Code Versioning

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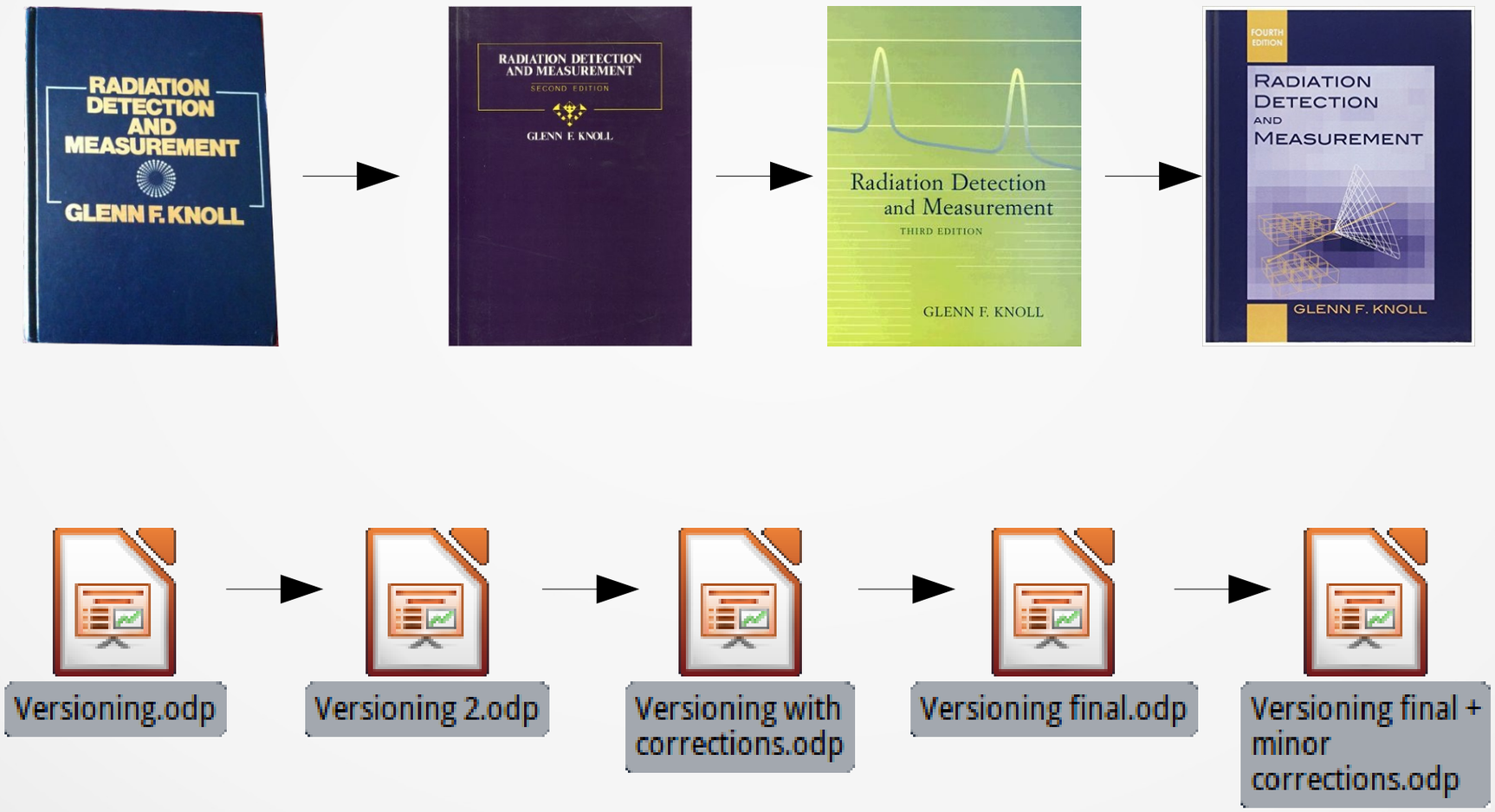
based on slides from
Damien Francois (CISM)
Juan Cabrera (NAMUR)
Jonathan Lambrechts (IMMC)
Scott Chalcon (git)

Road Map

- historical perspective
  - various method of code versioning
- Basic of code versioning
  - revision, tracking file, …
- Branch/Workflow
  - Conflict, merging, …
- Online support
  - github/gitlab and similar

What is code versioning



Goal of code versioning

1. History of modification
2. Team Work
3. WorkFlow

Goal of code versioning

1. History of modification

- Possibility to go back in time
  - Undo mistake / debugging /…
- Information about the modification
  - Who
  - When
  - Why

Goal of code versioning

2. Team Work

- **Simultaneous** work on a project
  - No need to send email to say “I’m working on that file” (dropbox organization)
- **Asynchronous** synchronisation
  - Allow work Offline (opposite to overleaf project)
  - Need conflict resolution

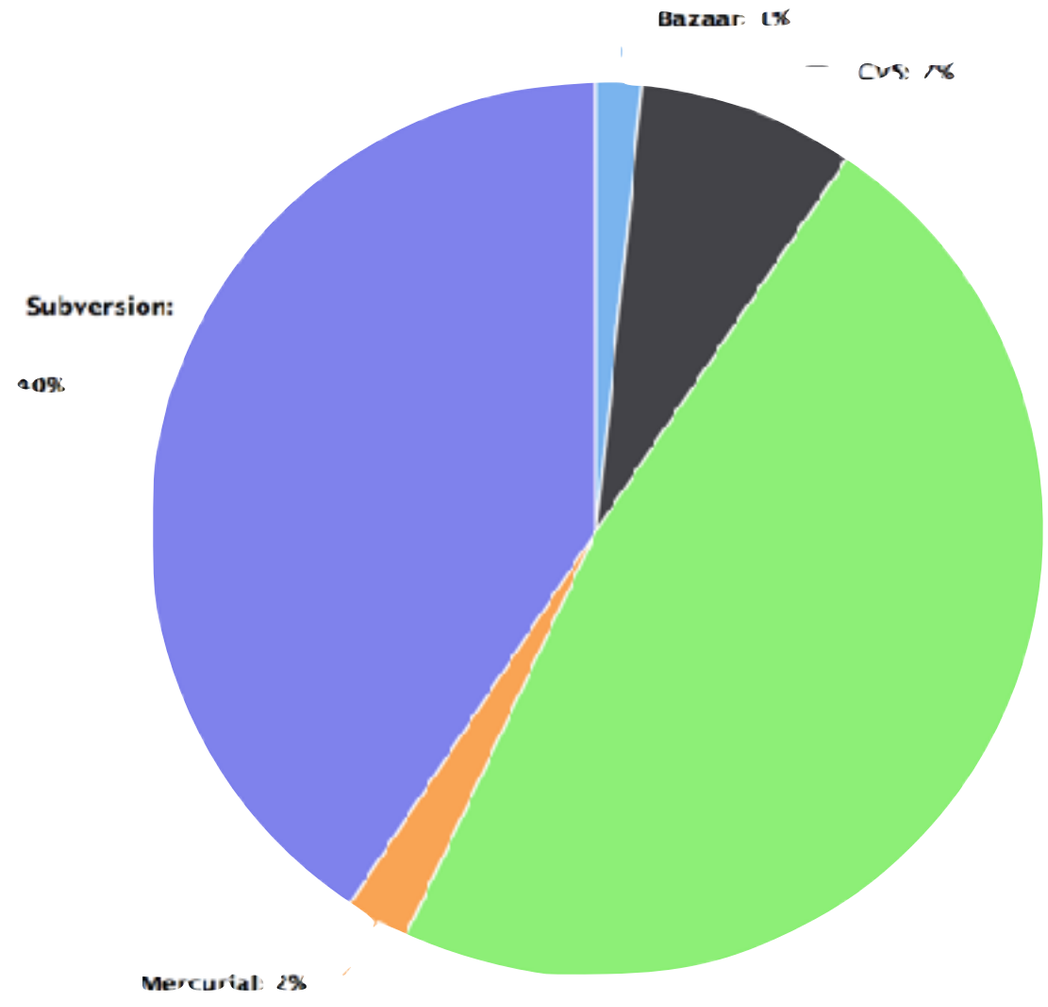
Goal of code versioning

2. Workflow

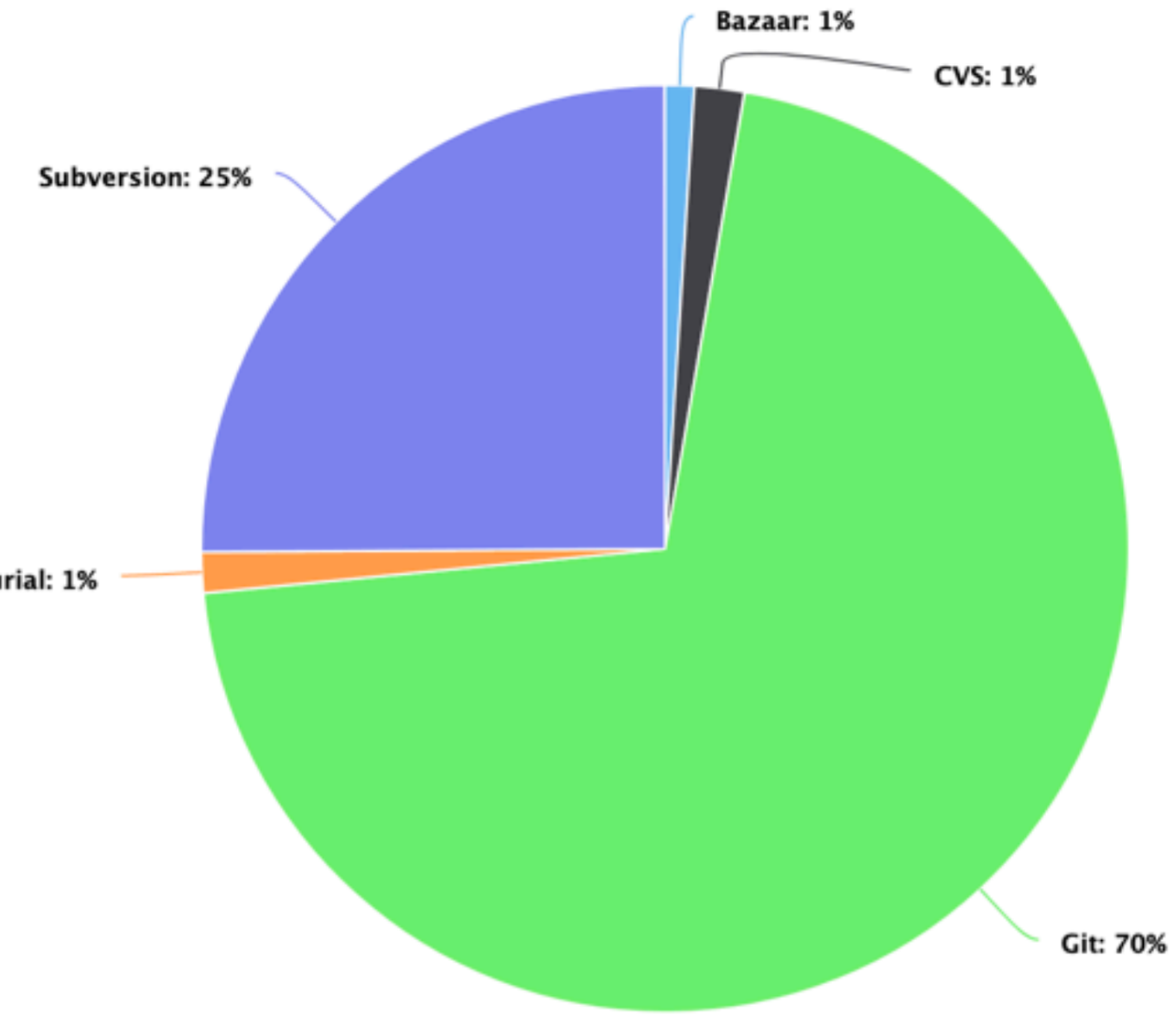
- **Testing new idea** (and easy way to throw them out)
- **Multiple version** of the code
  - Stable (1.x.y)
  - Debug (1.x.y+1)
  - Next “feature” release (1.x+1.0)
  - Next “huge” release (2.0.0)
- Need to pass modification from one version to next
  - Transfer of information between version

Open-Source Code

2017



2019



https://www.openhub.net/repositories/compare

source control taxonomy

delta storage

V1 ← V2

Repository content
Internal storage

V1 Δ_{12}

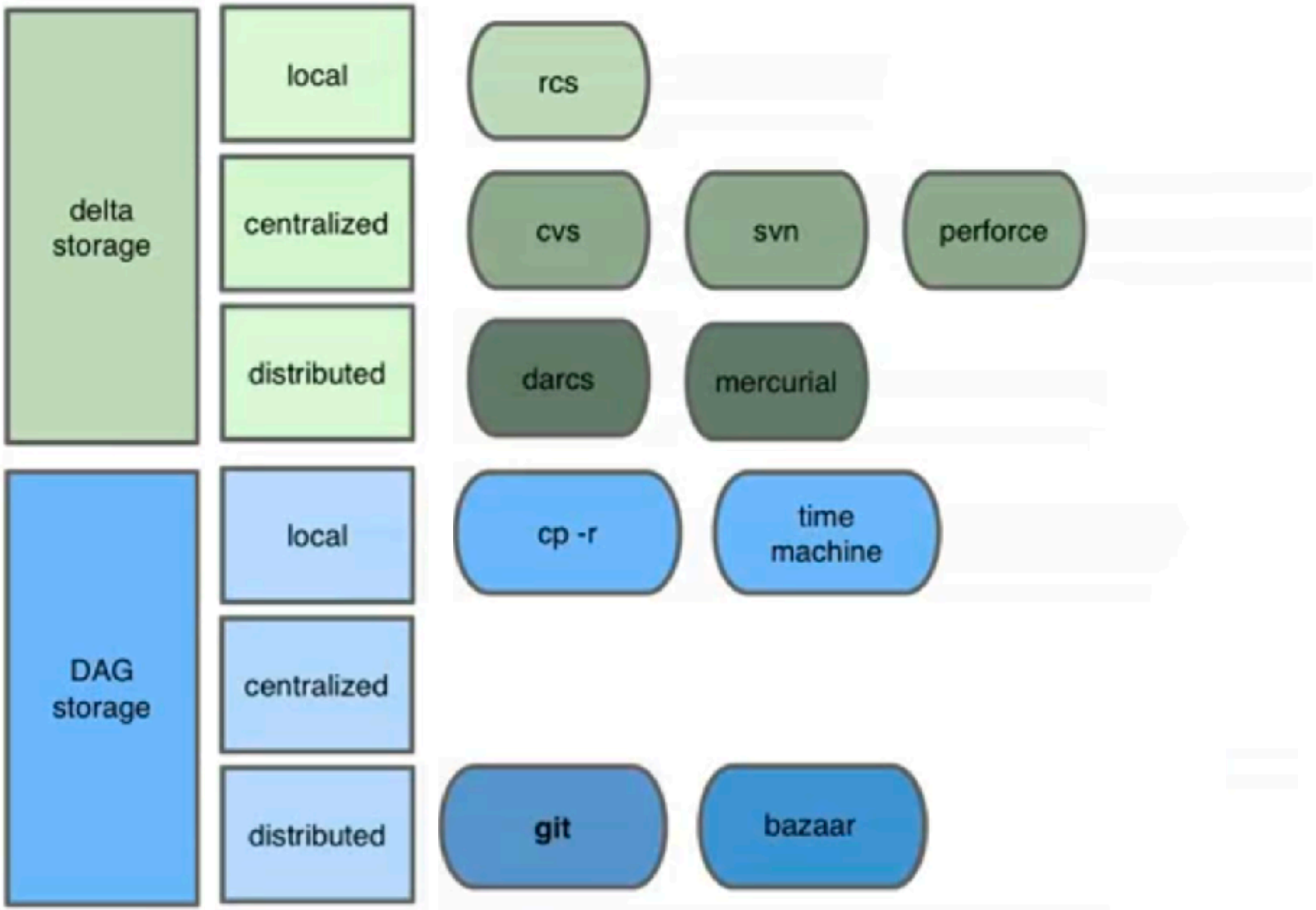
DAG storage

V1 ← V2

V1 V2

Slide from Scott Chalcon

source control taxonomy

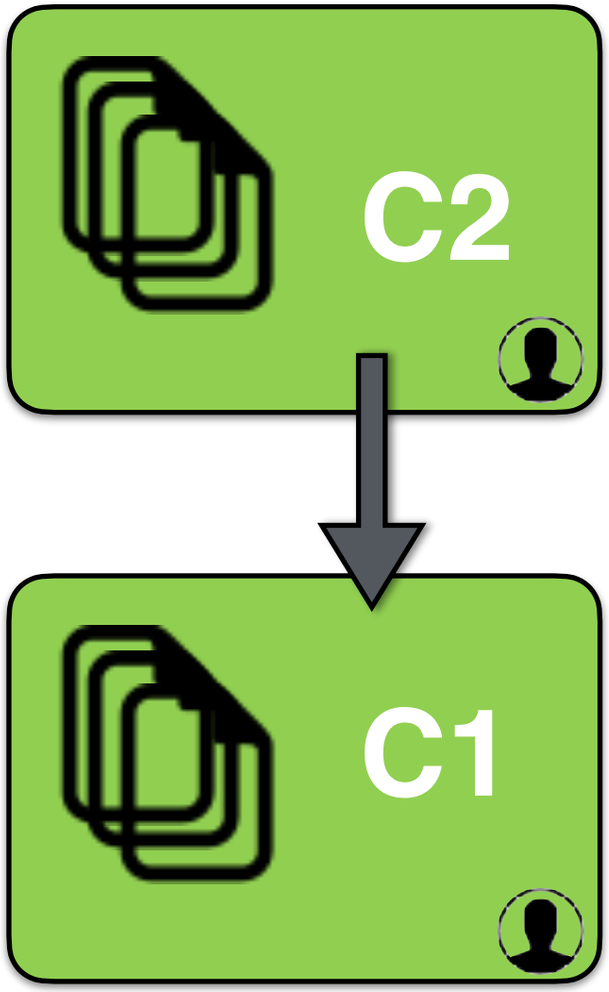


Key Concept

1. History
    1. History and commit
2. Three phases of git
    1. Workspace
    2. Index
    3. Repository

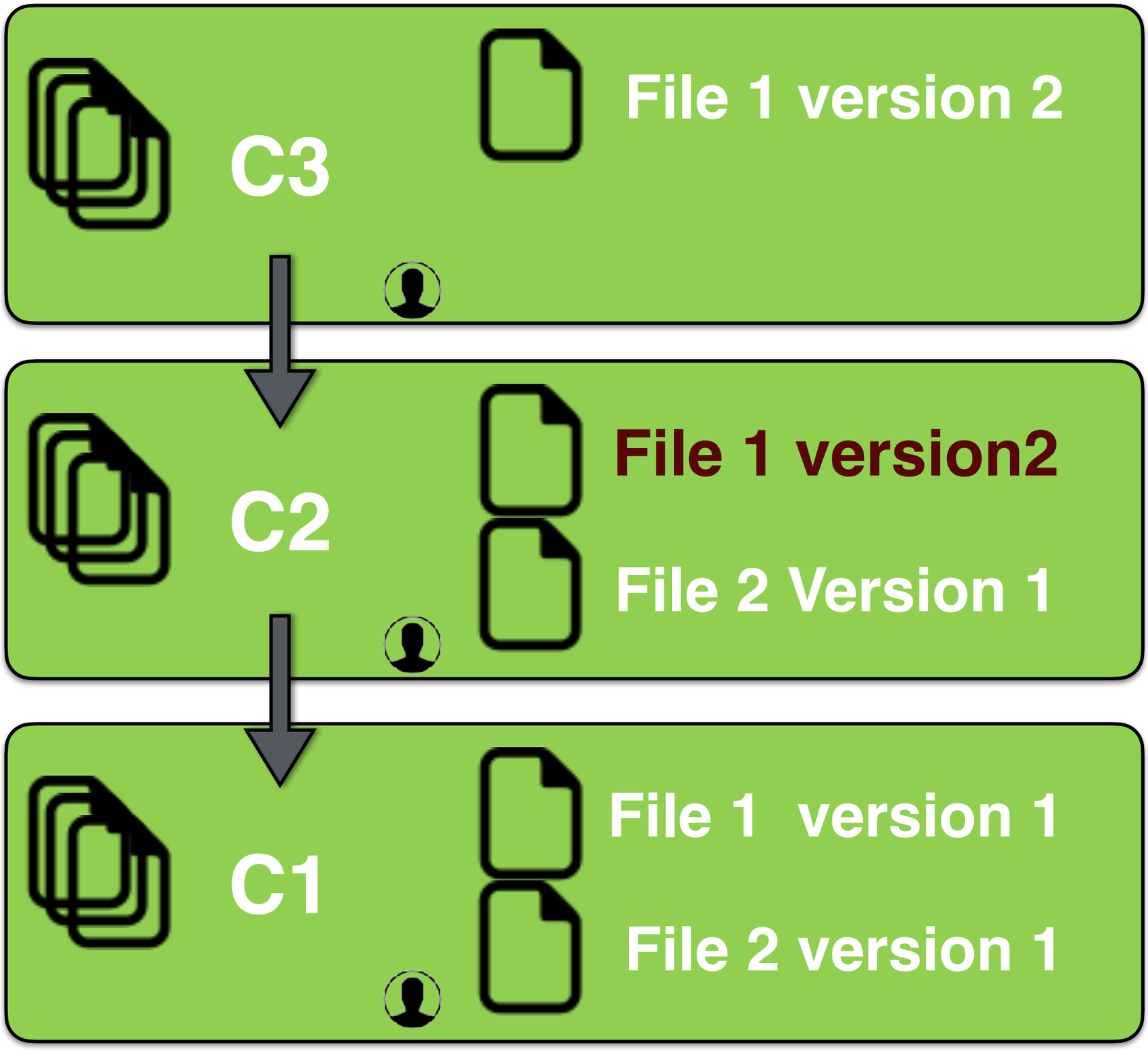
1. Commit

- An history: Is a **succession** of **snapshot** of your files at key time of their development
  - Each **snapshot** is called **COMMIT**



- Commit is
  - All the files at a given time
  - A unique name (SLHA1)
  - MetaData (who created/when/info)
  - Pointer to previous(es) commit

1. Commit


C3
File 1 version 2
Remove file 2
C2
File 1 version2
File 2 Version 1
Edit file 1
C1
File 1 version 1
File 2 version 1

1. Commit

1. Simplify representation of commit/history

Git Three area

Workspace

Index

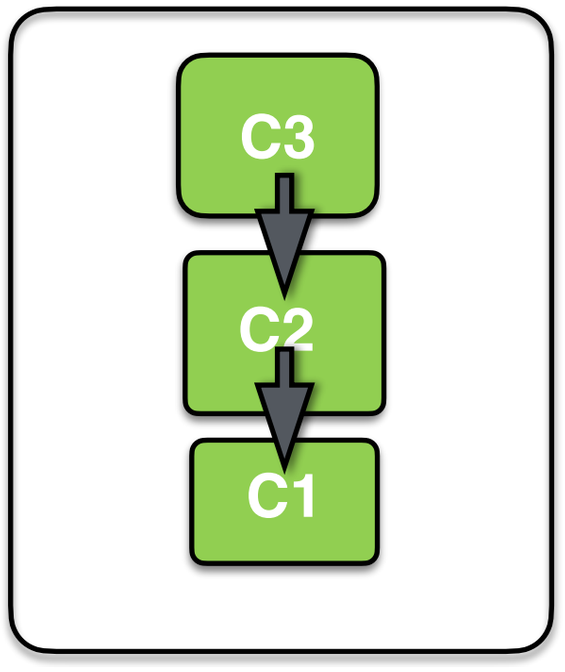
Repository

./WORKDIR

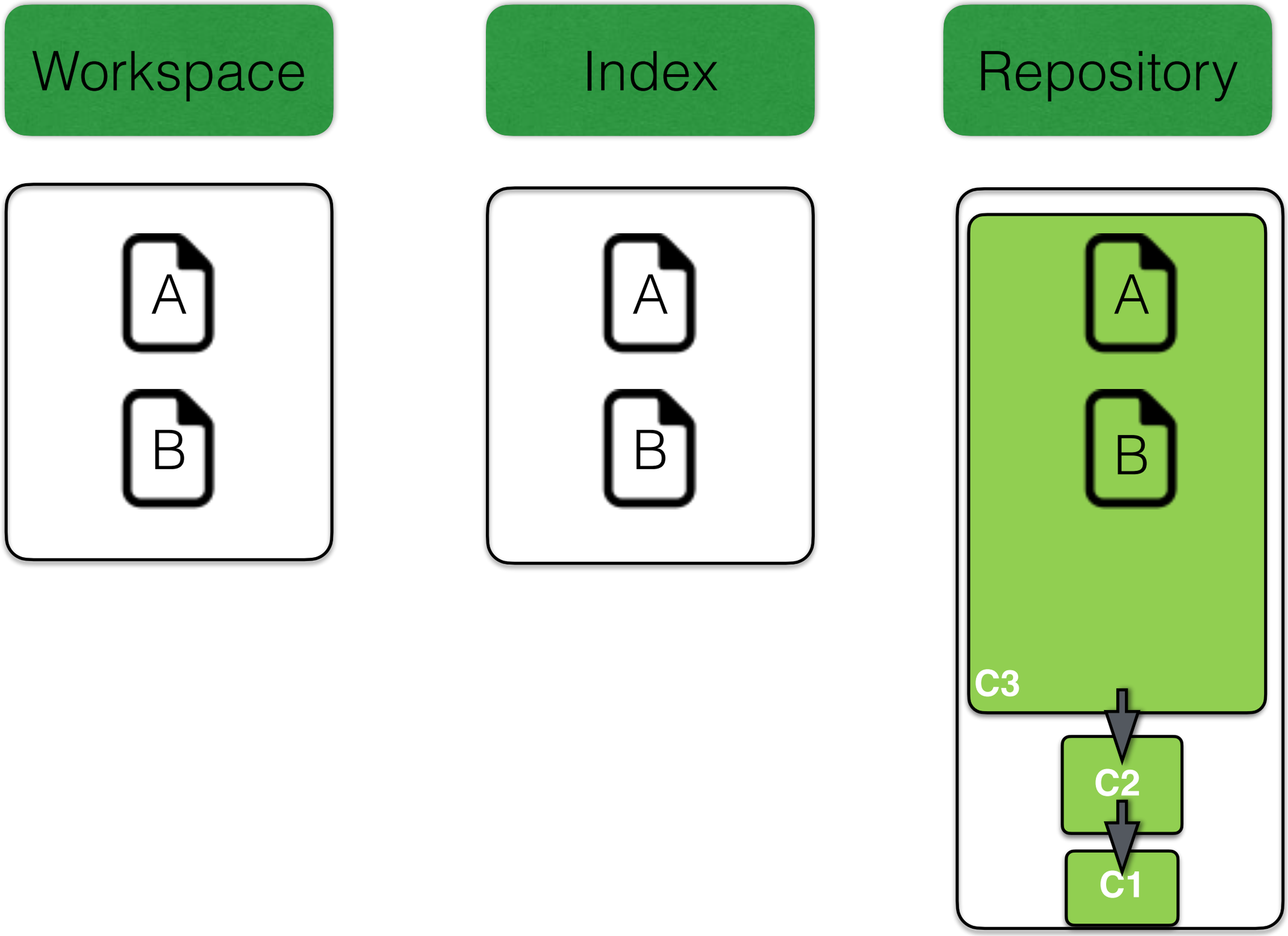
.git/index

Staging area

.git/

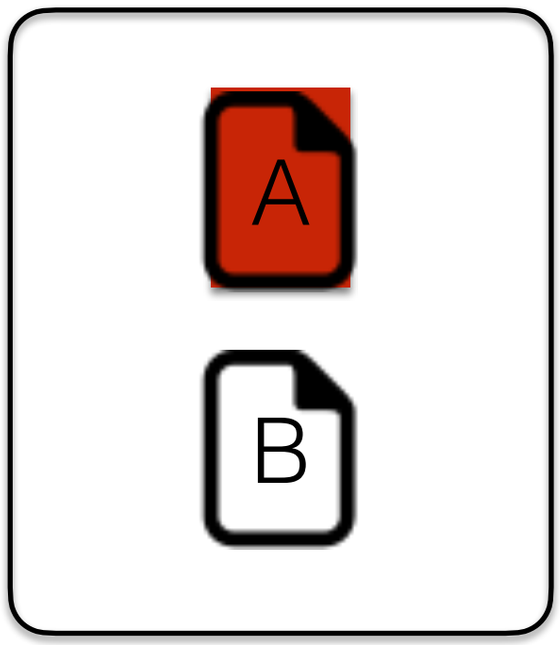


Git Three area

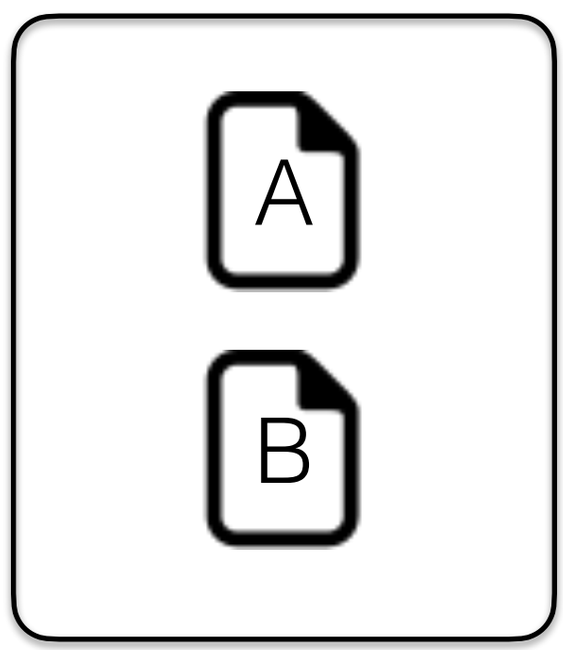


Git Three area

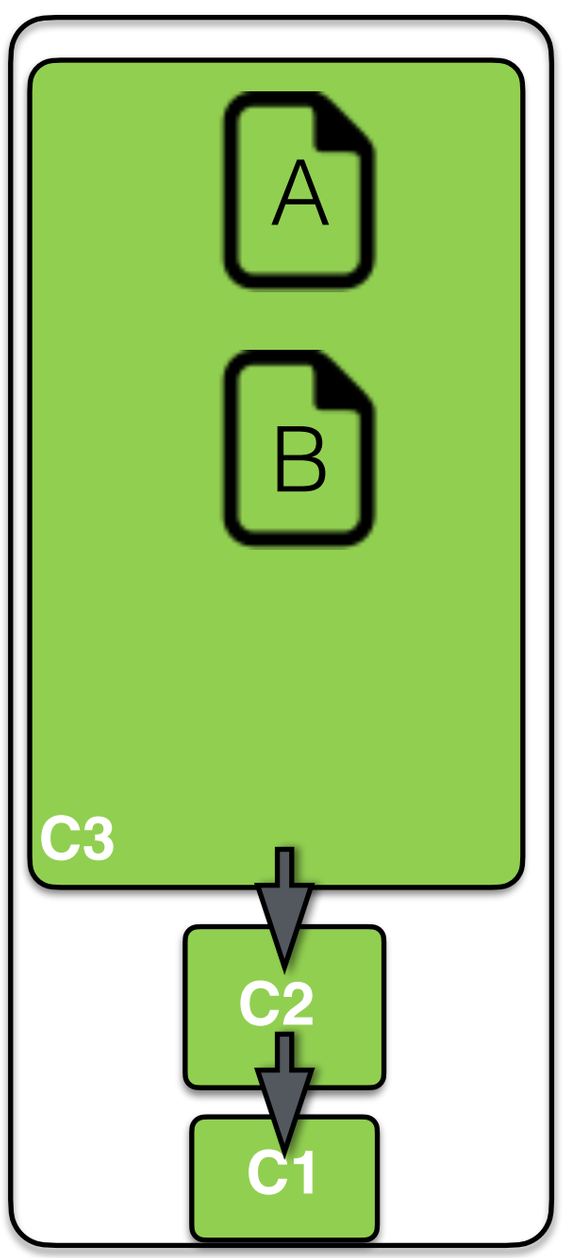
Workspace



Index



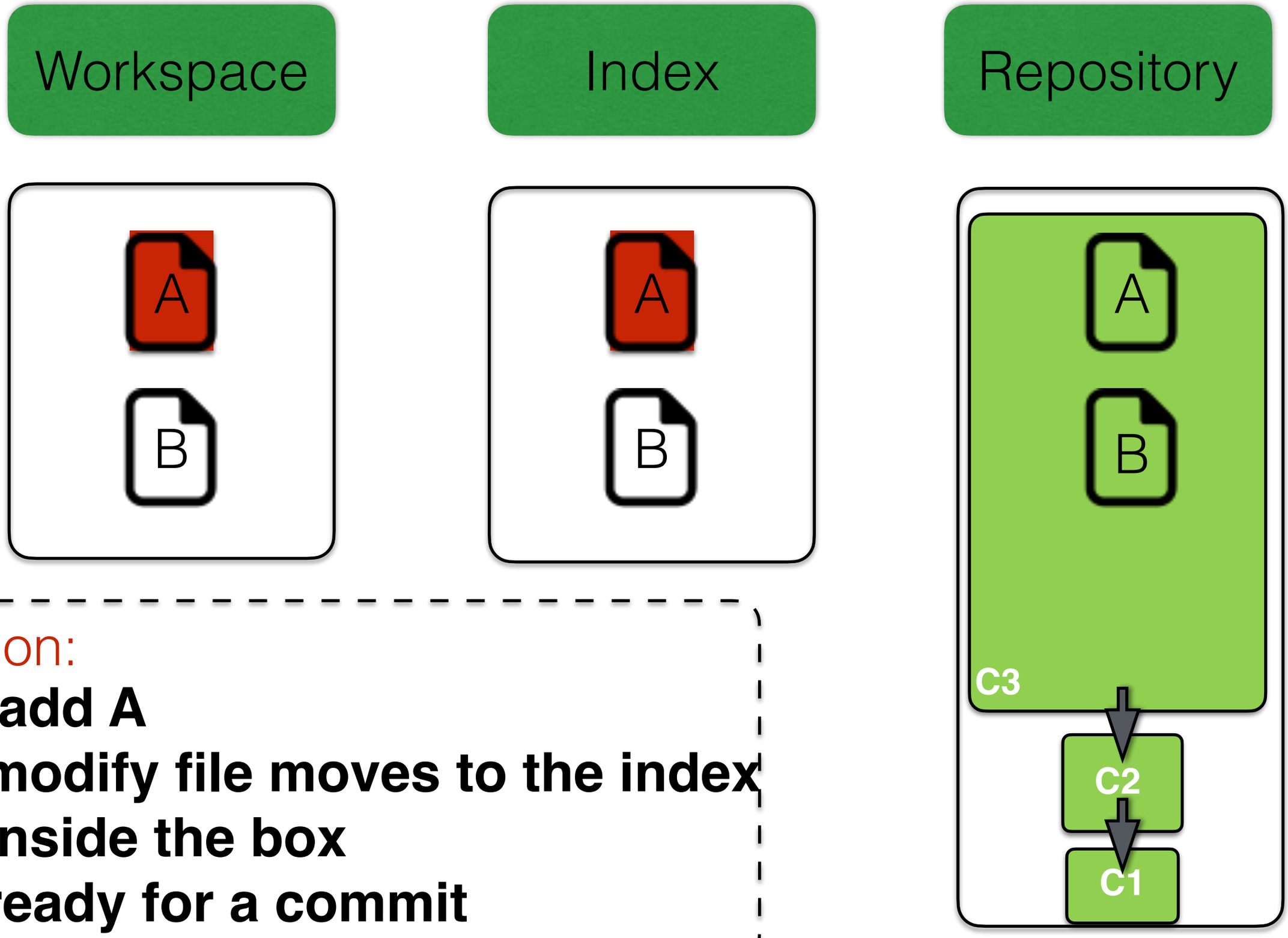
Repository



Action:

Modifying file A
-> add a line

Git Three area



Action:

git add A

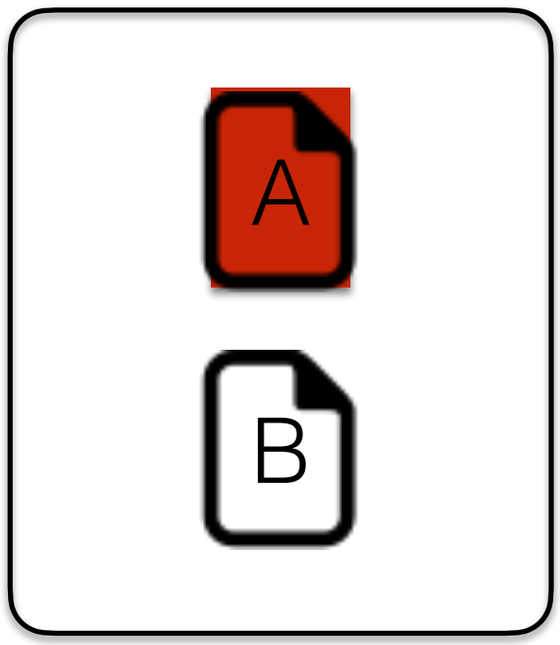
-> modify file moves to the index

-> inside the box

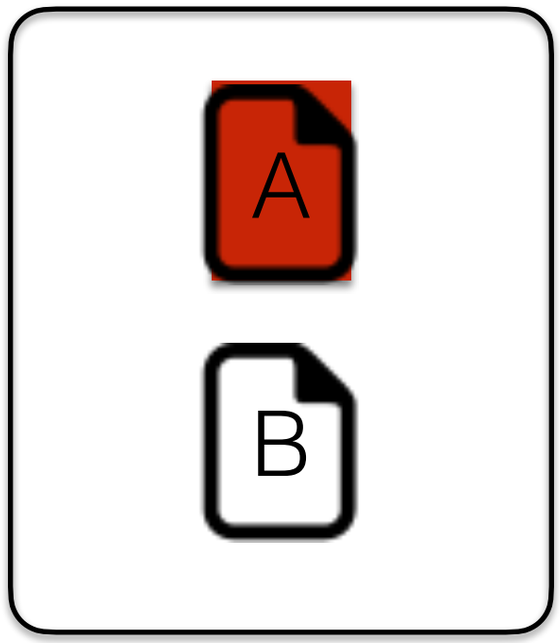
-> ready for a commit

Git Three area

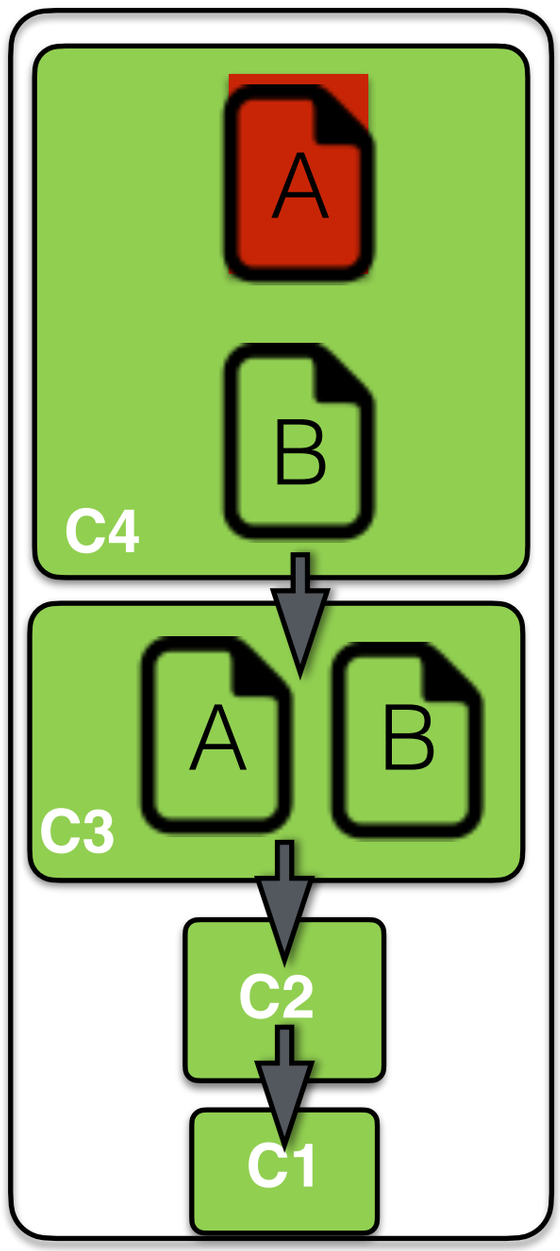
Workspace



Index



Repository



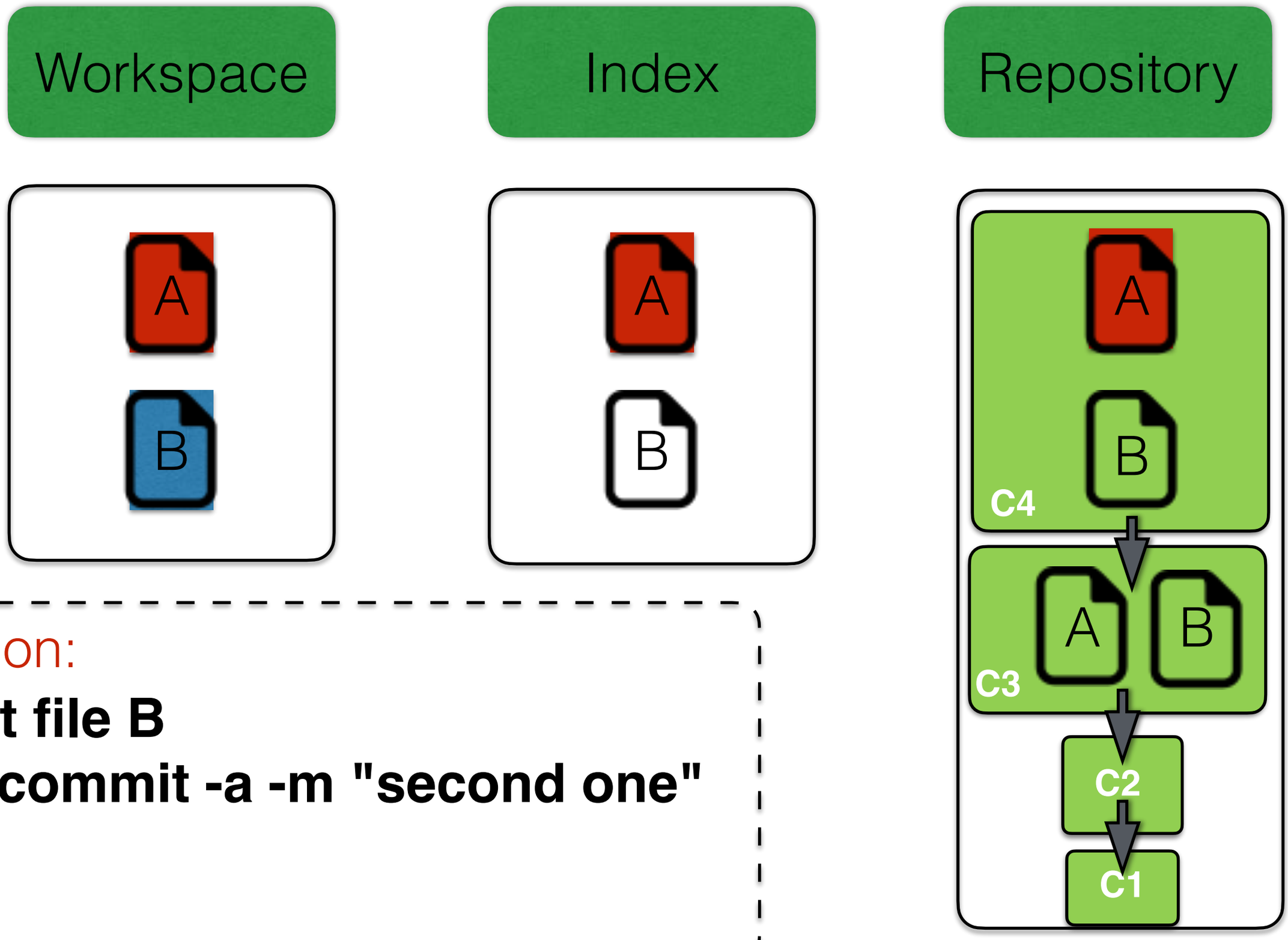
Action:

git commit -m "change color"

-> save the index current status

Into a new commit inside the Repository

Git Three area

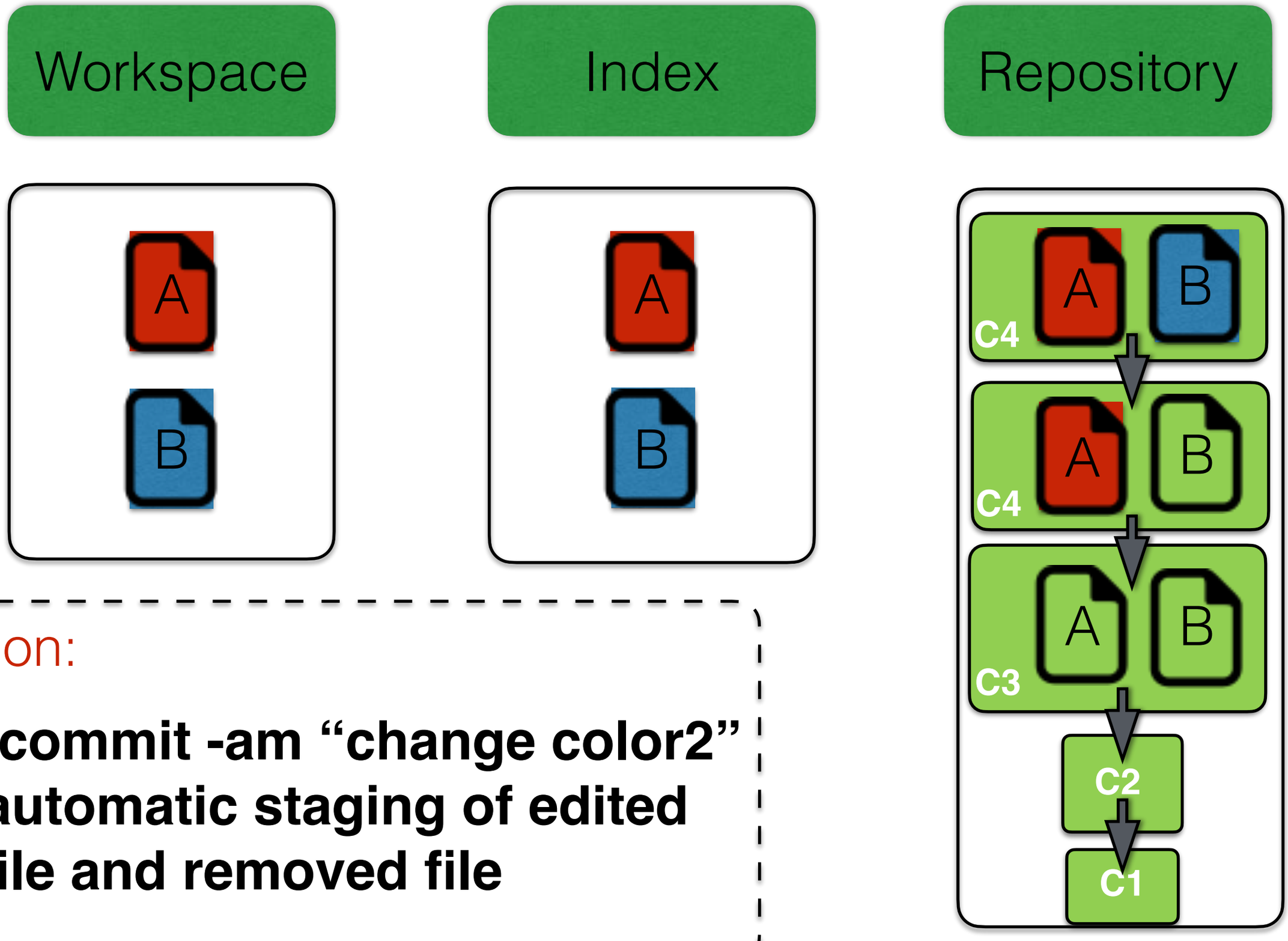


Action:

Edit file B

git commit -a -m "second one"

Git Three area



Action:

git commit -am “change color2”
-> automatic staging of edited file and removed file

Demo #1

Initialisation
Git init
Git log
Git status
Git commit

Nice display: git log --oneline --graph

1. Commit

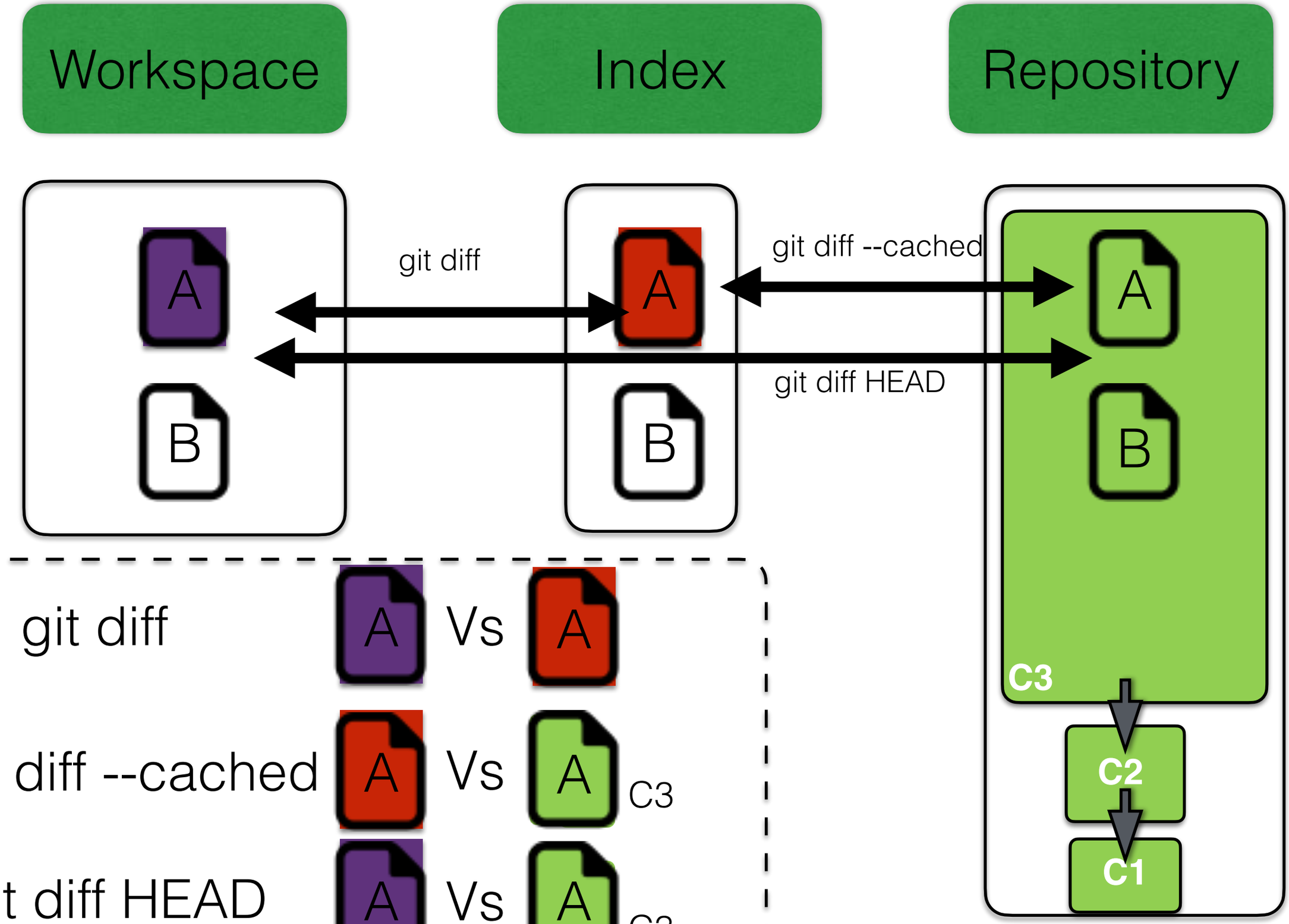
Head: place where the new commit will be attach

Head: latest committed version

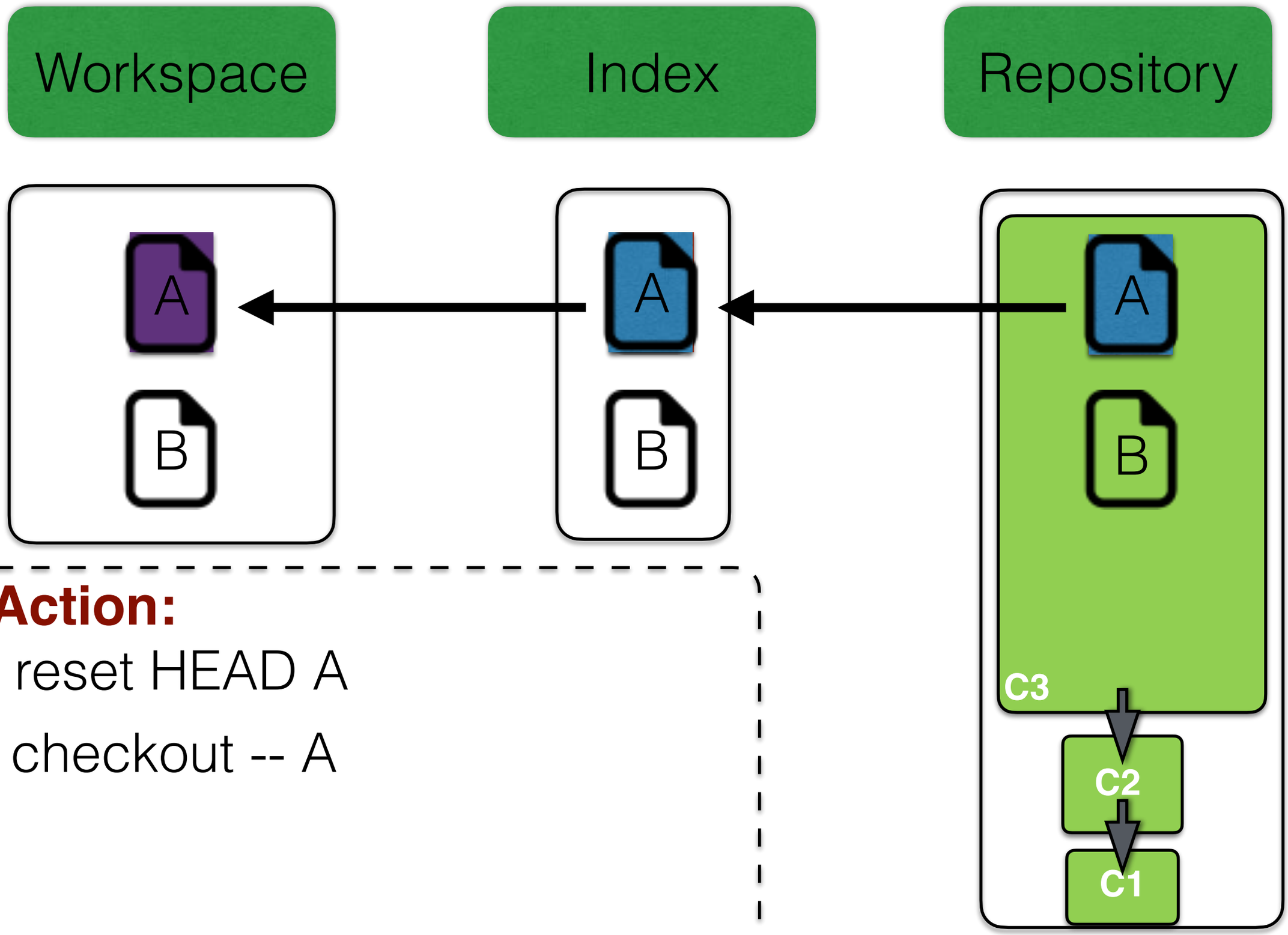
Head~1

Head~2

Git diff


Workspace
Index
Repository
A
B
A
B
A
B
git diff
git diff --cached
git diff HEAD
C3
C2
C1
git diff
A
Vs
A
git diff --cached
A
Vs
A
C3
git diff HEAD
A
Vs
A
C3

Git reset



Action:

git reset HEAD A

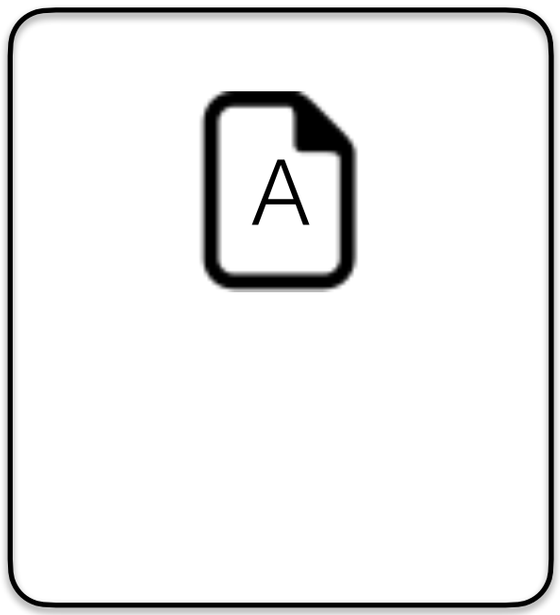
git checkout -- A

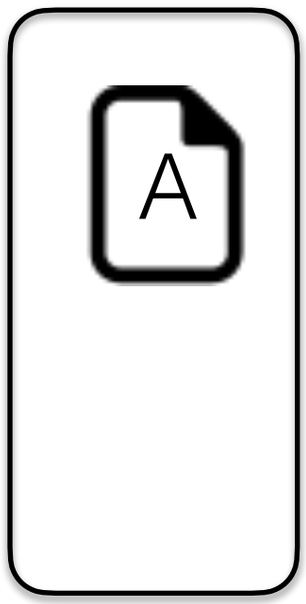
Restore file

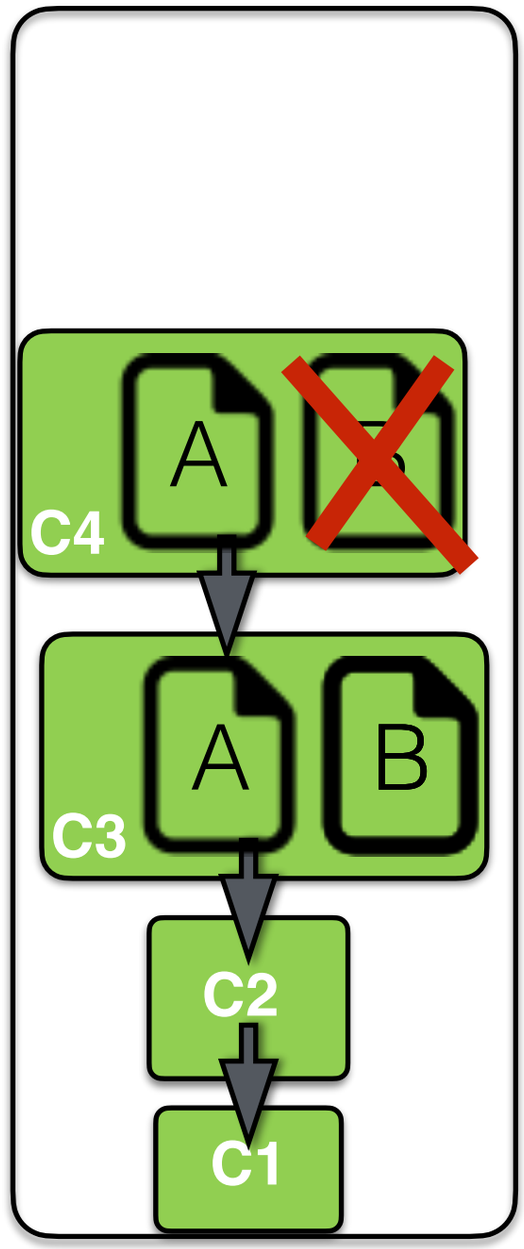
Workspace

Index

Repository





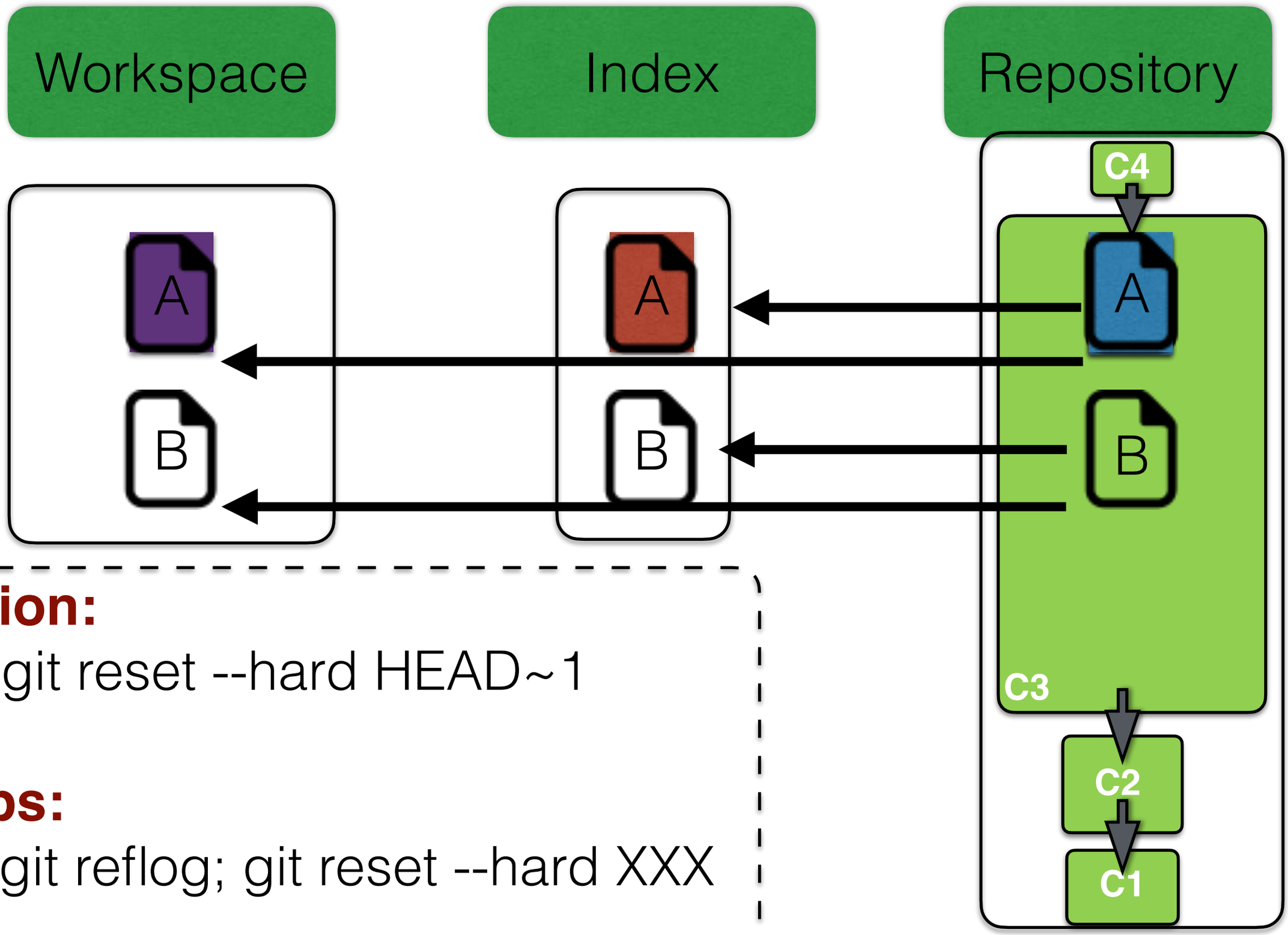


Action:

git checkout C3 -- B

-> restore file B from version C3

Git reset



Action:

git reset --hard HEAD~1

Oops:

git reflog; git reset --hard XXX

Local project

Exercise #1

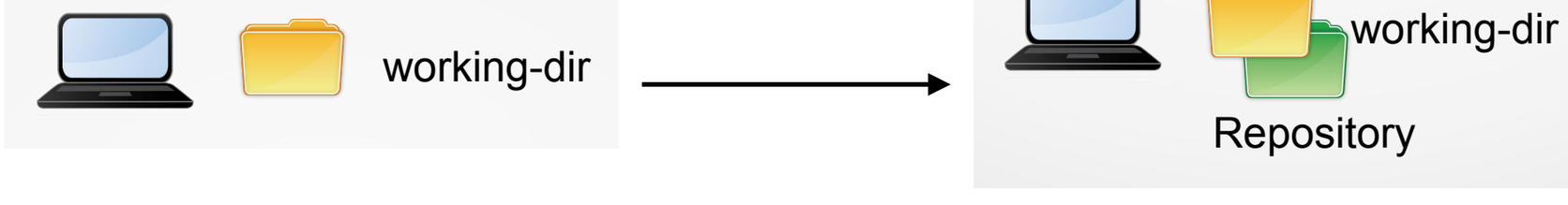
Starting with git

```
$ git config --global user.name "John Doe"
$ git config --global user.email johndoe@example.com
```

.config/git/ignore, .gitignore

```
# Backup files left behind by the Emacs and vim editor.
*~
# Temporary files used by the vim editor.
.*.swp
# compiled objects
*.pyc
*.o
# directory fileter example (case sensitive)
# ignore log dir
Logs/
```

```
$ git init
```



single user/project

```
$ vim test.c
$ vim test.h
$ git status
On branch master

Initial commit

Untracked files:
  (use "git add <file>..." to include in what will be committed)

        test.c
        test.h

nothing added to commit but untracked files present (use "git add" to track)
```

adding file (for next commit)

```
$ git add test.c
$ git status
On branch master

Initial commit

Changes to be committed:
  (use "git rm --cached <file>..." to unstage)

        new file:   test.c

Untracked files:
  (use "git add <file>..." to include in what will be committed)

        test.h
```

Commit

```
$ git commit -m'Add test.c'
[master (root-commit) 46ef322] Add test.c
 1 file changed, 0 insertions(+), 0 deletions(-)
 create mode 100644 test.c
$ git status
On branch master
Untracked files:
  (use "git add <file>..." to include in what will be committed)

        test.h

nothing added to commit but untracked files present (use "git add" to track)
```

checking modif

```
$ vim test.c
$ git diff
diff --git a/test.c b/test.c
index 0197793..0c7f097 100644
--- a/test.c
+++ b/test.c
@@ -1,4 +1,4 @@
 int main()
 {
-    int a=5;
+    int a=6;
 }
$
```

Do it yourself

- install git
- configure the tools (name + email)
- create a local repository
  - commit one file then modify it and re-commit
- check “diff”, “log”, “status” functionality

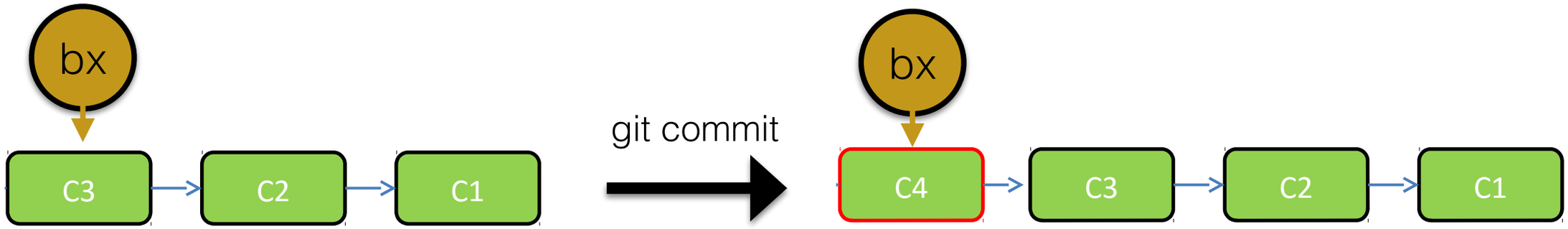
Workflow

branch in git

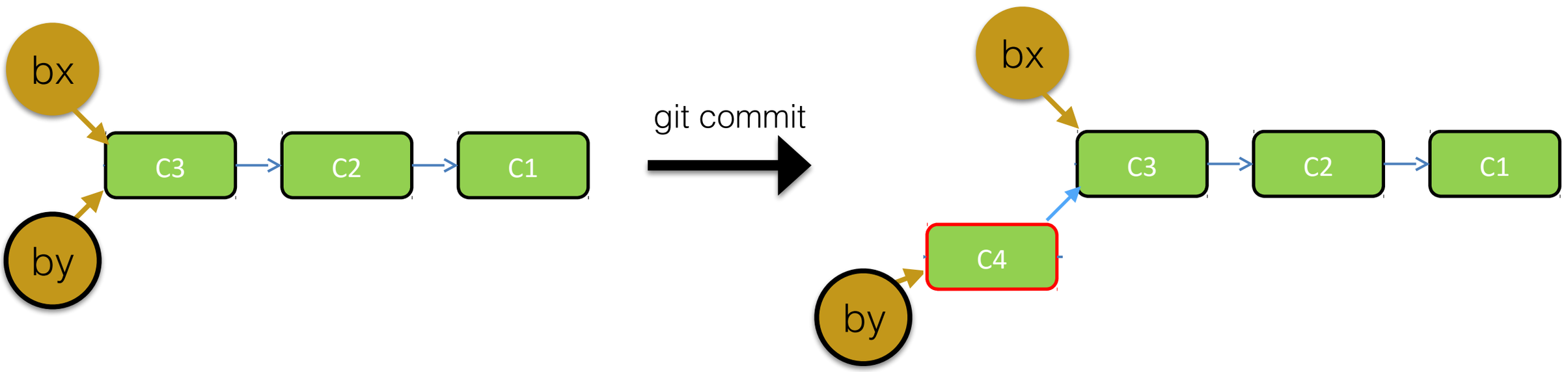
- Branch is **pointer** to a commit (represent an history)
- A branch can point at other commit, it can move!
- A branch is a way to organize your work and working histories
- Since commit know which commits they are based on, branch represents a commit and what came before it
- a branch is **cheap**, you can have multiple branch in the same repository and switch your working dir from one branch state to another

branches

- default branch: master
- When doing a commit, the branch moves to the new commit



- creating a new branch: add a pointer (git checkout -b by)
  - only selected branch affected by commit!



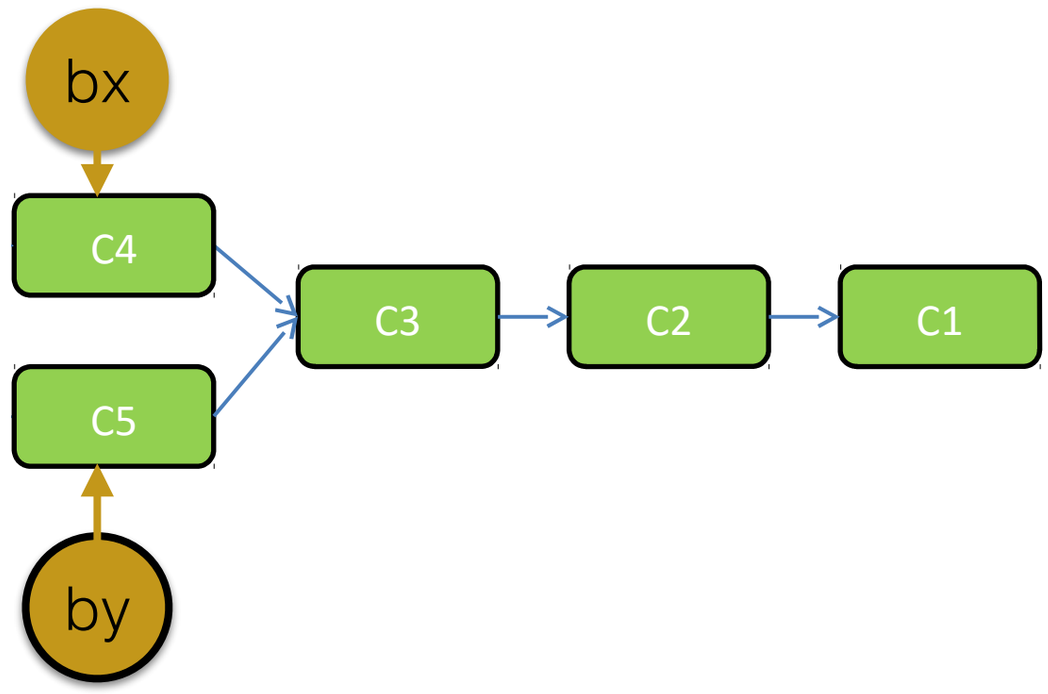
branches

create a new branch	`git checkout -b bx`
switch to a branch	`git checkout bx`
delete a branch	`git branch -d bx`
rename a branch	`git branch -m bx`
move a branch	`git branch -f bx rev`

- **master :** default created branch
- branch is cheap -> do it often
- branch allow to have short/long term parallel development

merging

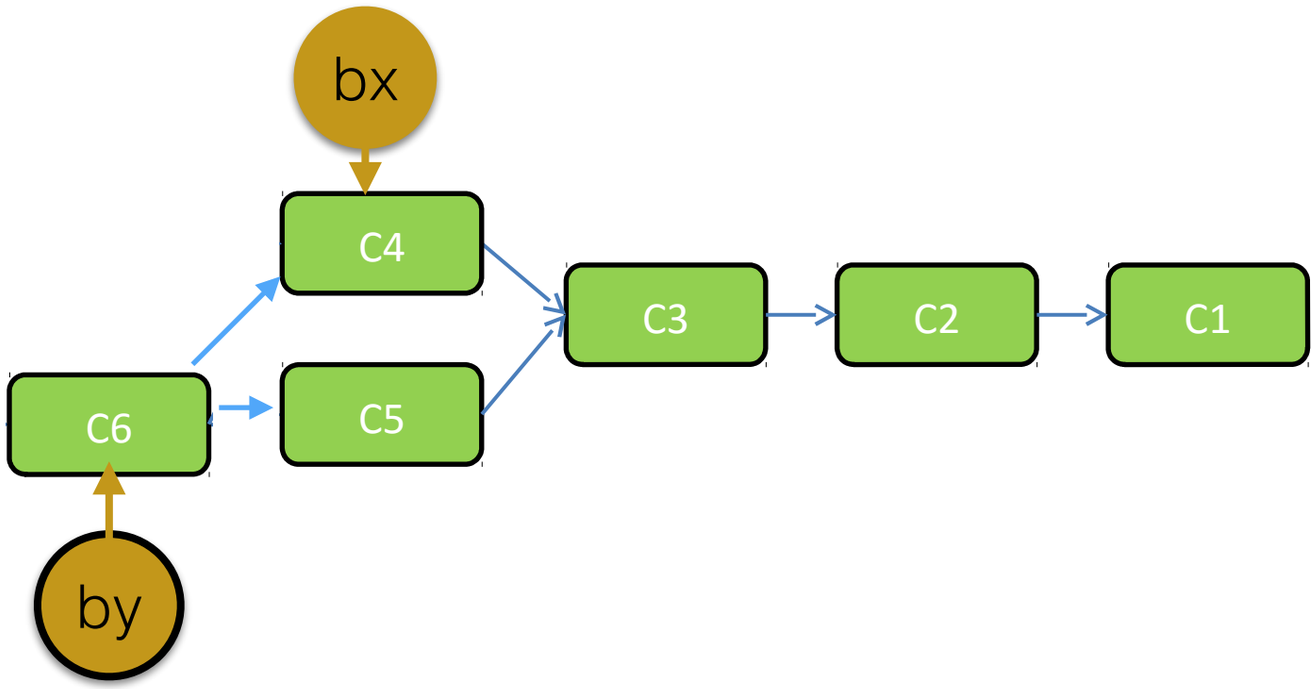
- The interest of branch is that you can **merge** them
  - Include in one (branch) file the modification done somewhere else



git merge bx

merging

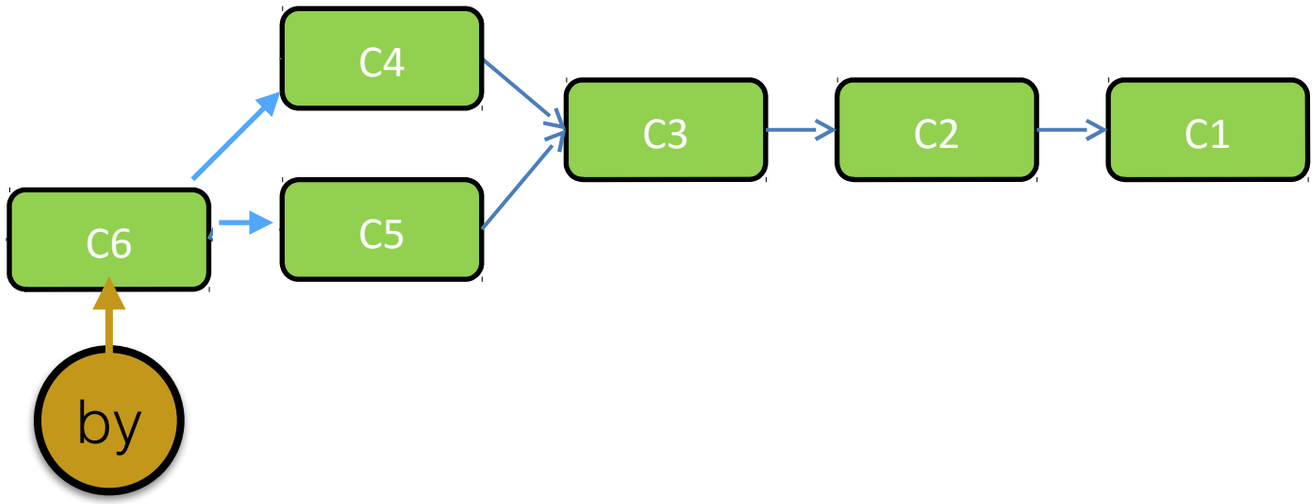
- merging two different modifications



git merge bx
git branch -d bx

merging

- merging two different modifications

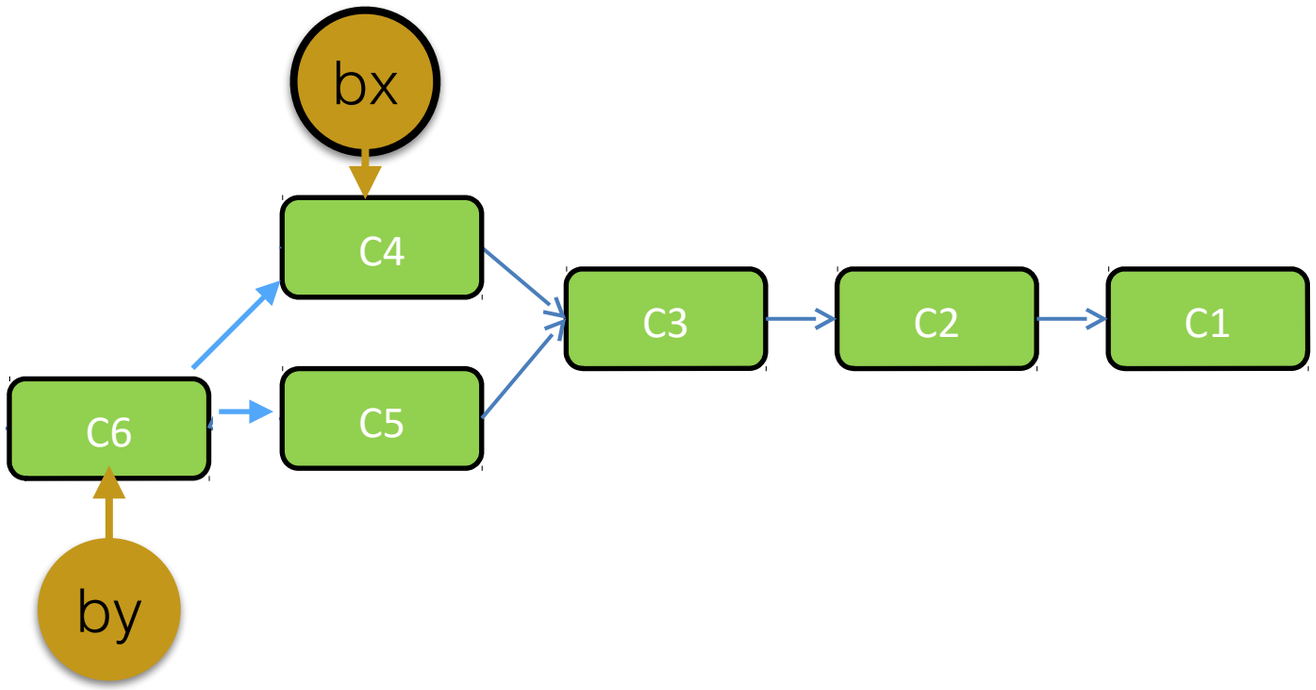


git merge bx

git branch -d bx

merging

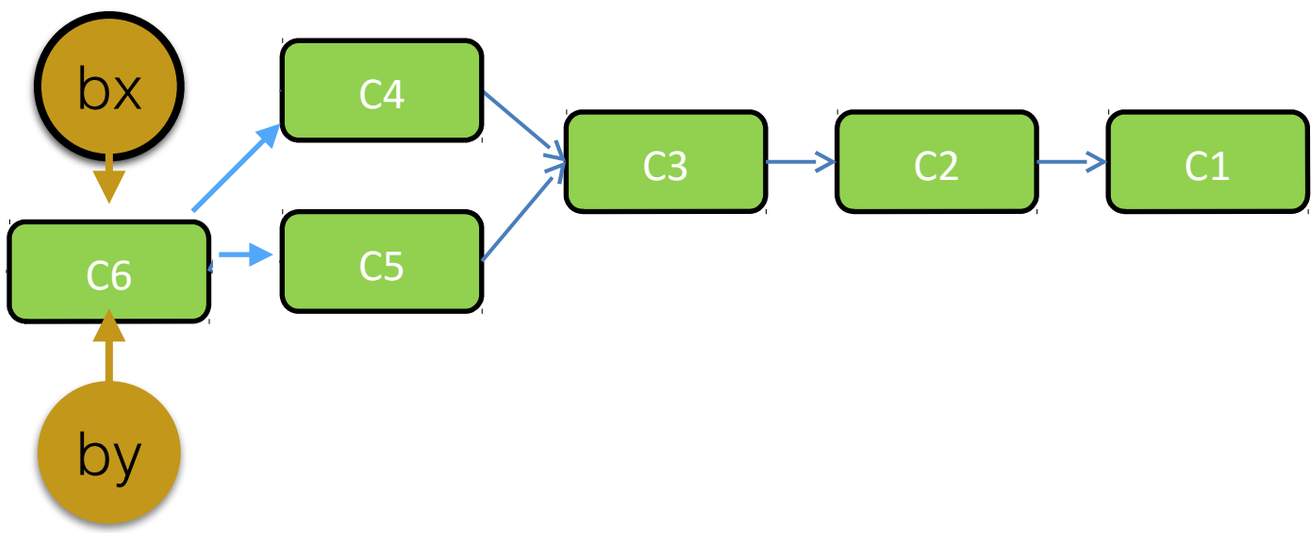
- merging two different modifications



git merge bx
git checkout bx
git merge by

merging

- merging two different modifications



git merge bx
git checkout bx
git merge by

merging can lead to conflict

```
[gittest]$ git merge hello
Auto-merging helloworld.py
CONFLICT (content): Merge conflict in helloworld.py
Automatic merge failed; fix conflicts and then commit the result.
[gittest]$
```

Conflict

```
print "Hello World"
<<<<<<< HEAD
print "changed from master branch"
=======
print "print from branch to be merged""
>>>>>>> hello
```

Edit the file to the “correct” version

```
print "Hello World"
print "print from master branch"
print "and from branch to be merged""
```

Run
-> git commit

Conflict

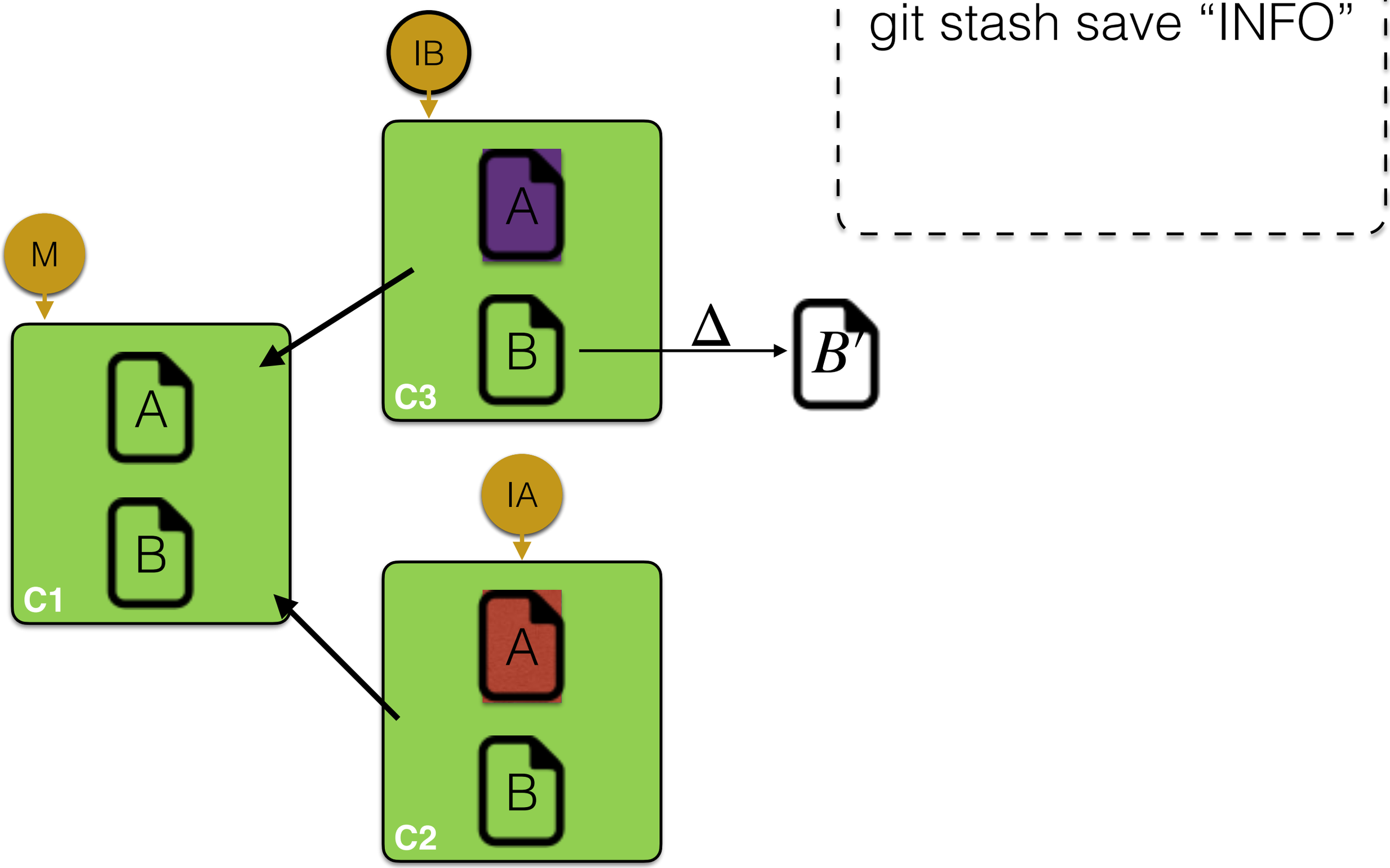
- **Multiple version of files** are great
  - Not always easy to know how to merge them
  - Conflict will happen (same line modify by both user)

- Conflict need to be resolved manually!
  - Boring task
  - need to understand why a conflict is present!
- **Do not be afraid of conflict!** Do not try to avoid them at all cost!
- stay in sync as most as possible and keep line short

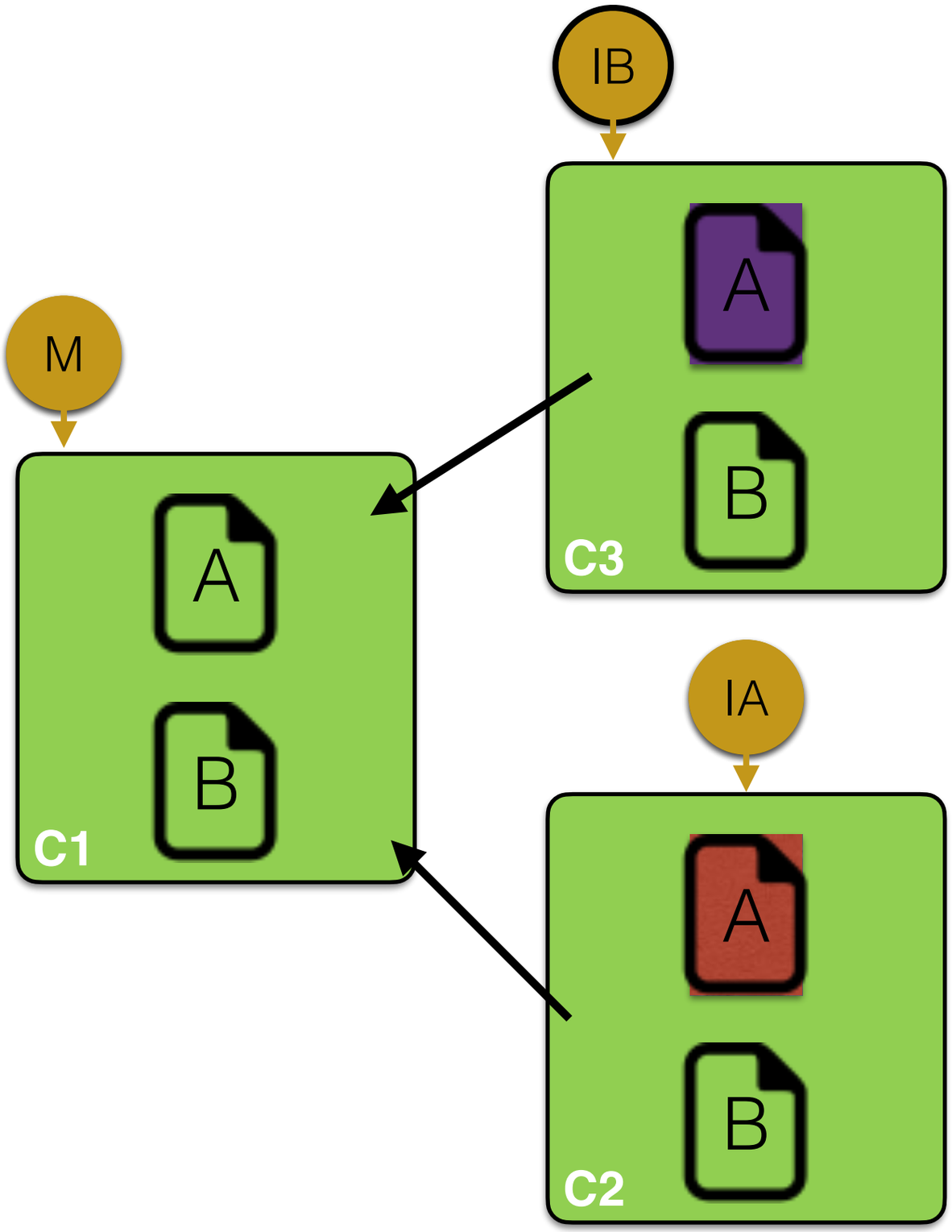
Keep history clean: Rebase

- Instead of merging, replays set of changes on top of another branch
- Affects the “rebased” branch only
- Changes the history of commits
- Can be dangerous
- Very useful to remove history clutter
- Simple rule, use locally only

Working on the wrong branch



Working on the wrong branch



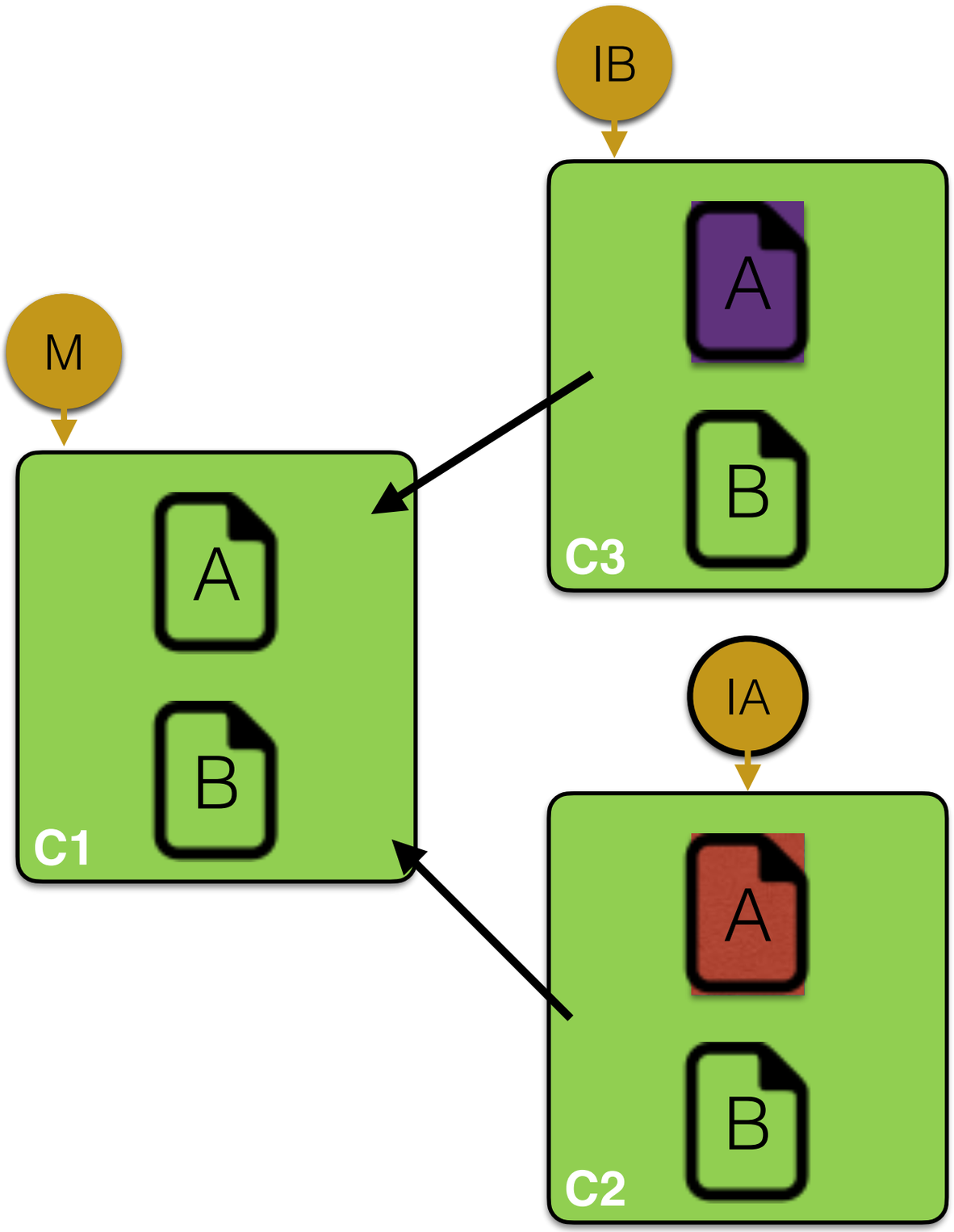
git stash save “INFO”

Stash storage

git stash list

stash@{0} Δ

Working on the wrong branch



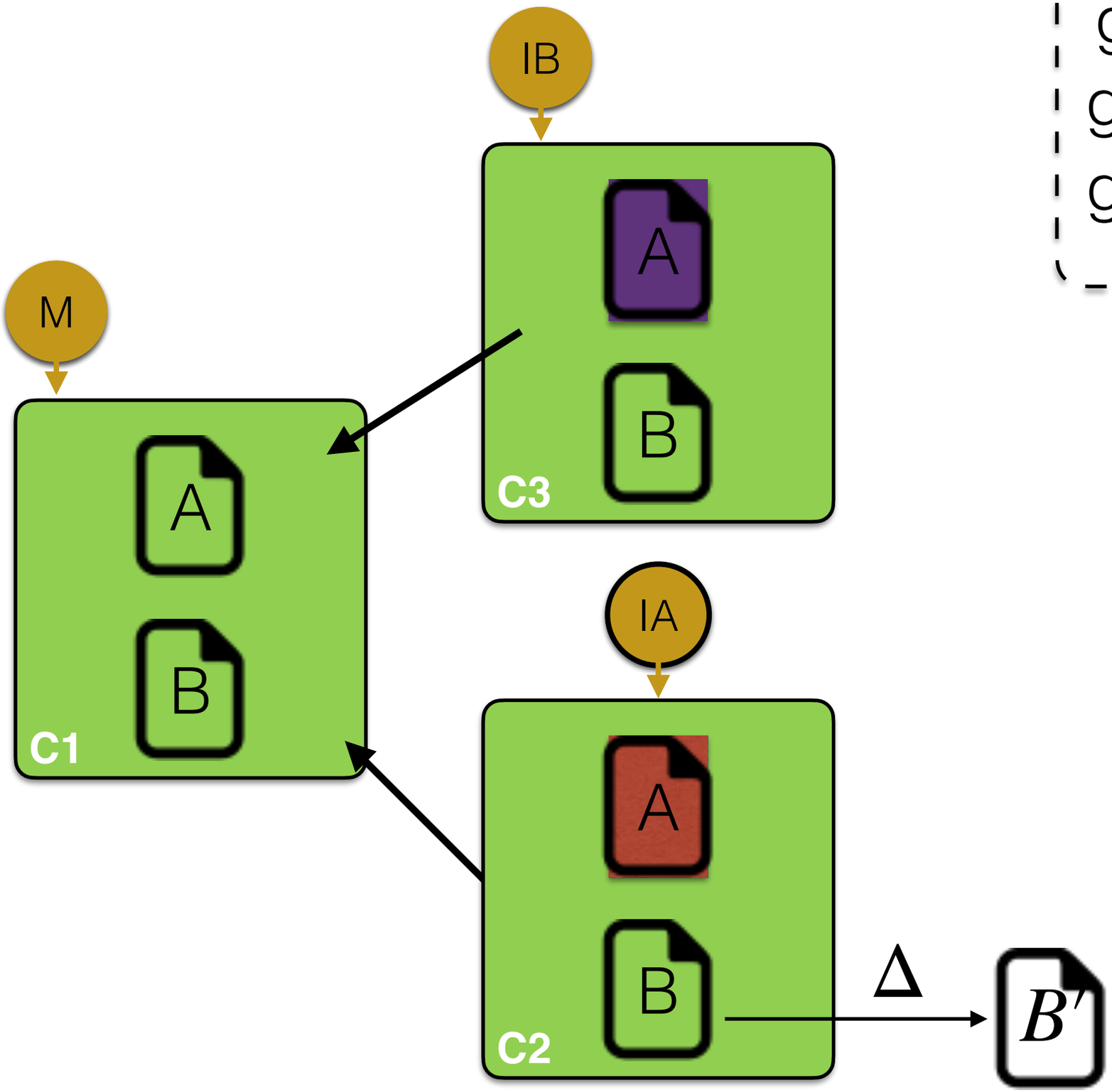
git stash save “INFO”

git checkout IA

Git stash list

stash@{0} Δ

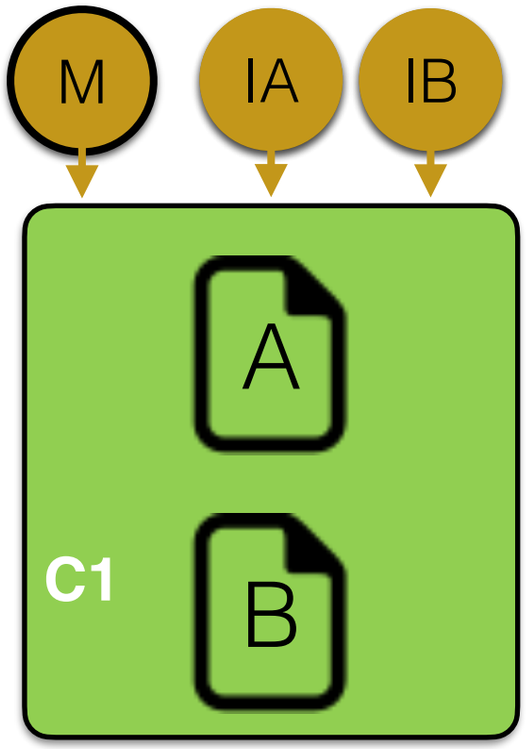
Working on the wrong branch



git stash save “INFO”
git checkout IA
git stash pop

Git stash list

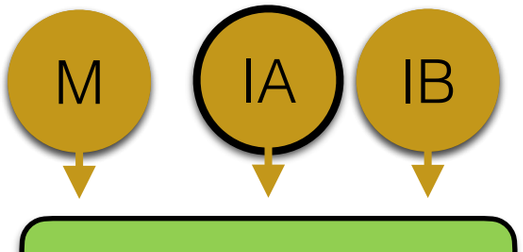
Keep history clean: Rebase

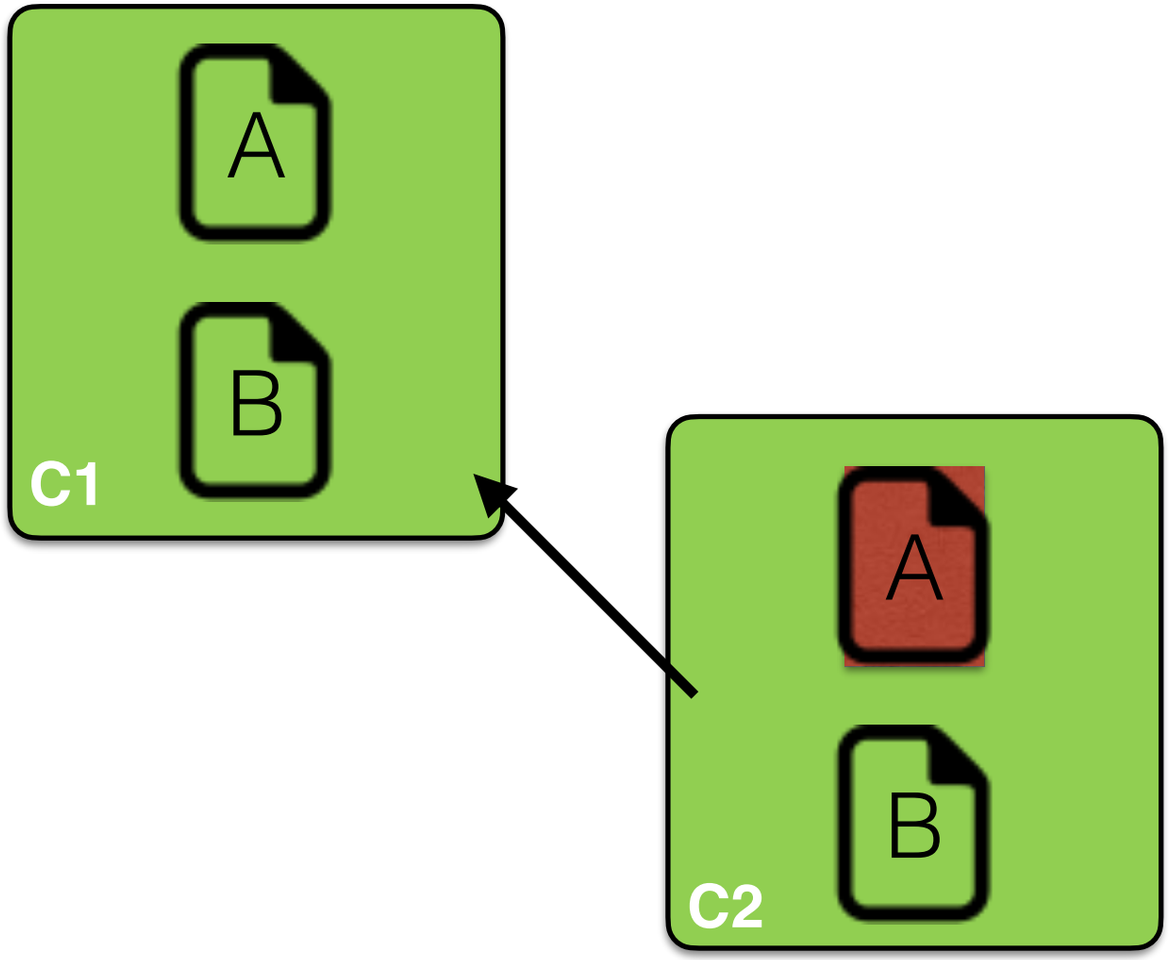


Keep history clean: Rebase

Git checkout IA

Git commit

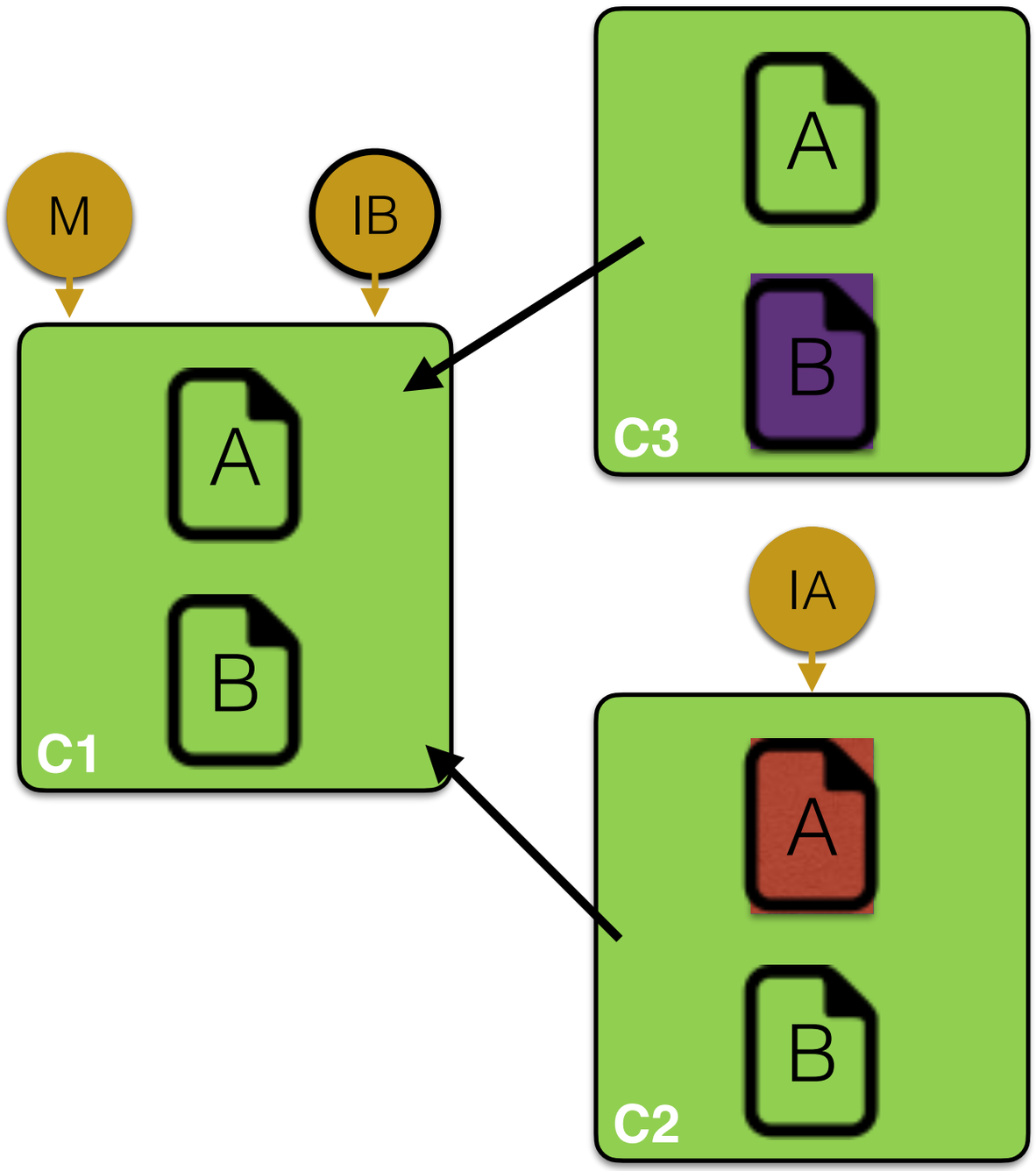




Keep history clean: Rebase

Git checkout IB

Git commit

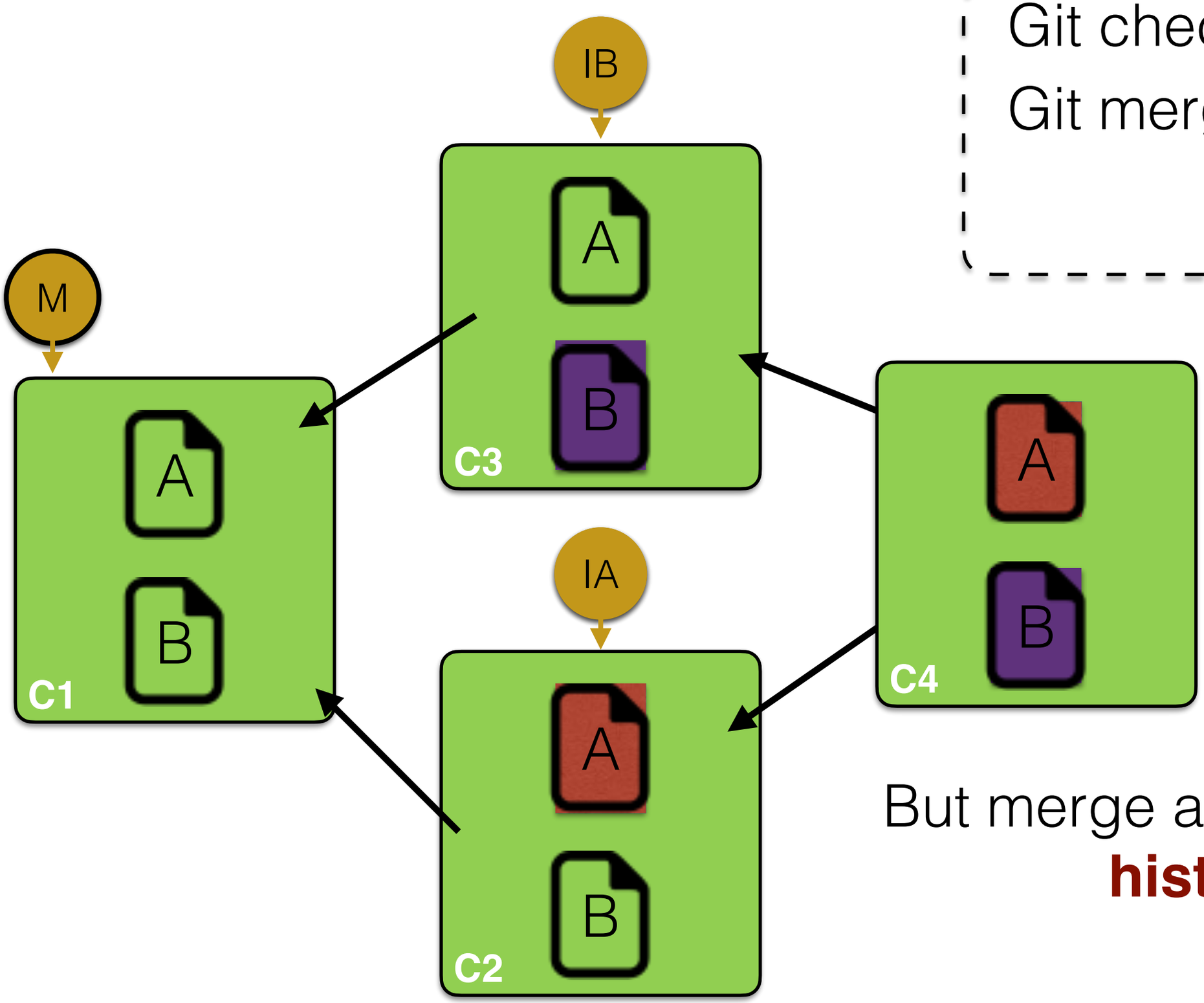


I want to include **BOTH** changes in master branch

Keep history clean: Rebase

Git checkout M

Git merge IA IB



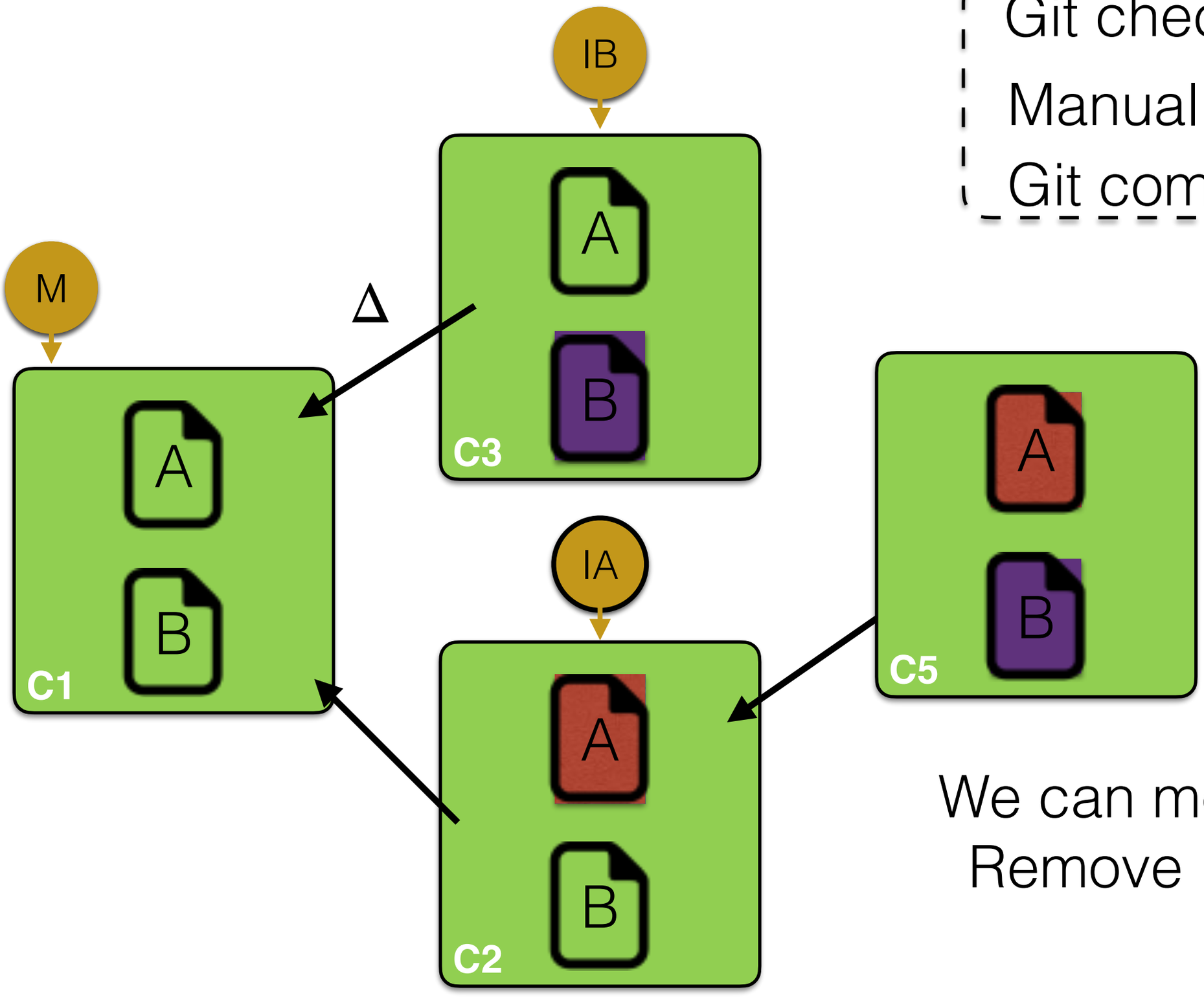
But merge are **not clean history**

Keep history clean: Rebase

Git checkout IA

Manual change of B

Git commit



We can merge M (ff)
Remove IB and IA

Keep history clean: Rebase

This is **not easy** to do
-> let automate that
-> “rebase”

Git checkout IA

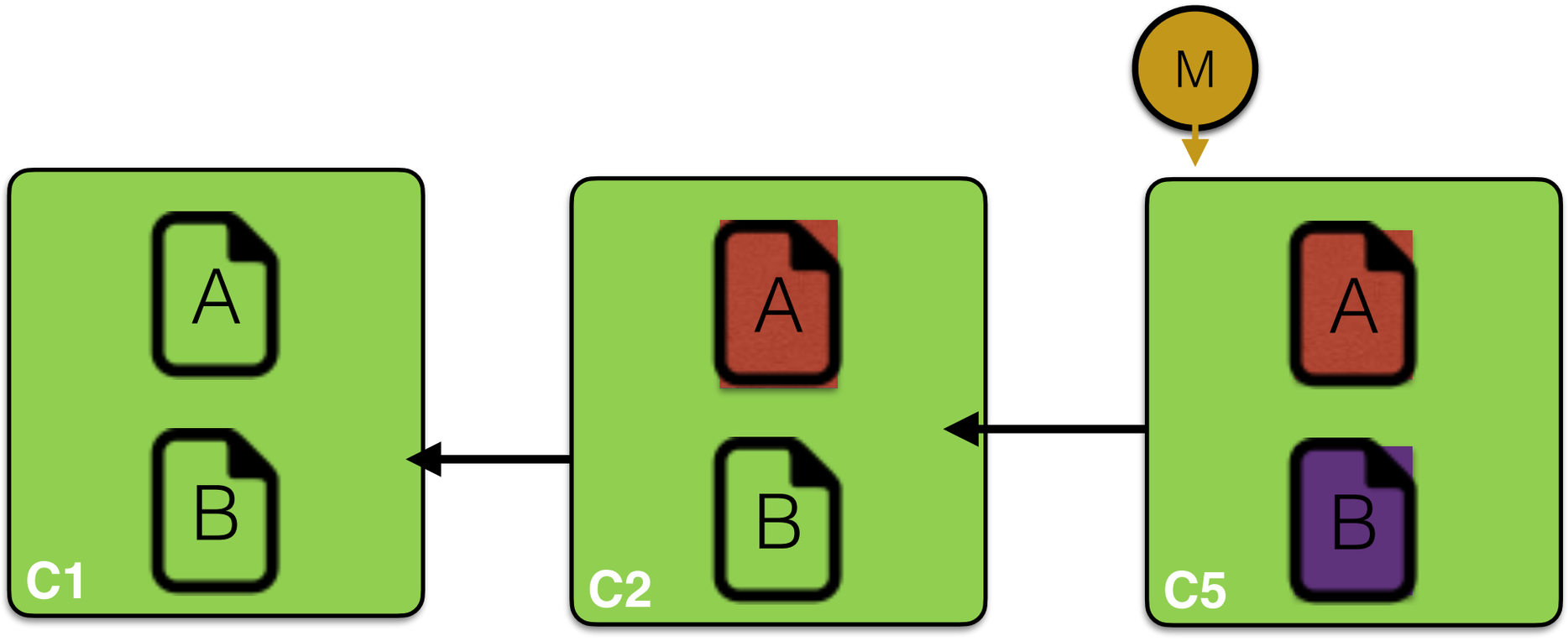
Manual change of B

Git commit

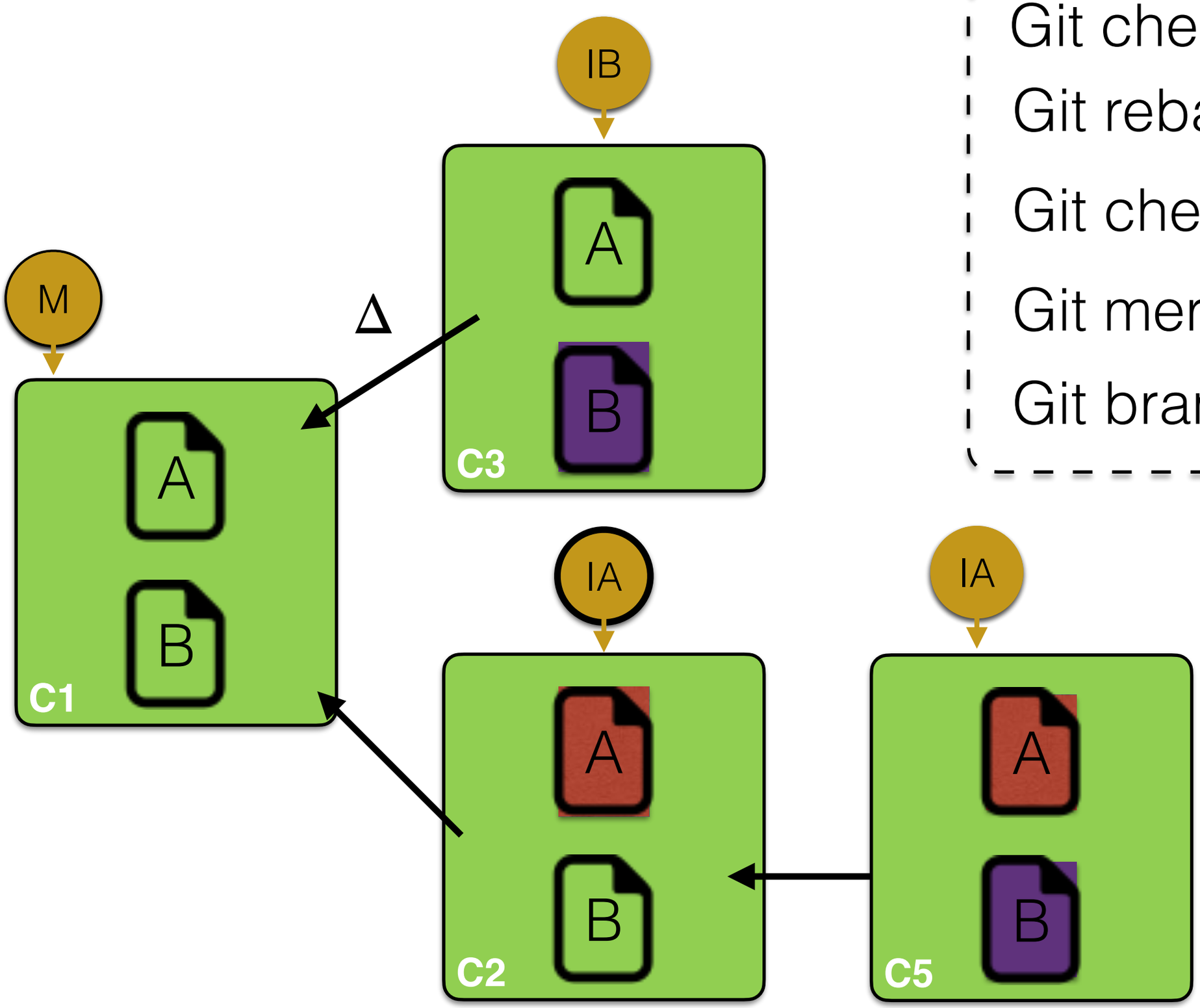
Git checkout M

Git merge IA

Git branch -D IA IB



Keep history clean: Rebase



Git checkout IA

Git rebase IB

Git checkout M

Git merge IA

Git branch -D IA IB

History

- Changing your history can create a lot of conflict with your collaborator!
- Keep it simple, secure and local
- Rebase has many additional features:
    - Split and or merge (squash) commit
    - Change commit message
    - Delete some commit / …
- Remember reflog in case of issue

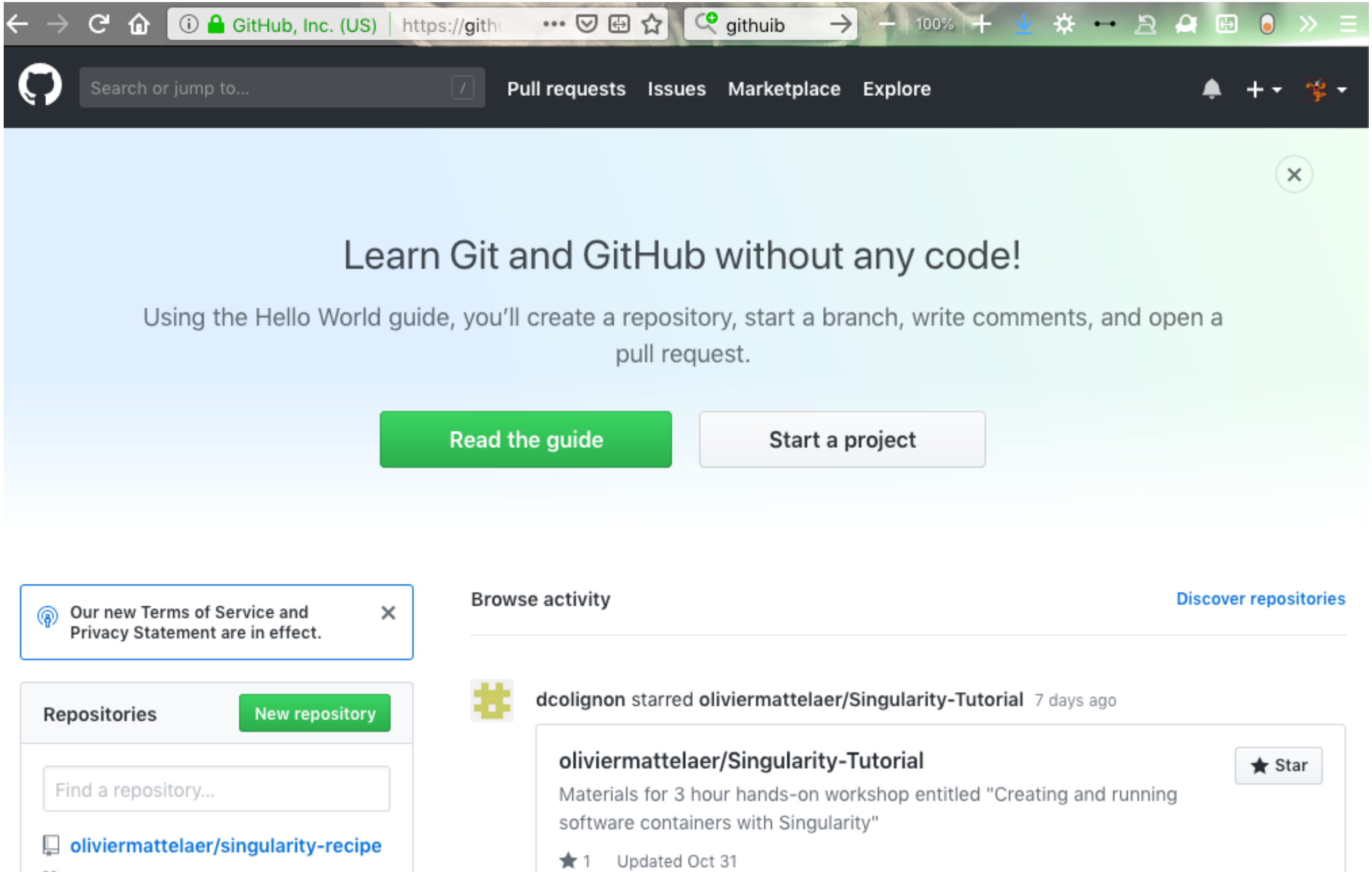
Nice video about history modification:
https://www.youtube.com/watch?v=ElRzTuYln0M

Do it yourself

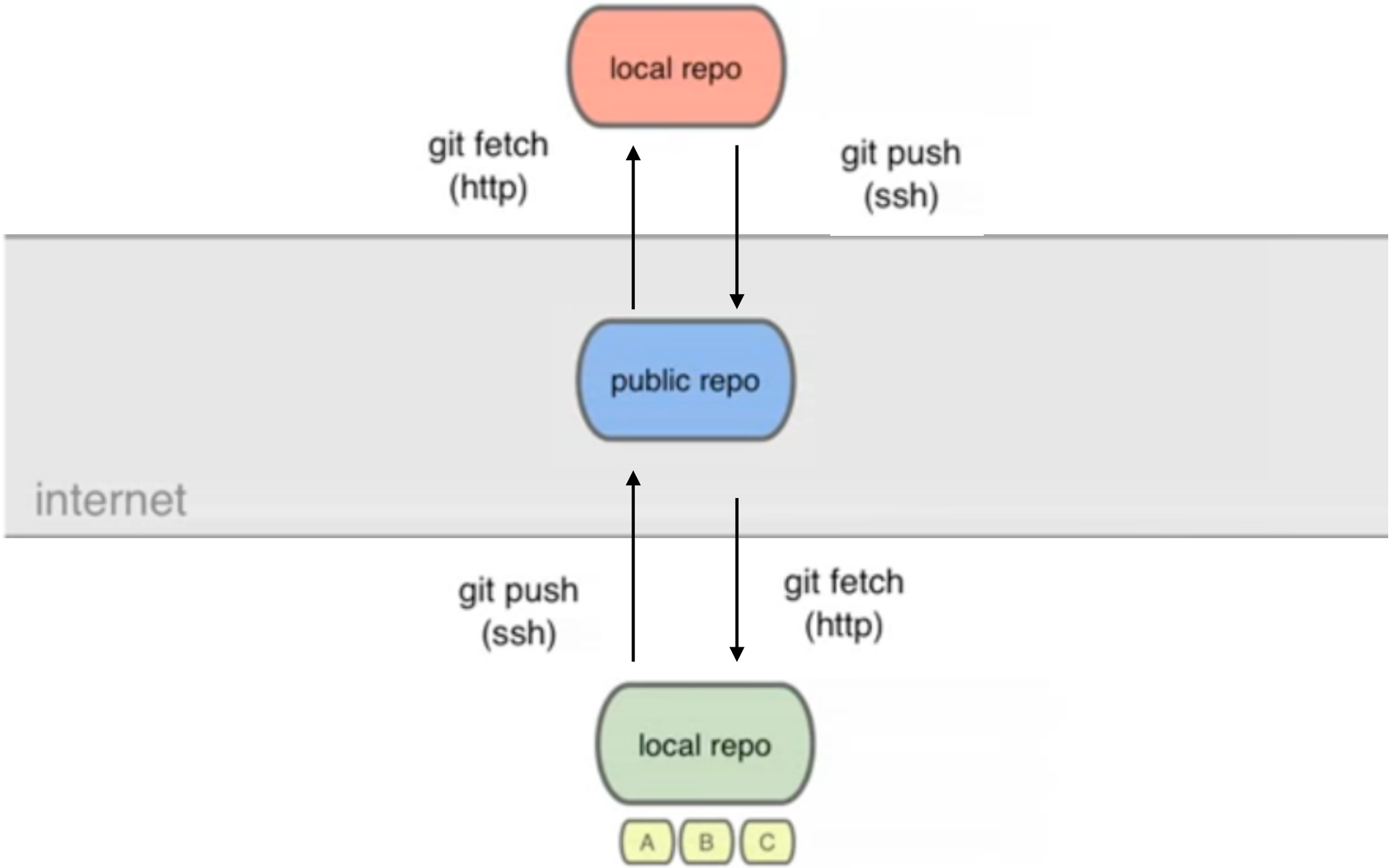
- create two branch on your repository
- make new commit on each branch
- merge (test case with and without conflict)
- redo the same but use the rebase method

Team Work

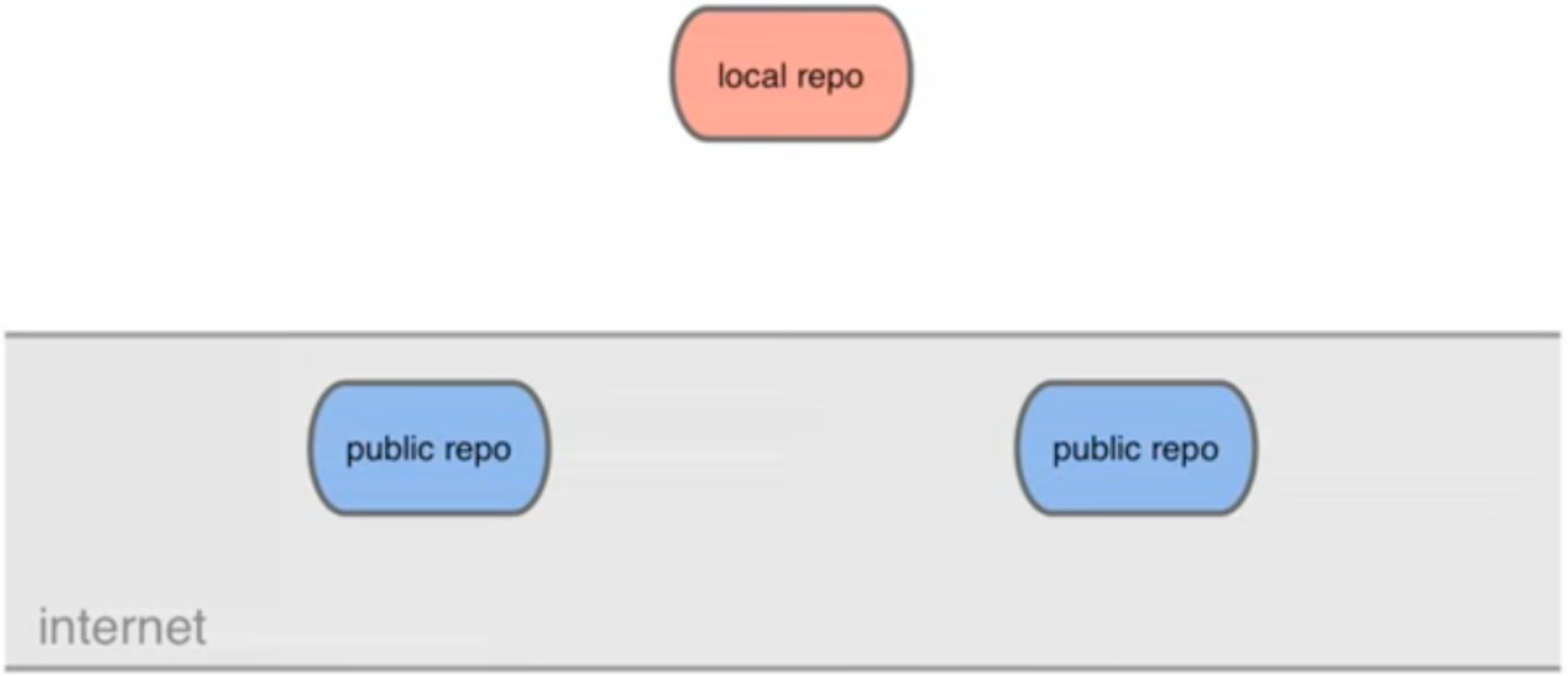
GitHub/Gitlab



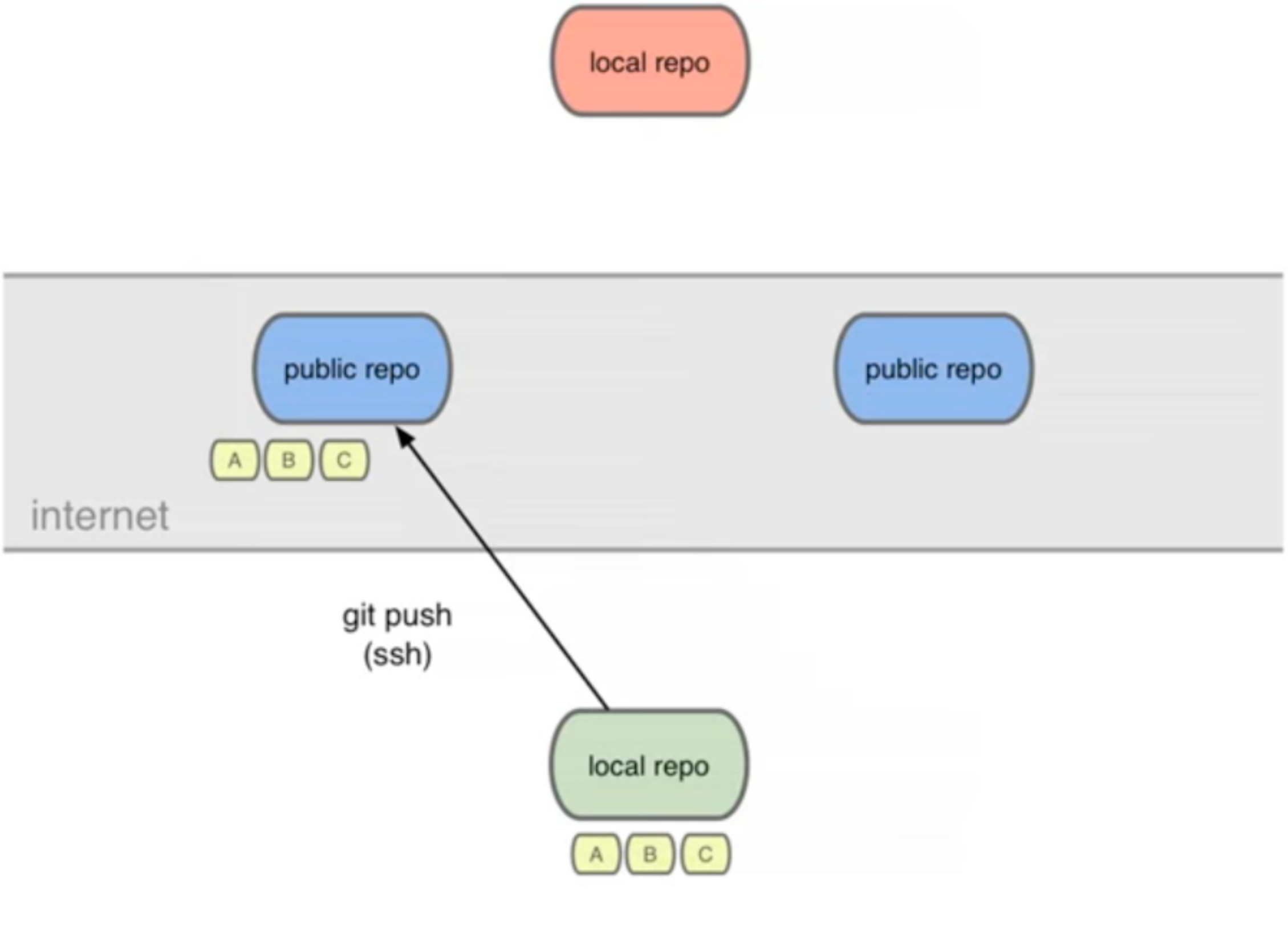
Collaboration



Collaboration



Collaboration



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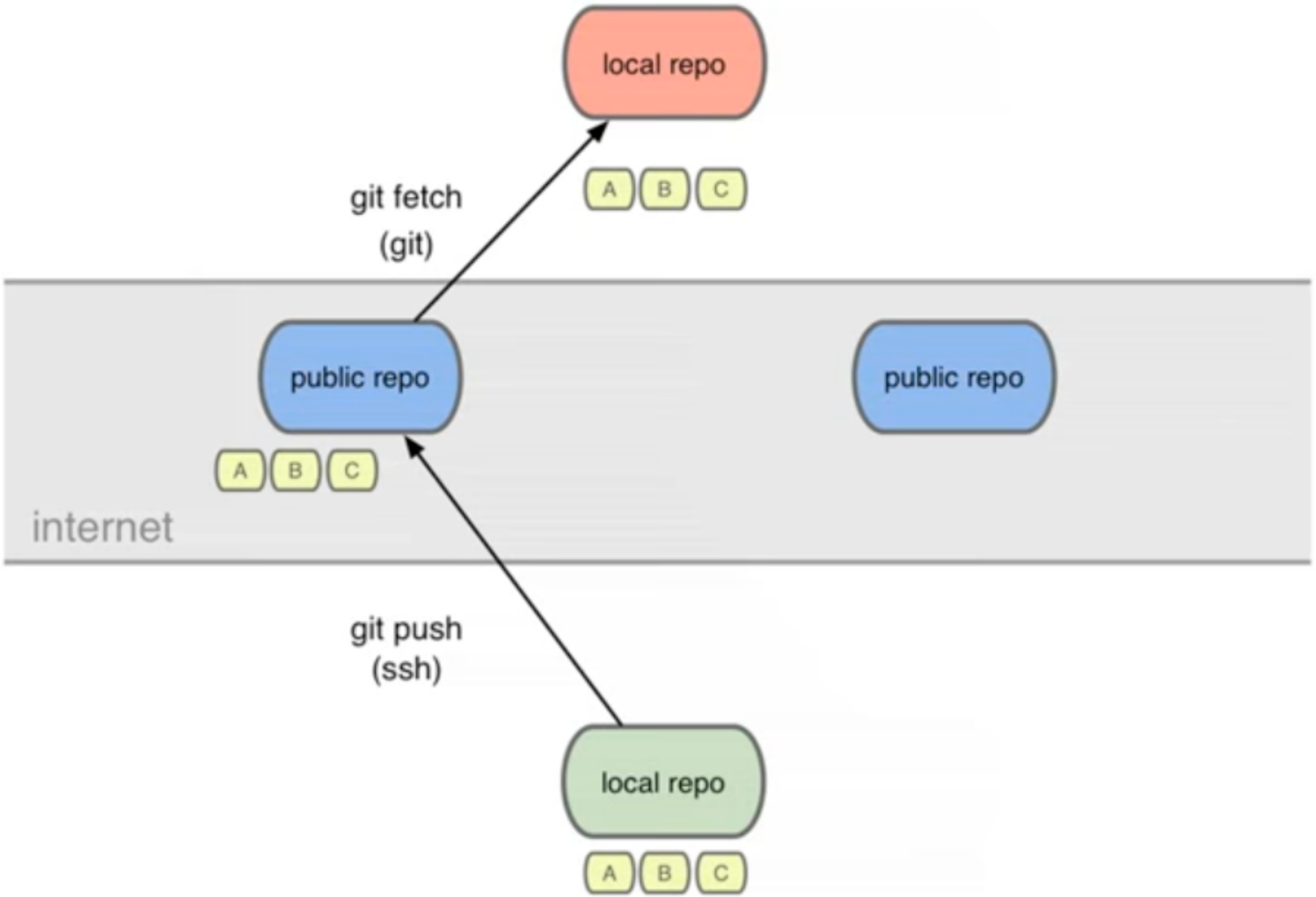
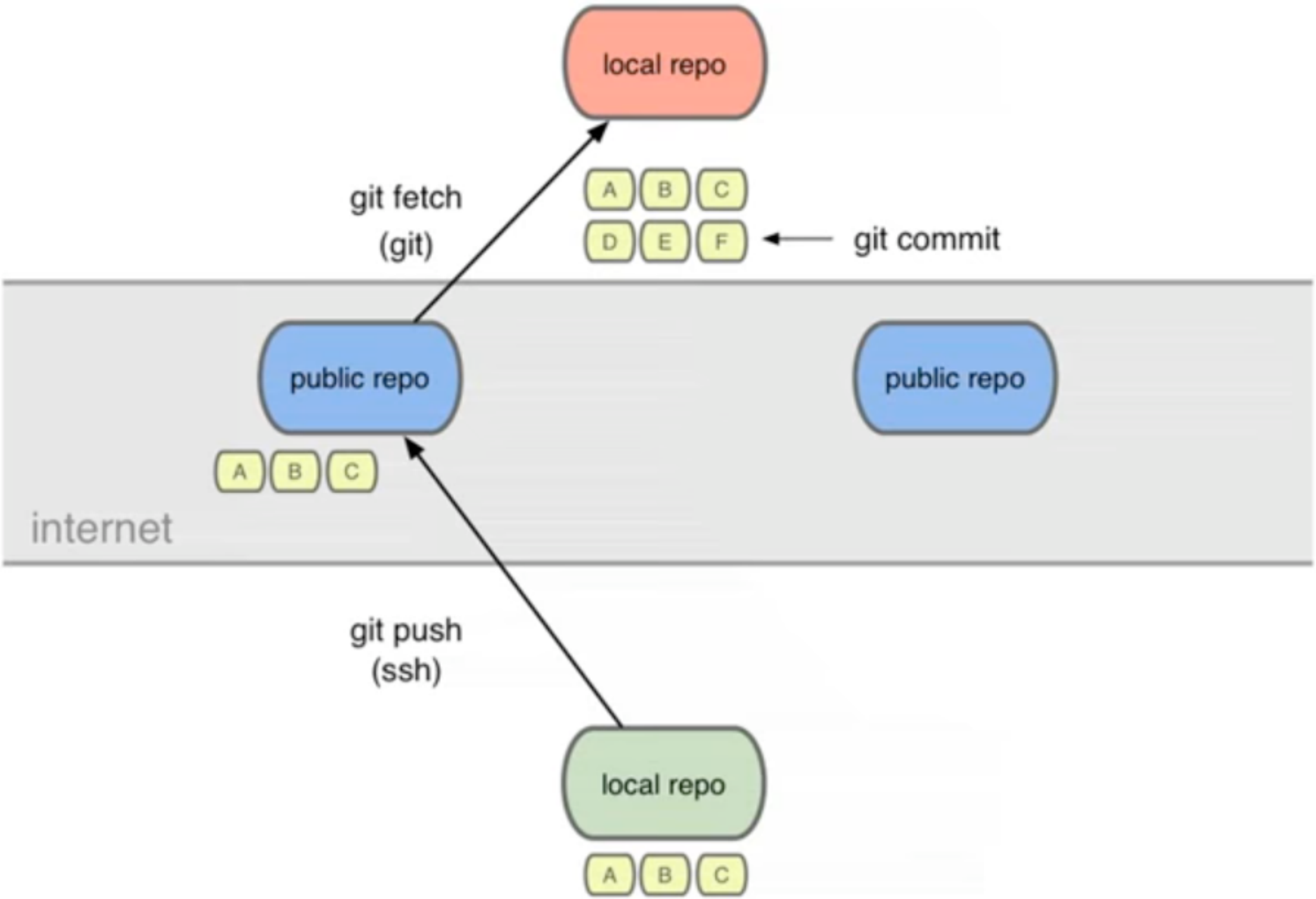
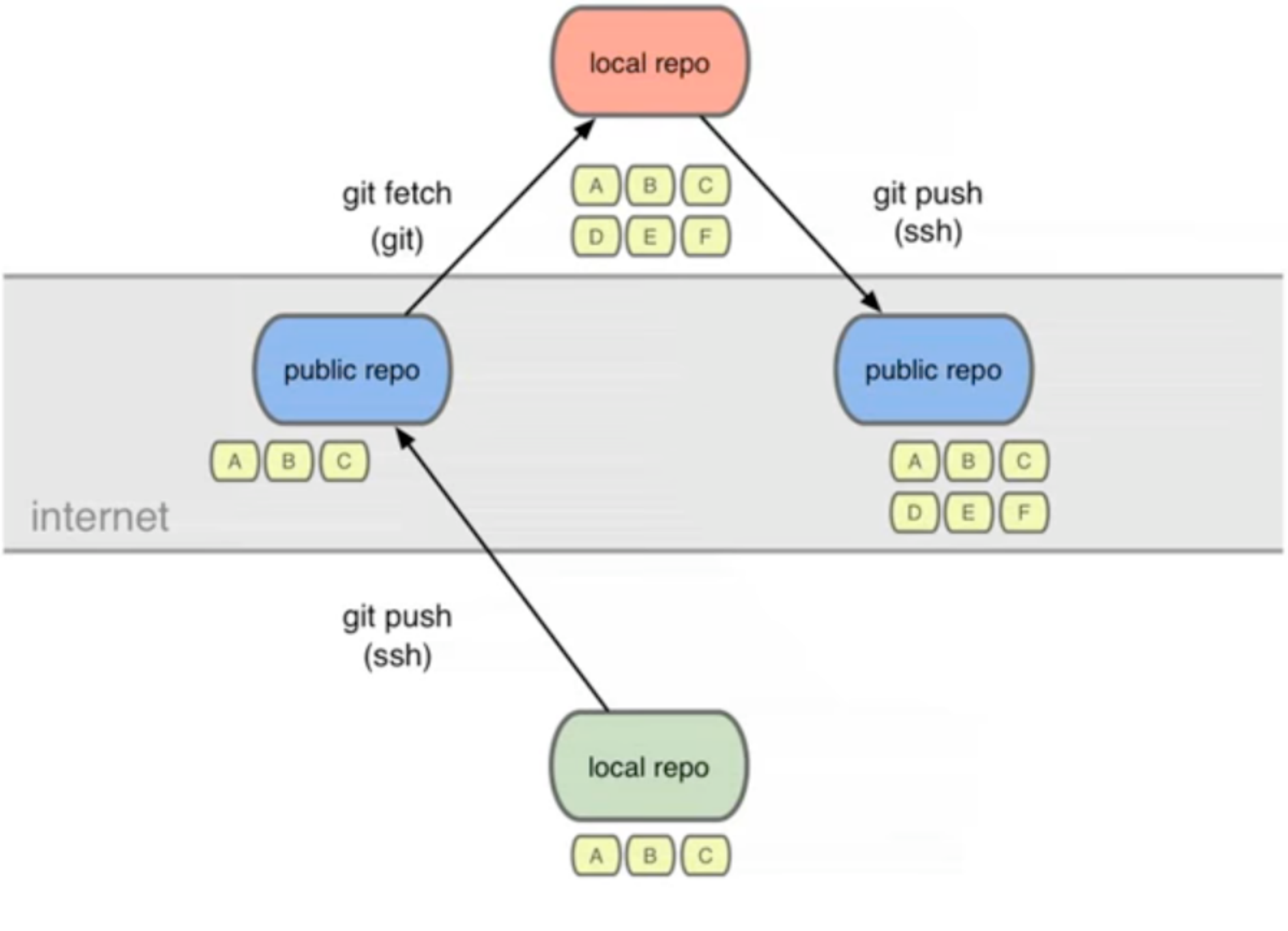


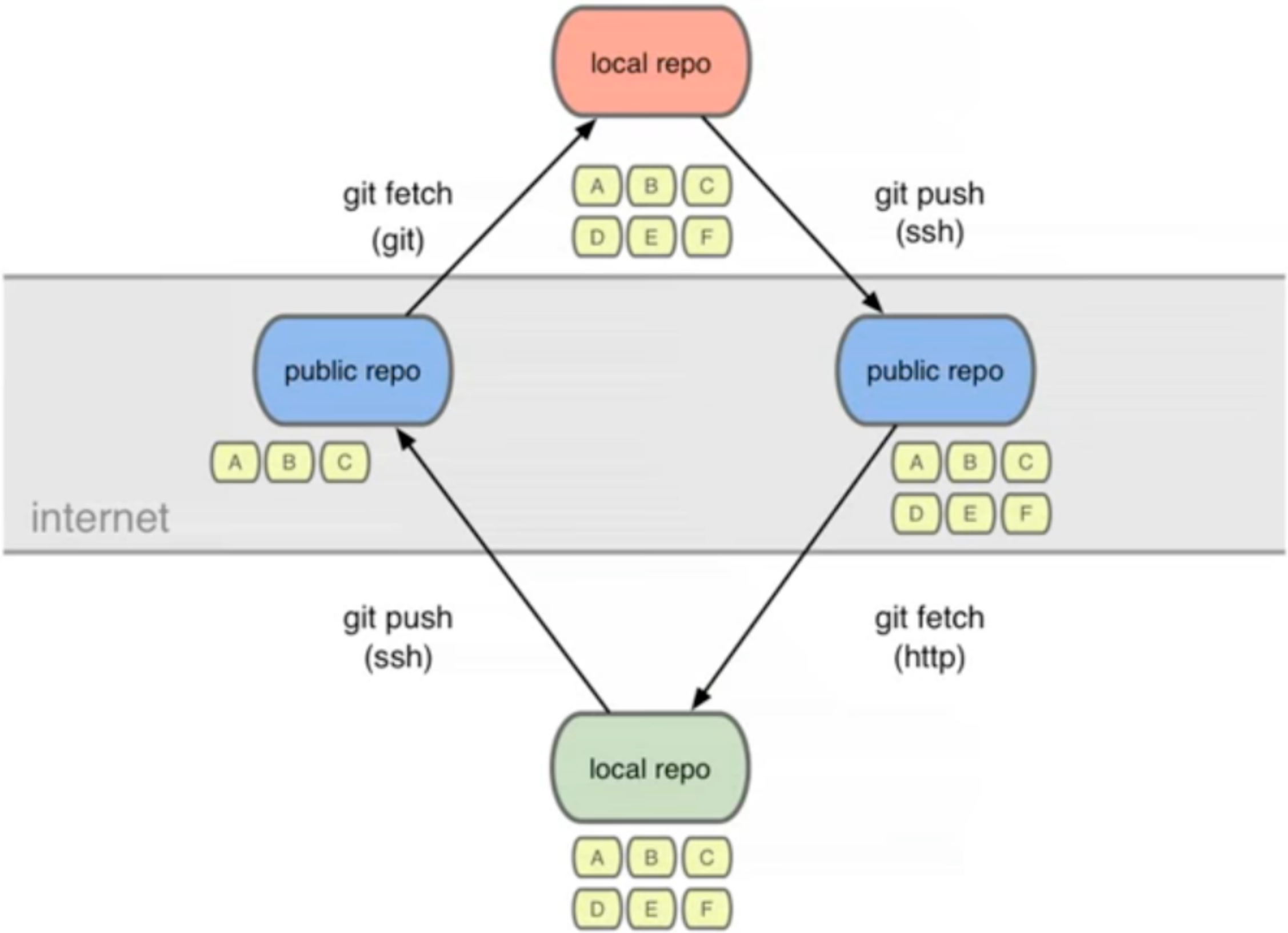
Collaboration



Collaboration



Collaboration



Remote Branches

This is a remote branch

My Machine

The Server

origin/master

master

C1

C0

clone

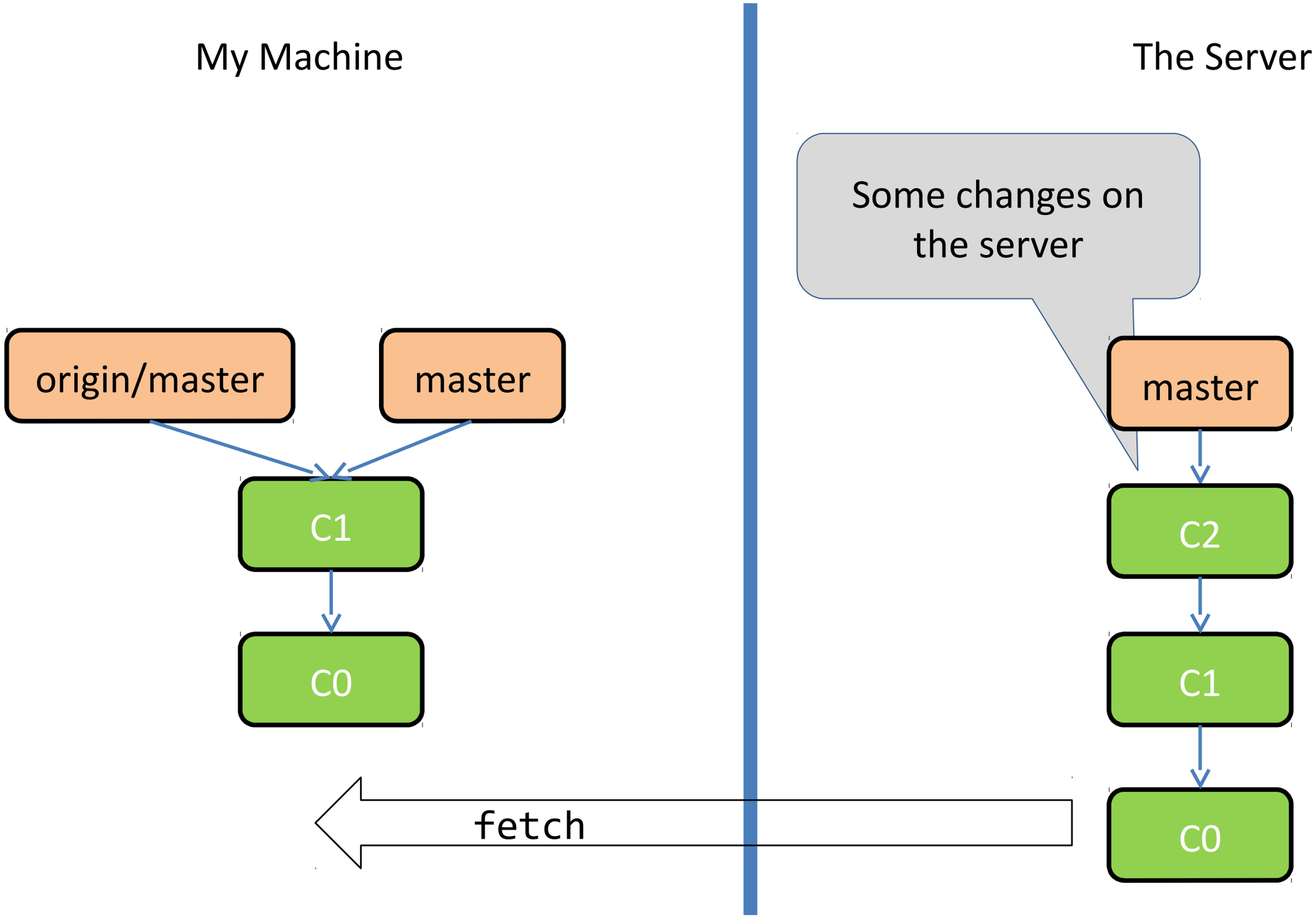
master

C1

C0

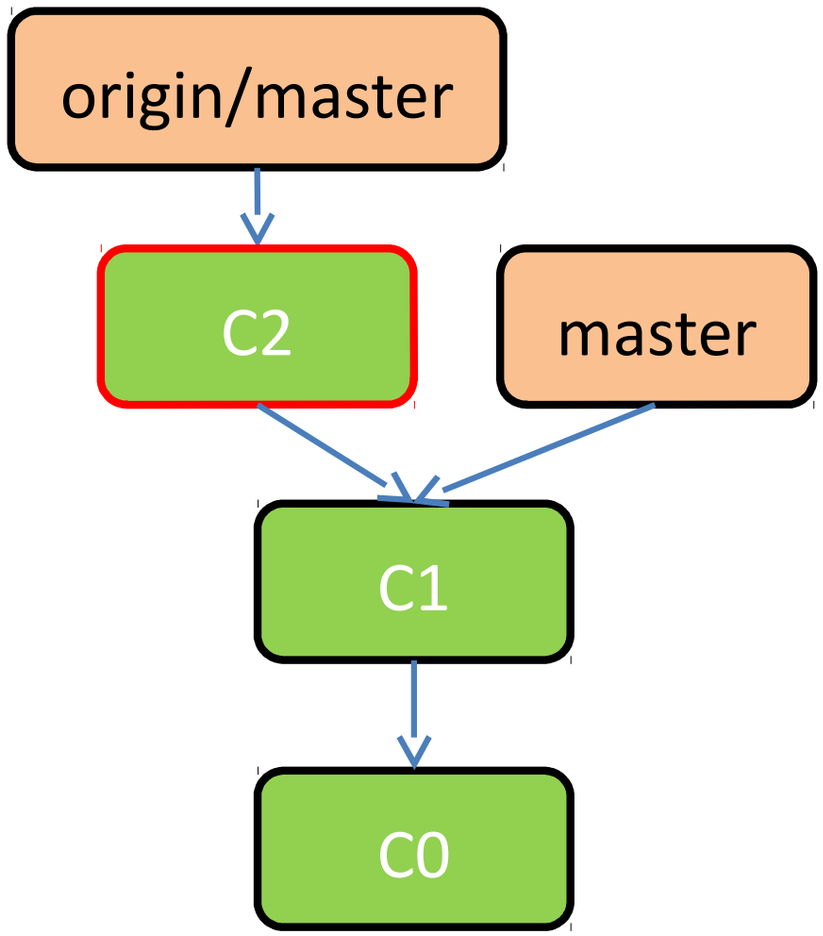
origin is just a name for a “remote”

Remote Branches - fetch

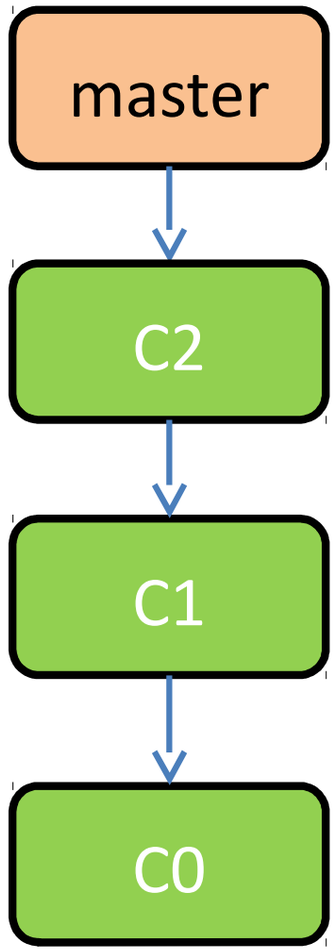


Remote Branches - fetch

My Machine

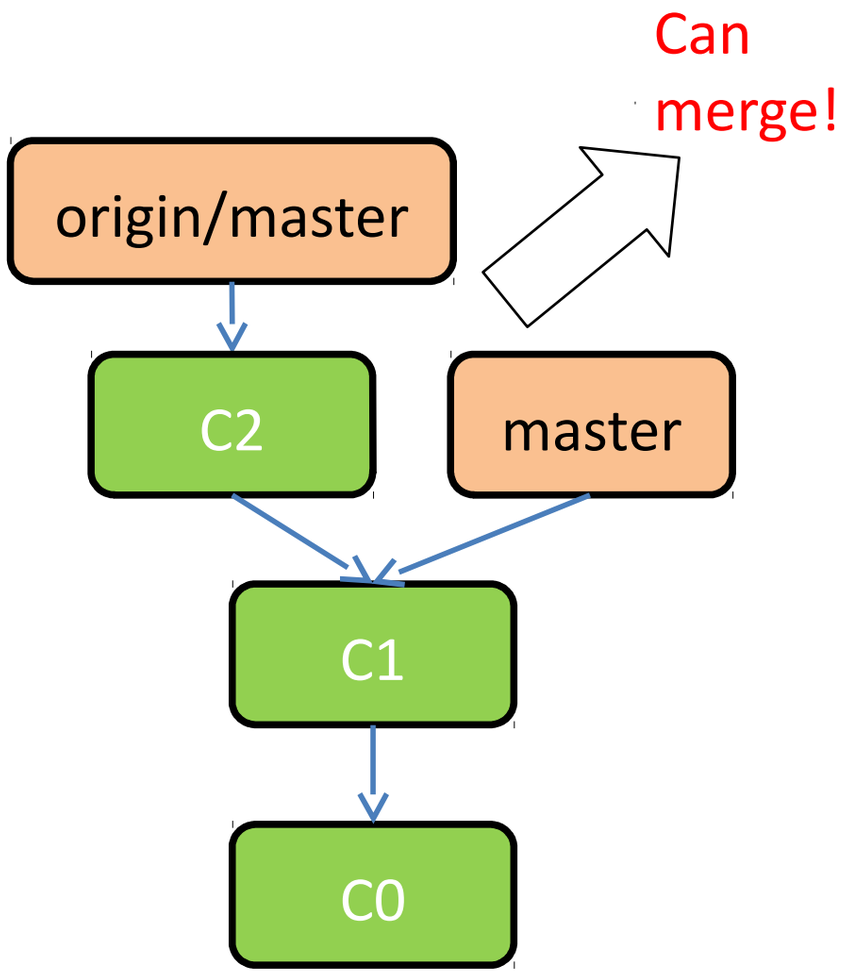


The Server



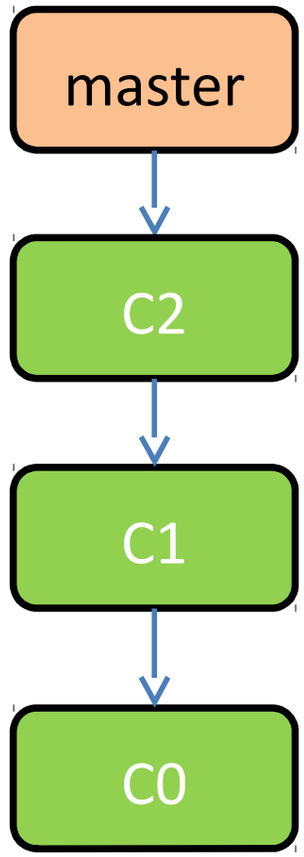
Remote Branches - fetch

My Machine



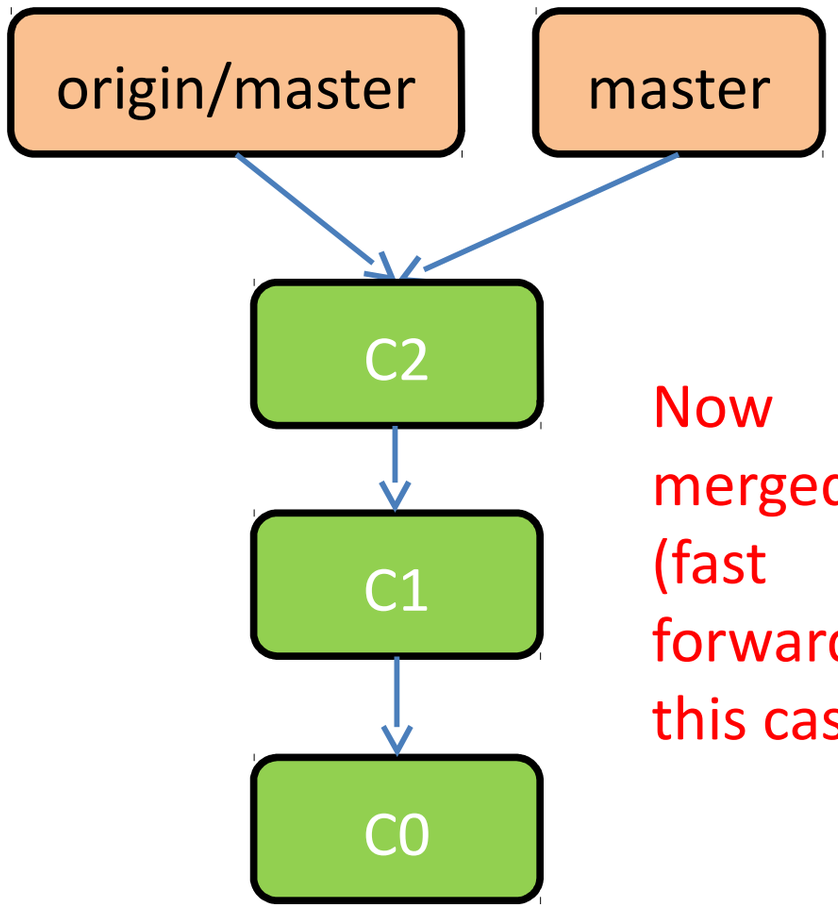
git merge

The Server



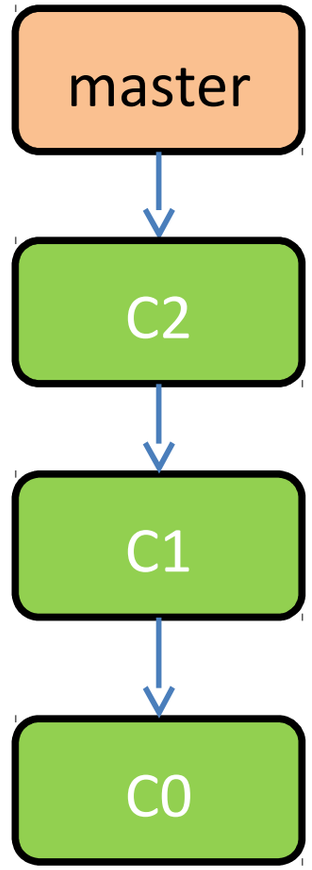
Remote Branches - fetch

My Machine



Now merged (fast forward in this case)

The Server



Remote Branches

- Reminder - Remote branches represent a branch on a remote repository
- The branch origin/master for example is a local pointer to the “master” on “origin”
- It reflects what the **local** repository **currently knows** about the state of “master” on “origin”

Send information: push

- Will take local object which are required to make a remote branch complete and send them
- Will merge (fast-forward only) those local changes into the remote branch
- If fast-forward not possible:
  - the push will fail
  - need manual merge
    - git fetch; git merge origin/master; git add .; git commit

Conflict

Pushed on the server refused

```
$ git push origin master
To ssh://hall/~/bcktestgit
 ! [rejected]        master -> master (fetch first)
error: failed to push some refs to 'ssh://hall/~/bcktestgit'
hint: Updates were rejected because the remote contains work that you do
hint: not have locally. This is usually caused by another repository pushing
hint: to the same ref. You may want to first integrate the remote changes
hint: (e.g., 'git pull ...') before pushing again.
hint: See the 'Note about fast-forwards' in 'git push --help' for details.
```

1) import the change from the server

```
$ git pull
remote: Counting objects: 5, done.
remote: Compressing objects: 100% (2/2), done.
remote: Total 3 (delta 0), reused 0 (delta 0)
Unpacking objects: 100% (3/3), done.
From ssh://hall/~/bcktestgit
   a547735..7f32455  master     -> origin/master
Auto-merging test.c
CONFLICT (content): Merge conflict in test.c
Automatic merge failed; fix conflicts and then commit the result.
```

Some change create conflict ! Need manual resolution

Conflict

Open the file(s) with conflict and resolve them

```
$ cat test.c
<<<<<<< HEAD
line you wanted to push
=======
current version of the line on the server
>>>>>>> 7f32455dbe6bea745bc94efd6b3d5f473446d581
$ vim test.c
```

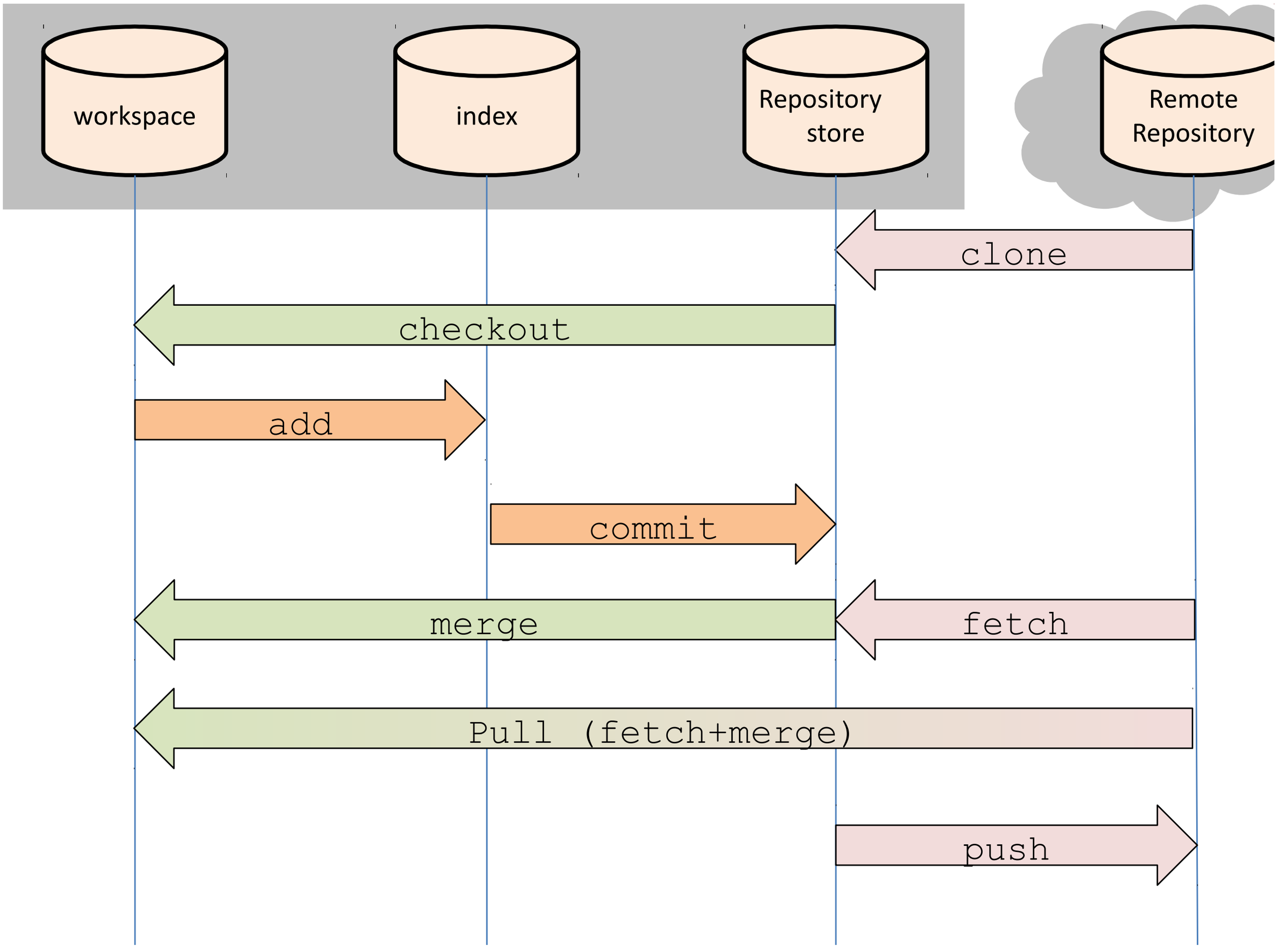
Commit your changes

```
$ git add .
$ git commit -m merge
[master 6b884f0] merge
```

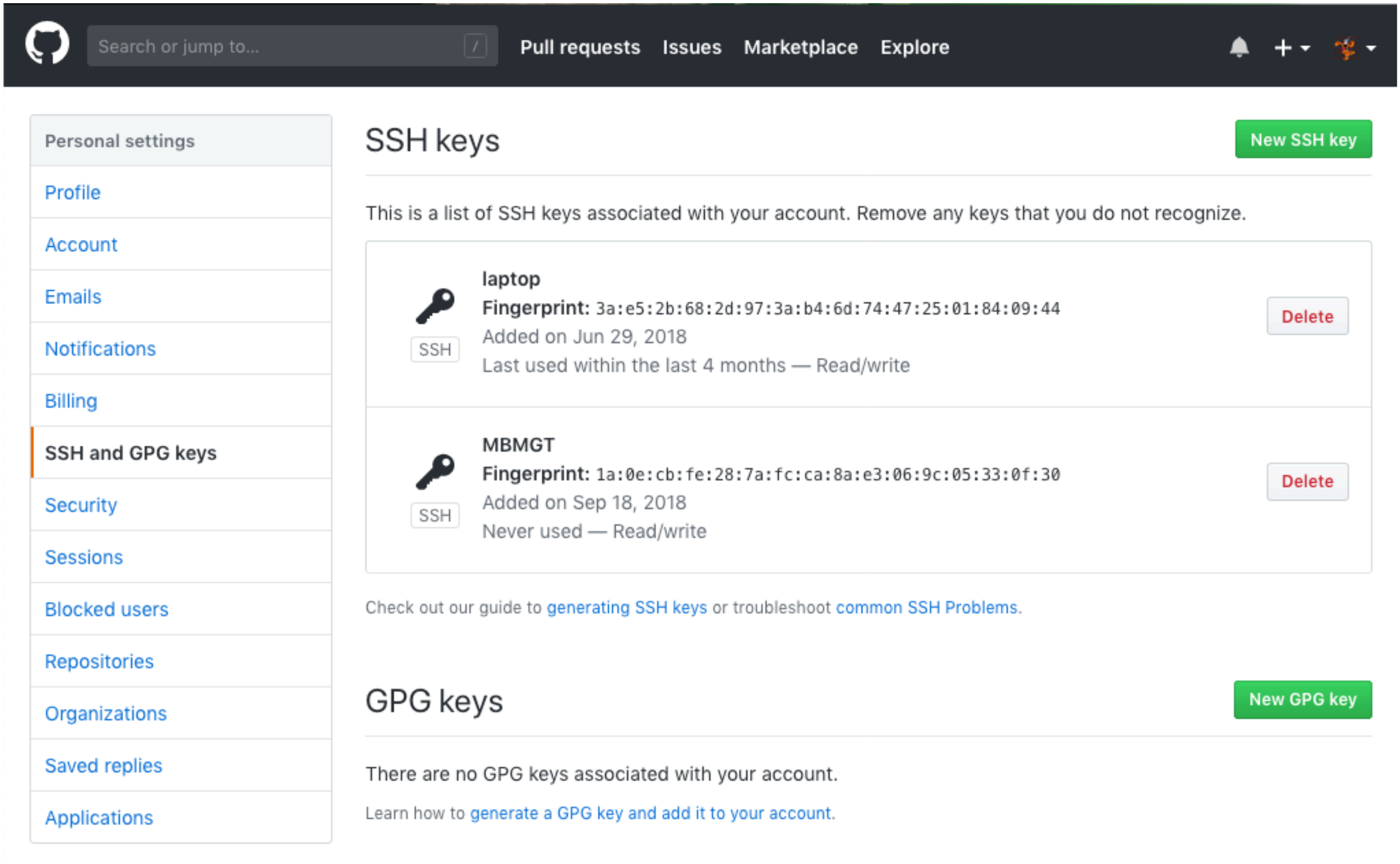
Push on the server

```
$ git push origin master
Counting objects: 6, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (5/5), done.
Writing objects: 100% (6/6), 676 bytes | 0 bytes/s, done.
Total 6 (delta 0), reused 0 (delta 0)
To ssh://hall/~/bcktestgit
   7f32455..6b884f0  master -> master
```

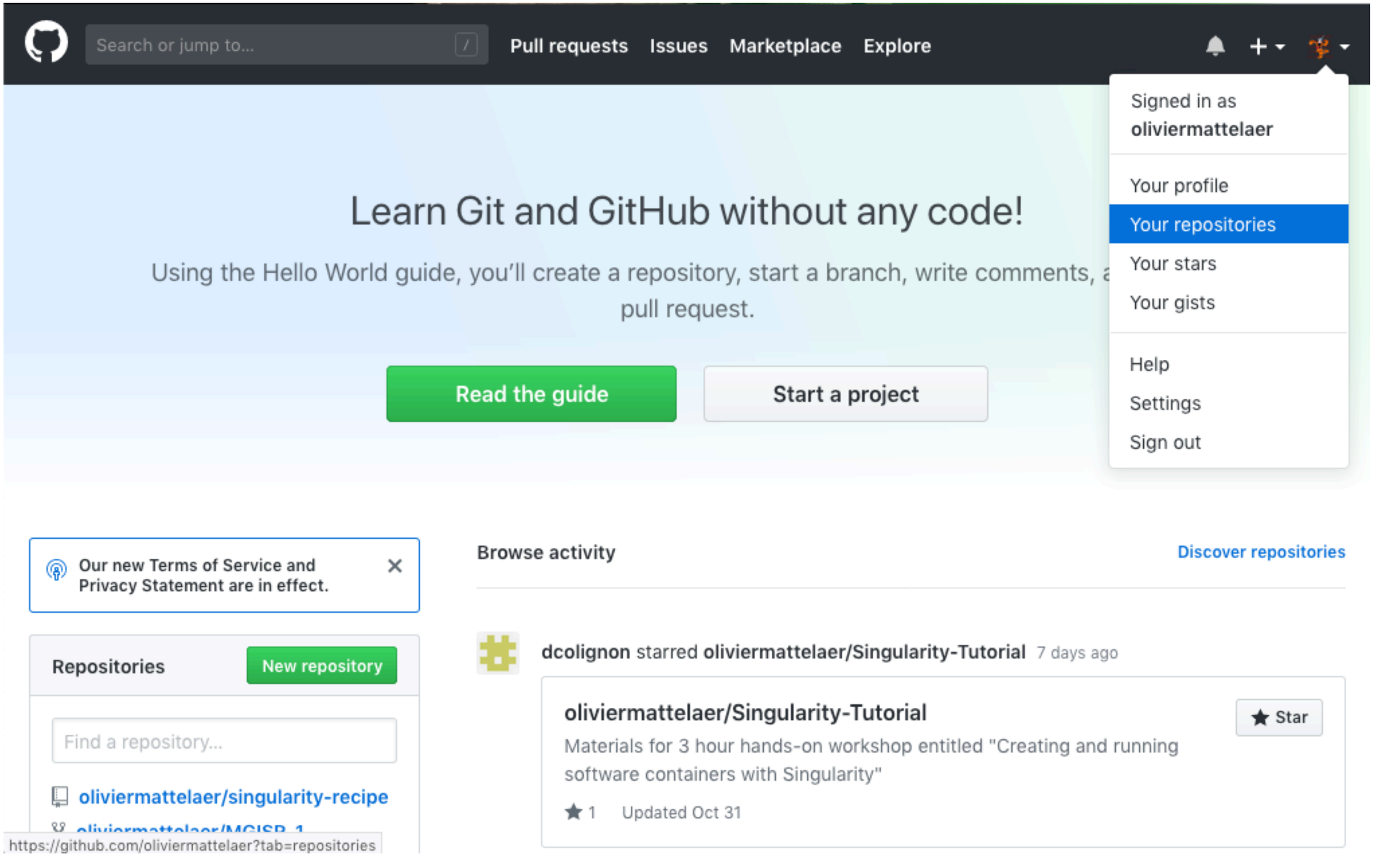
Summary of operations



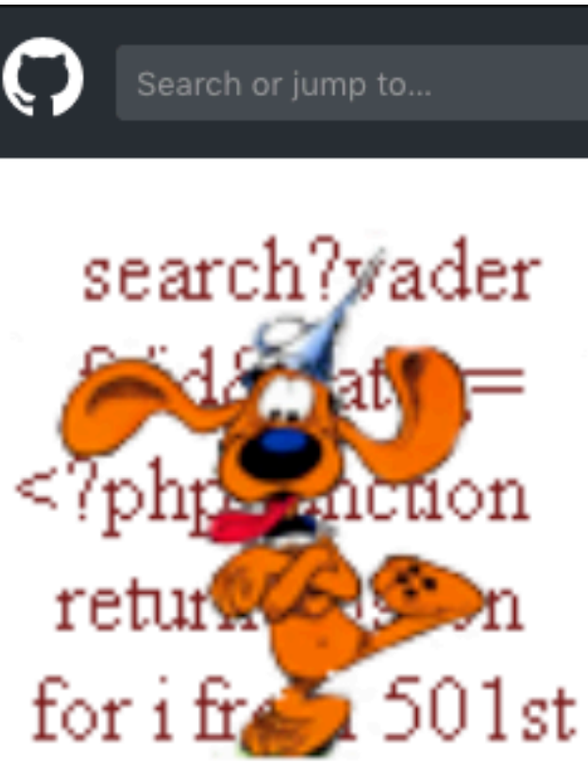
Add your ssh keys!



Add your project in git



Add it in a git repo



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ProTip! Updating your profile with your name, location, and a profile picture helps other GitHub users get to know you. Edit profile

Overview **Repositories** 10 Stars 0 Followers 0 Following 0

Find a repository... Type: All Language: All New

oliviermattelaer

Add a bio

Edit profile

Singularity-Tutorial

Forked from NIH-HPC/Singularity-Tutorial

Materials for 3 hour hands-on workshop entitled "Creating and running software containers with Singularity"

★ 1 11 Updated 8 days ago

Add it in a git repo

Create a new repository

A repository contains all the files for your project, including the revision history.

Owner **Repository name**

oliviermattelaer / gittuto

Great repository names are short and memorable. Need inspiration? How about **legendary-octo-happiness**.

Description (optional)

Public
Anyone can see this repository. You choose who can commit.

Private
You choose who can see and commit to this repository.

Initialize this repository with a README
This will let you immediately clone the repository to your computer. Skip this step if you're importing an existing repository.

Add .gitignore: **None** | Add a license: **None**

Create repository

Add it in a git repo

oliviermattelaer / **gittuto**

Watch 0 | Star 0 | Fork 0

Code | Issues 0 | Pull requests 0 | Projects 0 | Wiki | Insights | Settings

Quick setup — if you've done this kind of thing before

Set up in Desktop or HTTPS SSH https://github.com/oliviermattelaer/gittuto.git

Get started by creating a new file or uploading an existing file. We recommend every repository include a README, LICENSE, and .gitignore.

...or create a new repository on the command line

```
echo "# gittuto" >> README.md
git init
git add README.md
git commit -m "first commit"
git remote add origin https://github.com/oliviermattelaer/gittuto.git
git push -u origin master
```

...or push an existing repository from the command line

```
git remote add origin https://github.com/oliviermattelaer/gittuto.git
git push -u origin master
```

Adding Collaborator to GitHub

Search or jump to... / Pull requests Issues Marketplace Explore

oliviermattelaer / gittuto

Watch 0 Star 0 Fork 0

Code Issues 0 Pull requests 0 Projects 0 Wiki Insights Settings

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```
s://github.com/oliviermattelaer/gittuto.git
```

https://github.com/oliviermattelaer/gittuto/settings

Conclusion

- Versioning is crucial both for small/large project
  - Avoid dropbox for paper / project
- make meaningful commit
  - logical block
  - meaningful message
- git more complicated but the standard

More information

- Why an index: http://gitolite.com/uses-of-index.html
- technical tutorial on git (details on storage structure): https://www.youtube.com/watch?v=xbLVvrb2-fY
- https://git-scm.com/doc