

CS 241: Systems Programming

Lecture 23. Advanced Git

Fall 2023

Prof. Stephen Checkoway

Branches

Visualize a project's development as initially a *linked list* of commits

When a development track splits, a new branch is created

- This gives us a *tree* of commits

In Git, a branch is actually just a pointer to a leaf in the tree of development

Two or more branches can be merged together

- This gives a *graph* of commits

Using branches

Development and release versions

Trying out new features

Focusing on fixing a bug

Simpler to do in Git than other VCS, consider using more frequently

Git branching

List all branches in the project

- `git branch`

Create a new branch

- `git branch <branchname>`

Switch to a branch

- `git checkout <branchname>`

Create and immediately switch

- `git checkout -b <branchname>`

Delete a branch

- `git branch -d <branchname>`

Using branches

Create and switch to a branch

```
$ git branch working  
  
$ git checkout working  
M README  
Switched to branch 'working'  
  
$ git branch  
main  
* working
```

Stashing

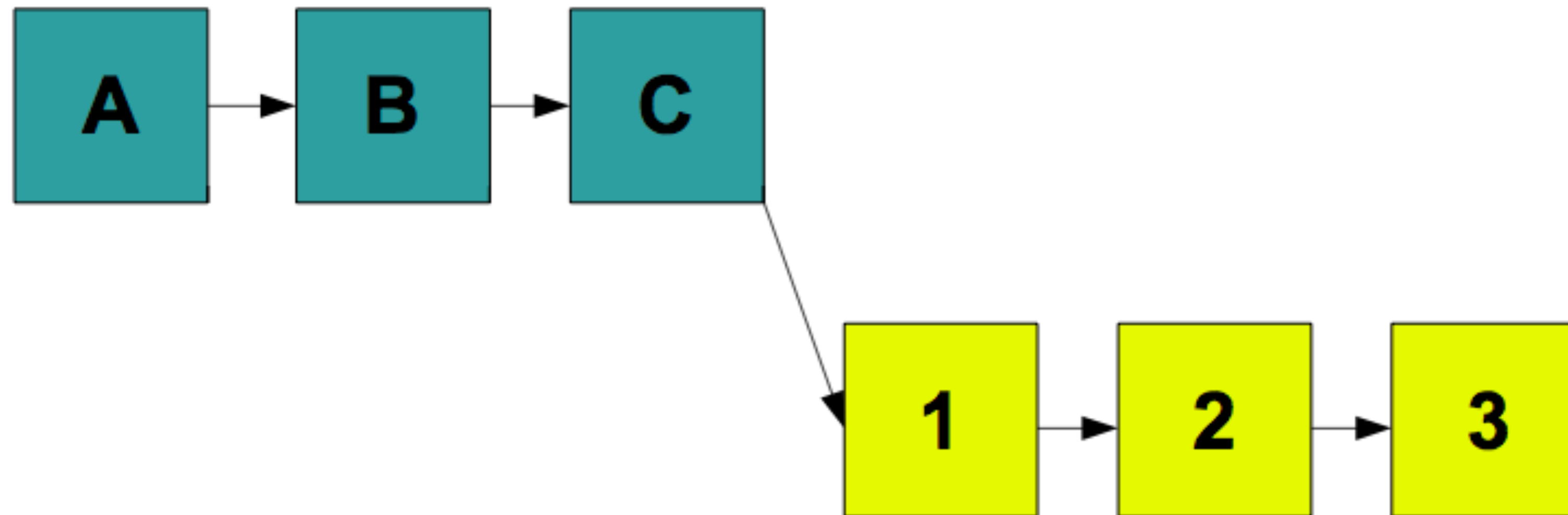
Working tree should be clean when switching branches

Save/hide changes you're not ready to commit with `git stash`

- Pushes changes onto a stash stack

Recover changes later with `git stash pop`

Using branches



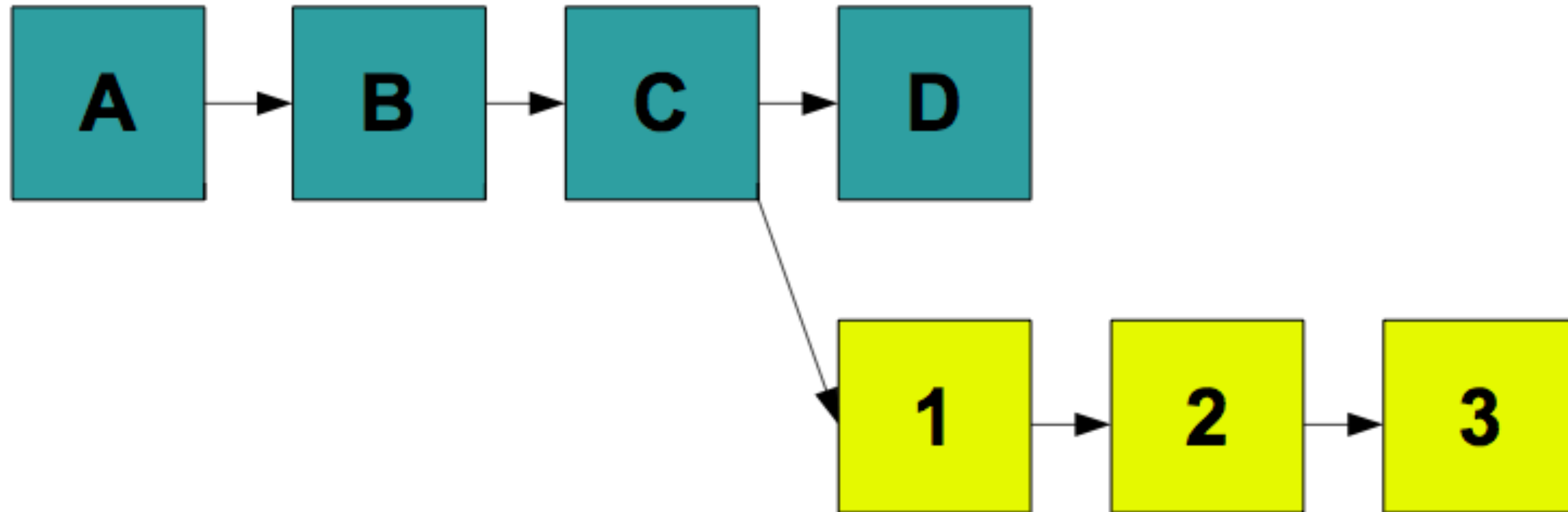
Using branches

Integrate changes back into **main**

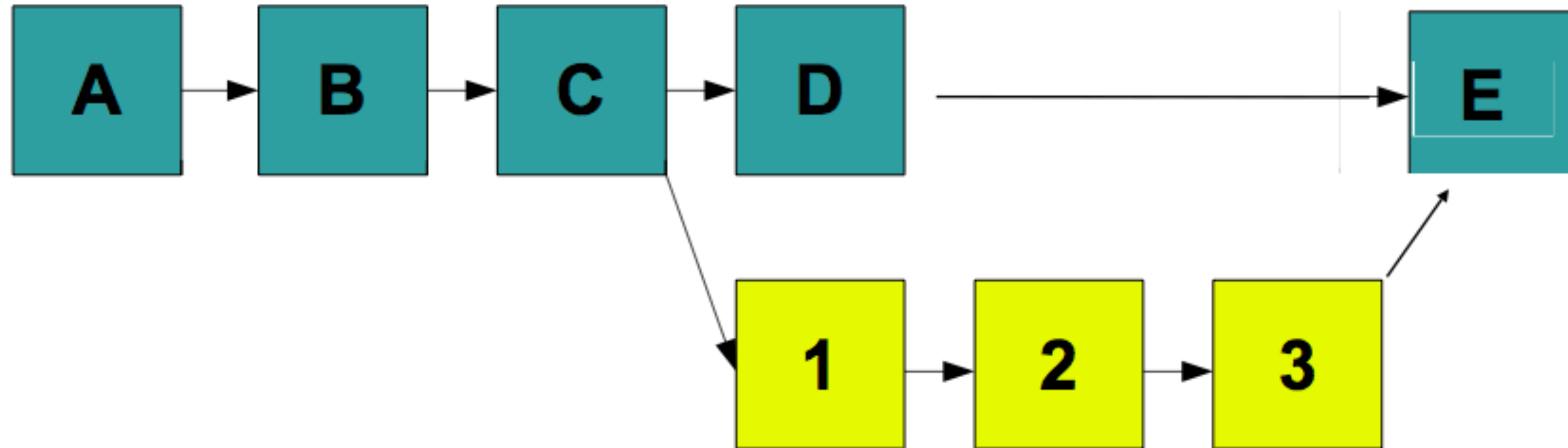
```
$ git checkout main
Switched to branch 'main'

$ git merge working
Merge made by the 'recursive' strategy.
 newfile.txt | 1 +
 1 file changed, 1 insertion(+)
 create mode 100644 newfile.txt
```


Before git merge



After git merge



Merged history

```
*   cdd07b2 - (HEAD, main) Merge branch
'working'
| \
| * 1ccf9e7 - (working) Added a new file
* | 3637a76 - Second change
* | cf98d00 - First change
| /
* cf31a23 - Updated README to 2.0
* 2a8fc15 - Initial commit
```

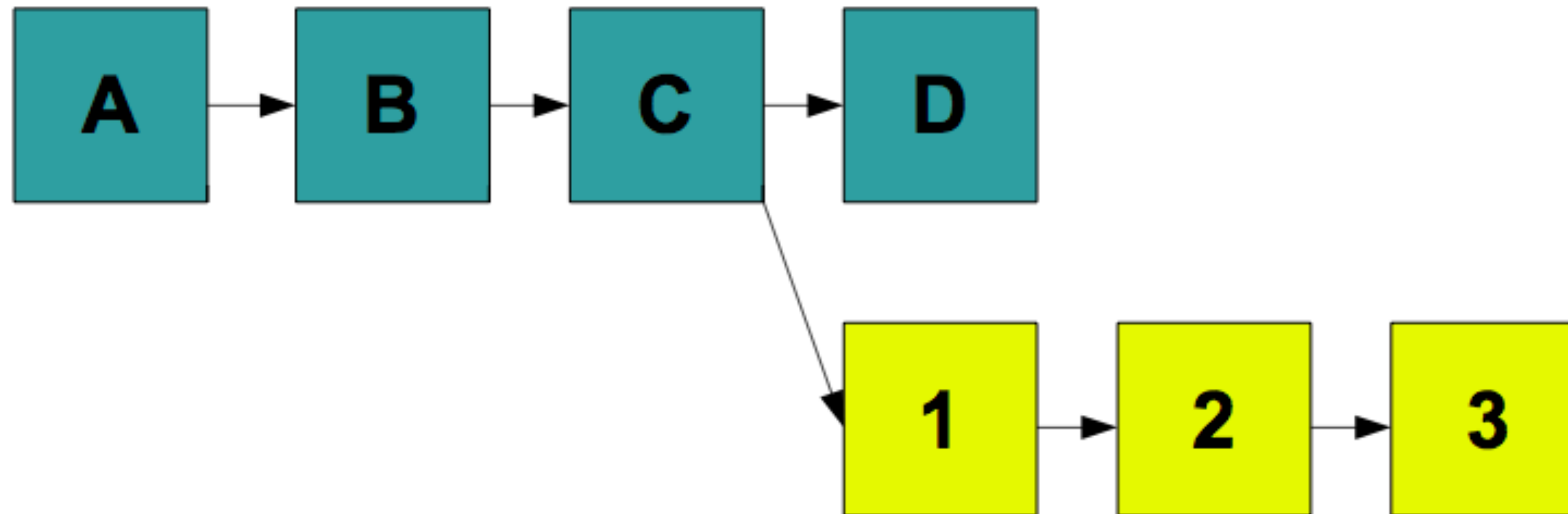
Rebasing

Like merging, rebasing transfers changes from one branch to another

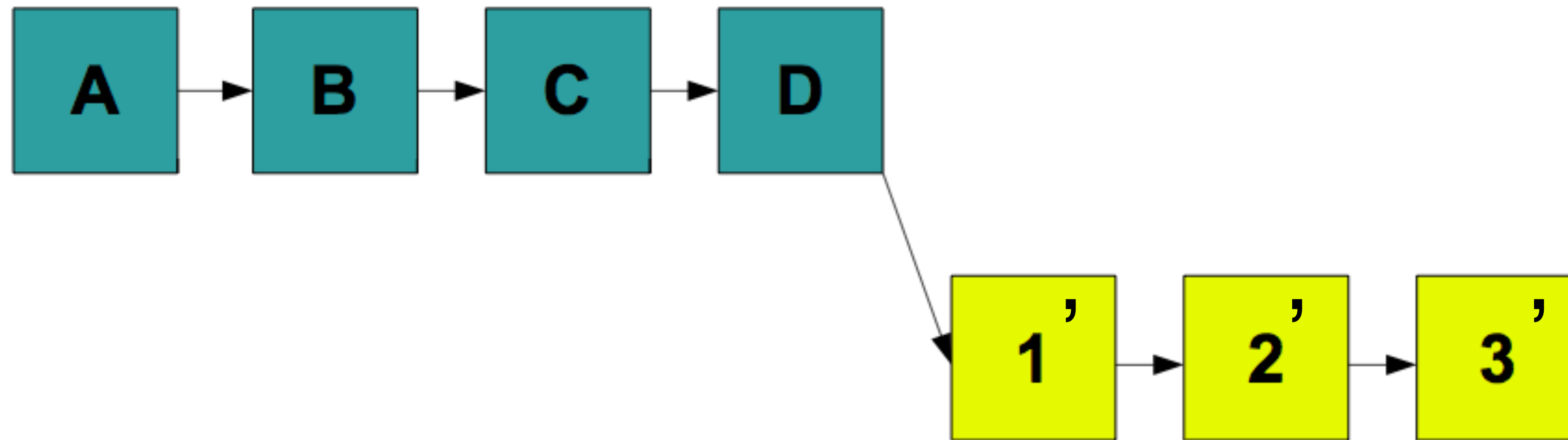
Does not create a new commit

Replays changes from current branch onto head of other branch

Before git rebase



After git rebase



git rebase

Powerful tool

Can change the commit order

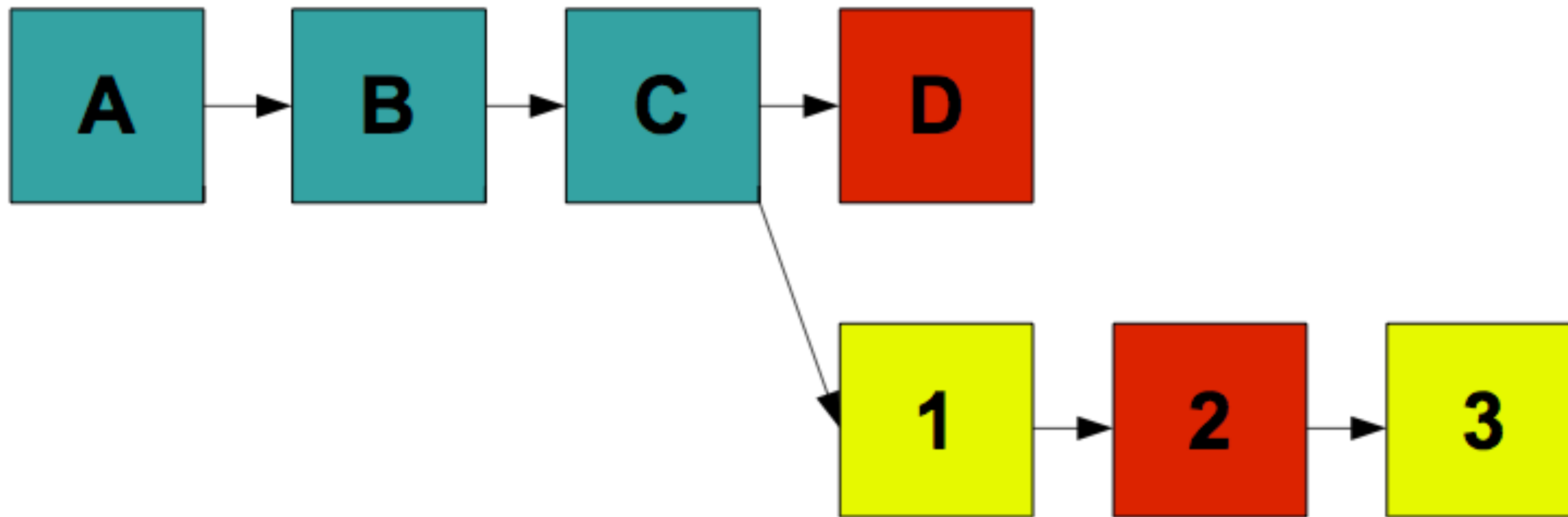
Merge/split commits

Make fixes in earlier commits

- DO NOT DO ON PUSHED CHANGES OR PUBLIC BRANCH

```
$ git rebase -i main
```

Conflicts



Git conflict markers


```
$ cat foo.c
<<<<<<< HEAD
current content
=====
branch content
>>>>>>> newbranch
$ vim foo.c
$ git add foo.c
$ git rebase --continue
```

Pull requests with Github

Contributing changes to repositories on Github

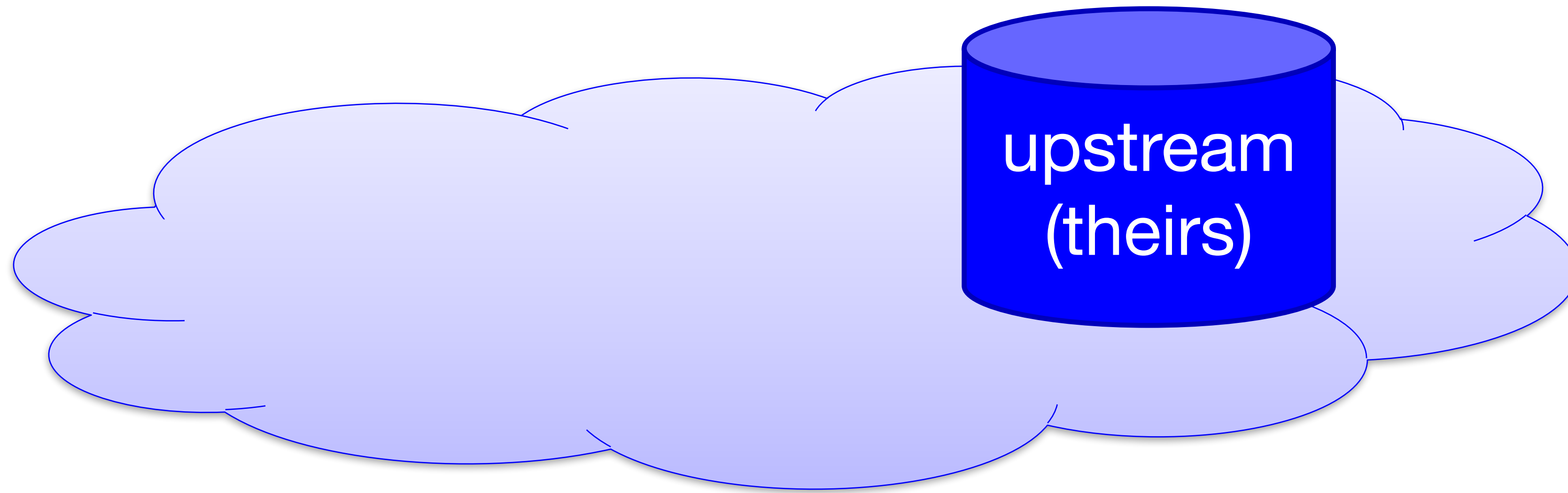
Requests the owner of the code integrate your changes

Setup

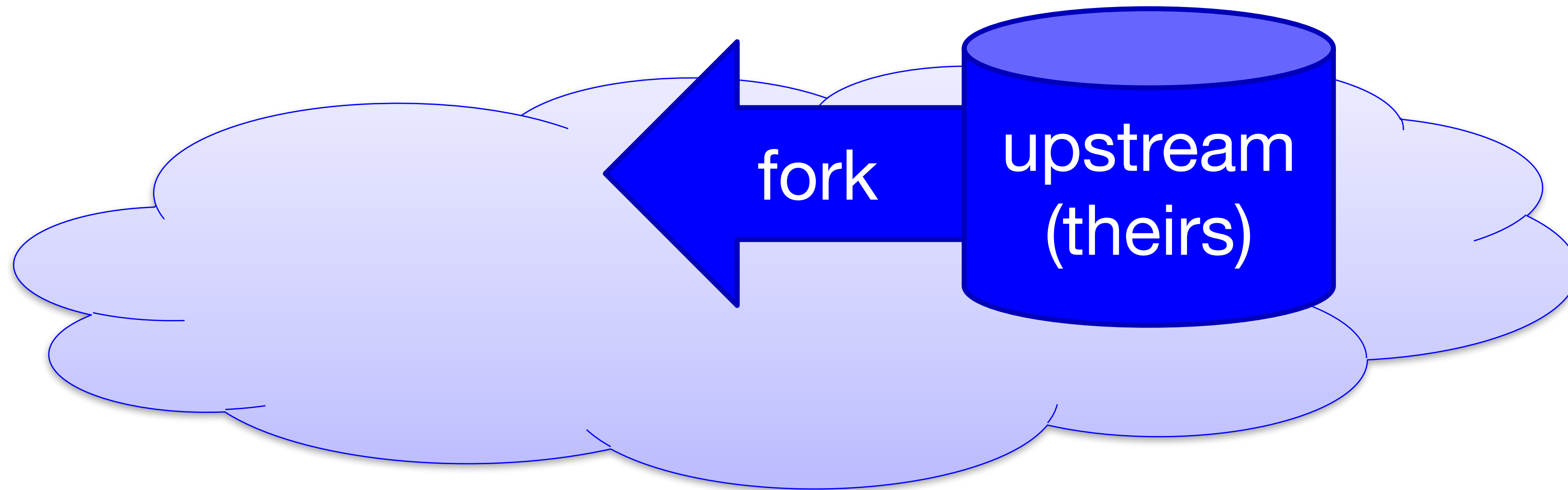


GitHub

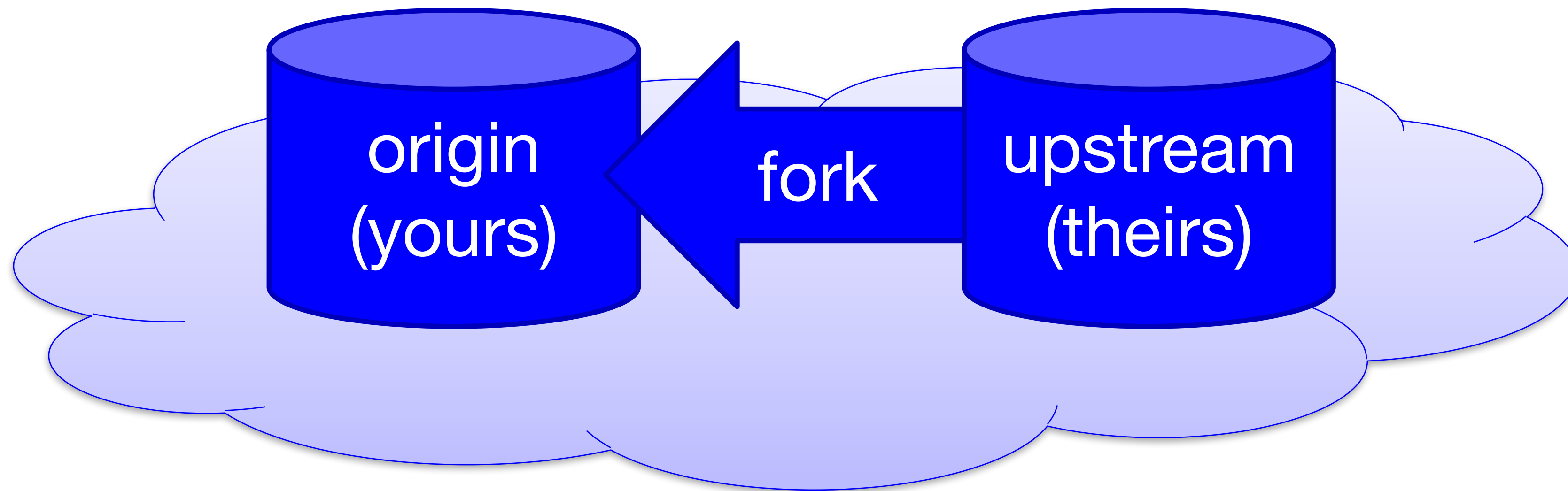
Setup



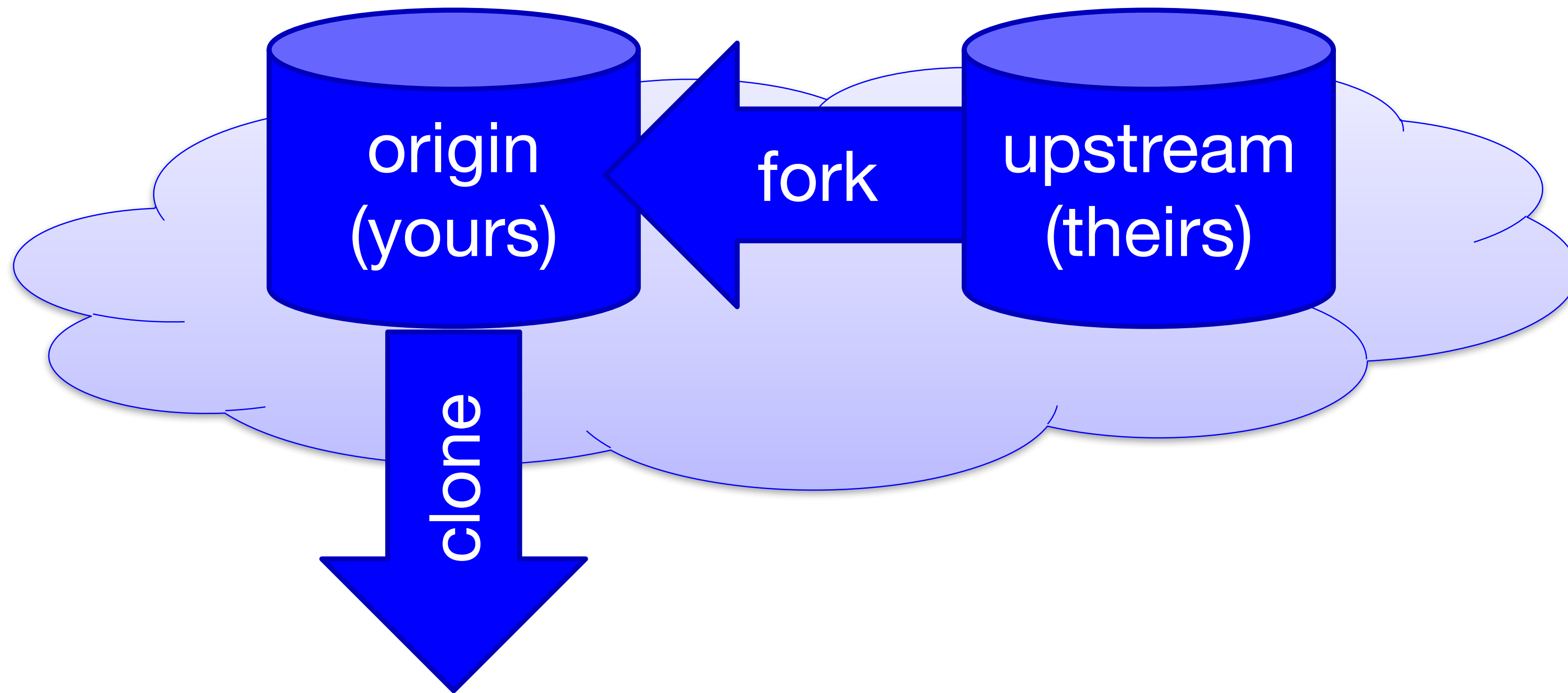
Setup



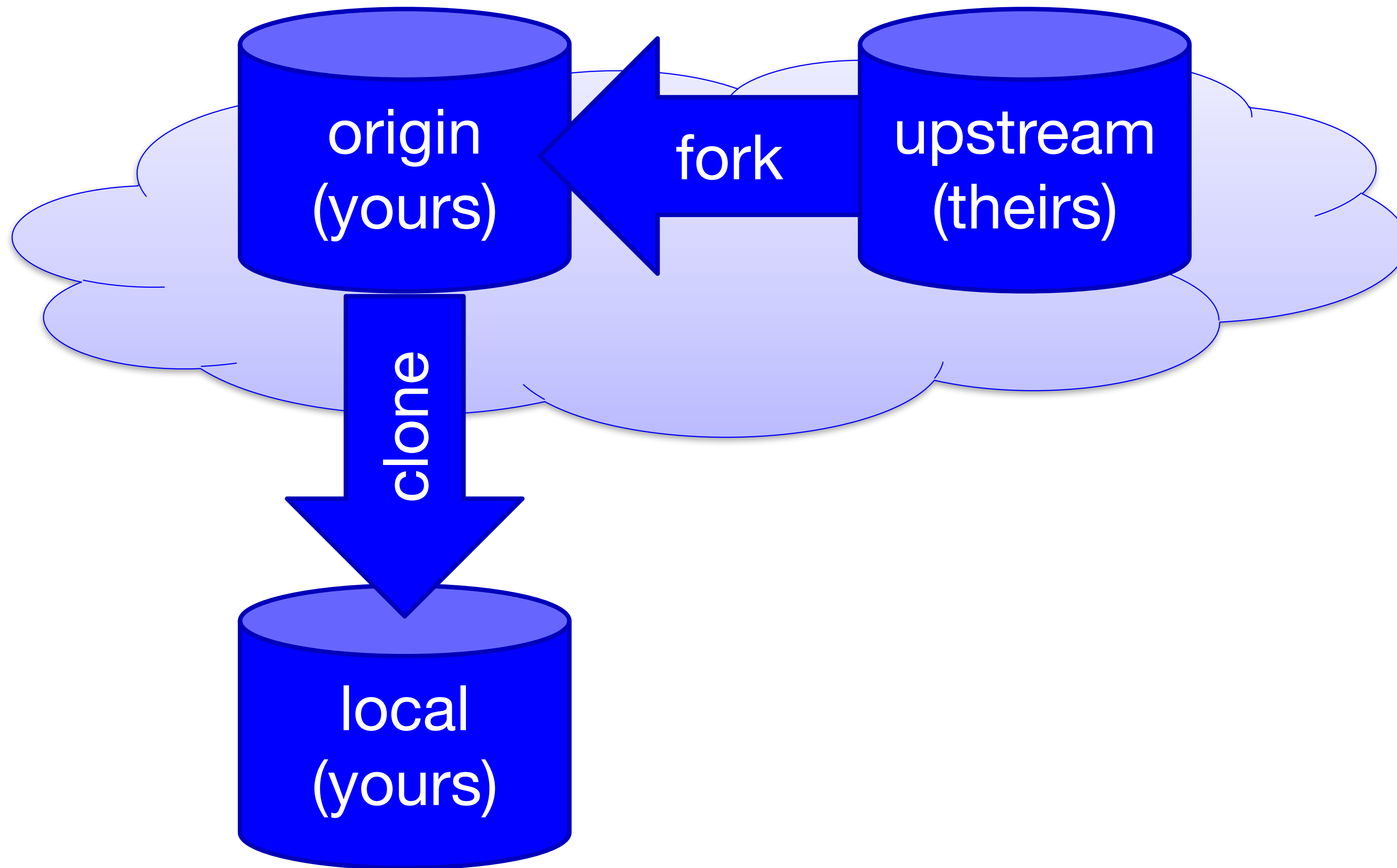
Setup



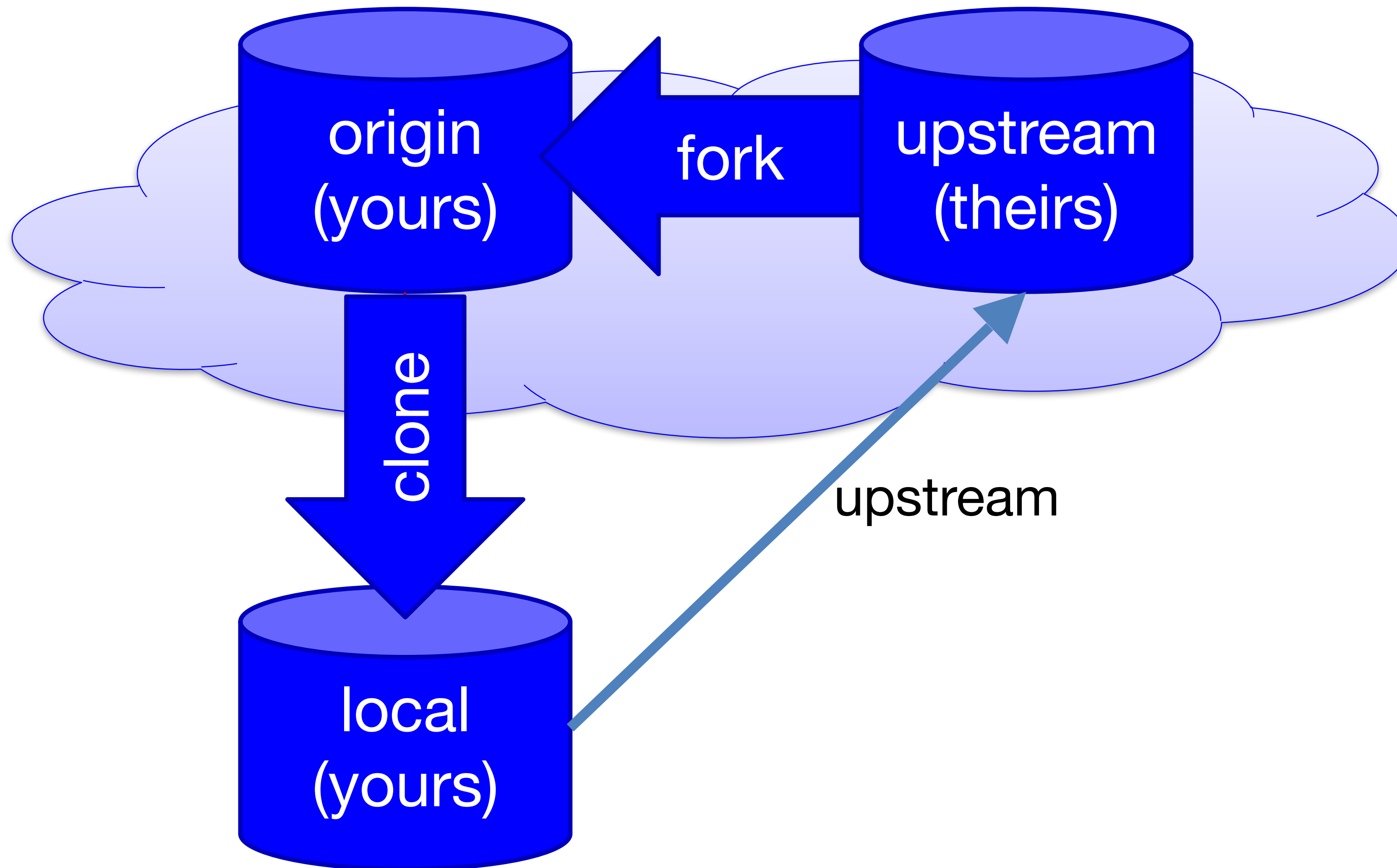
Setup



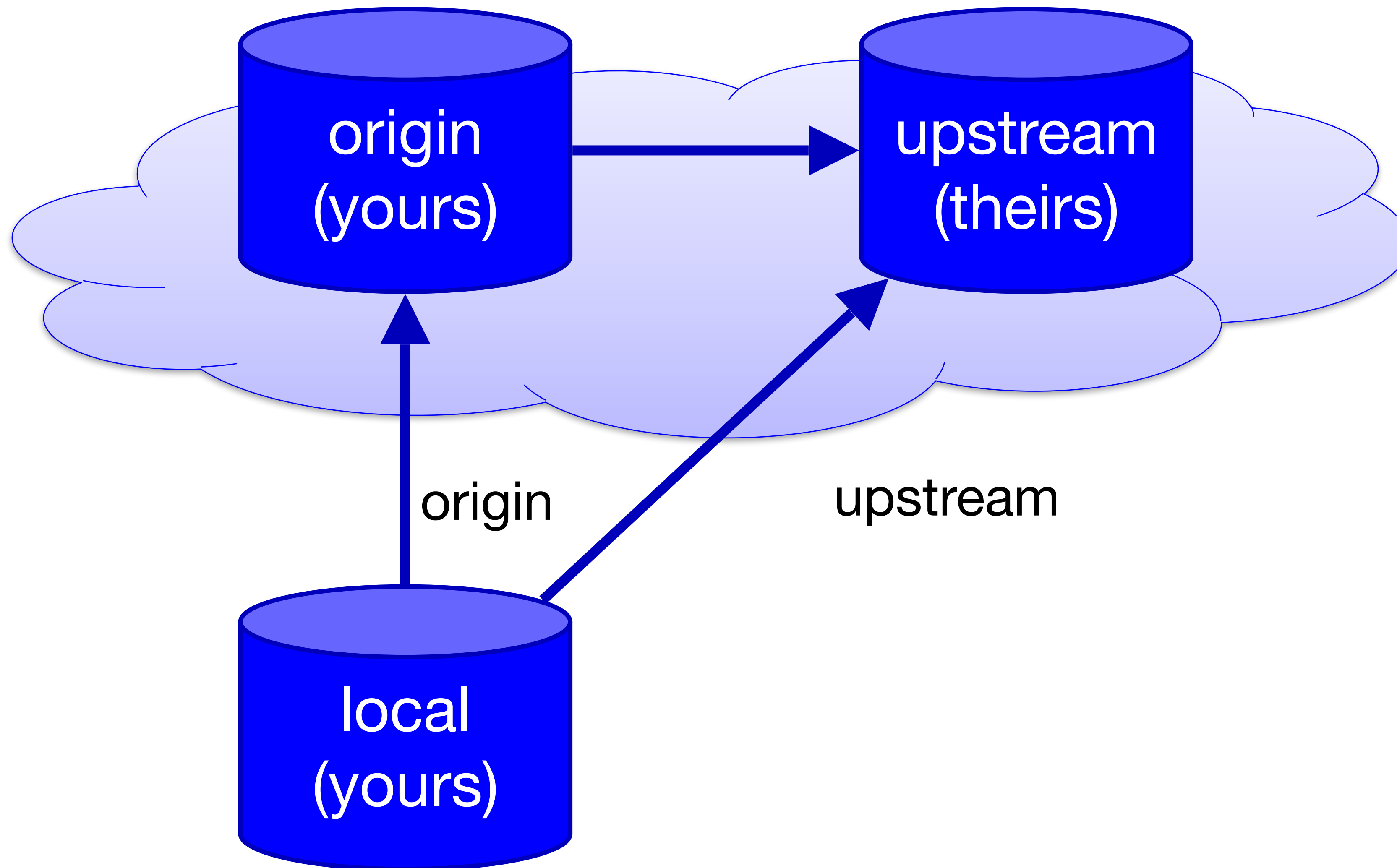
Setup



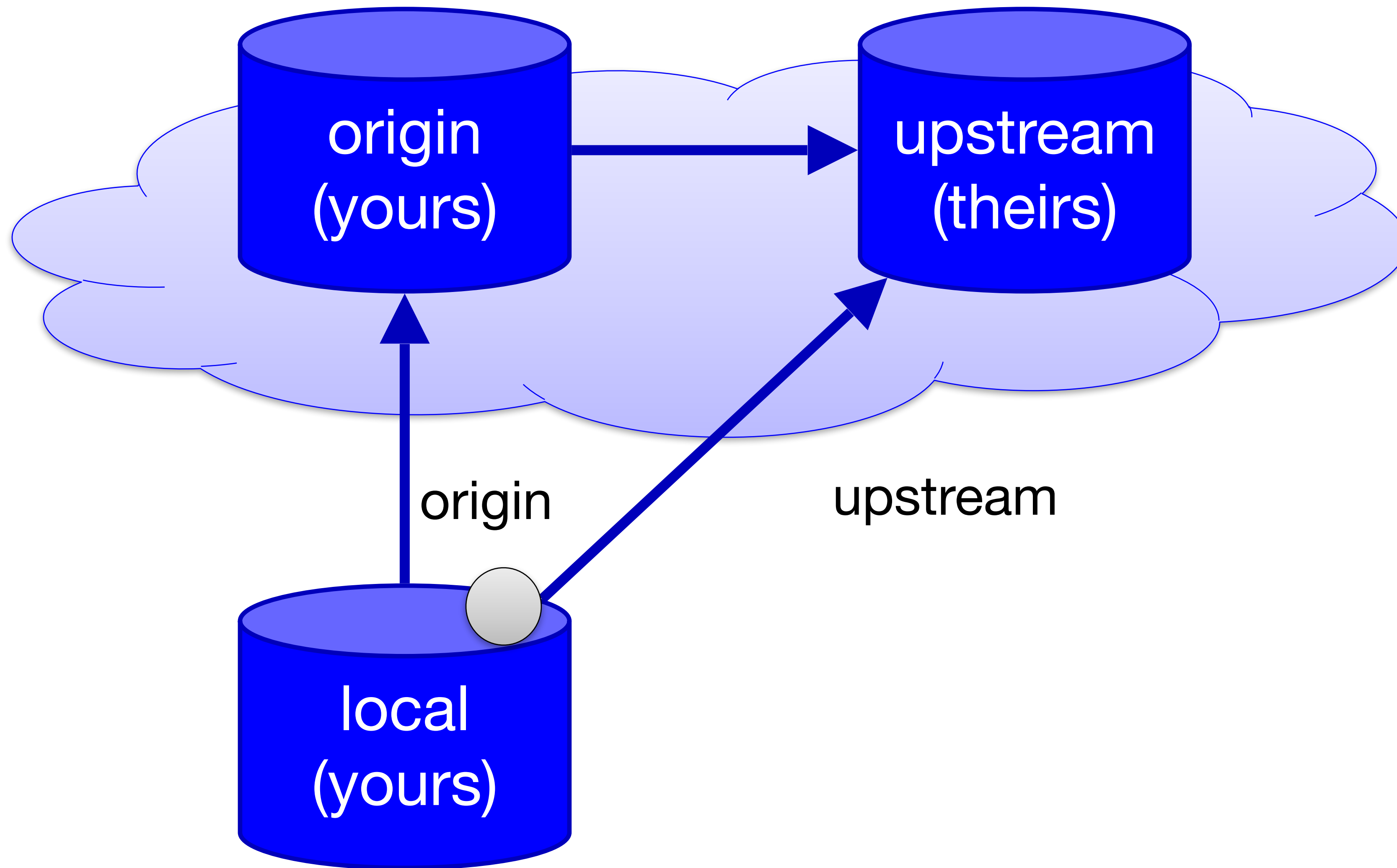
Setup



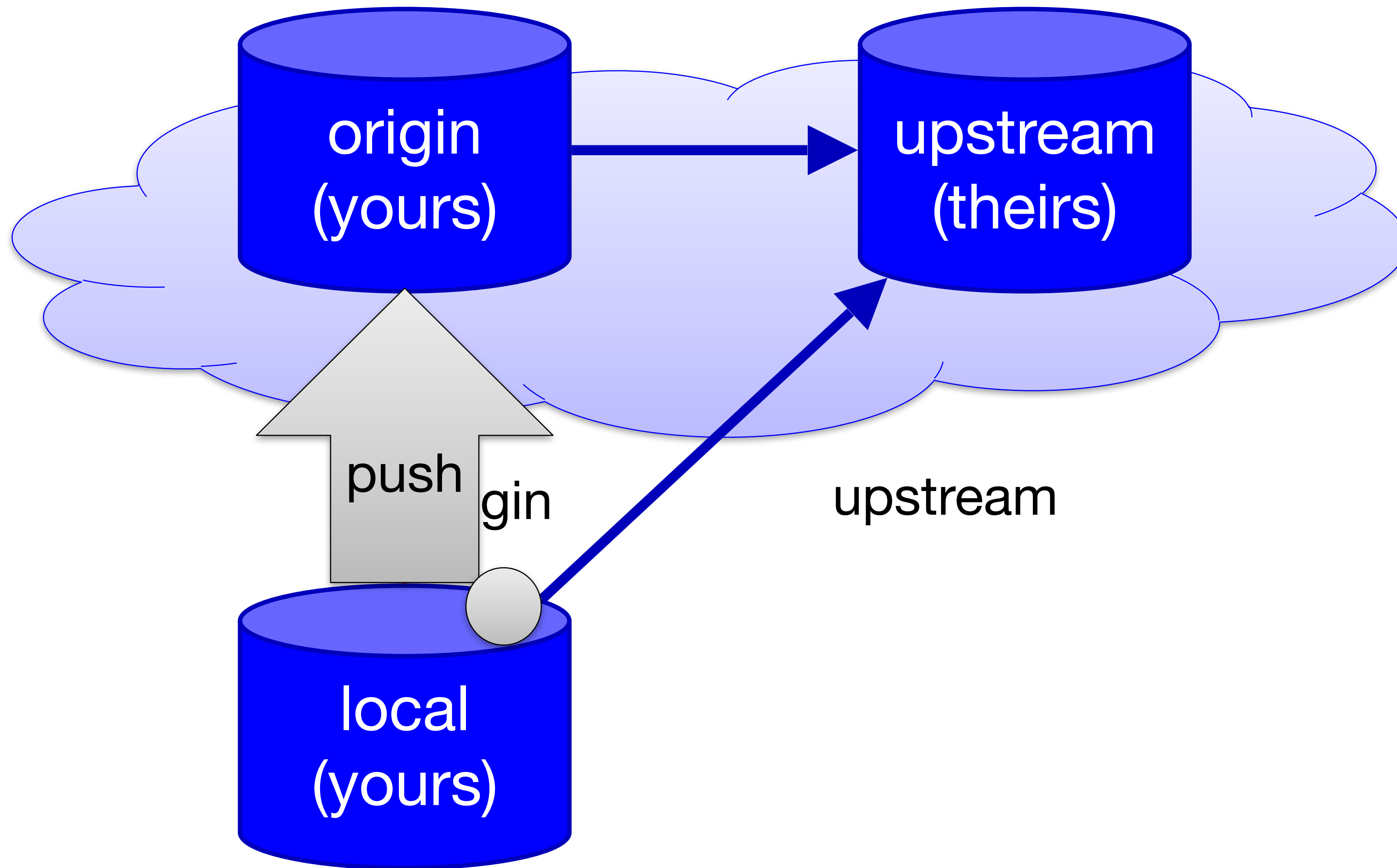
Setup



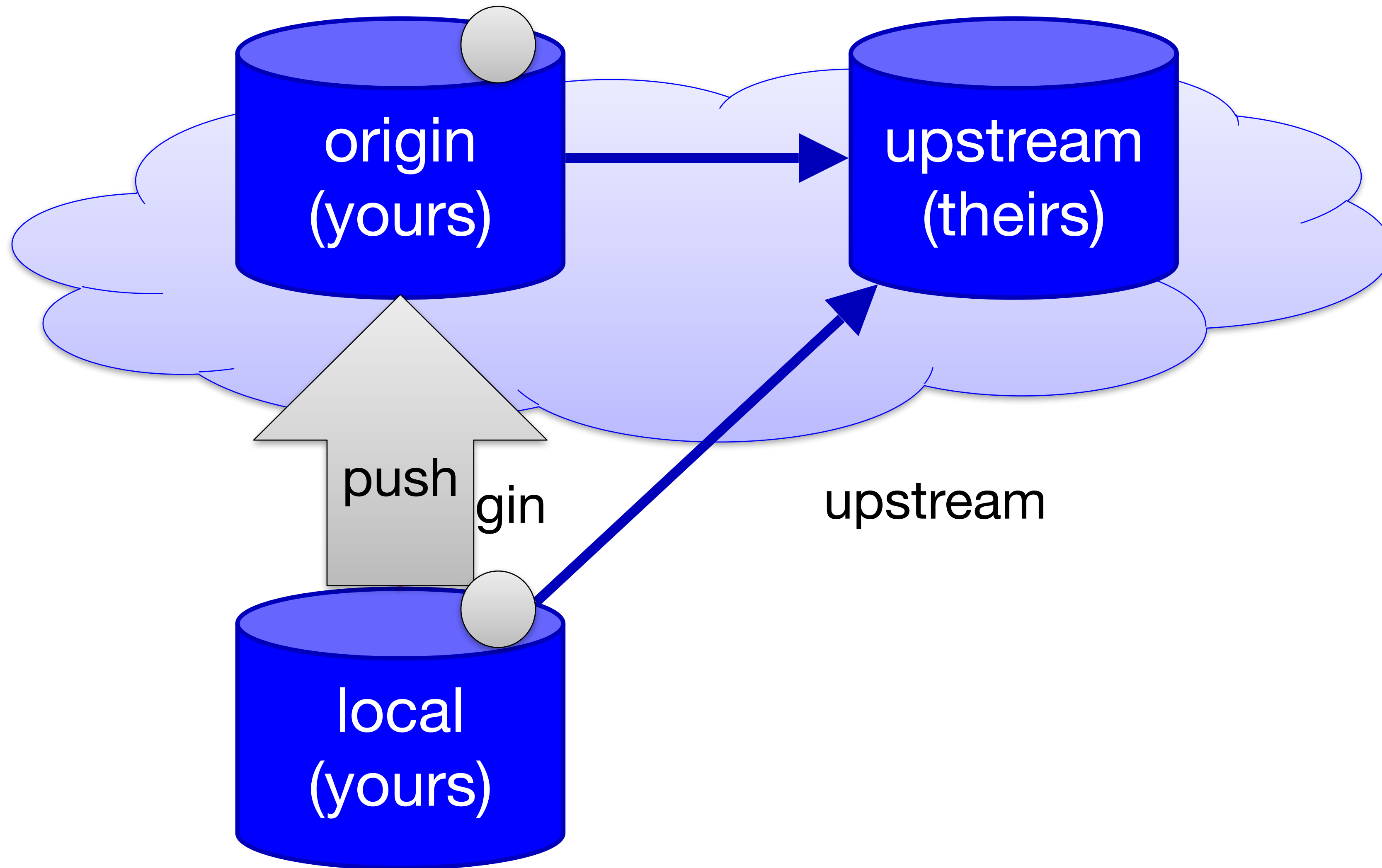
Contribute Changes



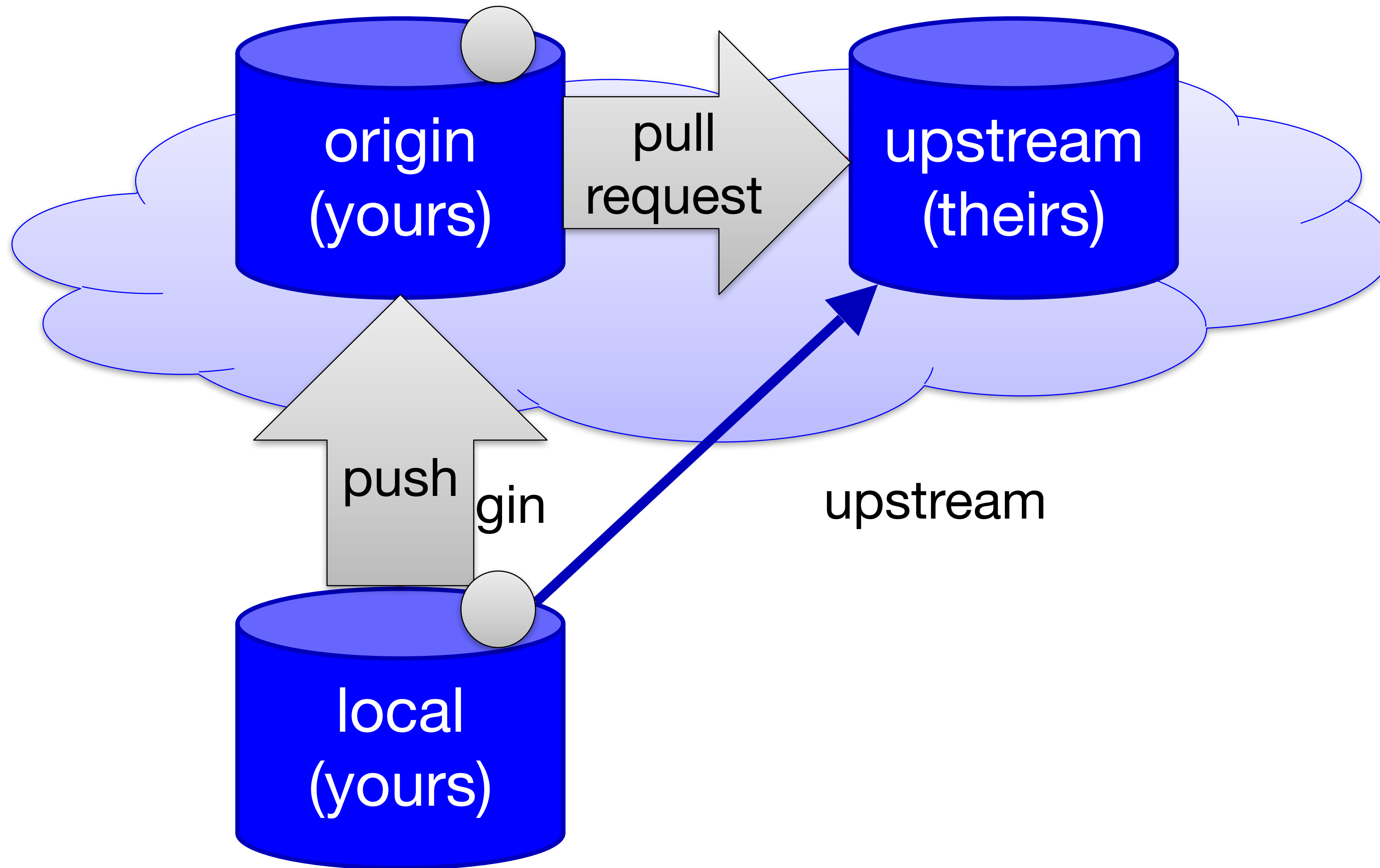
Contribute Changes



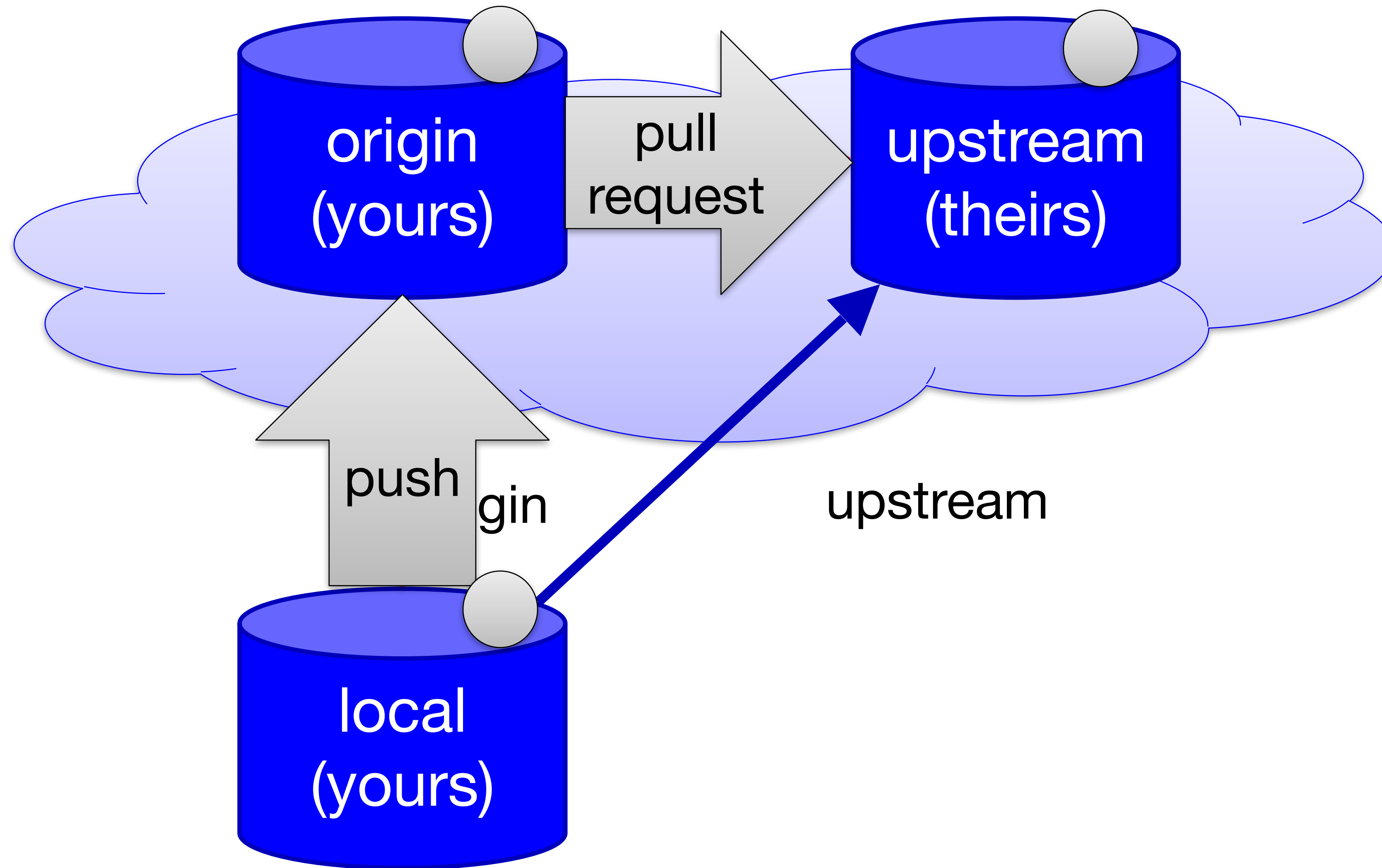
Contribute Changes



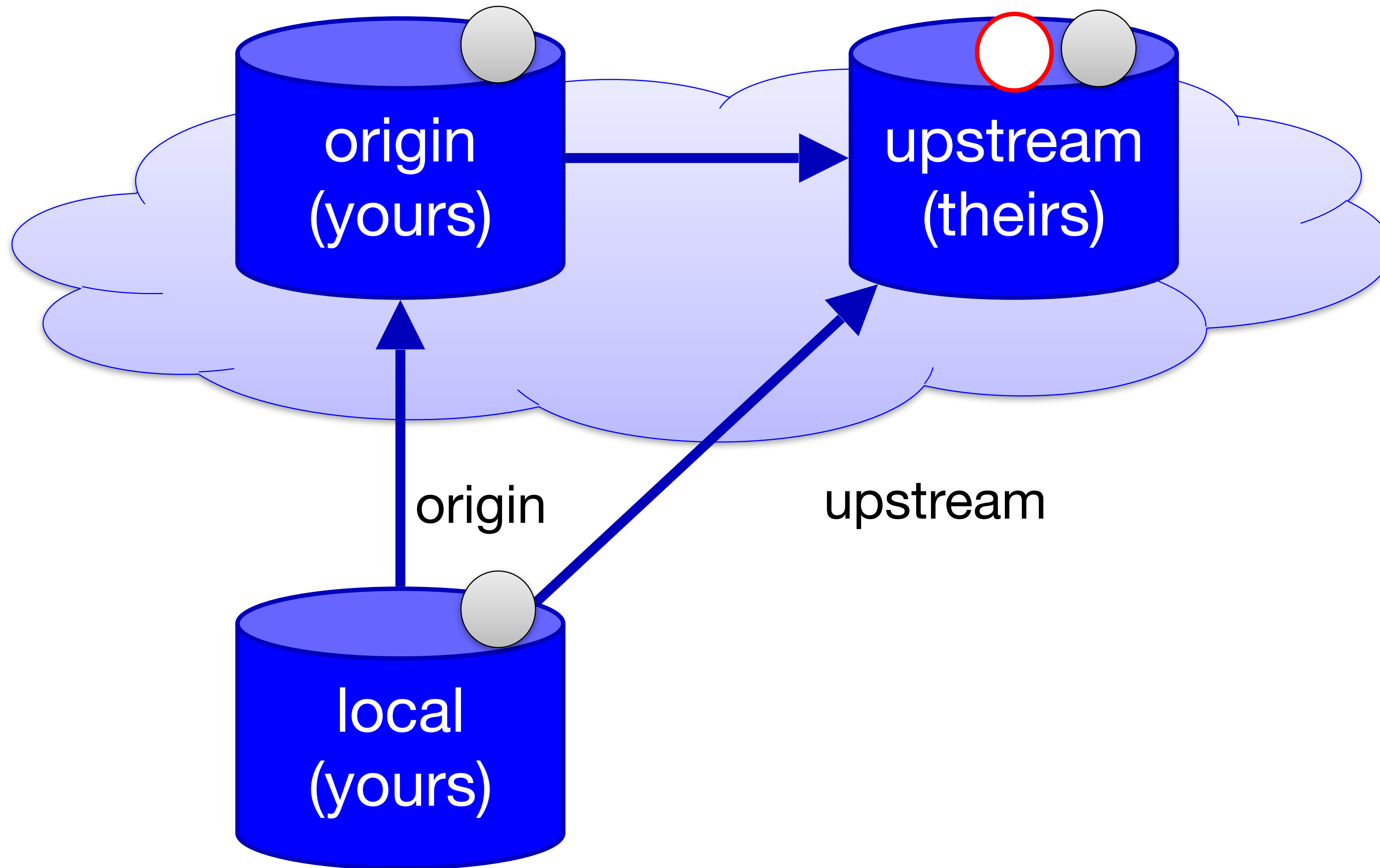
Contribute Changes



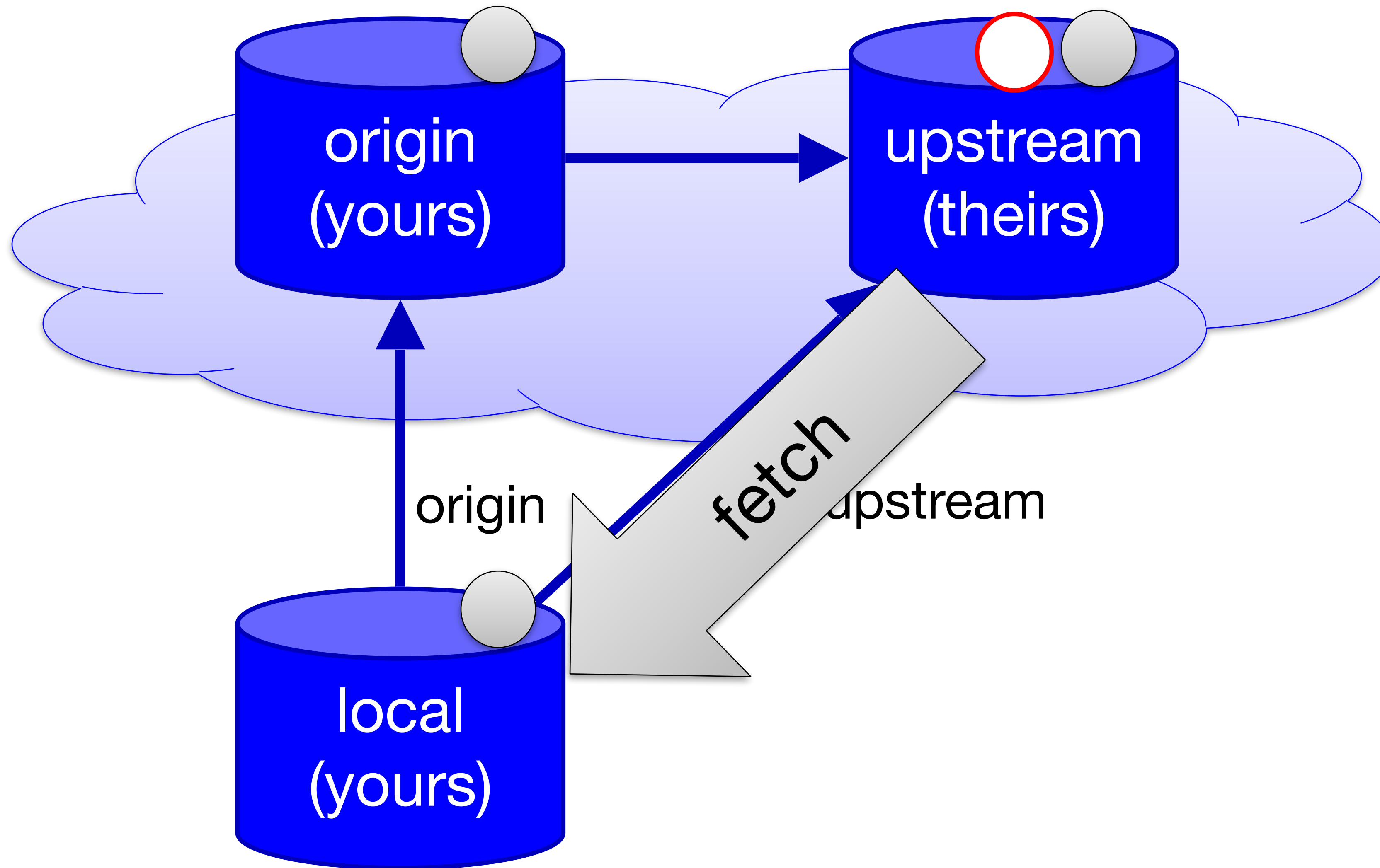
Contribute Changes



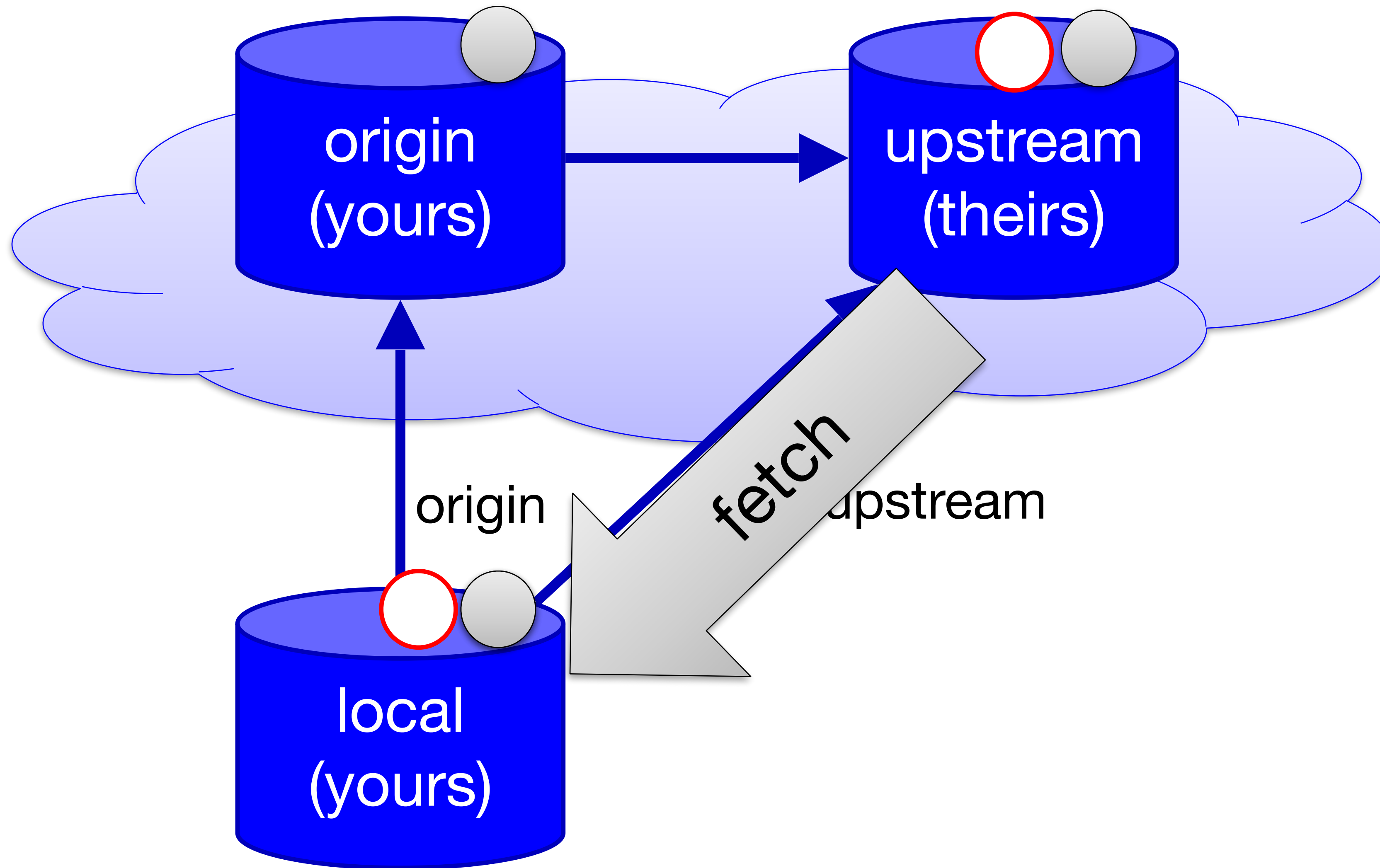
Integrate Changes



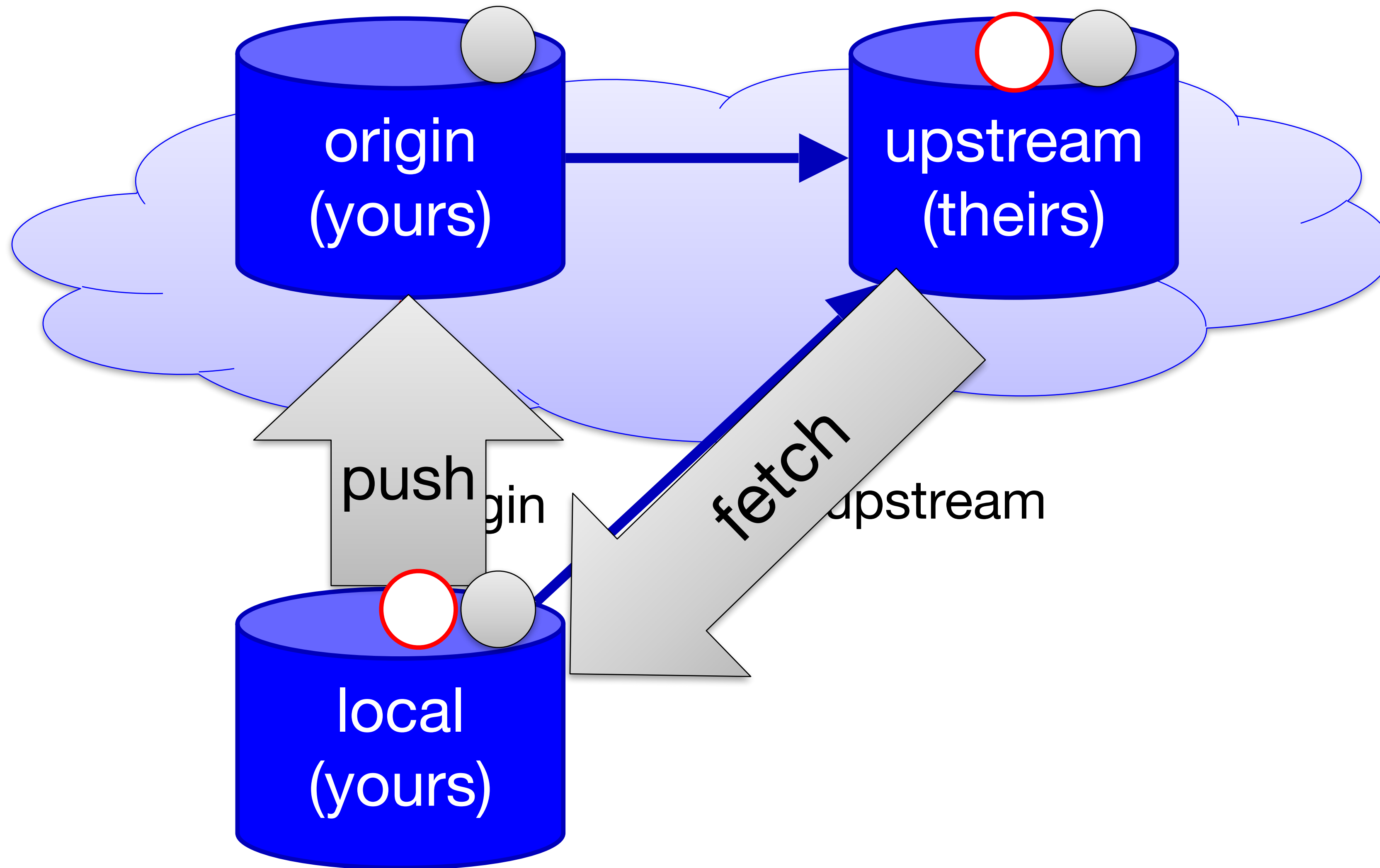
Integrate Changes



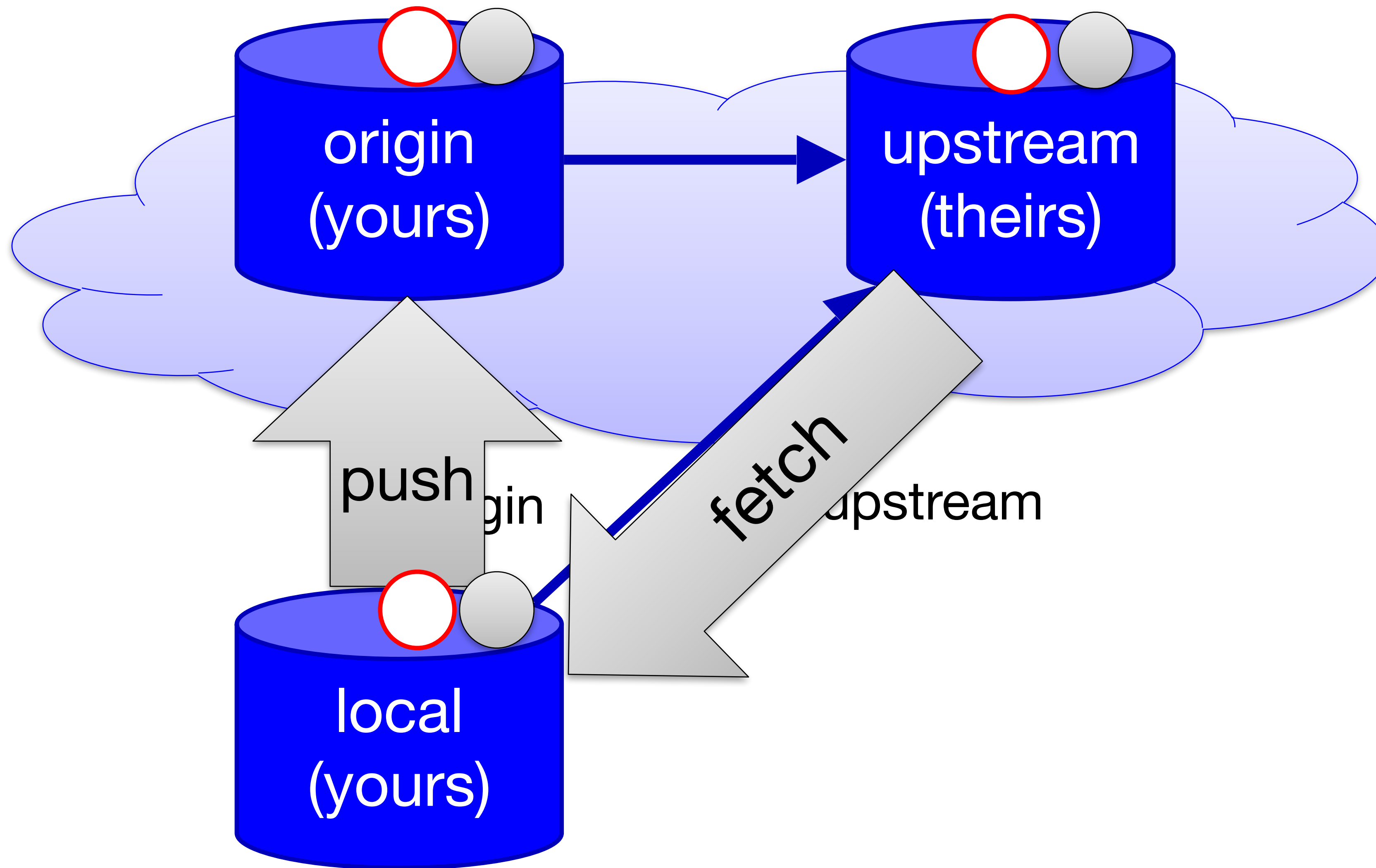
Integrate Changes



Integrate Changes



Integrate Changes

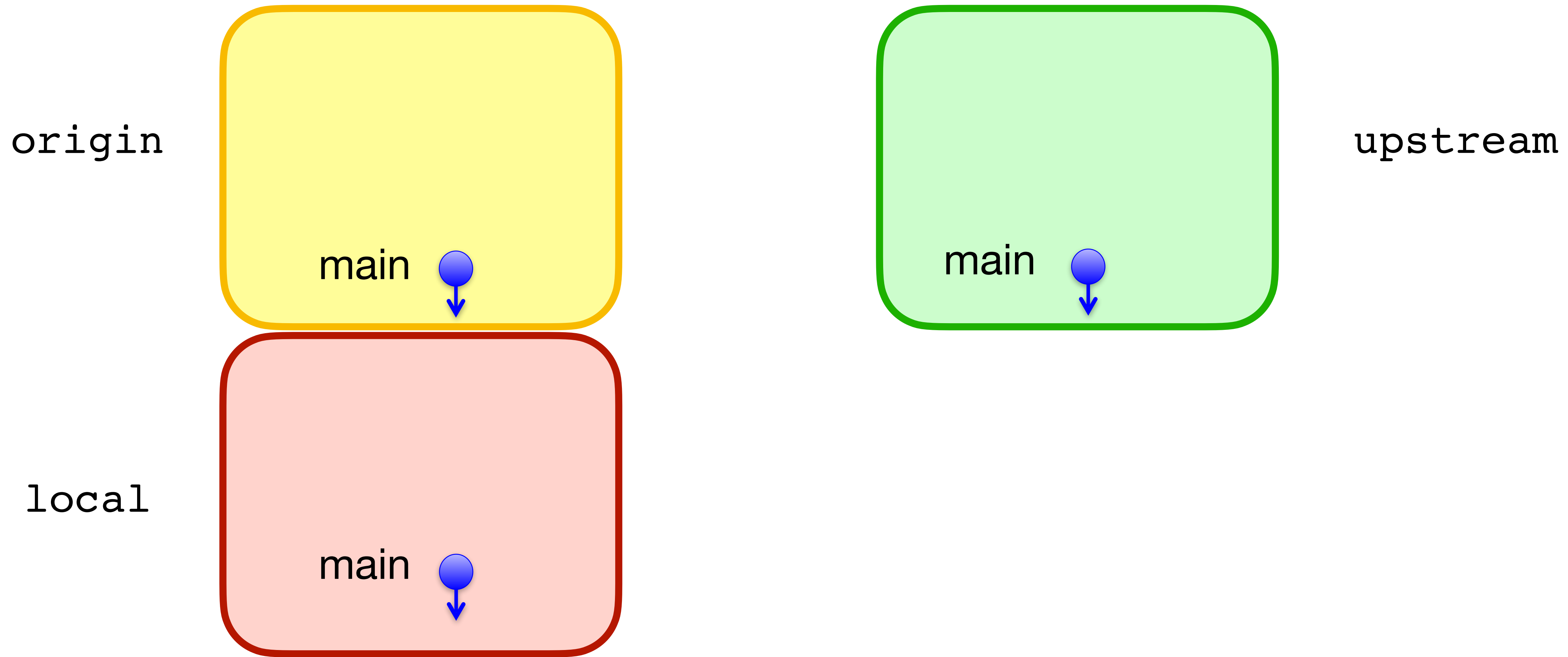


You want to contribute code to the Github project `fancy/project` (`fancy` is the name of the owner, `project` is the name of the repo). You fork the repo (producing `student/project`), commit your changes, and push to `student/project`. Next, you make a pull request for `fancy/project`.

Which statement is true?

- A. Your code is now integrated into `fancy/project` via merging
- B. Your code is now integrated into `fancy/project` via rebasing
- C. You have requested that your code be integrated into `fancy/project`, but no changes have been made
- D. You cannot make any additional commits until the pull request has been accepted

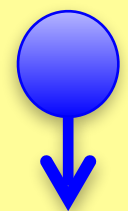
Branches



```
$ git checkout -b feature
```

origin

main



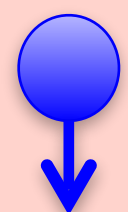
upstream

main



local

main

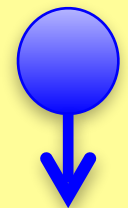


feature

```
$ git commit
```

origin

main



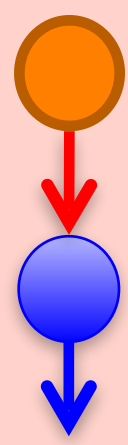
upstream

main



local

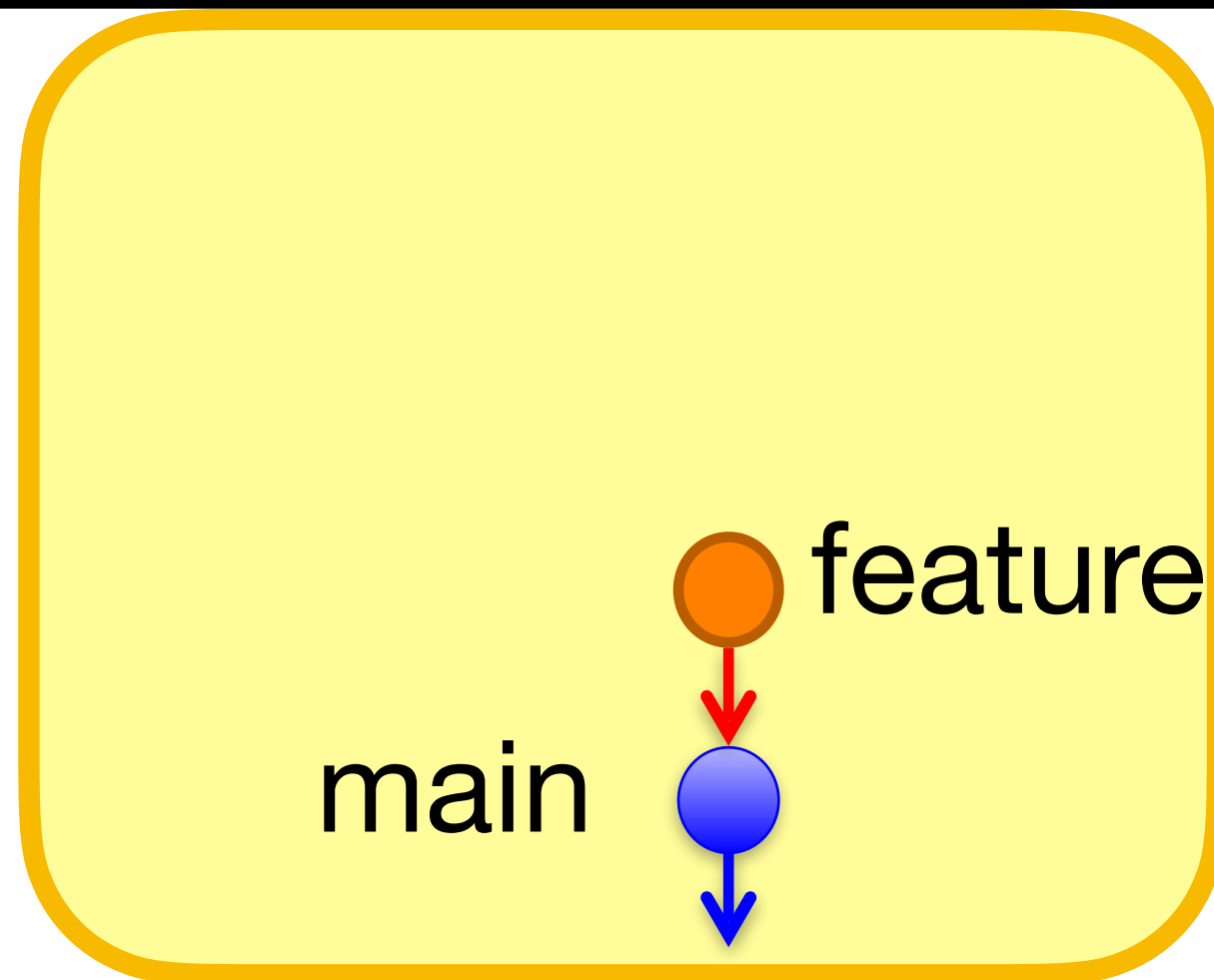
main



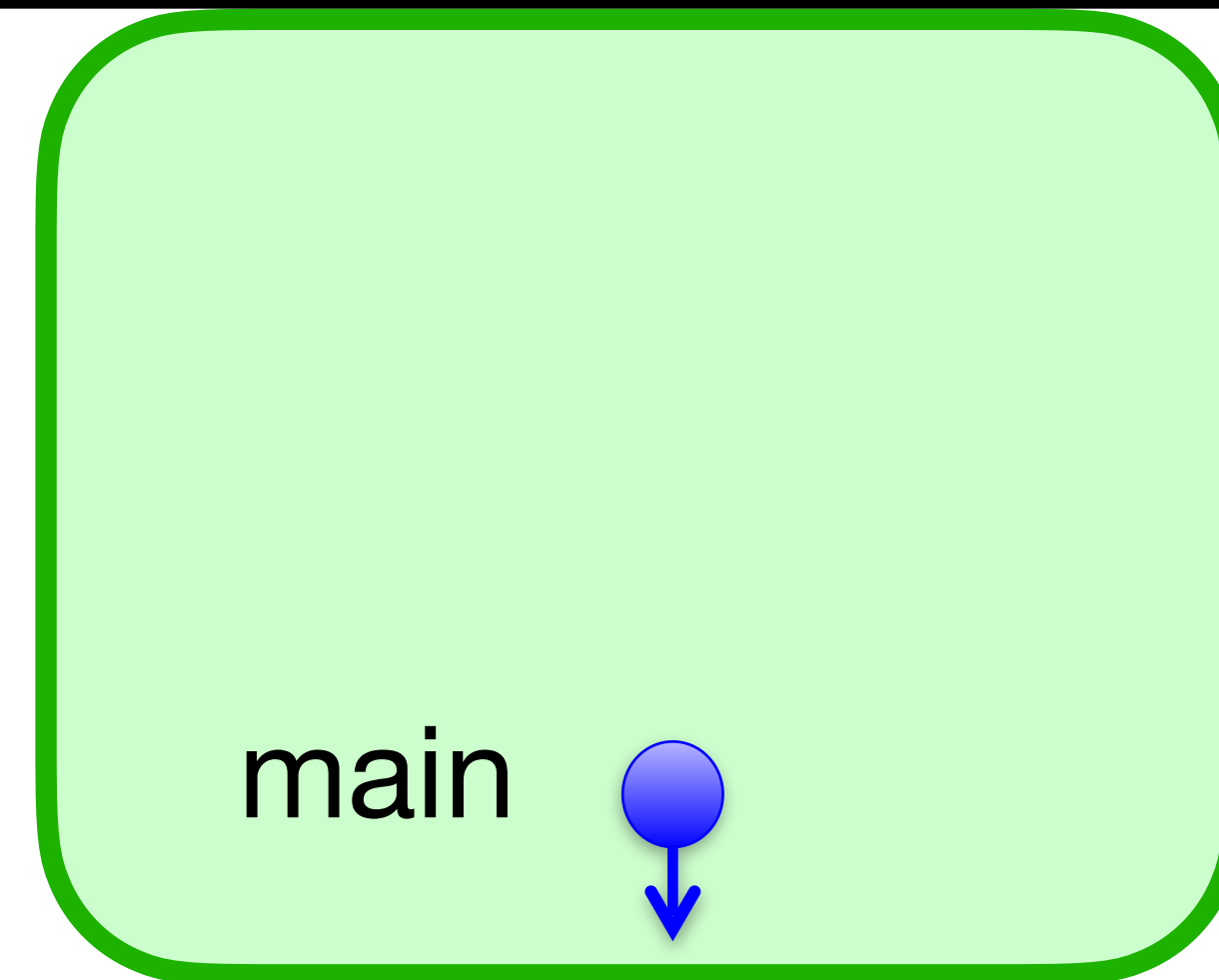
feature


```
$ git push -u origin feature
```

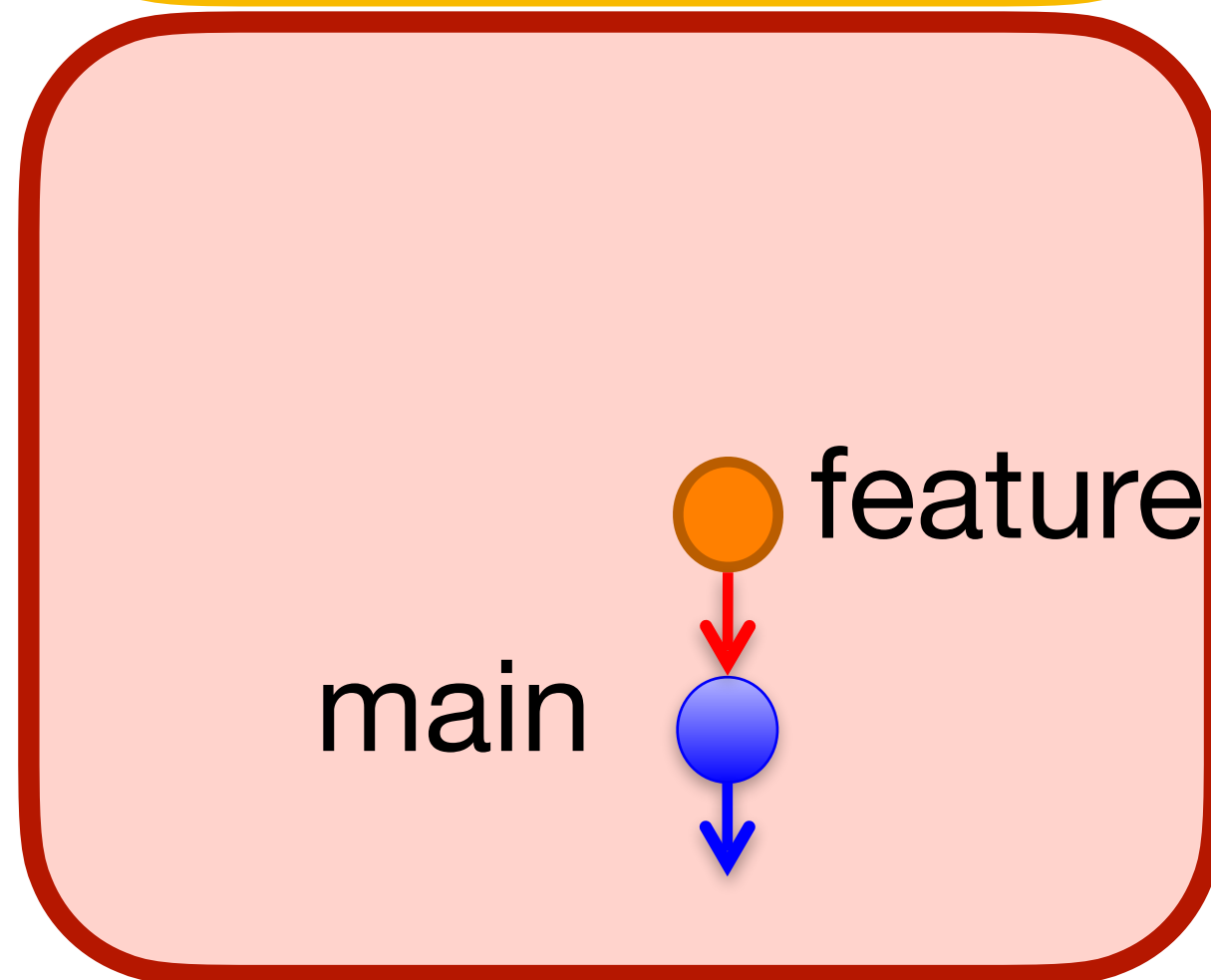
origin



upstream



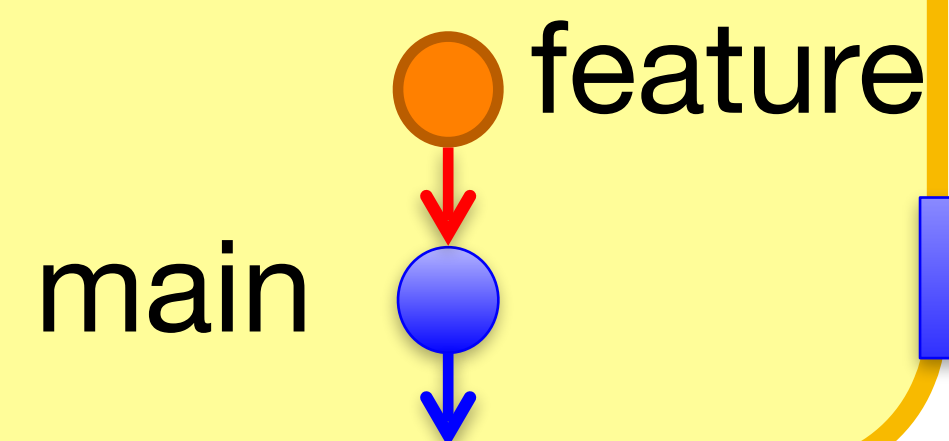
local



New pull request

origin

upstream

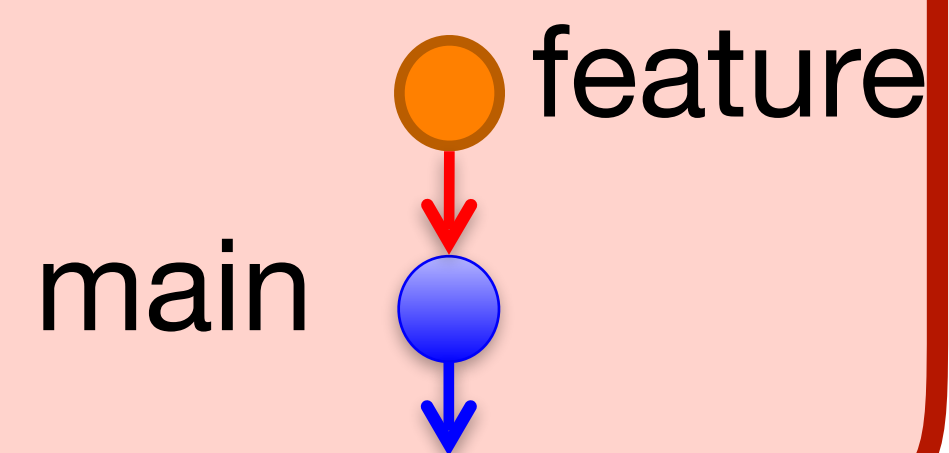


pull request

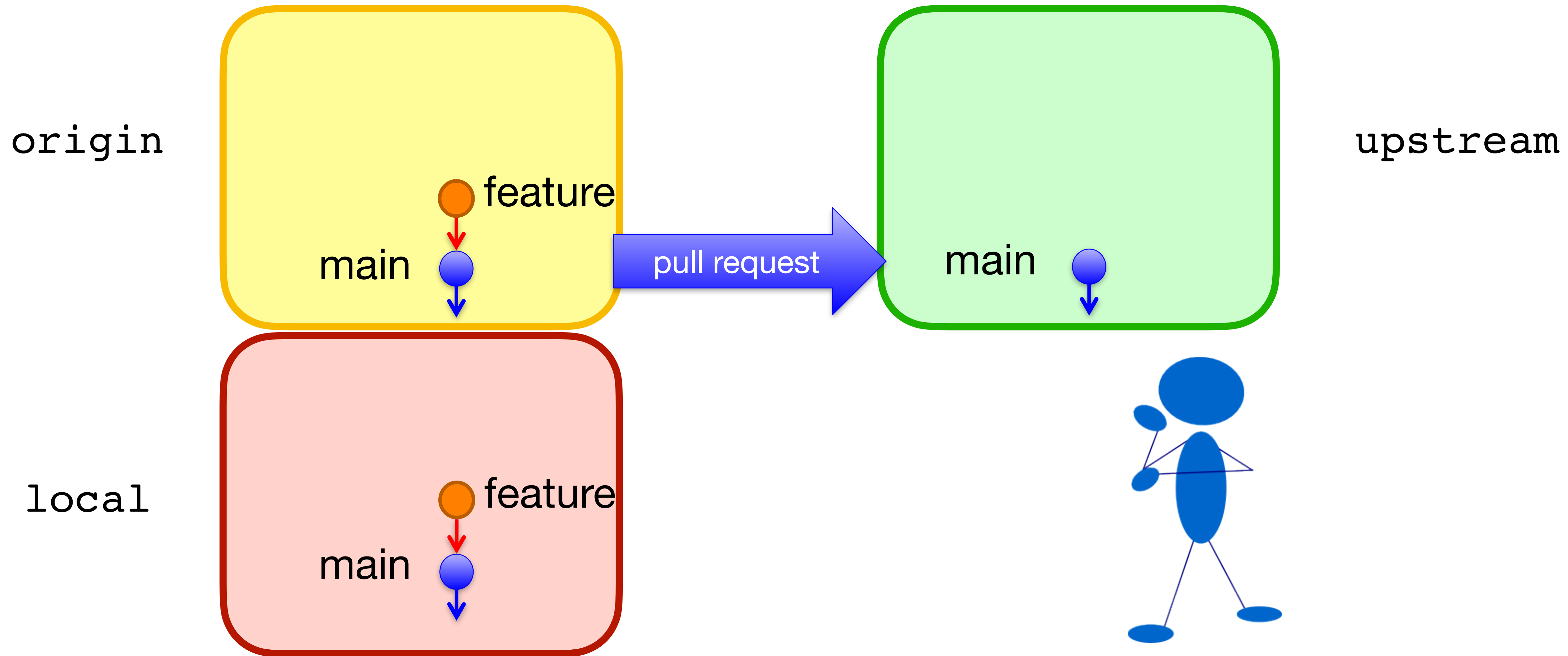
main



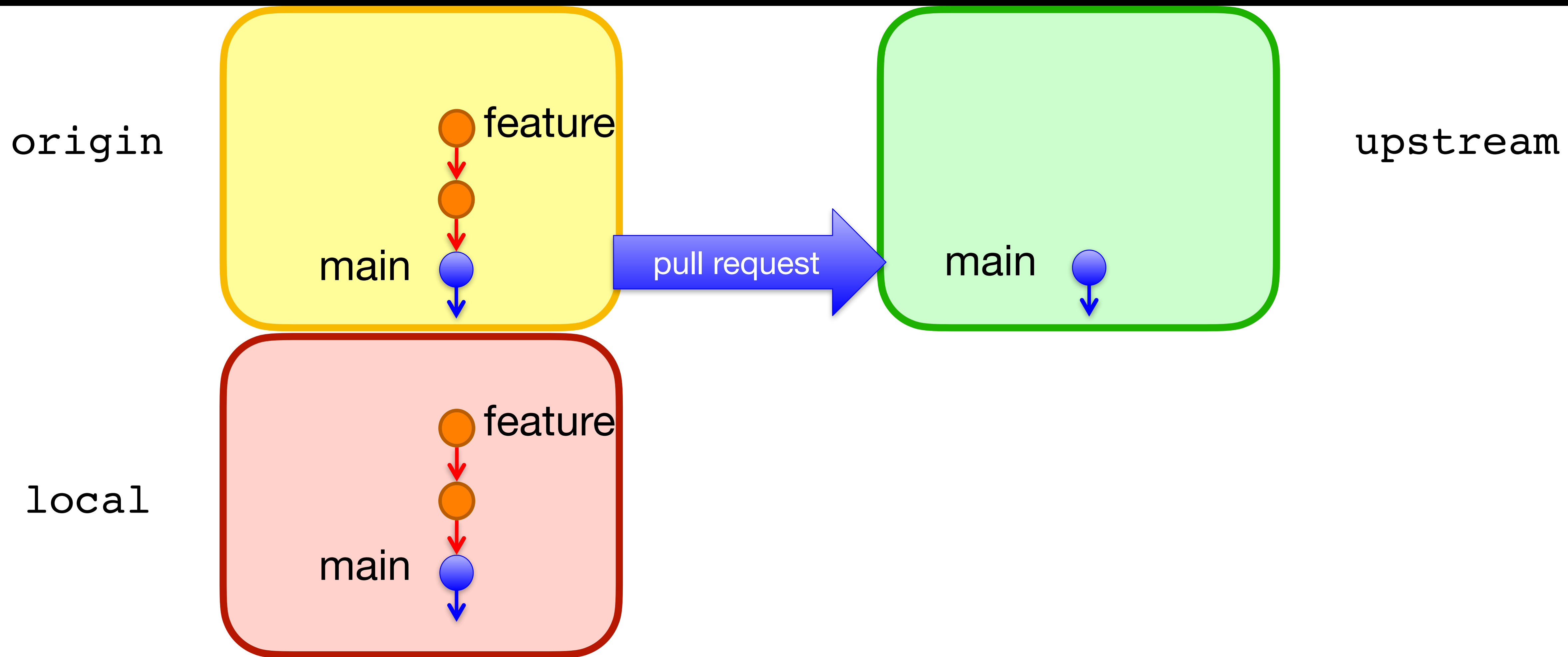
local



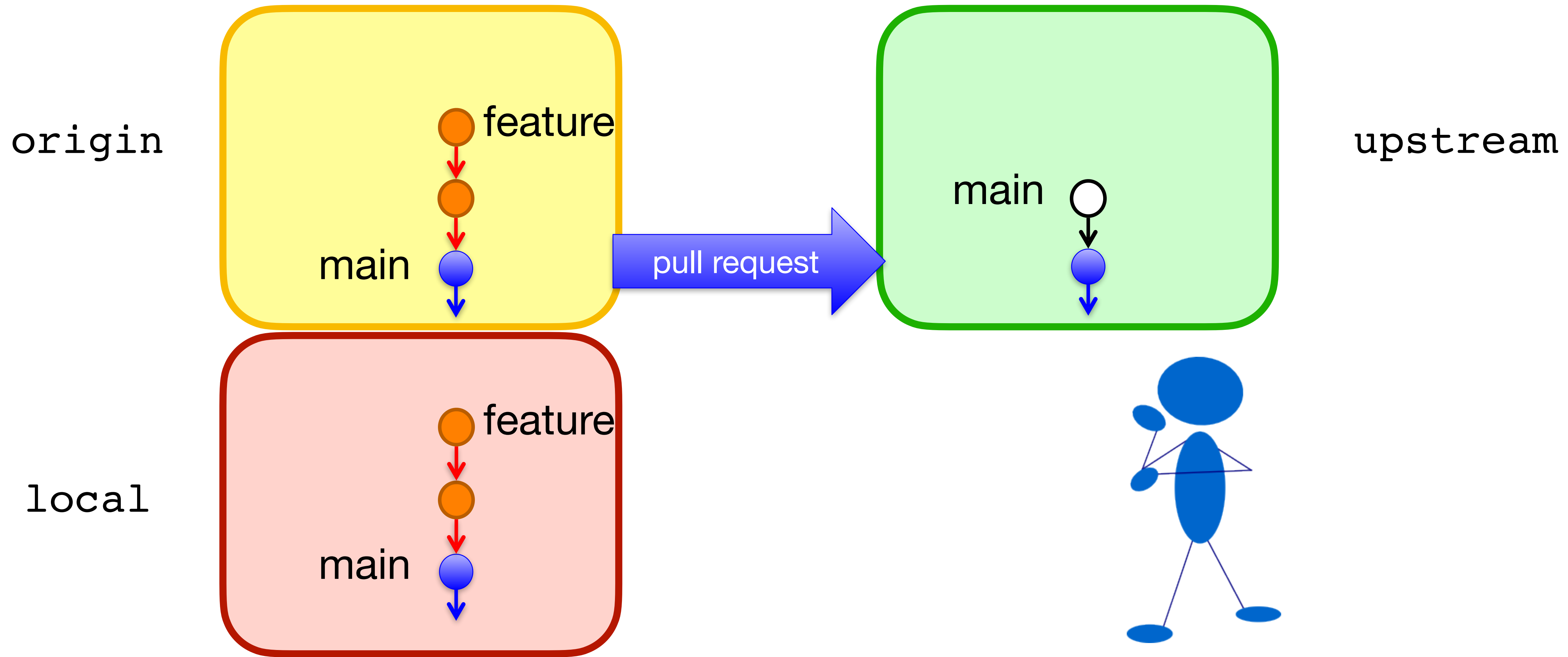
Great idea, now can you do it more like this?



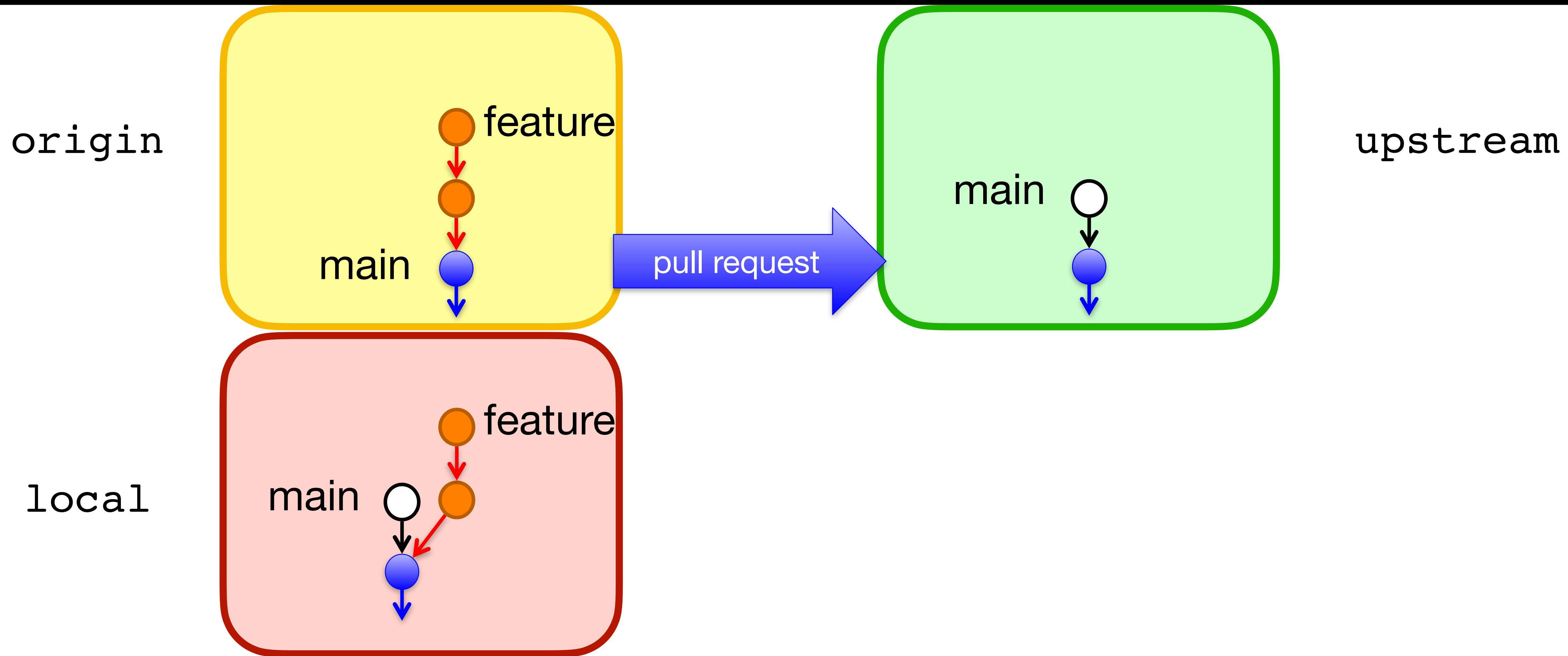
```
$ git commit  
$ git push
```



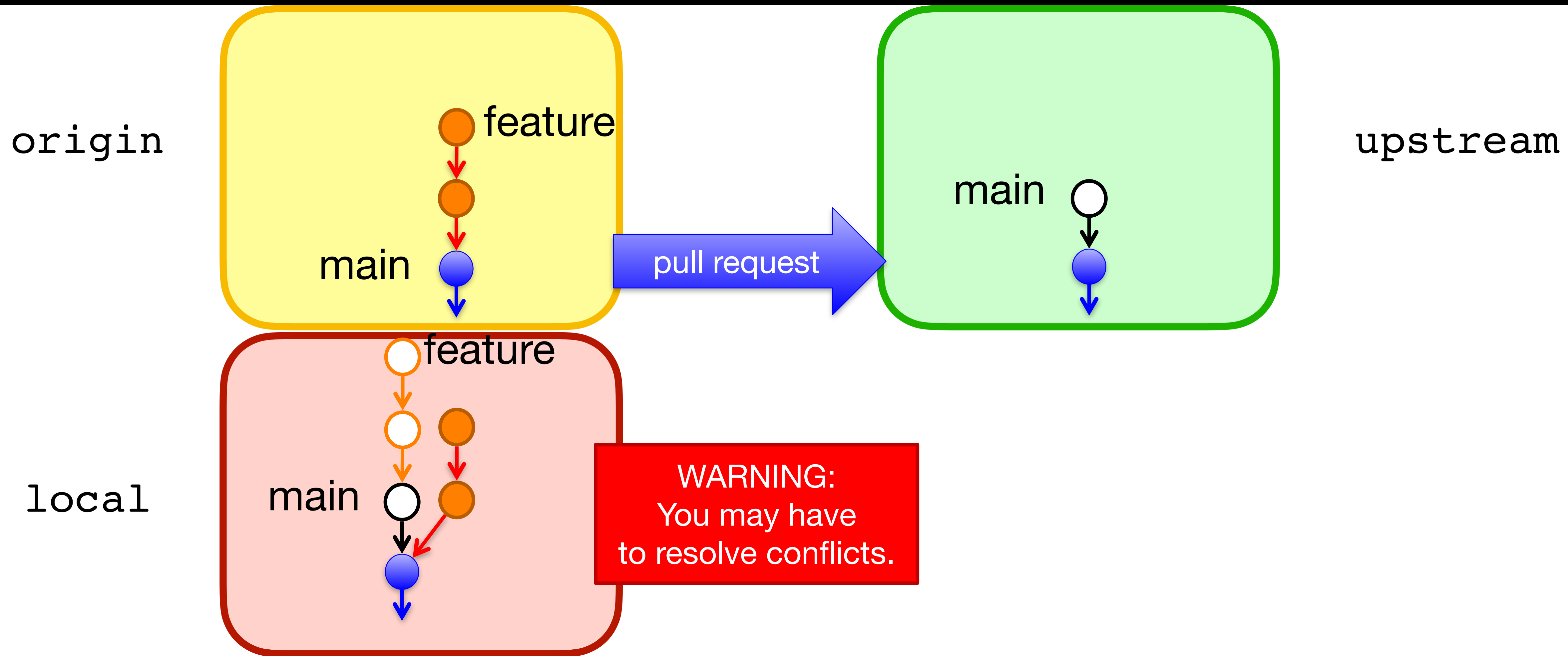
Awesome, but please update with new changes in main



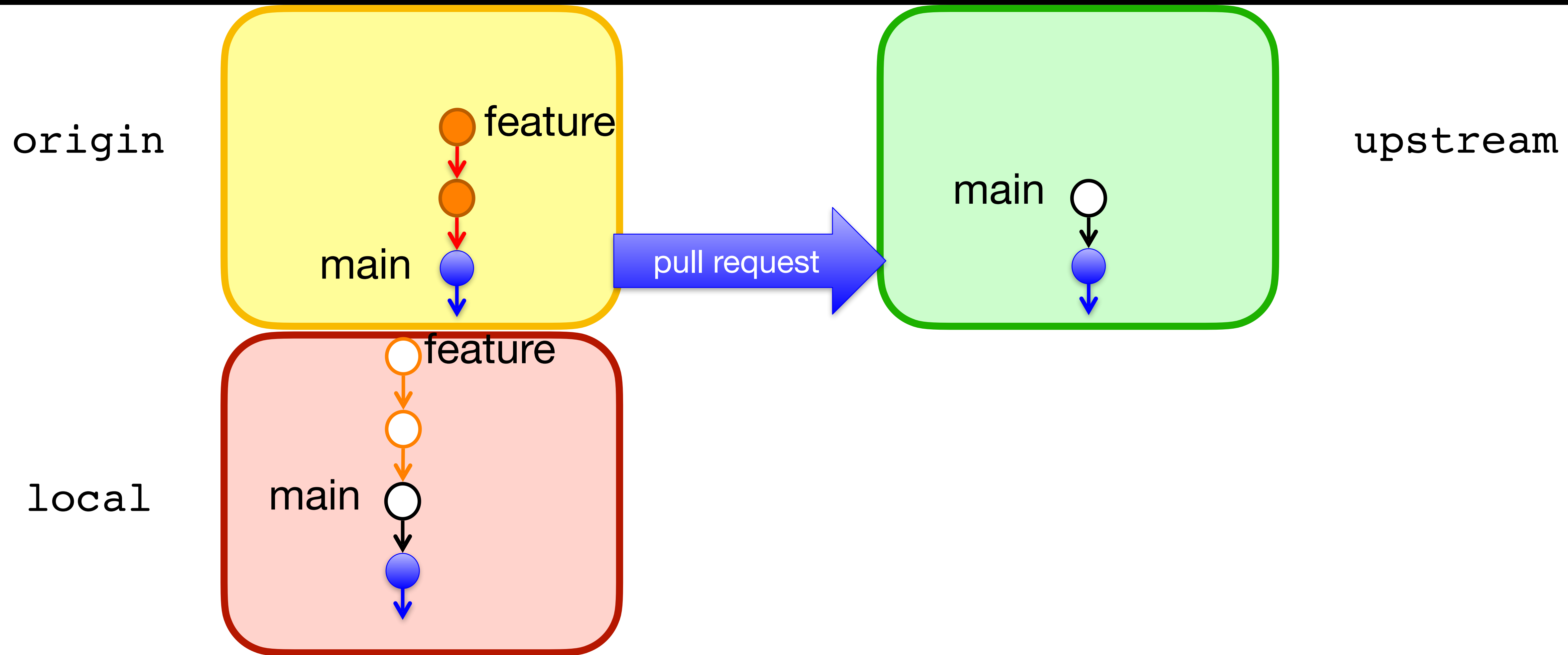
```
$ git remote add upstream https://github.com/..  
$ git fetch upstream main:main
```



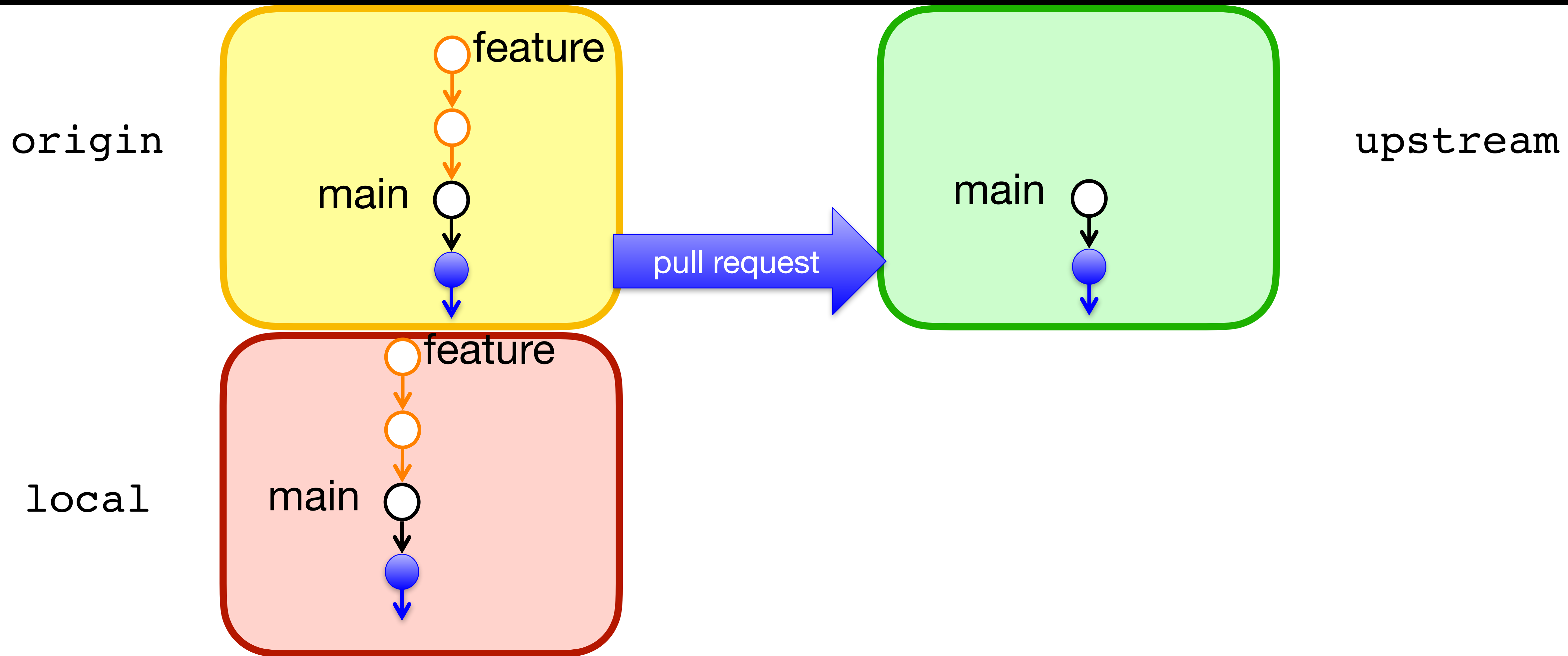
```
$ git rebase main
```



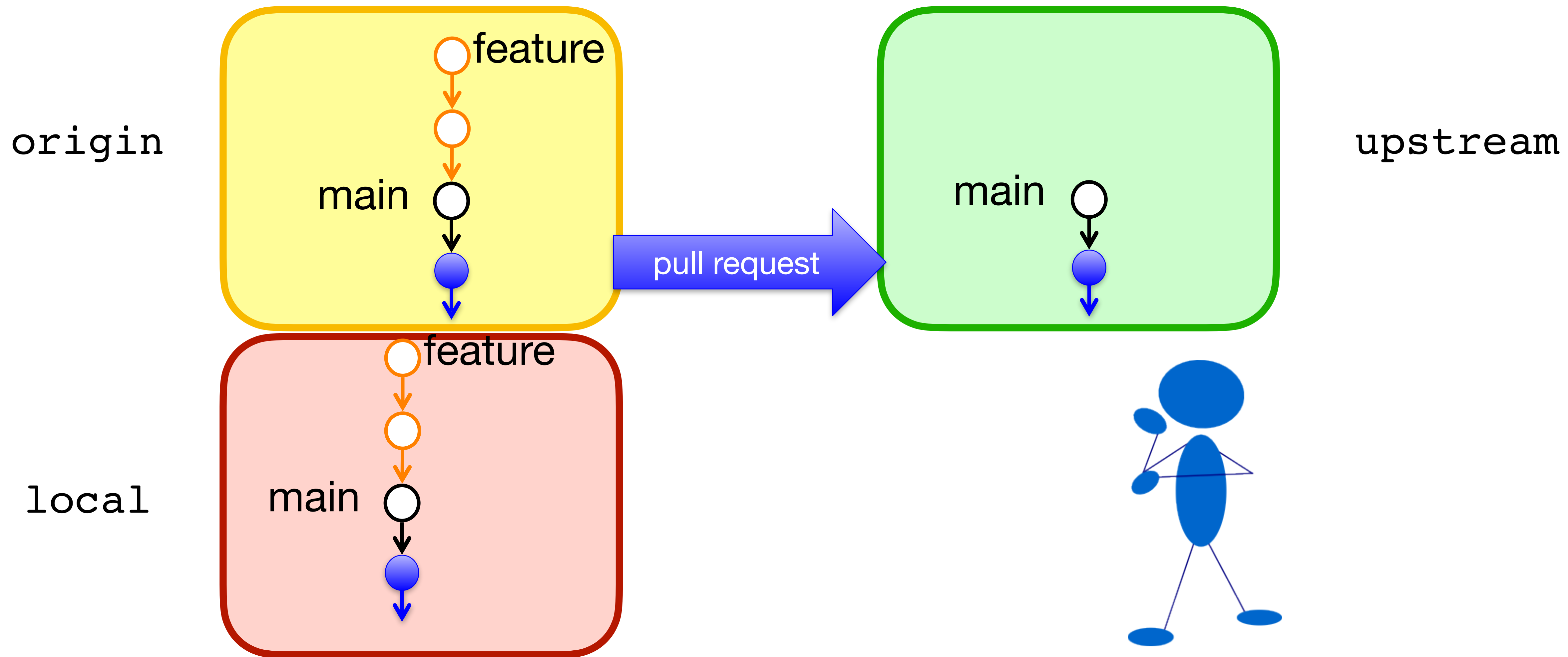
```
$ git rebase main
```



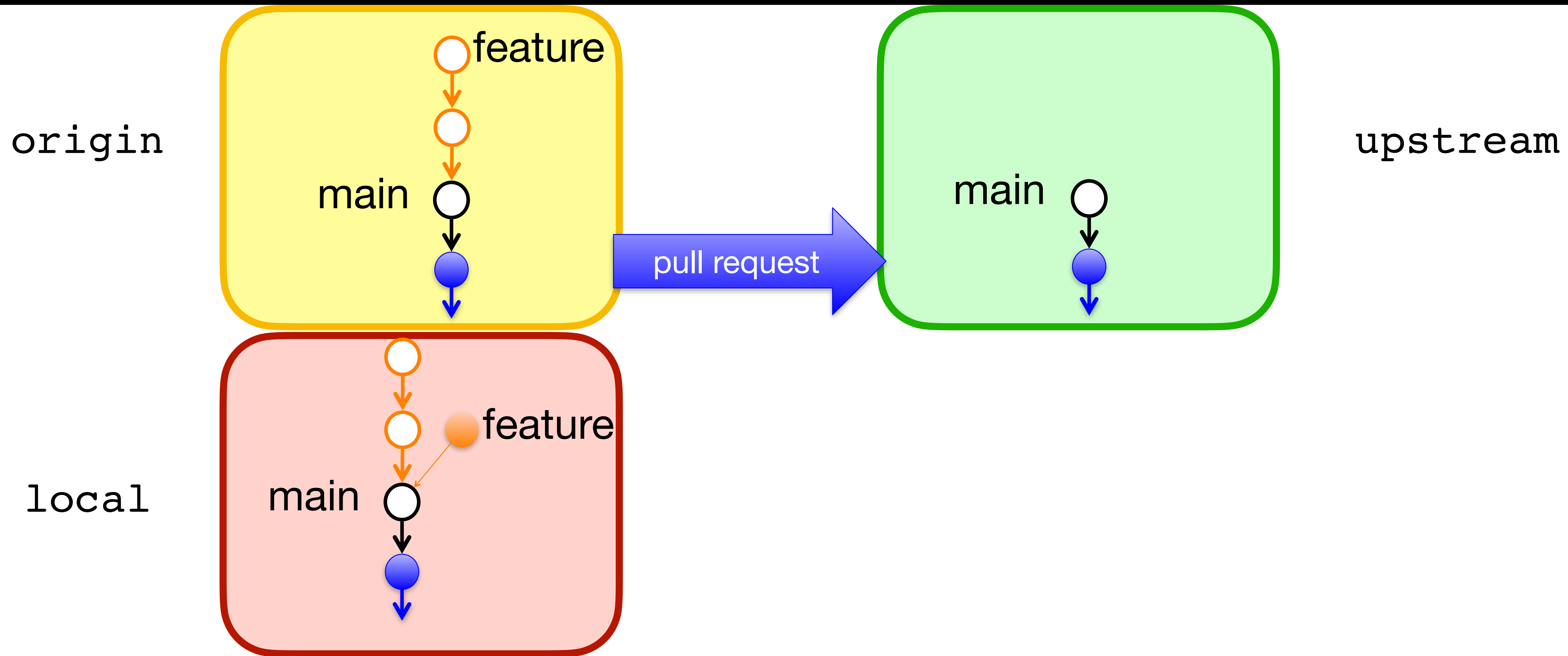

```
$ git push -f origin main feature
```



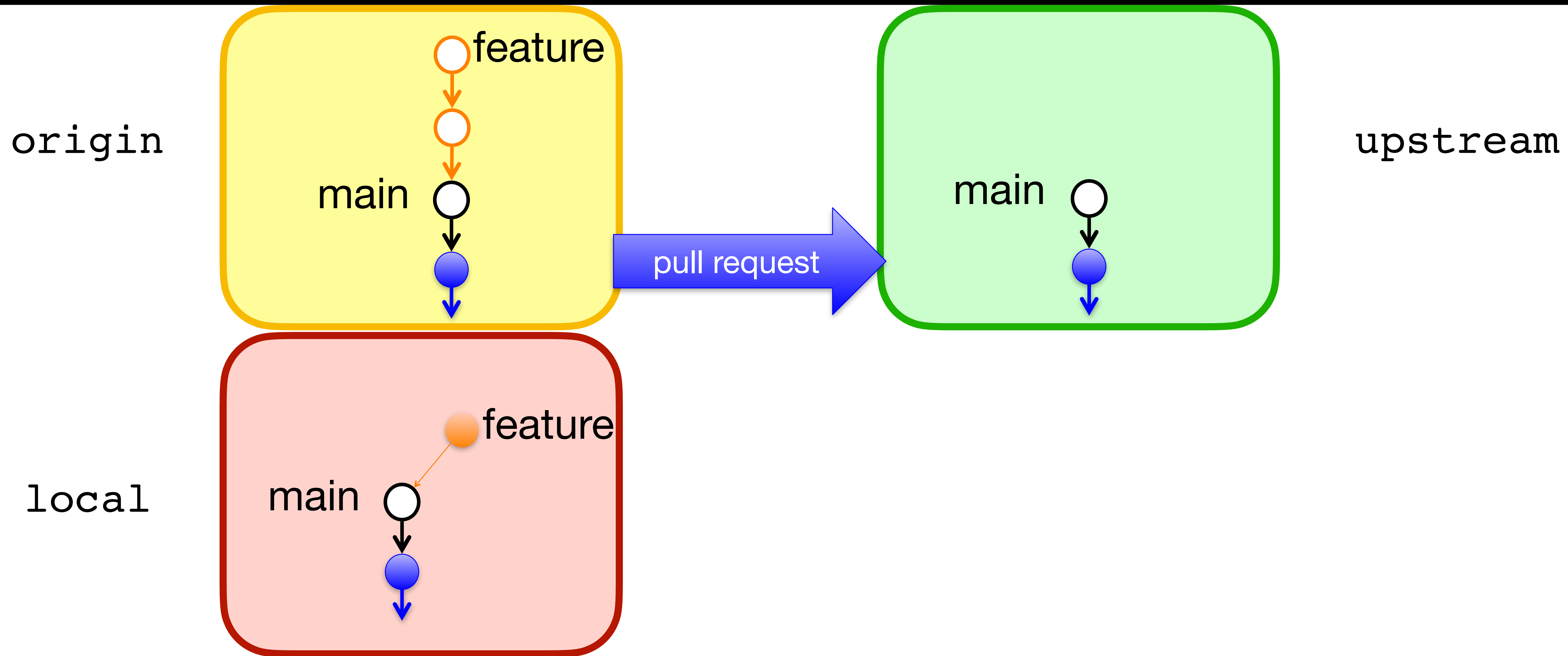
Great. Please squash your commits.



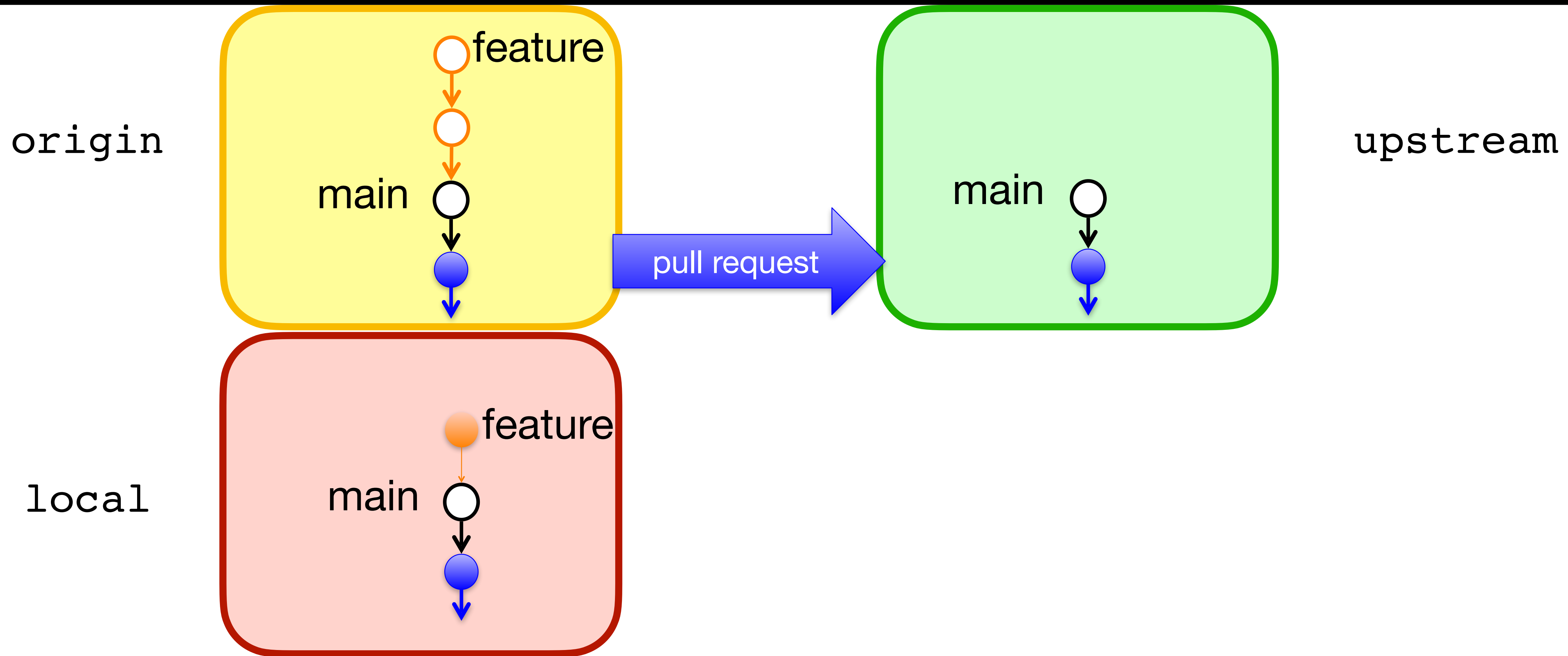
```
$ git rebase -i main
```



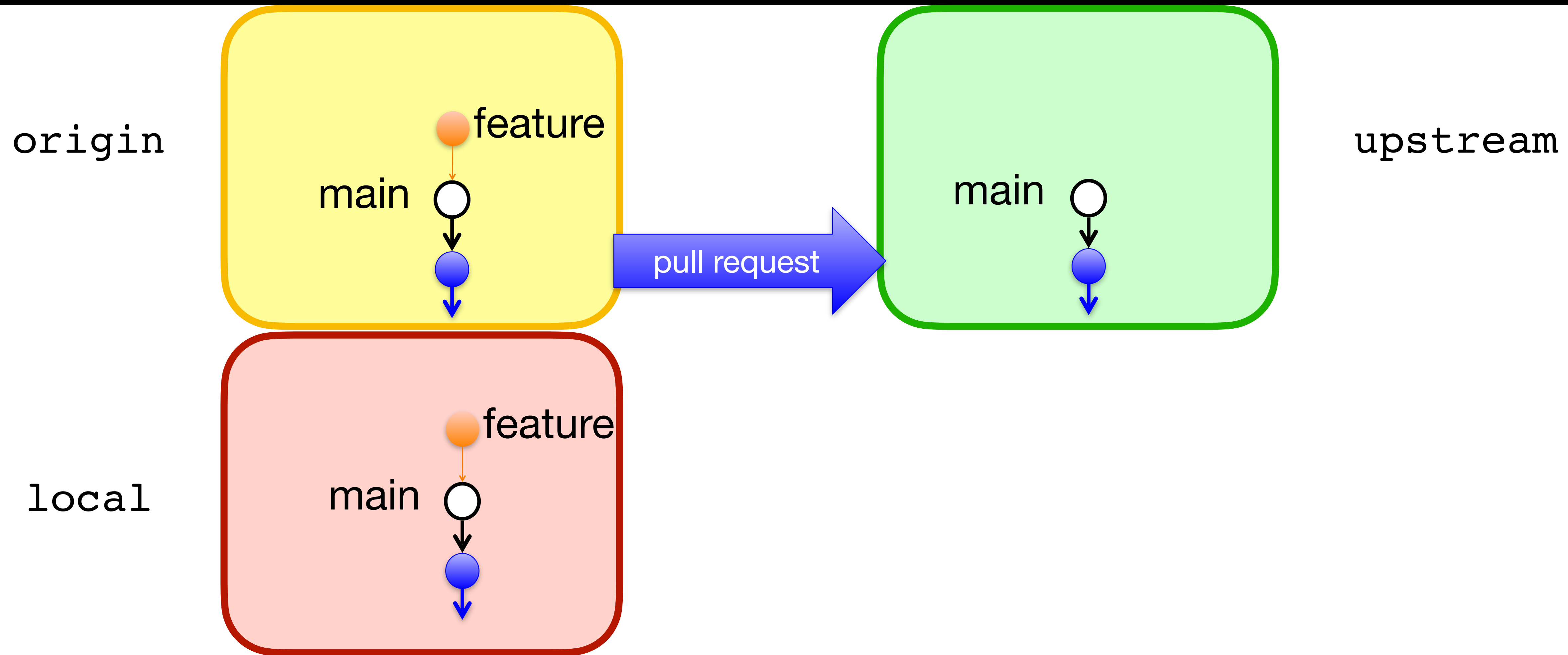
```
$ git rebase -i main
```



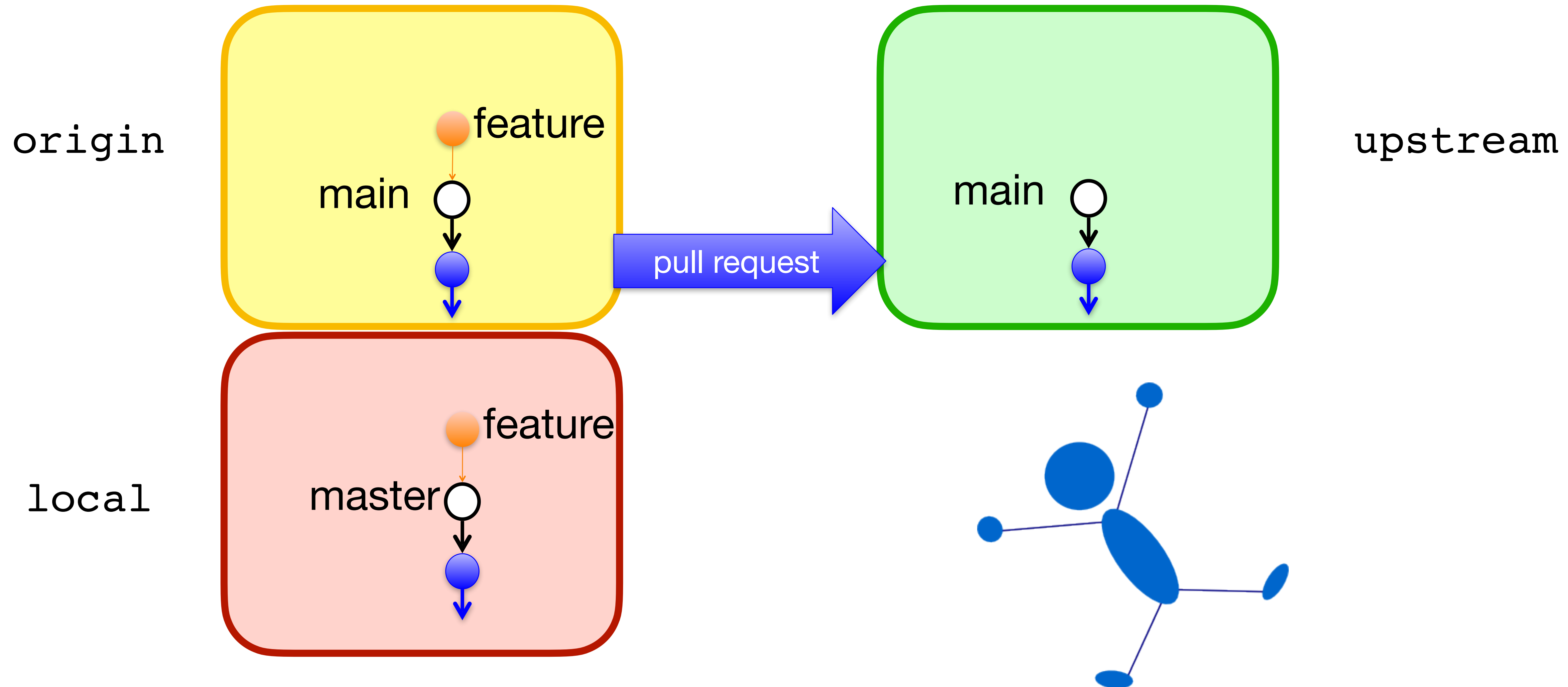
```
$ git rebase -i master
```



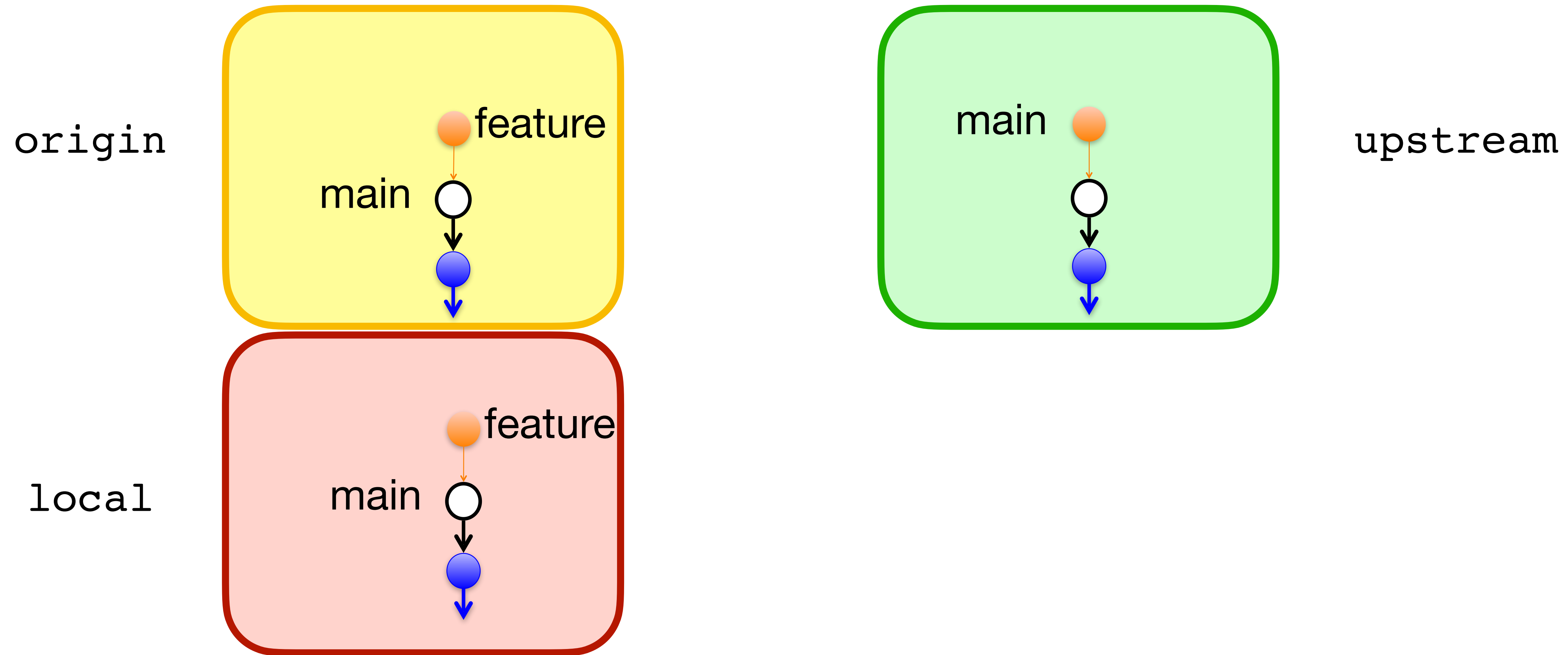
```
$ git push -f origin feature
```



Perfect, I accept!

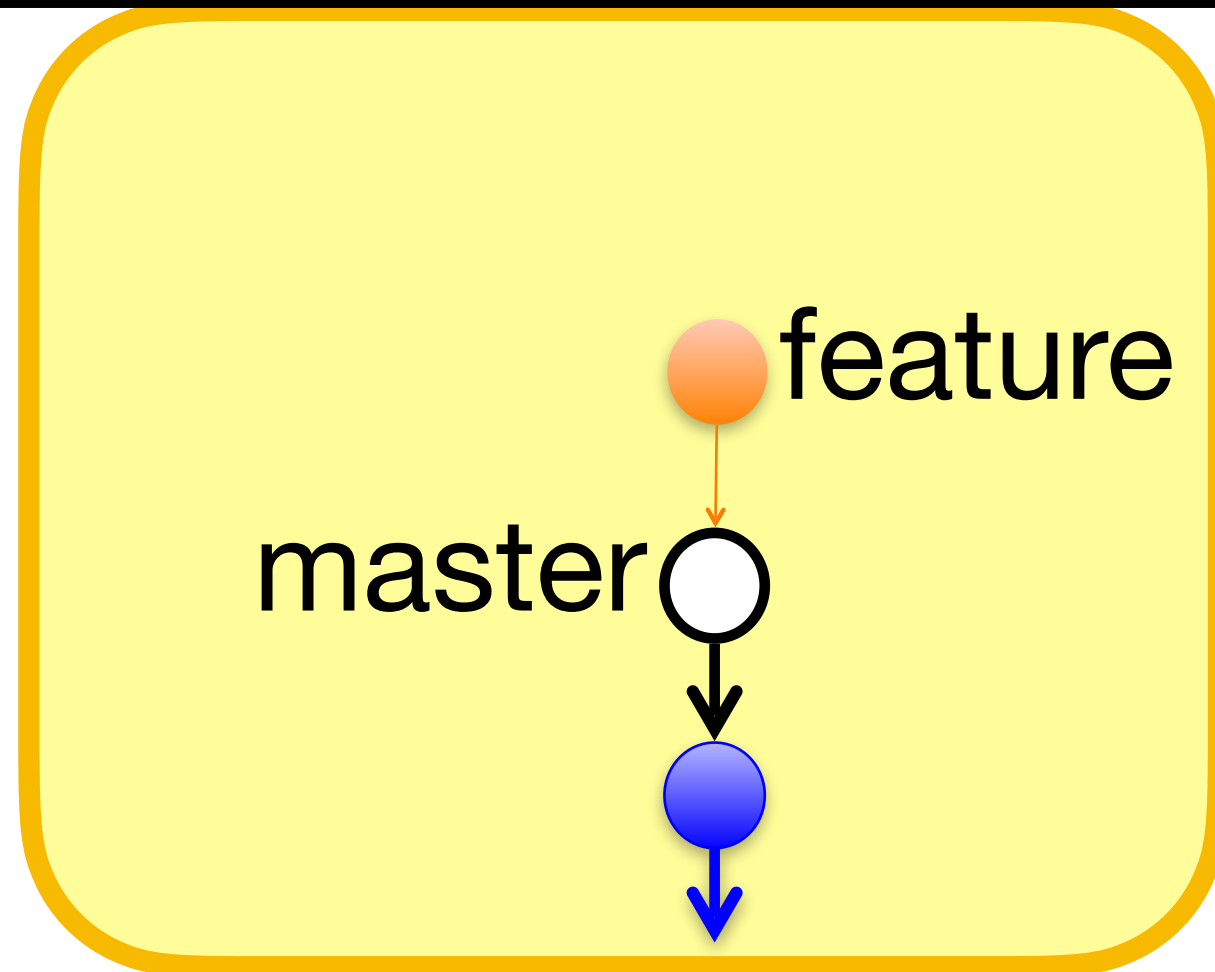


Time to Clean Up

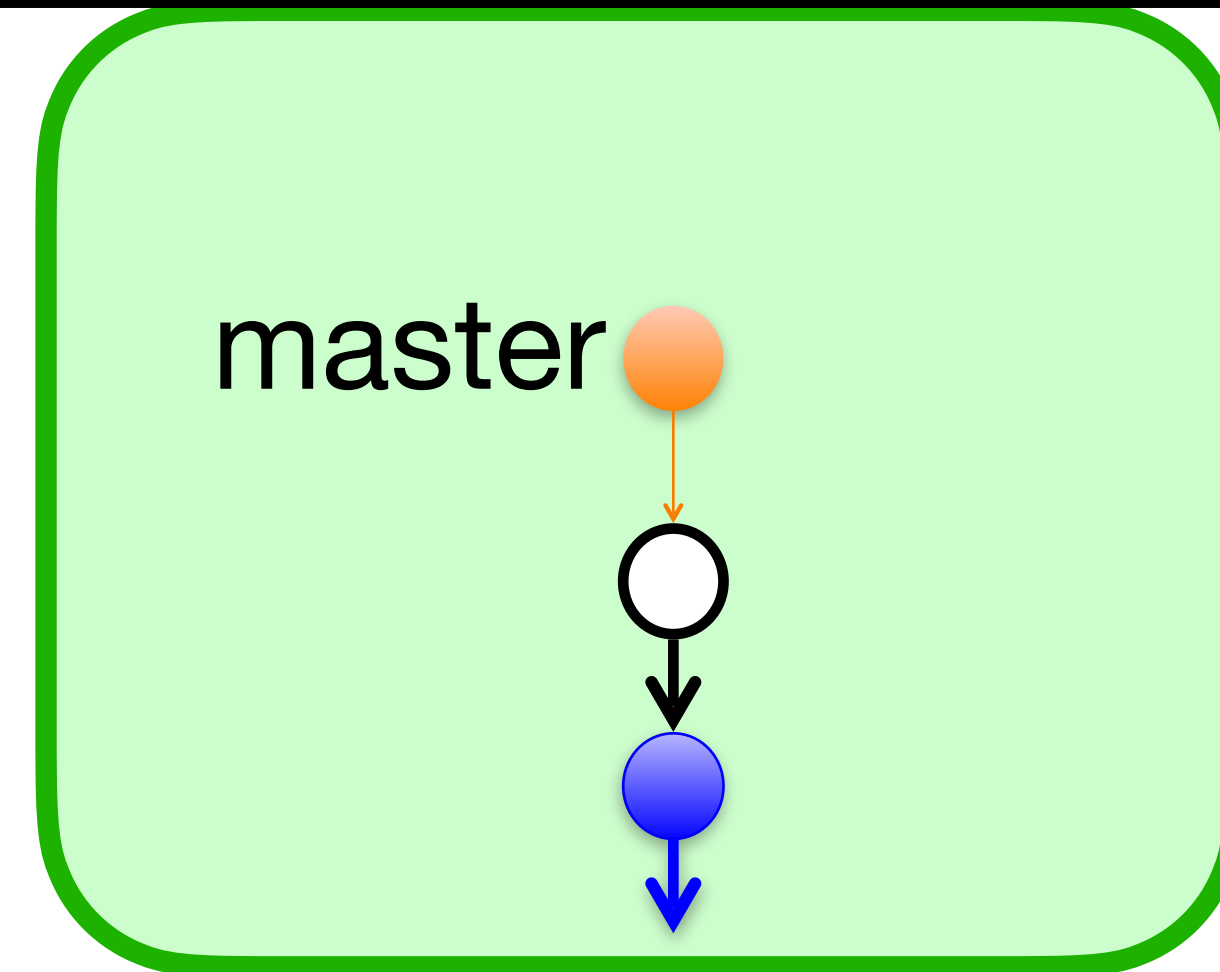



```
$ git fetch upstream main:main
```

origin

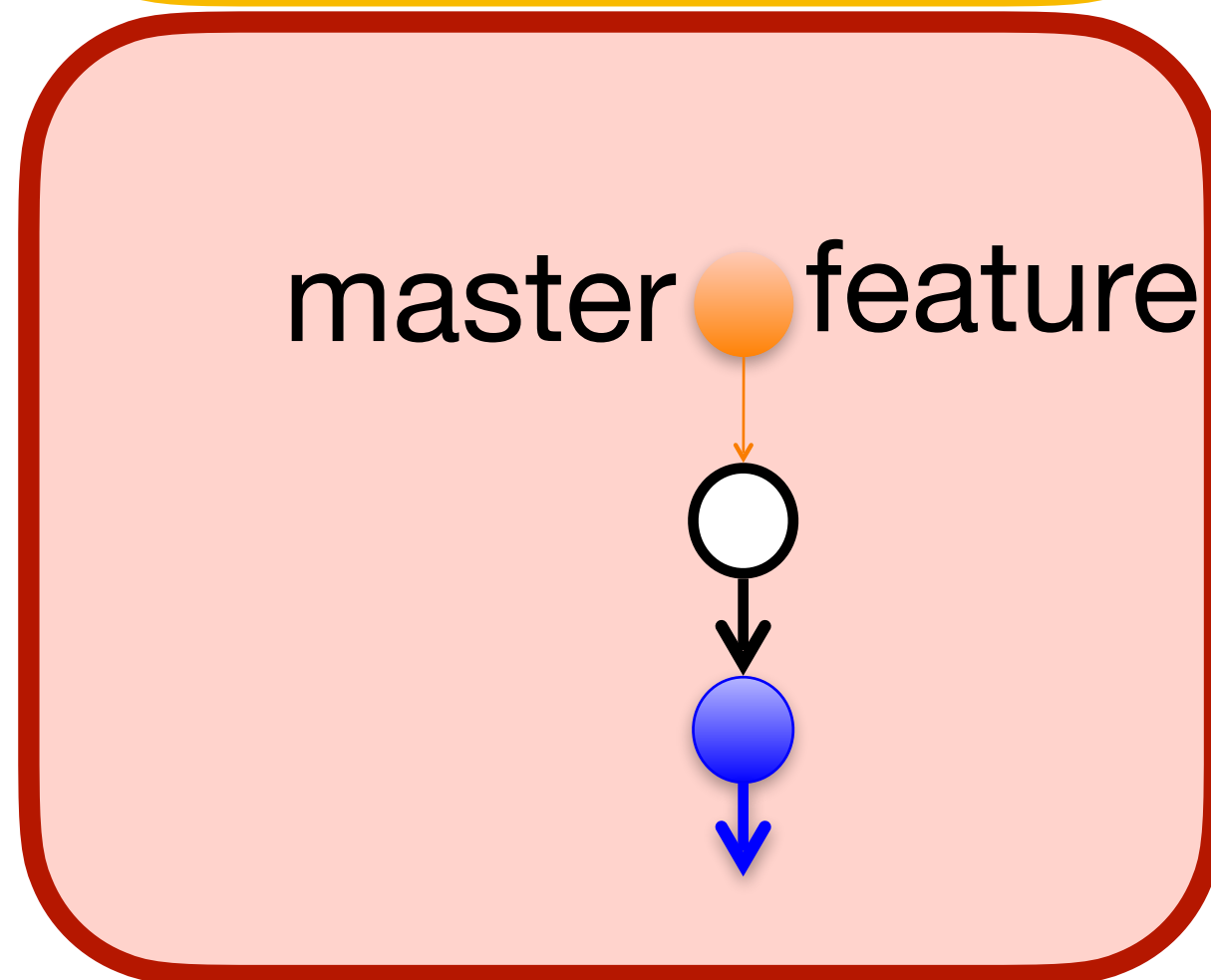


master

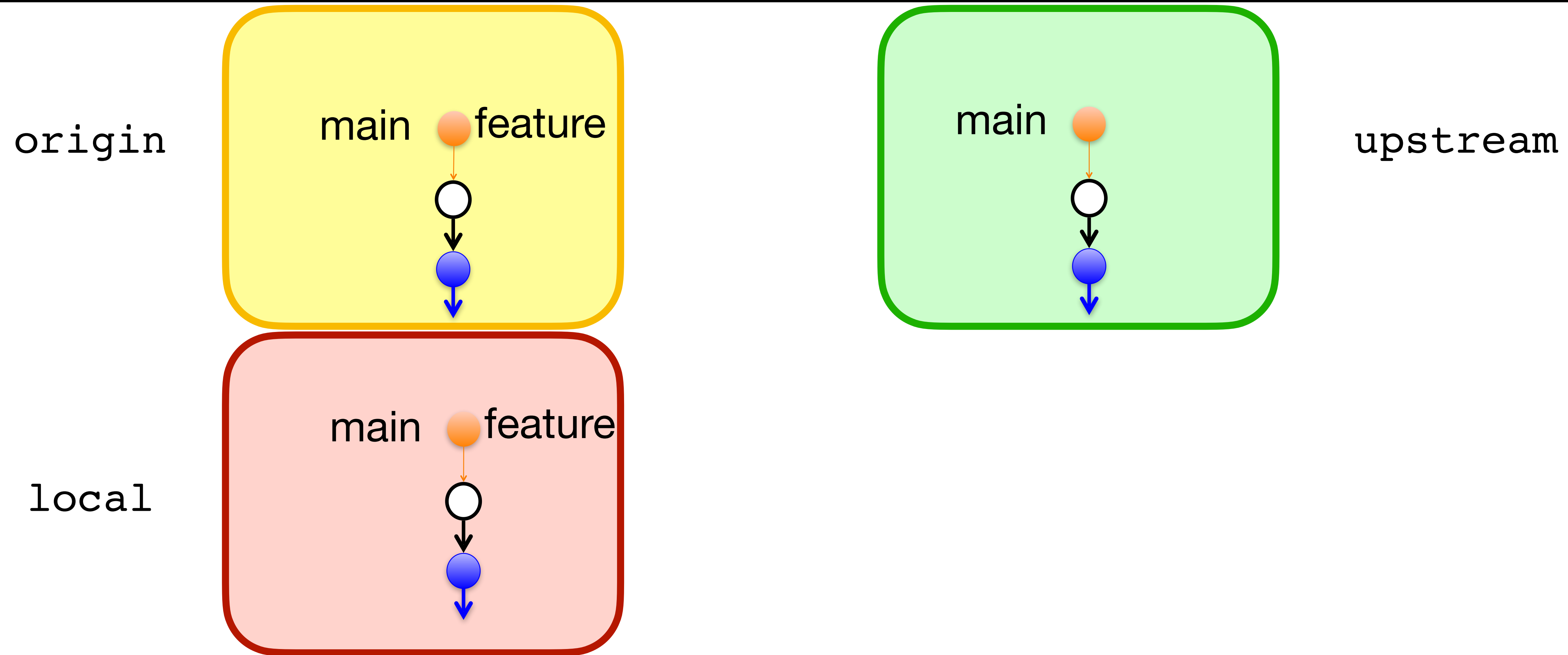


upstream

local



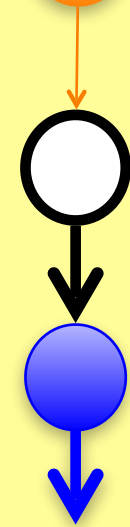
```
$ git push origin main
```



```
$ git checkout main  
$ git branch -d feature
```

origin

main feature



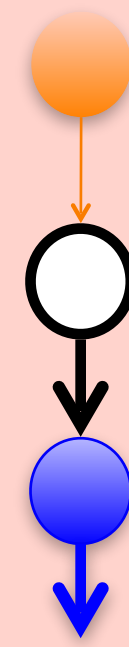
main



upstream

local

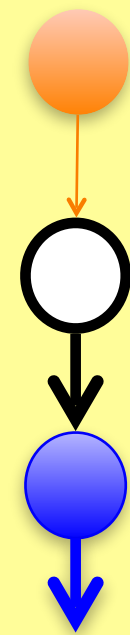
main



```
$ git push origin -d feature
```

origin

main



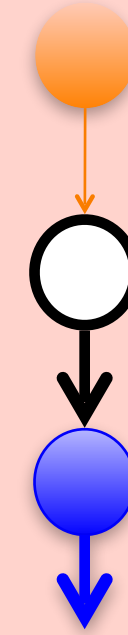
main



upstream

local

main



After a PR is accepted, Github will ask you if you want to delete your feature branch. If you say yes, which branches get deleted?

- A. `feature` — the branch named `feature` in your local repo
- B. `origin/feature` — the branch named `feature` in your remote repo
- C. `upstream/feature` — the branch named `feature` in their remote repo
- D. `feature` and `origin/feature`
- E. `feature`, `origin/feature`, and `upstream/feature`

Now that `origin/feature` has been deleted, how do you delete feature?

- A. `$ git delete feature`
- B. `$ git delete -b feature`
- C. `$ git branch -d feature`
- D. `$ git push origin -d feature`
- E. I would google "delete a git branch" and then click on <https://stackoverflow.com/questions/2003505/how-do-i-delete-a-git-branch-locally-and-remotely> like every other programmer