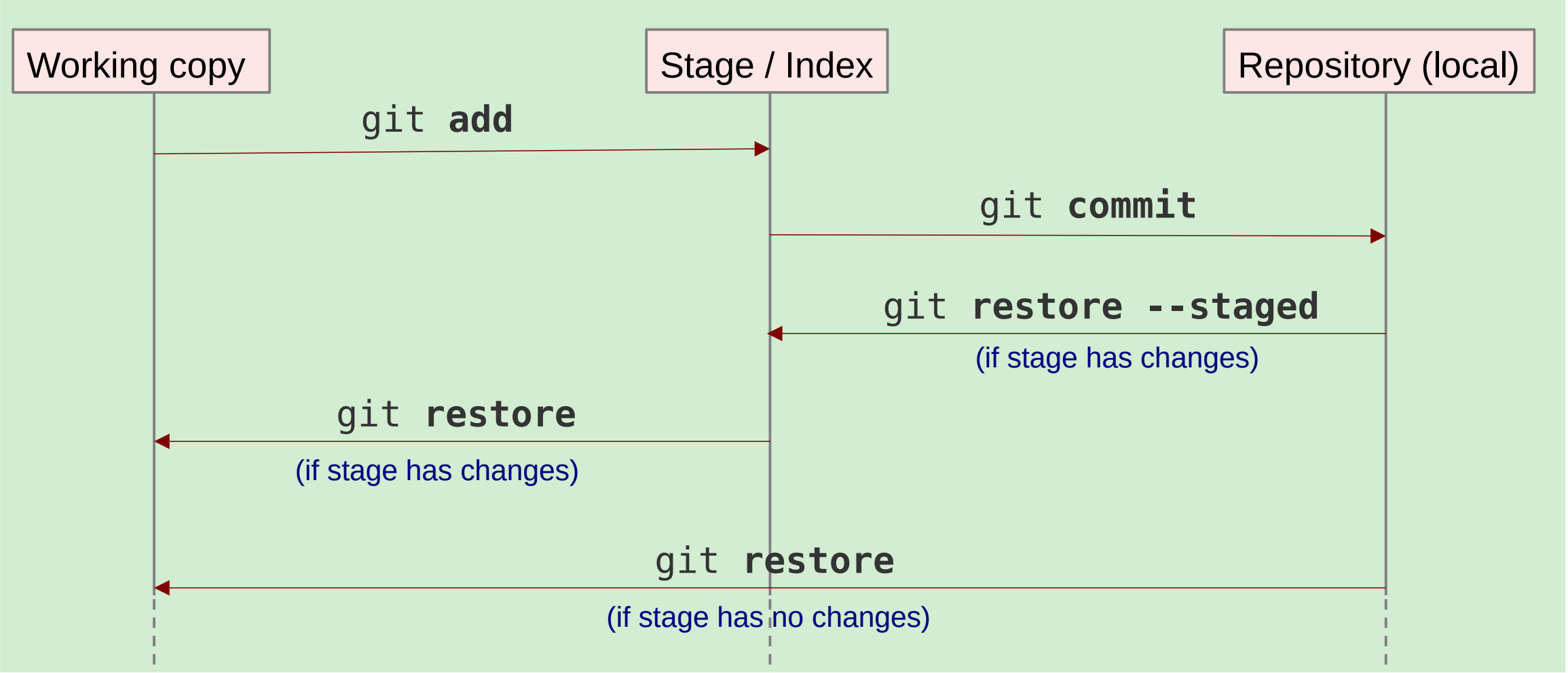
- If you specify a **directory** (e.g. “.” = current directory) all files within will be **restored recursively**

Unstage files

- Staged files can be **unstaged**, if they should not be part of the next commit
- Corresponding file in the **work directory is not affected** by the operation

```
git status
On branch main
Changes to be committed:

   modified:   README.txt

git restore --staged README.txt

git status
On branch main
Changes not staged for commit:

   modified:   README.txt
```

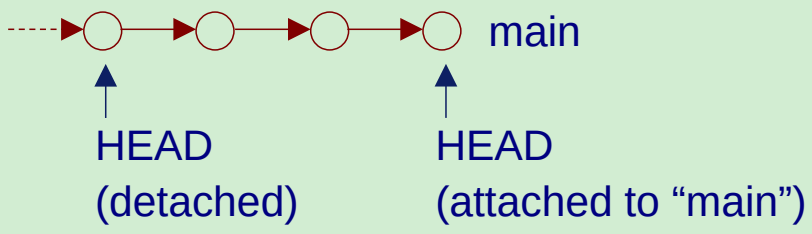
Overview: Git file transfer commands



Time travel: switching to an earlier commit

branch = line of history

HEAD = currently active commit



Attached HEAD

- points to last commit (in current branch)
- next commit appended to this commit

Detached HEAD

- points to earlier commit
- no new commits can be appended in current branch to keep history intact
  (but new branch can be created from commit)

- **Switching to a specific commit**
  (by specifying its hash value)

```
git switch --detach 2a31862
HEAD is now at 2a31862 ...

git status
HEAD detached at 2a31862
```

- You have to **change back to most recent commit** before commiting any changes
  (otherwise history would change!)

```
git switch main
Switched to branch 'main'
```

- Alternative: new branch from detached HEAD,

Tagging versions

- **Commits with special importance** (e.g. release) can be tagged
- Annotated tags are distributed with the repository

tag = symbolic name for a commit

```
git log --oneline
7d8cf66 (HEAD -> main, origin/main) Add readme and .gitignore
ddd085a Start linsolver project with stub files

git tag -a v0.1   ← HEAD tagged by default if no commit specified

git log --oneline
7d8cf66 (HEAD -> main, tag: v0.1, origin/main) Add readme and .gitignore
ddd085a Start linsolver project with stub files
```

- Tag names can be used instead of revision hashes in all git commands

```
git diff 04d3866 v0.1
```

Git aliases

- Aliases help to **abbreviate often used git commands and options**

```
git config --global alias.ci commit
git config --global alias.sw switch
git config --global alias.swd "switch --detach"
git config --global alias.st status
git config --global alias.gdiff difftool
```

Please create these aliases for your account, since the following examples will make use of them!

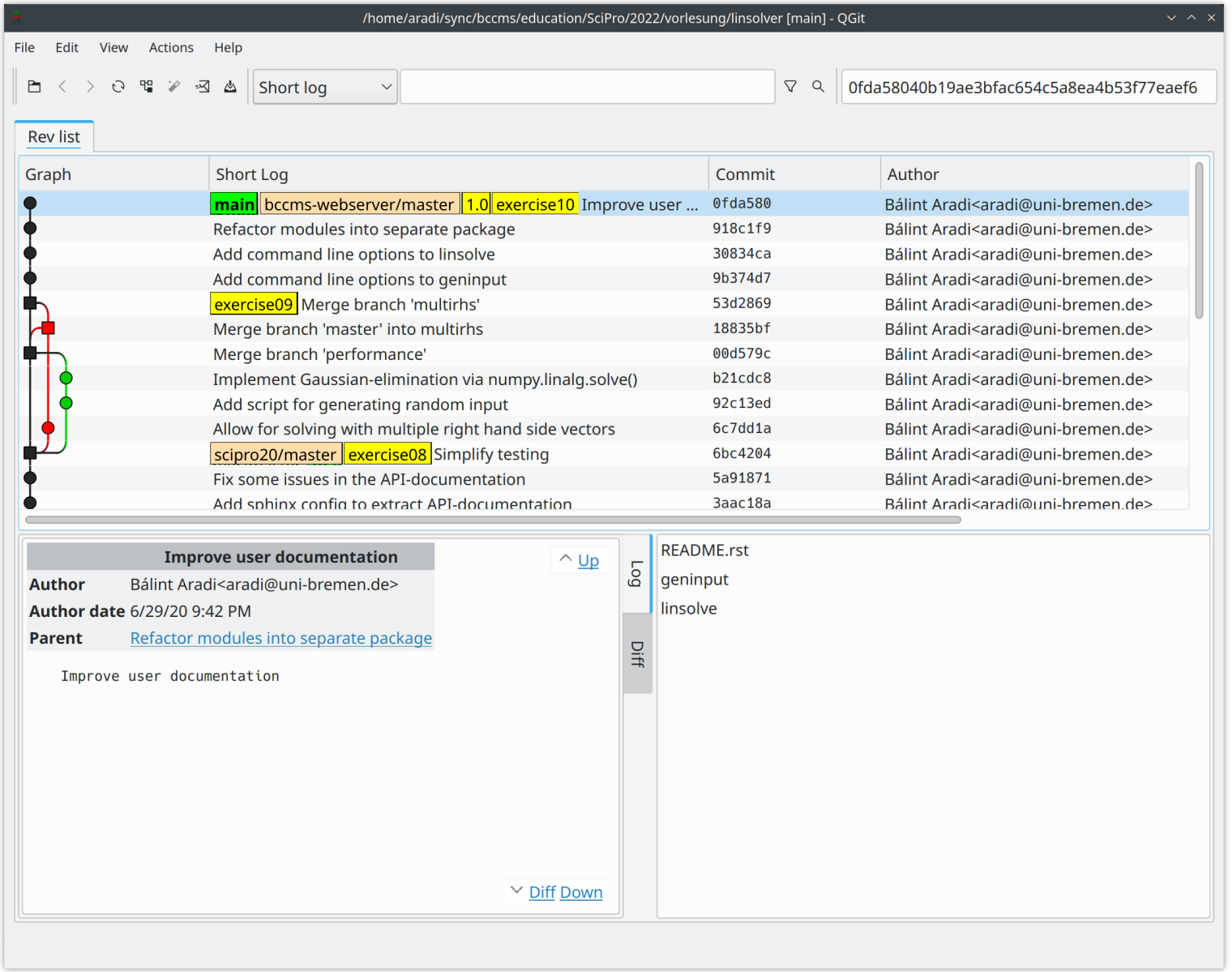
- If an alias is used, the corresponding command / options will be substituted

```
git ci -m "Add quick changes"
git swd 2a31862
git st
git gdiff README.rst
```

Graphical git-viewers

- Several graphical git-clients exist to visualize development history:

```
qgit &
```



Windows

- gitk is automatically installed with Git

Linux / MacOS

- several viewer installable as packages (qgit, gitk, ...)

Tracking remote repositories

- Remote repository must be cloned first to create a local git repository

```
git clone https://github.com/aradi/scipro-demo.git
Cloning into 'scipro-demo'...
```

- Remote repository will be associated with the new local repository (under then name “**origin**”)

```
cd scipro-demo
git remote -v
origin  https://github.com/aradi/scipro-demo.git (fetch)
origin  https://github.com/aradi/scipro-demo.git (push)
git status
On branch main
Your branch is up to date with 'origin/main'.
```

- Recent changes in the remote repository can be pulled

```
git pull
Updating ddd085a..7d8cf66
```

Note: This only works without side-effects, if the local repository was not modified apart of “git pull” calls.

Some further git-notes

- **Read the manual!**
- **Commit after each non-trivial change**
  Rule of thumb: It should be easy for other developers
  to follow and understand the changes of a commit.
- **One commit**: **only logically related changes**.
- **Each commit: working project**
- **Git commands** must be executed **in the project directory** (or in a subdirectory of it).
- **Version history** is stored in the **.git sub-directory**.
  If it is copied with the project, the version history is copied as well.

Hosting git repositories

- **Raw Git repositories** can be easily hosted on any webserver
- Hosting **Git repositories with user friendly web interfaces** is also possible, but more complex (e.g. running a **GitLab server**)
- Several companies offer **“free” git repository hosting** (with some constraints):

GitHub (Microsoft): https://github.com

GitLab (GitLab Inc.): https://gitlab.com

Bitbucket (Atlassian): https://bitbucket.org

See https://github.com/aradi/scipro-demo for an example …