20 – Collaborative development with Git

Bálint Aradi

Scientific Programming in Python (2026)

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

Branch & merge in two repositories

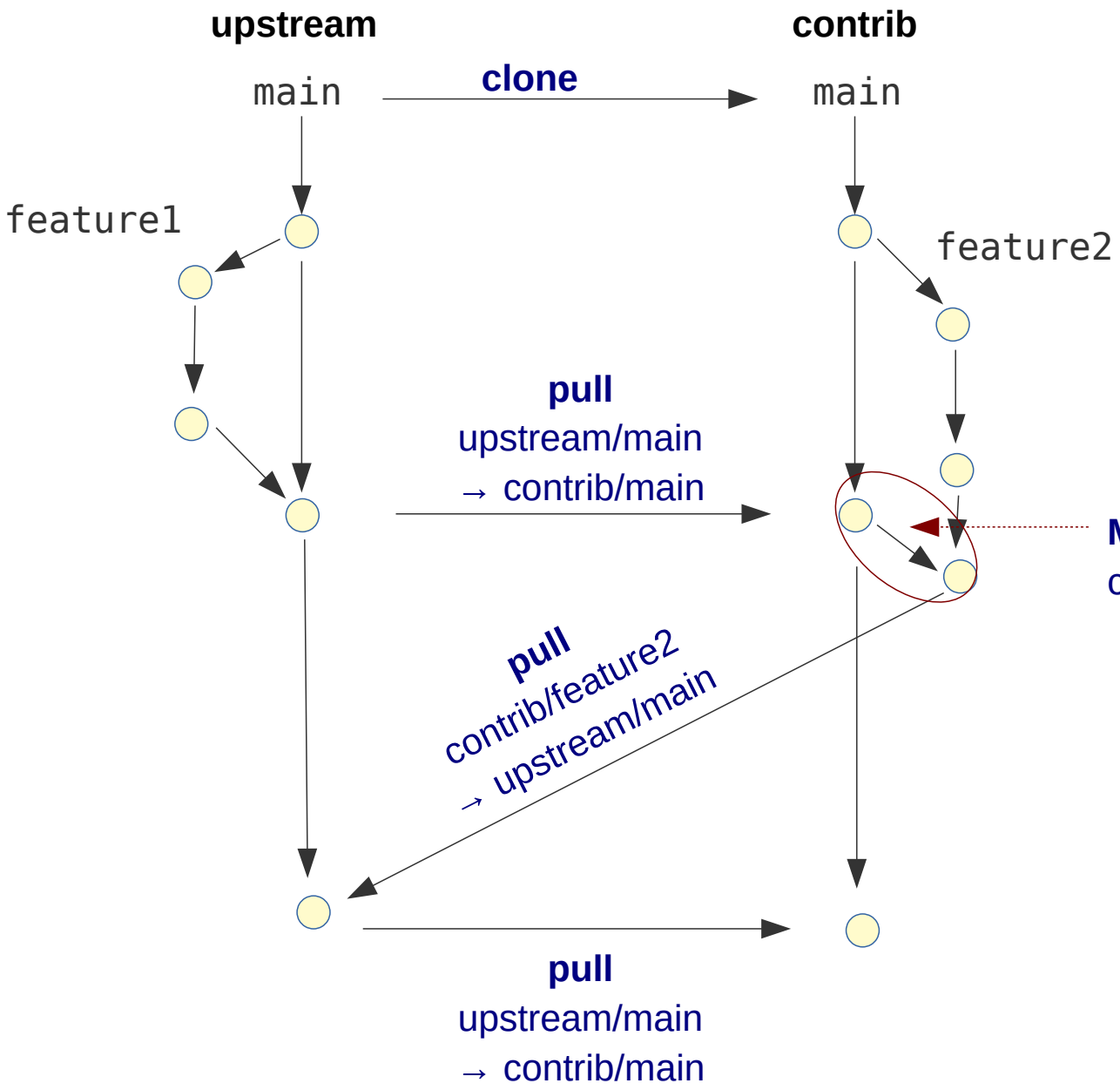
Typical scenario (e.g. open source projects)

- Program is developed by **multiple developers** simultaneously
- There is one “official” (**upstream**) version of the project with main developer(s) (developer(s) in charge) and several **contributors**.
- Parties have only **read-only access** to each others repositories

Typical workflow

- Every developer regularly synchronizes **main** to keep it identical to **upstream/main**
- Each developer implements features in **feature branches** derived from his/her main branch
- The main branch of the contributors is never modified directly, only when synchronized with **upstream/main**
- If feature development is finished, **main developer pulls contributors feature branch** and merges it into upstream main

Branch & merge in two repositories



- Work-flow works very well also with **large nr. of contributors**
- Developers need write access only to their own repositories

Merge
contrib/main → contrib/feature2

Brings feature branch up-to-date with upstream/main (ensures it contains all changes on upstream/main)
→ no conflict should arise if feature branch is merged into upstream/main

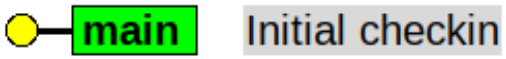
Branch & merge in two repositories (#1)

Developer 1: create “official” reporitory

```
mkdir -p gitdemo/devel1/hello
cd !$
git init
```

```
print("Hello!")
```
hello.py

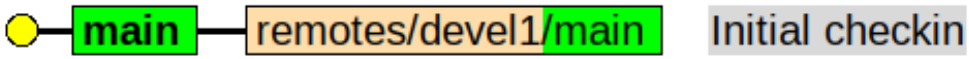
```
git add hello.py
git commit -m "Initial checkin"
```



Developer 2: clone repository of Developer 1

```
mkdir -p gitdemo/devel2
cd !$
git clone -o devel1 ../devel1/hello
```

How we refer to cloned repository (default: origin)



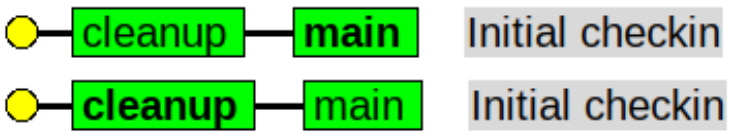
main in current repo

main in devel1’s repo

Branch & merge in two repositories (#2)

Developer 1: develop feature in feature branch and merge into main

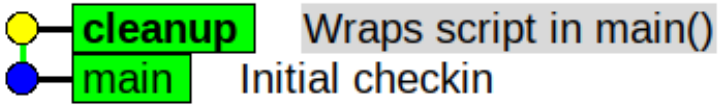
```
git branch cleanup
git switch cleanup
```



hello.py

```
def main():
    print("Hello!")

if __name__ == "__main__":
    main()
```

```
git add -u
git commit -m "Wrap script in main()"
```

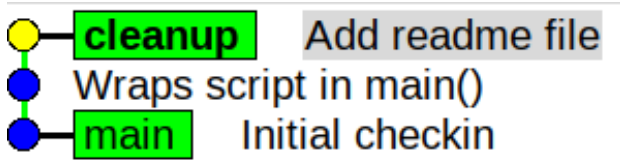


Branch & merge in two repositories (#3)

README.rst

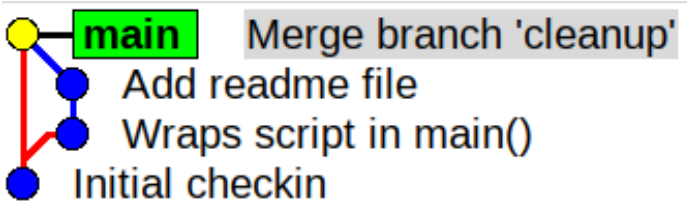
```
*****
Hello
*****


Trivial demo project.
```

```
git add README.rst
git commit -m "Add readme file"
```




```
git switch main
git merge --no-ff cleanup
git branch -d cleanup
```

Optional, in case you want to avoid fast-forward



Branch & merge in two repositories (#4)

Developer 2: develop feature in a branch

```
git switch main
git switch -c extend
```



```
print("Hello, World!")
```
hello.py

```
git add -u
git commit -m "Extend greeting"
```

```
print("Hello, World!")
print("How are you doing?")
```
hello.py

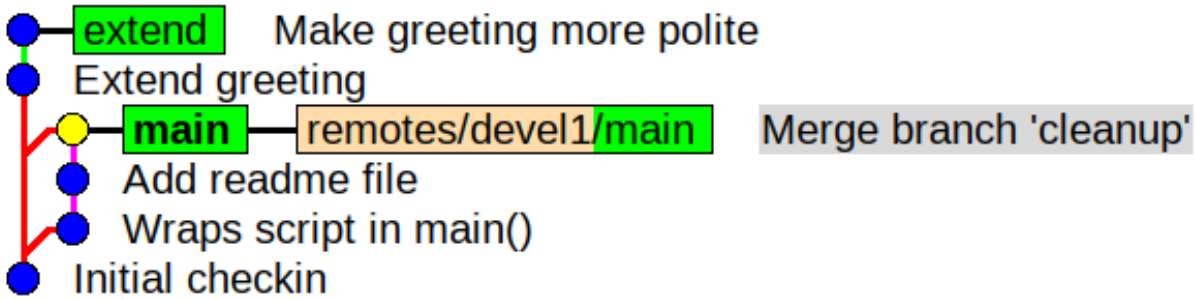
```
git add -u
git commit -m "Make greeting more polite"
```

Branch & merge in two repositories (#5)

Developer 2: synchronize main branch with devel1/main

```
git switch main
git pull --ff-only devel1 main
```

Fast-forward only: Would fail if main had been modified apart of being pulled from devel1/main



→ Main branch of developer 2 identical to devel1/main

Branch & merge in two repositories (#6)

Developer 2: merge updated main into feature branch, fix eventual conflicts

```
git switch extend
git merge main
```

hello.py

```
<<<<<<< HEAD
def main():
    print("Hello!")

if __name__ == "__main__":
    main()
=======
print("Hello, World!")
print("How are you doing?")
>>>>>>> extend
```

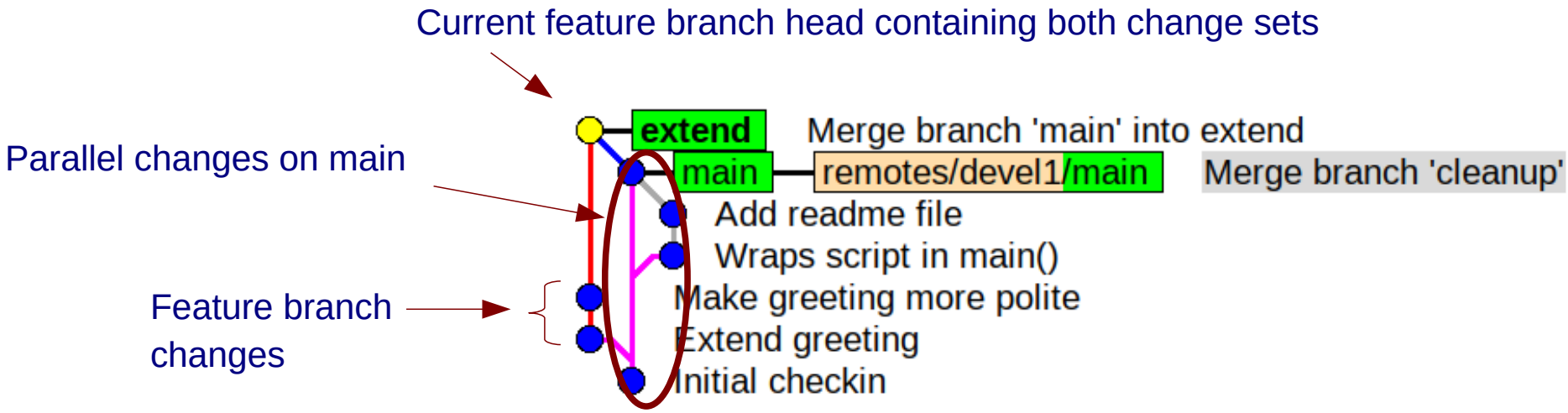
hello.py (resolved)

```
def main():
    print("Hello, World!")
    print("How are you doing?")

if __name__ == "__main__":
    main()
```

```
git add hello.py
git commit
```

Branch & merge in two repositories (#7)

- Updated feature branch now contains all changes from the original feature branch as well as all changes happened on devel1/main since the feature branch was created



→ Feature branch is ready to be merged into devel1/main
No conflicts expected (as they had been resolved by Developer 2)

→ Publish feature branch (send repository to Developer 1, push it to GitHub/GitLab

→ Issue **pull request / merge request**:
Ask Developer 1 to pull and merge the updated feature branch into devel1/main

Branch & merge in two repositories (#8)

Developer 1: Fetch and investigate changes from Developer 2

```
git remote add devel2 ../../devel2/hello
git remote -v
```

Register contributors repository
(needed only once)

```
devel2  ../../devel2/hello (fetch)
devel2  ../../devel2/hello (push)
```

```
git fetch devel2 extend
```

Fetch content of “extend” branch
from devel2’s repository

```
From ../../devel2/hello
* branch            extend     -> FETCH_HEAD
* [new branch]      extend     -> devel2/extend
```

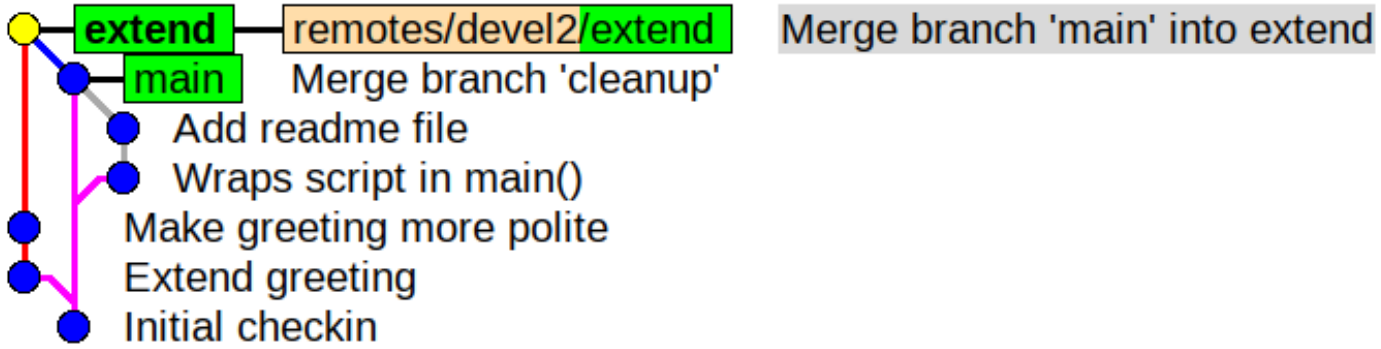
```
git switch extend
```

Check out contrib/extend as extend for further inspection

```
Branch 'extend' set up to track remote branch 'extend' from 'devel2'.
Switched to a new branch 'extend'
```

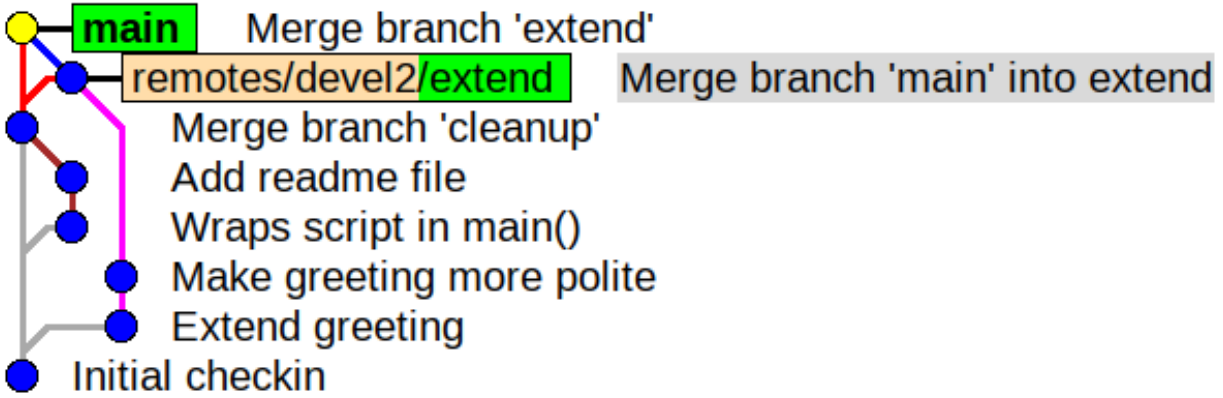
Branch & merge in two repositories (#9)

- Developer 1 has an exact local copy of Developer 2's feature branch



Developer 1: merge feature branch into main

```
git switch main
git merge --no-ff extend
git branch -d extend
```

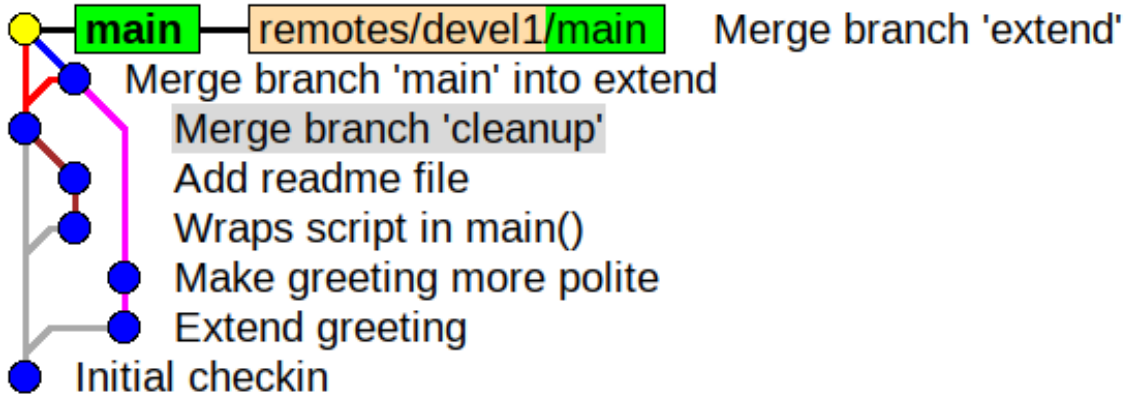


Developer 1's main contains all previous commits + changes from contributor

Branch & merge in two repositories (#10)

Developer 2: sync main branch with Developer 1's main

```
git switch main
git pull --ff-only devel1 main
git branch -d extend
```



Developer 2's main branch indentical to devel1/main!

Publishing a repository

Publish repository, so that others can clone it and pull from it

- Allow read-access to repository in local file system (multi-user environment)
- Upload repository to public file- / webserver
- Send repository (including .git/) as an archive
- Publish repository on a git hosting site (e.g. GitHub, GitLab, Bitbucket)
  - Very convenient and de-facto standard for open-source projects
  - **Note:** Those site are **commercial** ones (with commercial interests), but usually offer free of charge services for private persons, students, etc.
- Run your own git hosting infrastructure (e.g. self-hosted GitLab)

Some random git notes

- Git is very flexible and powerful, allowing for almost **arbitrary workflows**
  → Most open source projects document their git-workflow (e.g. DFTB+ git-workflow)
  → If you start your own project, pick a common one (e.g. **GitHub flow**)!

- Public git-hosting sites are usually offering very good tutorials on git and git-workflows (see for example **GitHub guides**)

- The free “git book” **Pro Git** contains an excellent introduction to git.

- Instead of merging a source branch into a target one, one can also rebase the target branch upon the source branch. (**Rebasing** is not trivial, so make sure you understand its consequences, before you do it.)