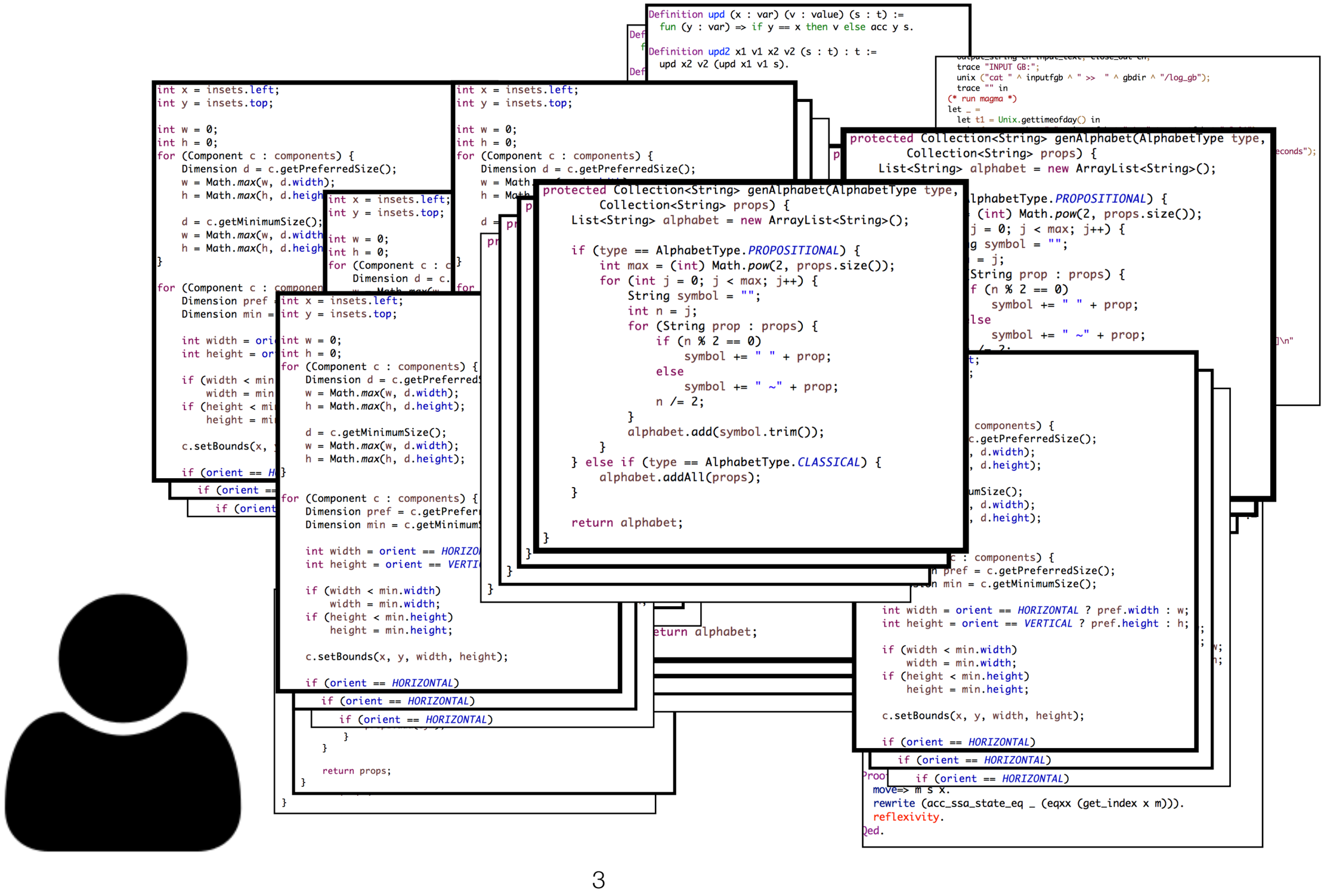
Git

SDM 2021

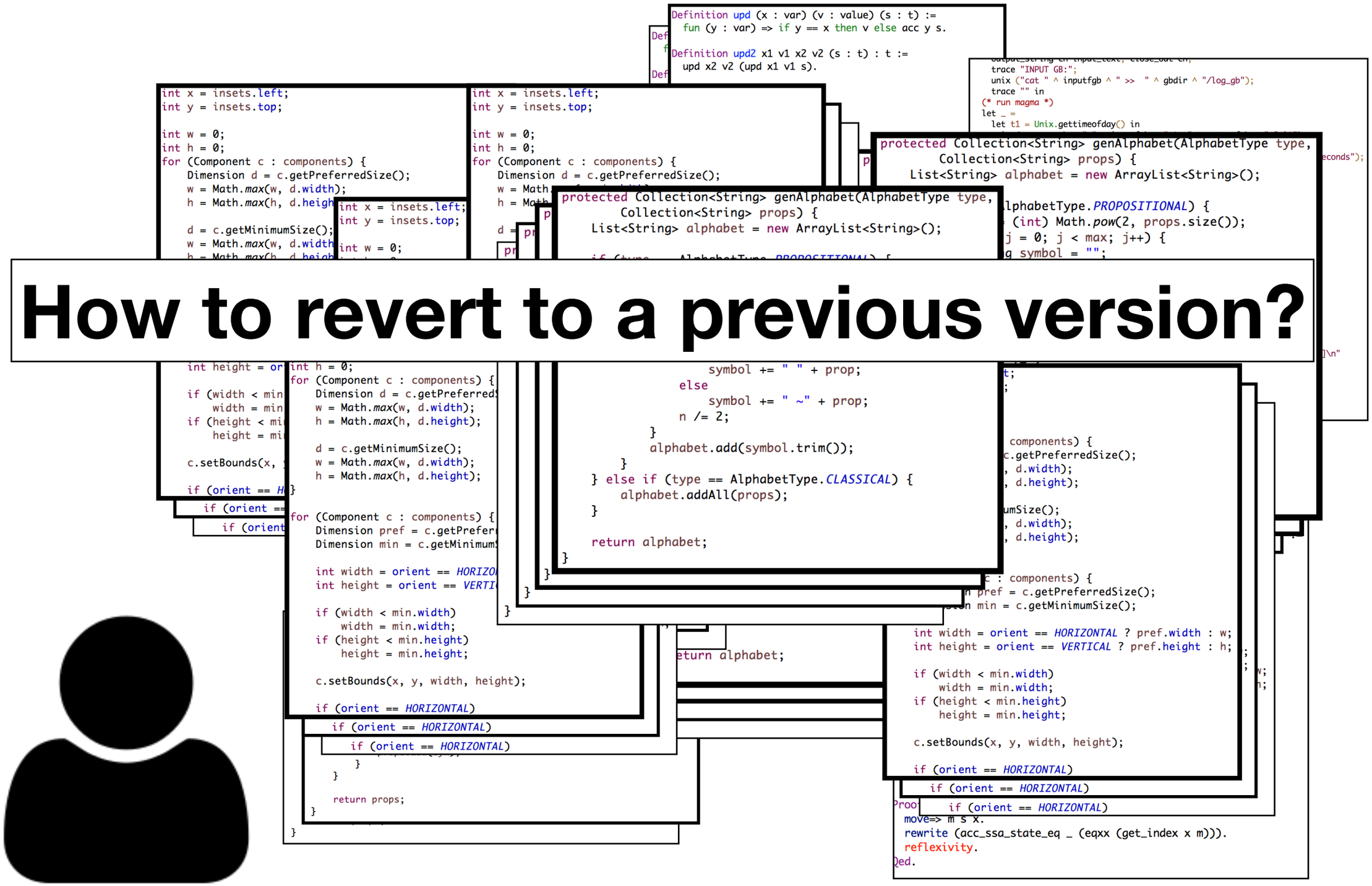
Productivity Tools for Developers

- Editors
- Debuggers
- Build automation tools
- Integrated development environment
- Modeling tools
- Source code analyzers / testing tools
- Version control tools $\Longleftarrow$ ***git***

File Changes

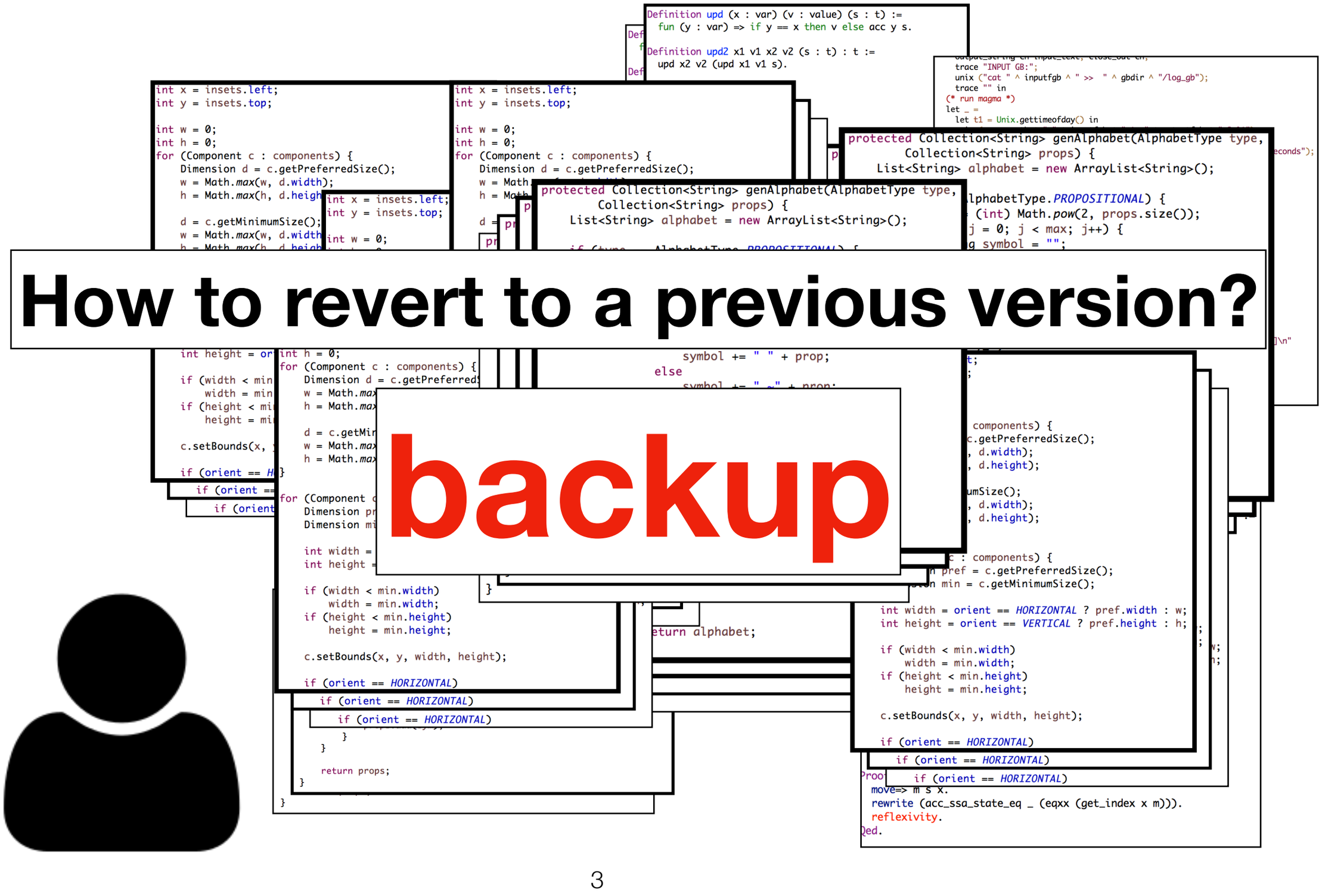


File Changes



How to revert to a previous version?

File Changes



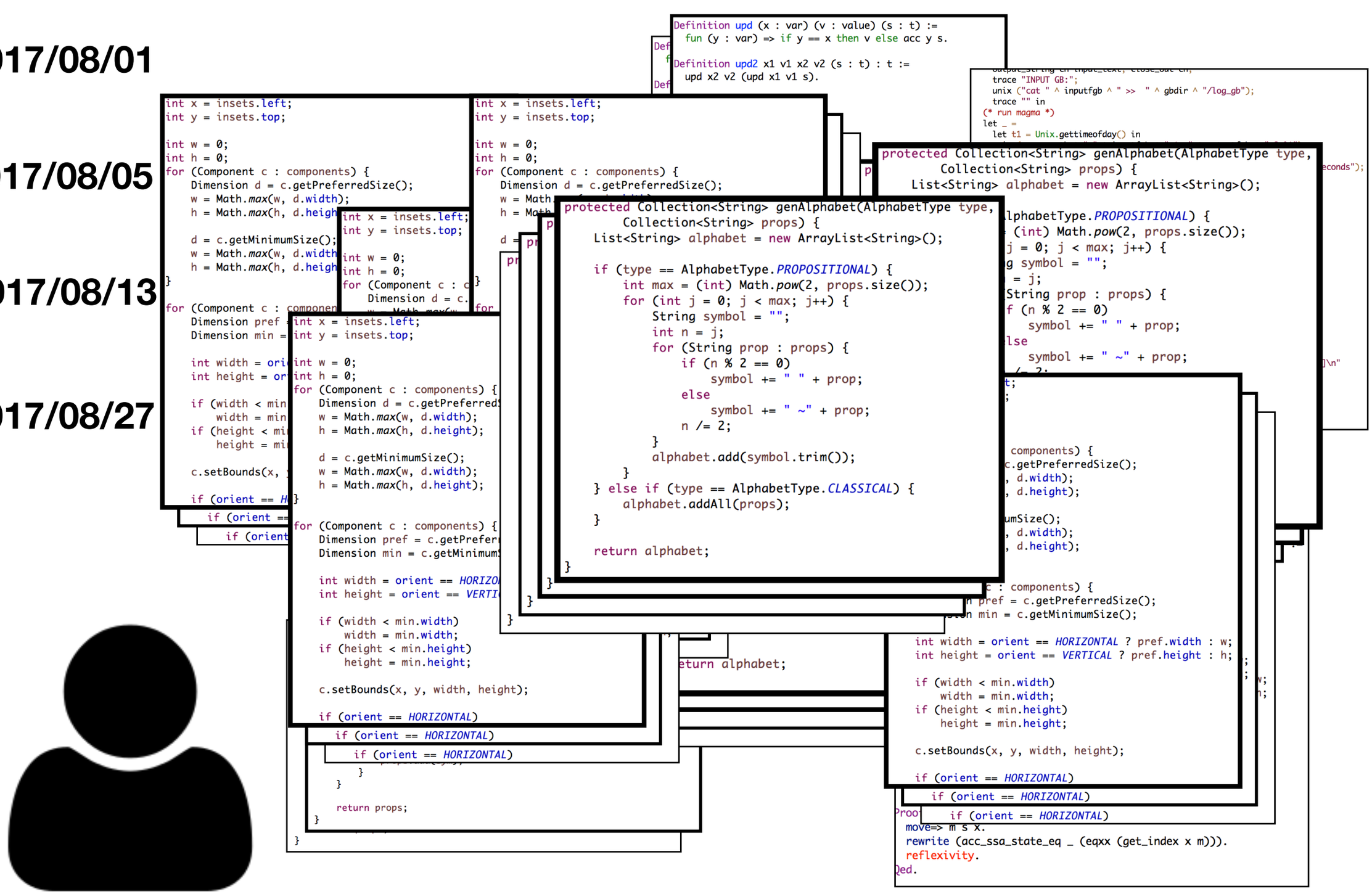
Project Backup

2017/08/01

2017/08/05

2017/08/13

2017/08/27



Project Backup

2017/08/05

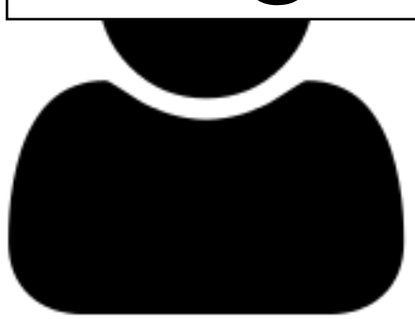
2017/08/13

2017/08/27

What has been done in a version?

How is a bug in version A fixed in version B?

Merge code from two developers?



Project Backup

2017/08/05

2017/08/13

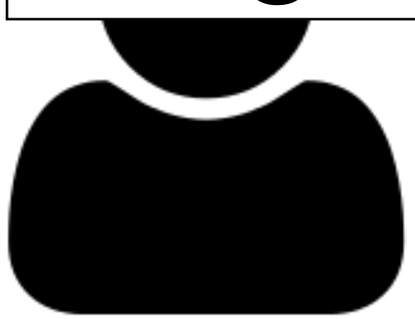
2017/08/27

What has been done in a version?

log

diff

How is a bug in version A fixed in version B?



Merge code from two developers?

diff3

Project Backup

201

What has been done in a version?

2017/08/05

Version Control Systems (VCS)

Version Control System

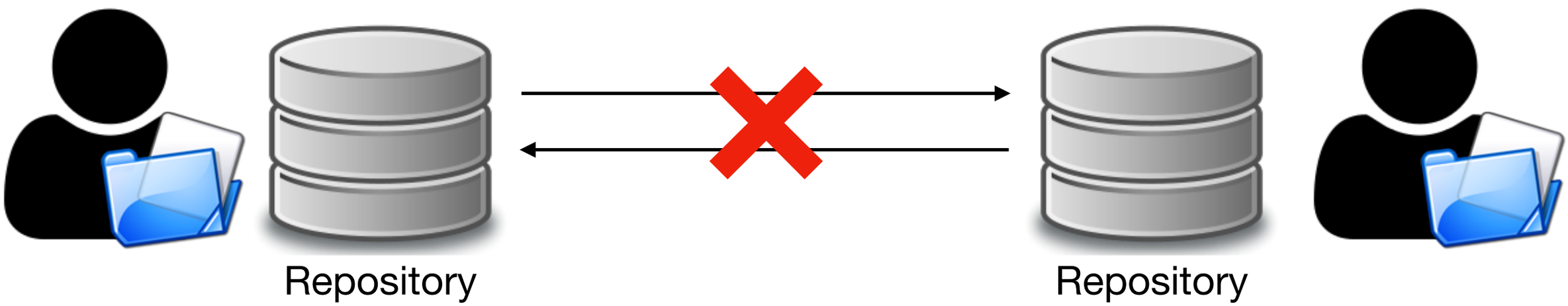
- The developer needs a system that can
  - store files in different versions with log messages,
  - compare files between different versions,
  - restore files from specific versions,
  - …

- All versions of files are stored in a ***repository***

- A version of project is checked out to a ***working area*** for editing

Local Version Control

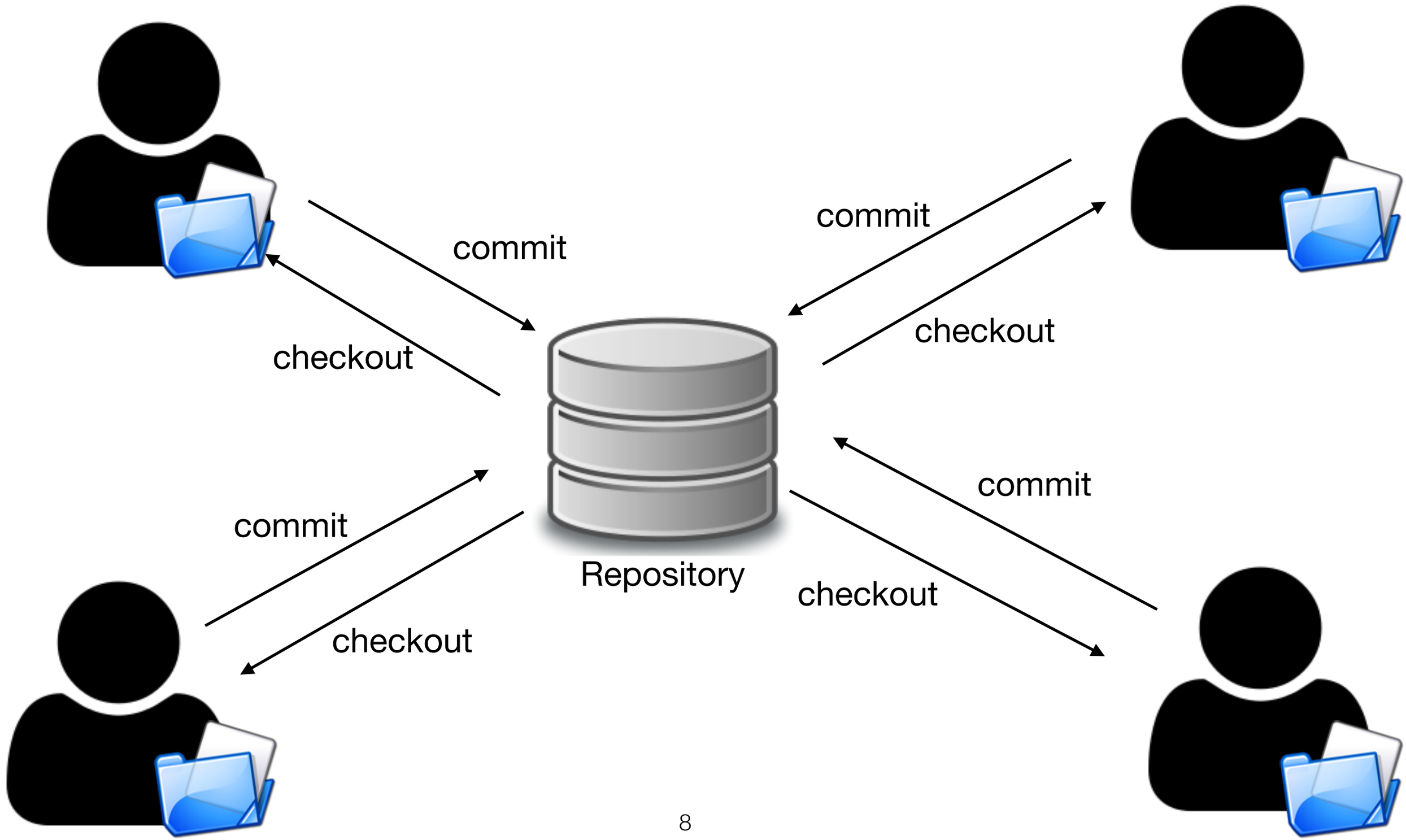
- SCCS (Source Code Control System, 1972)
- RCS (Revision Control System, 1982)



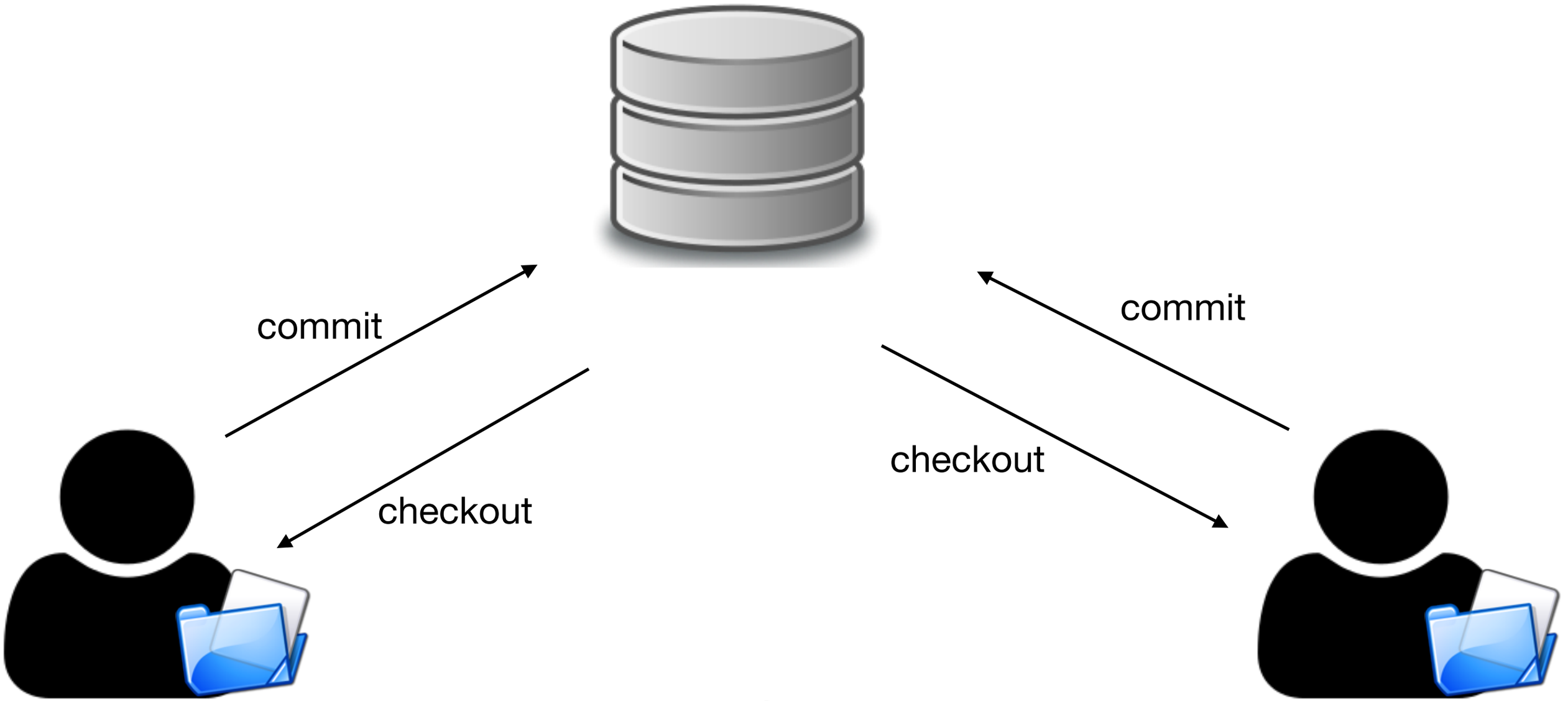
Centralized Version Control

- CVS (Concurrent Versions System, 1990)
- SVN (Subversion, 2000)
- ClearCase
- Visual SourceSafe

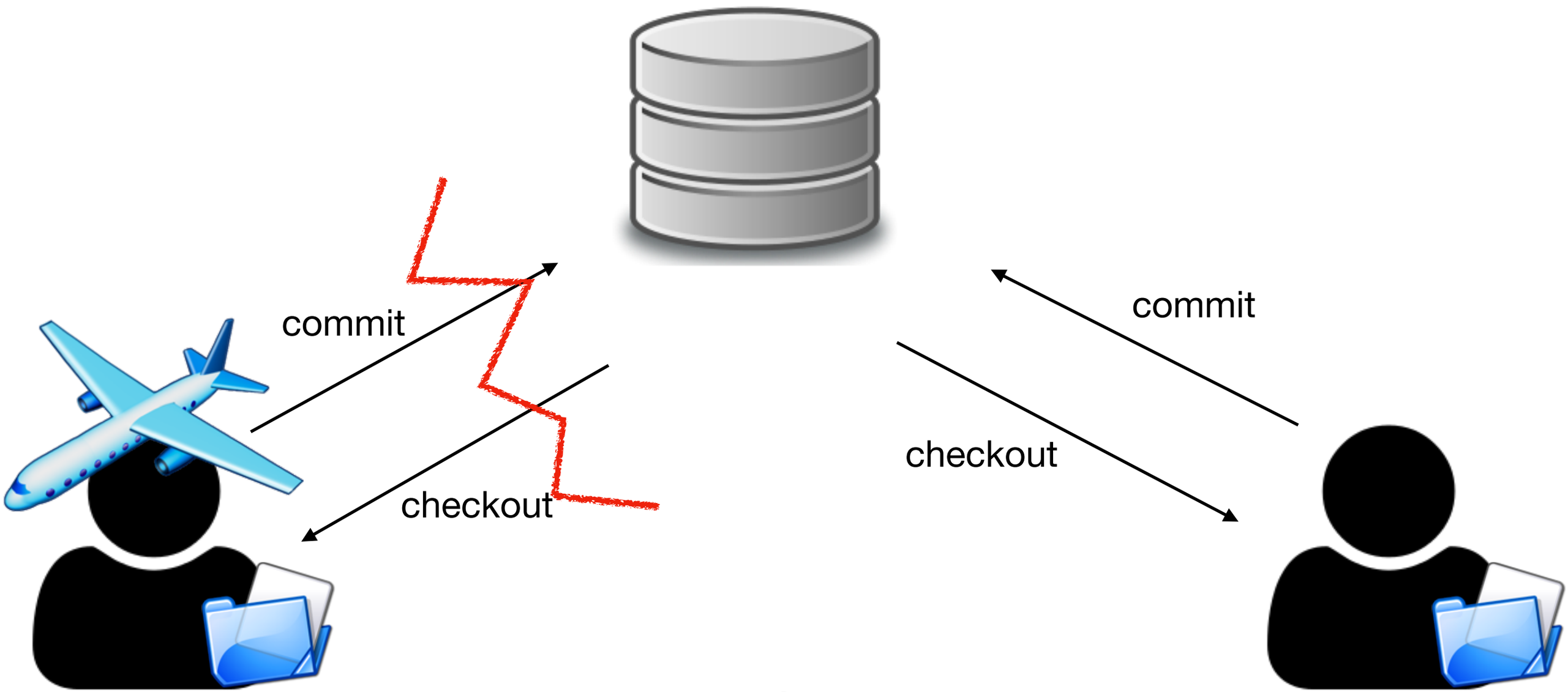
Multiple Developers



Problems



Problems



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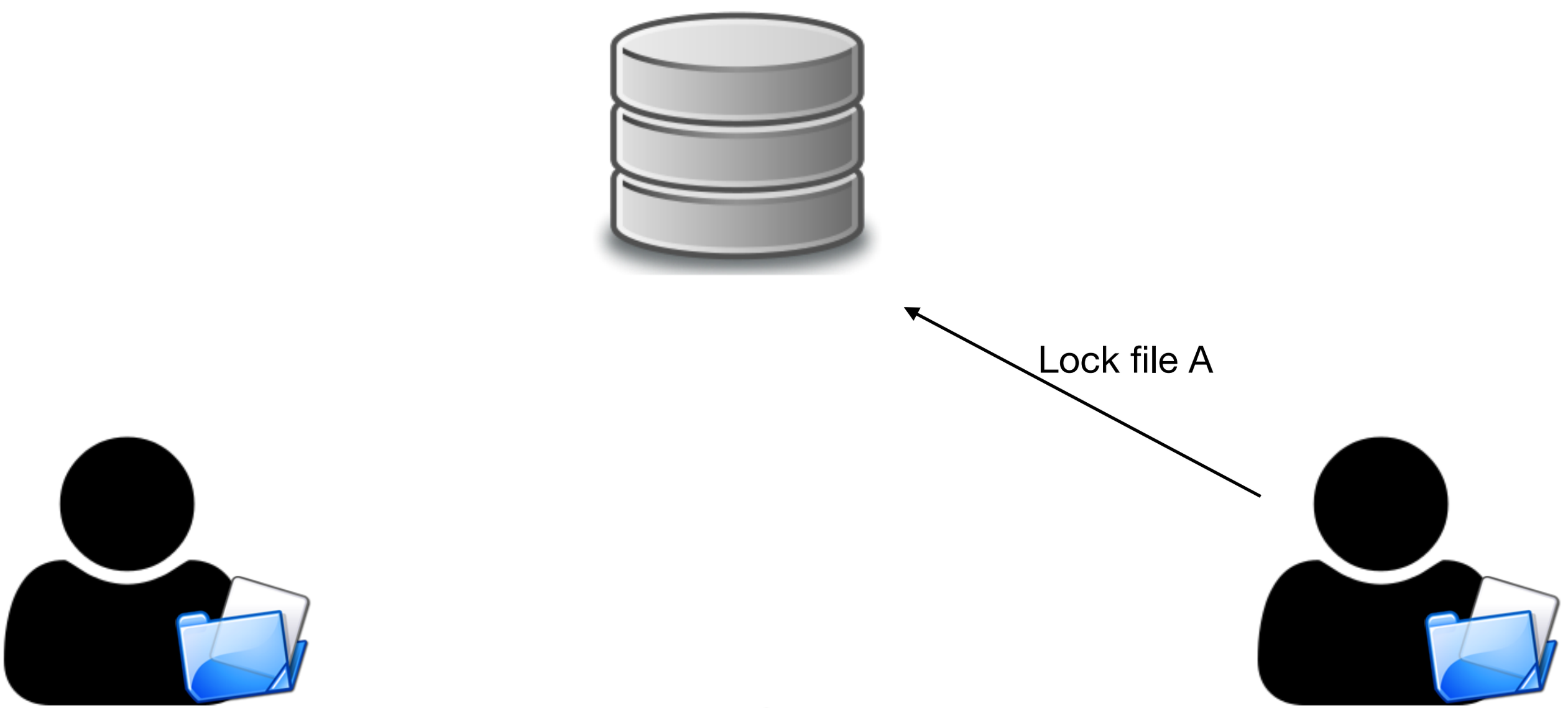
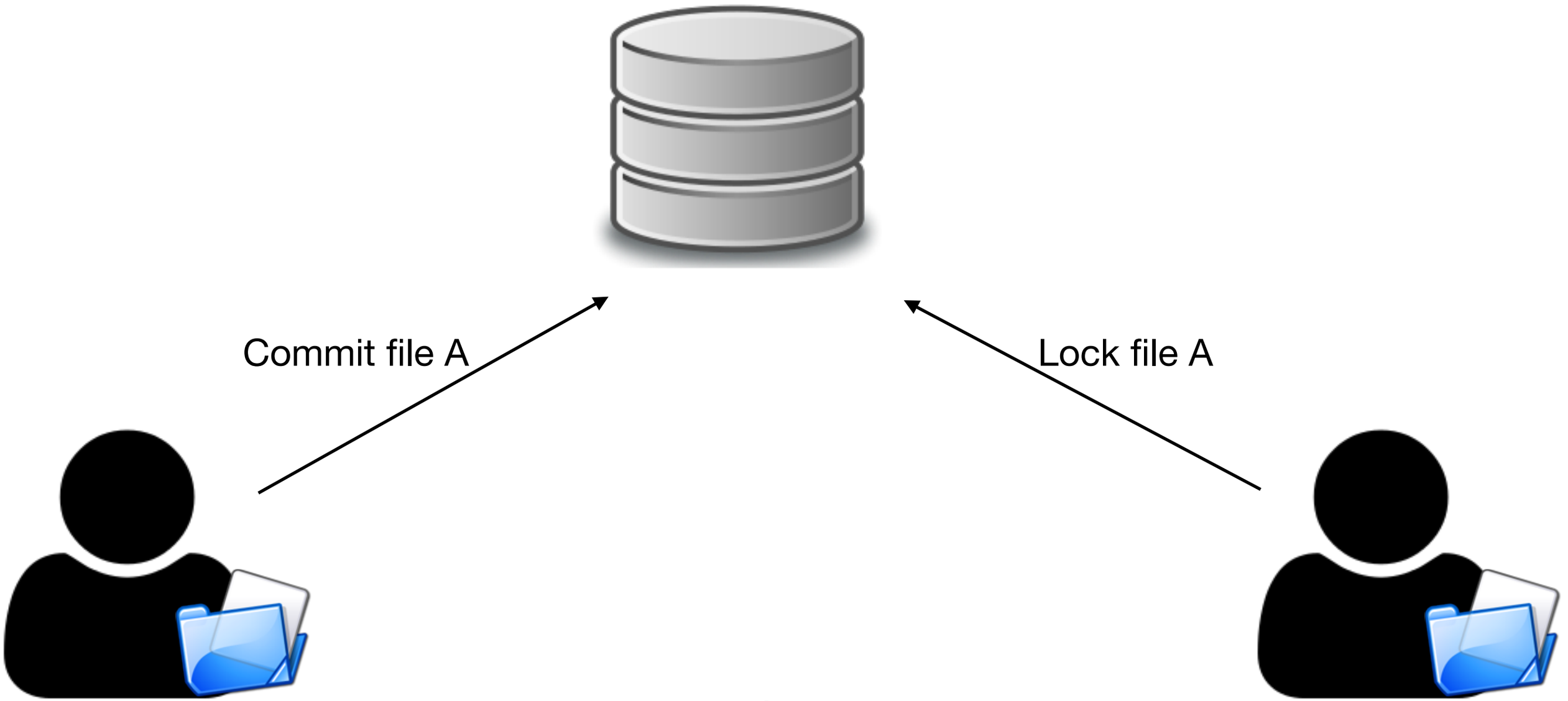


Problems



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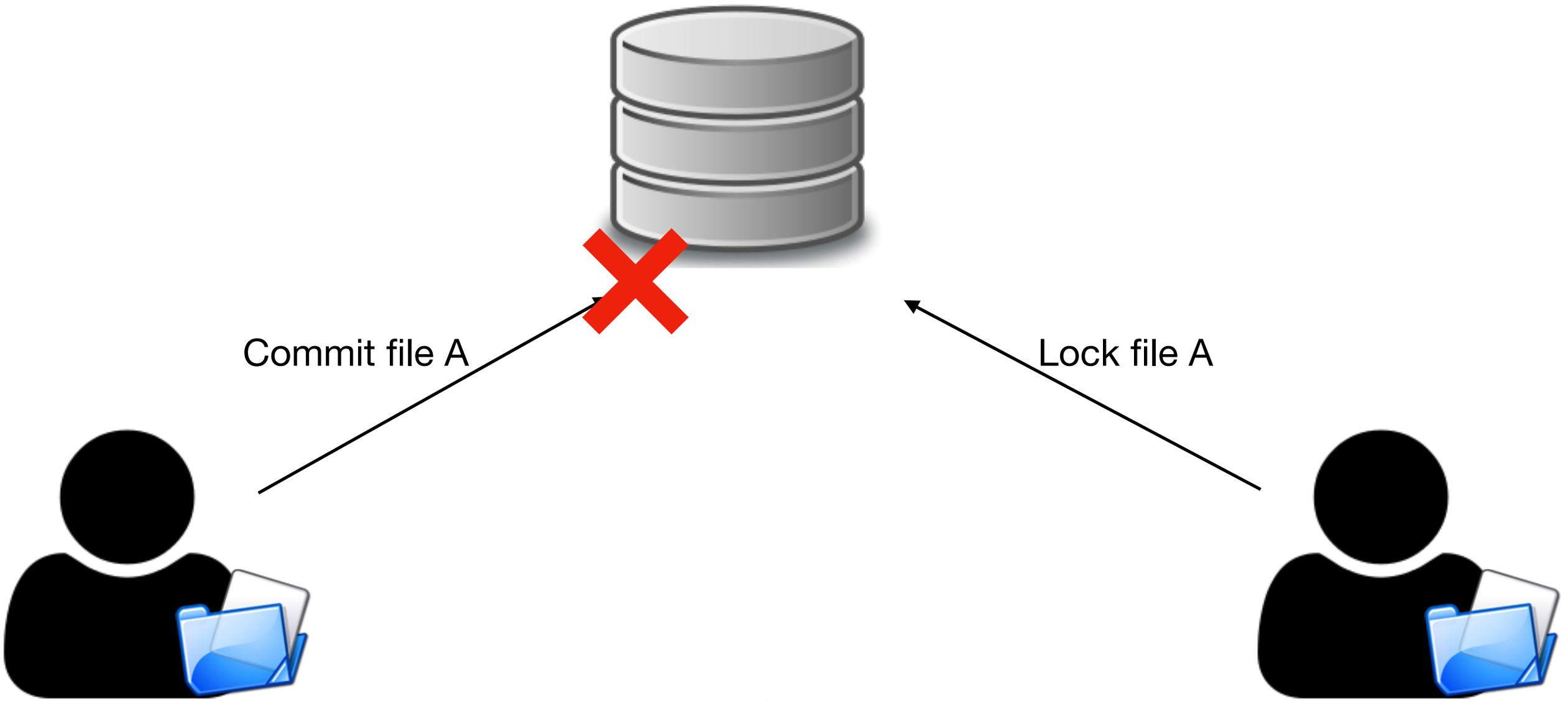
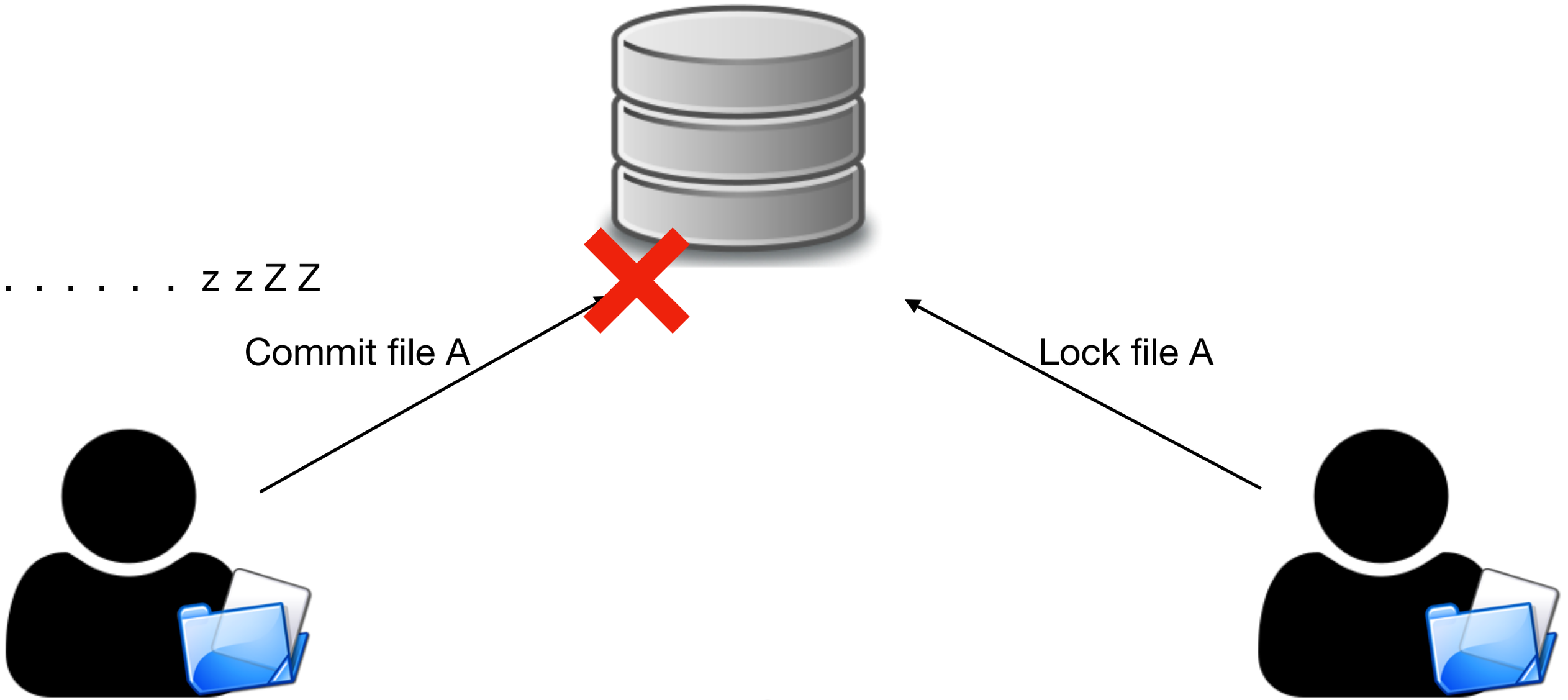


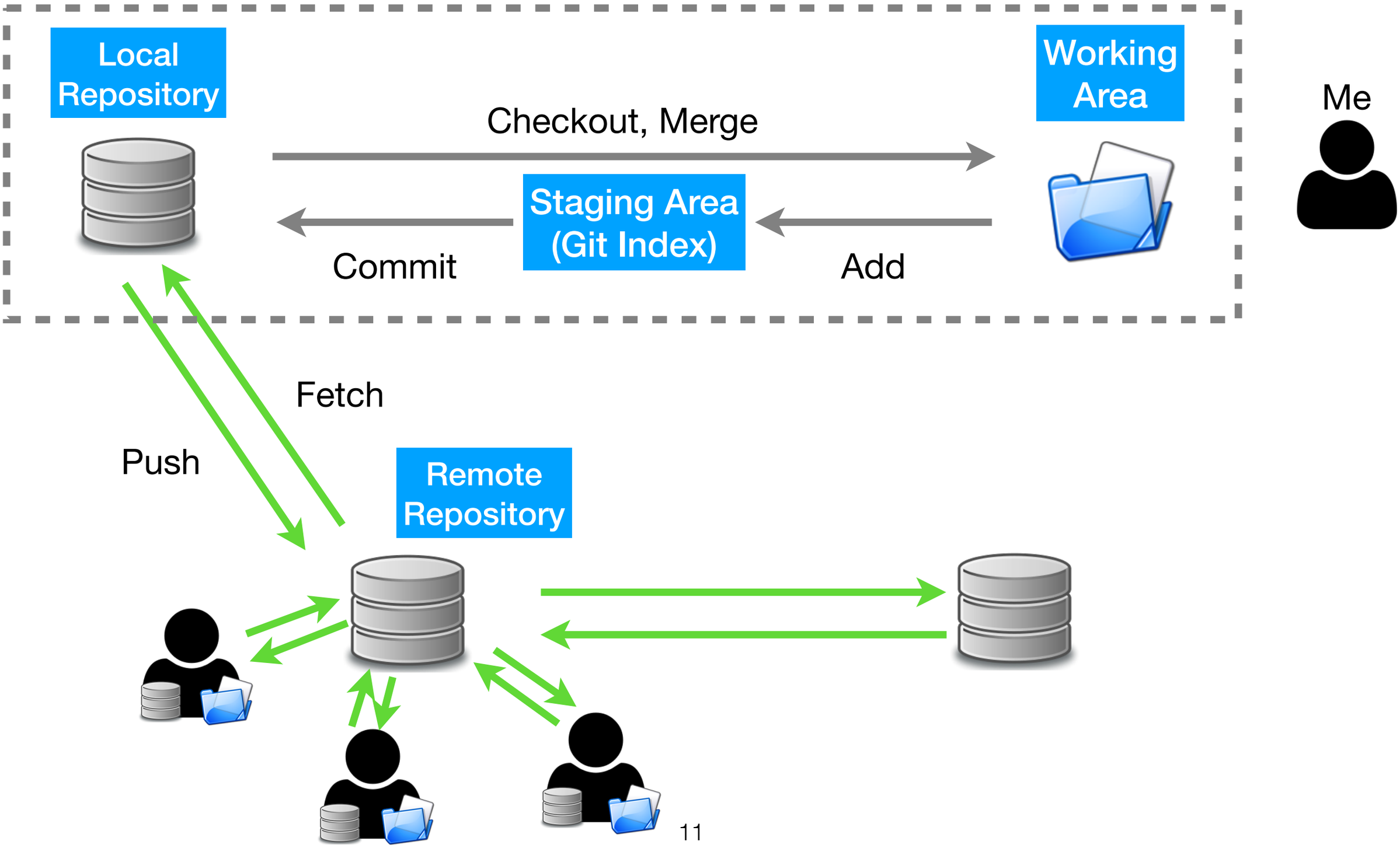
Problems



Distributed Version Control

- BitKeeper
- Git (2005)
- Mercurial (2005)

Distributed Approach (Git)



Create a Repository

```
DHCP-22126 project $ git init
Initialized empty Git repository in /Users/mht208/project/.git/
DHCP-22126 project $ ls
DHCP-22126 project $ ls -a
.     ..    .git
DHCP-22126 project $
```

repository

working area (working tree)

Files in the “project” folder can be added to the repository

Repository

Bare Repository

```
~/project
▶ git init --bare --shared
Initialized empty shared Git repository in /Users/mht208/project/

~/project  master ✔
▶ ls -a
.               HEAD            description info            refs
..              config          hooks       objects

~/project  master ✔
▶
```

no working area in a bare repository

Clone

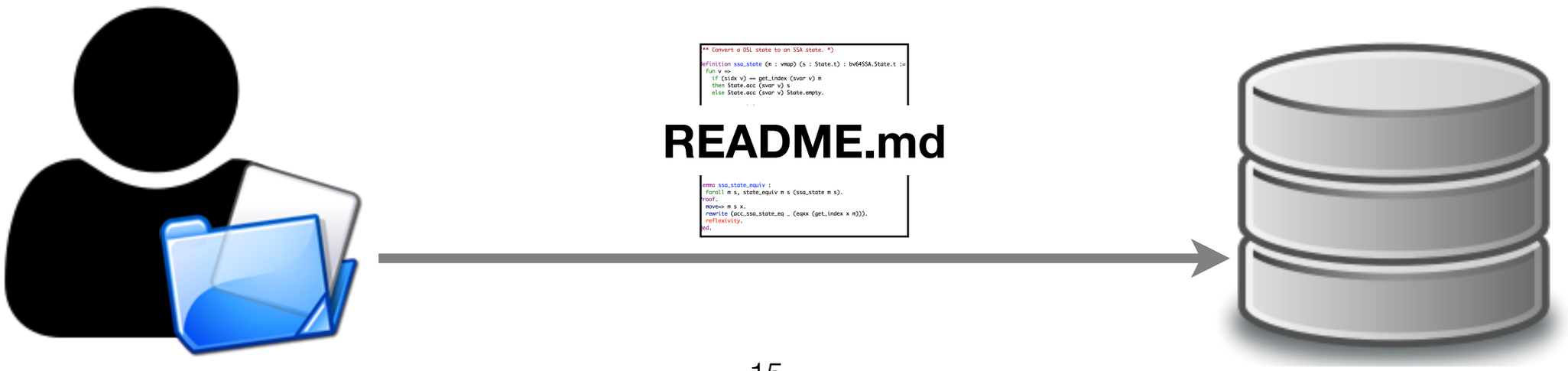
Clone

Supported protocols: ssh, git, http, and https

```
DHCP-22126 demo $ ls
DHCP-22126 demo $ git clone https://github.com/atom/atom.git
Cloning into 'atom'...
remote: Counting objects: 179291, done.
remote: Compressing objects: 100% (16/16), done.
remote: Total 179291 (delta 13), reused 13 (delta 10), pack-reused 179265
Receiving objects: 100% (179291/179291), 285.63 MiB | 4.65 MiB/s, done.
Resolving deltas: 100% (127760/127760), done.
DHCP-22126 demo $ ls
atom
DHCP-22126 demo $
```

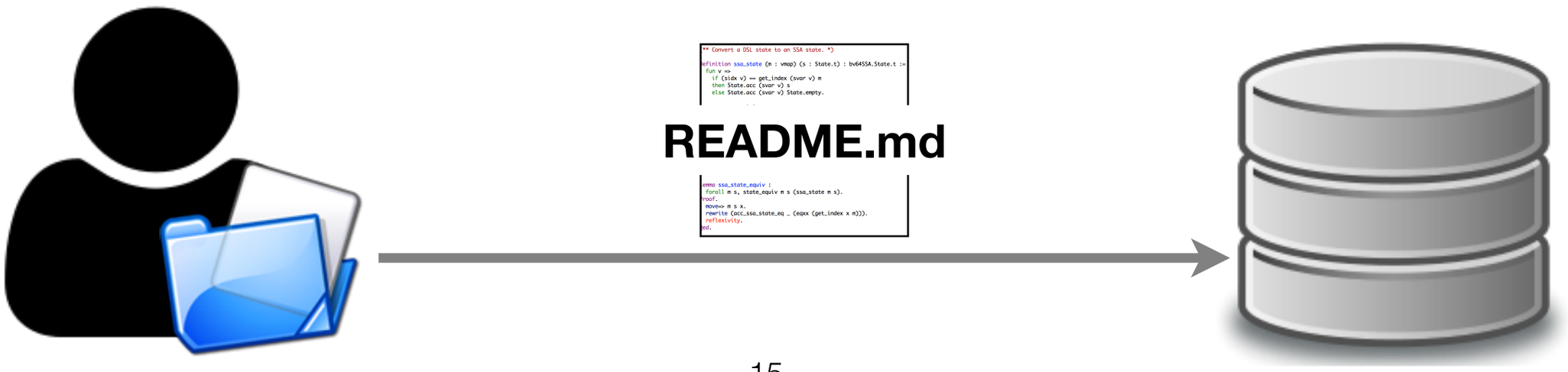
Add Commit

```
DHCP-22126 project $ ls -a
.           ..          .git        README.md
DHCP-22126 project $
```

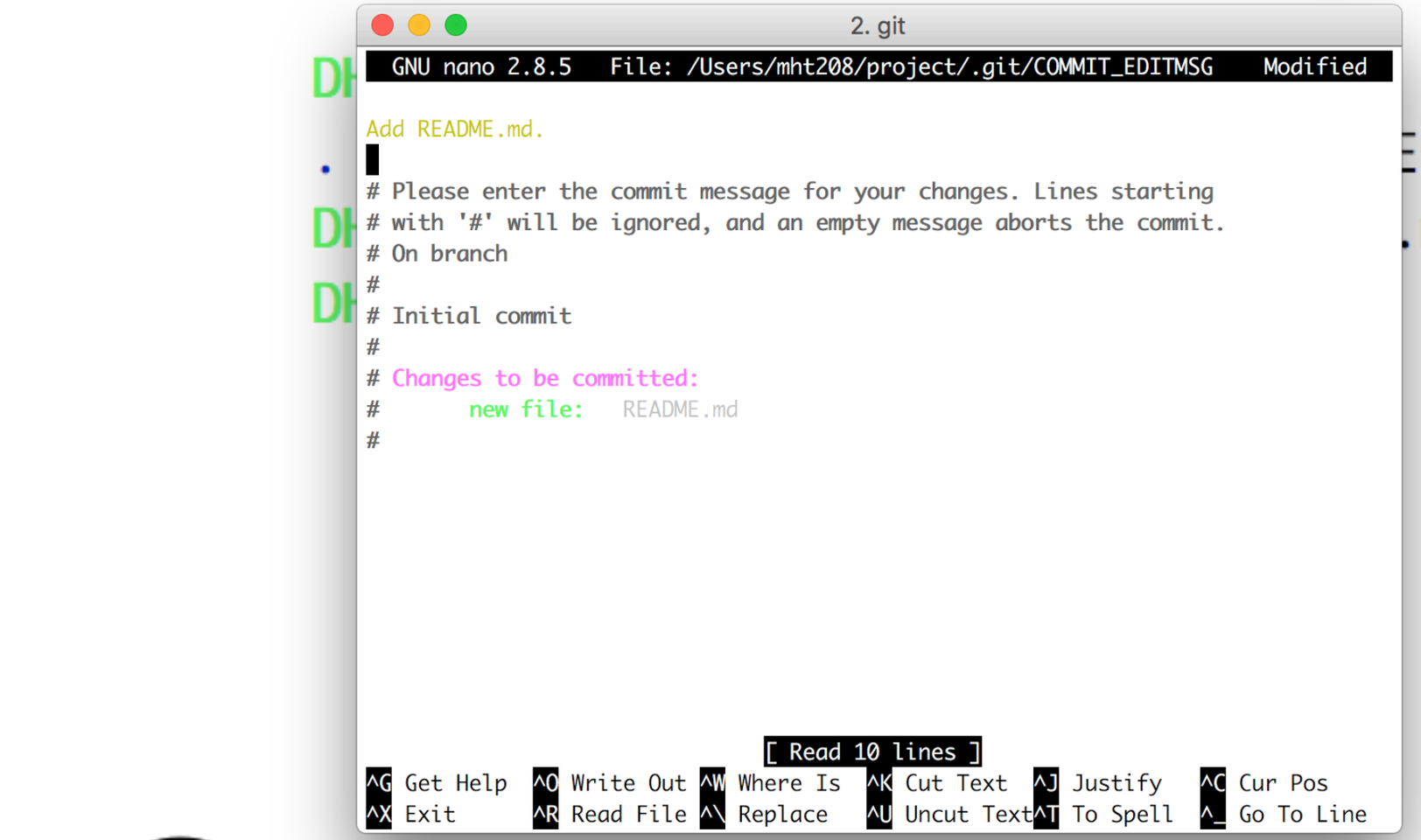


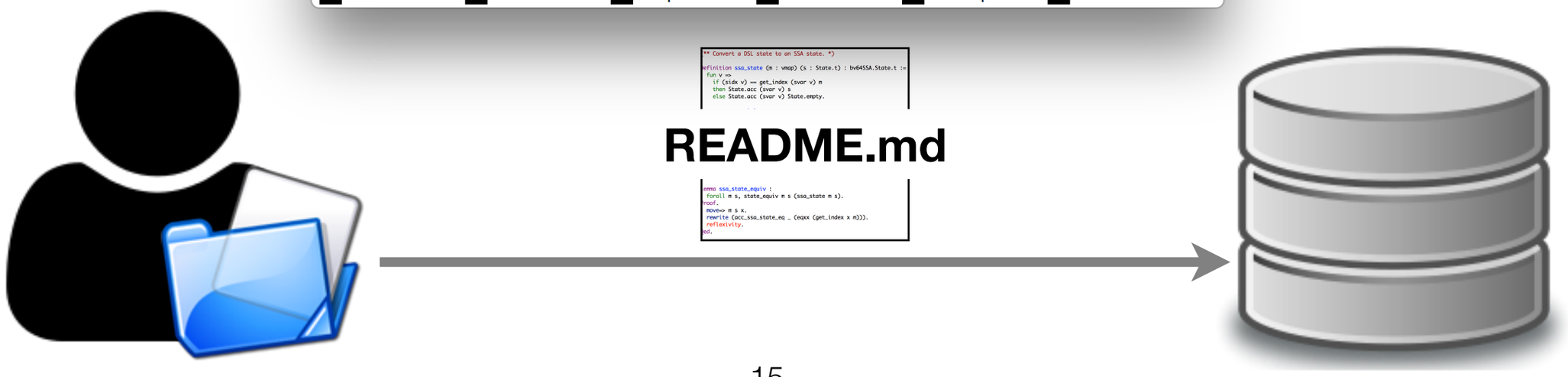
Add Commit

```
DHCP-22126 project $ ls -a
.           ..          .git        README.md
DHCP-22126 project $ git add README.md
DHCP-22126 project $ git commit
```

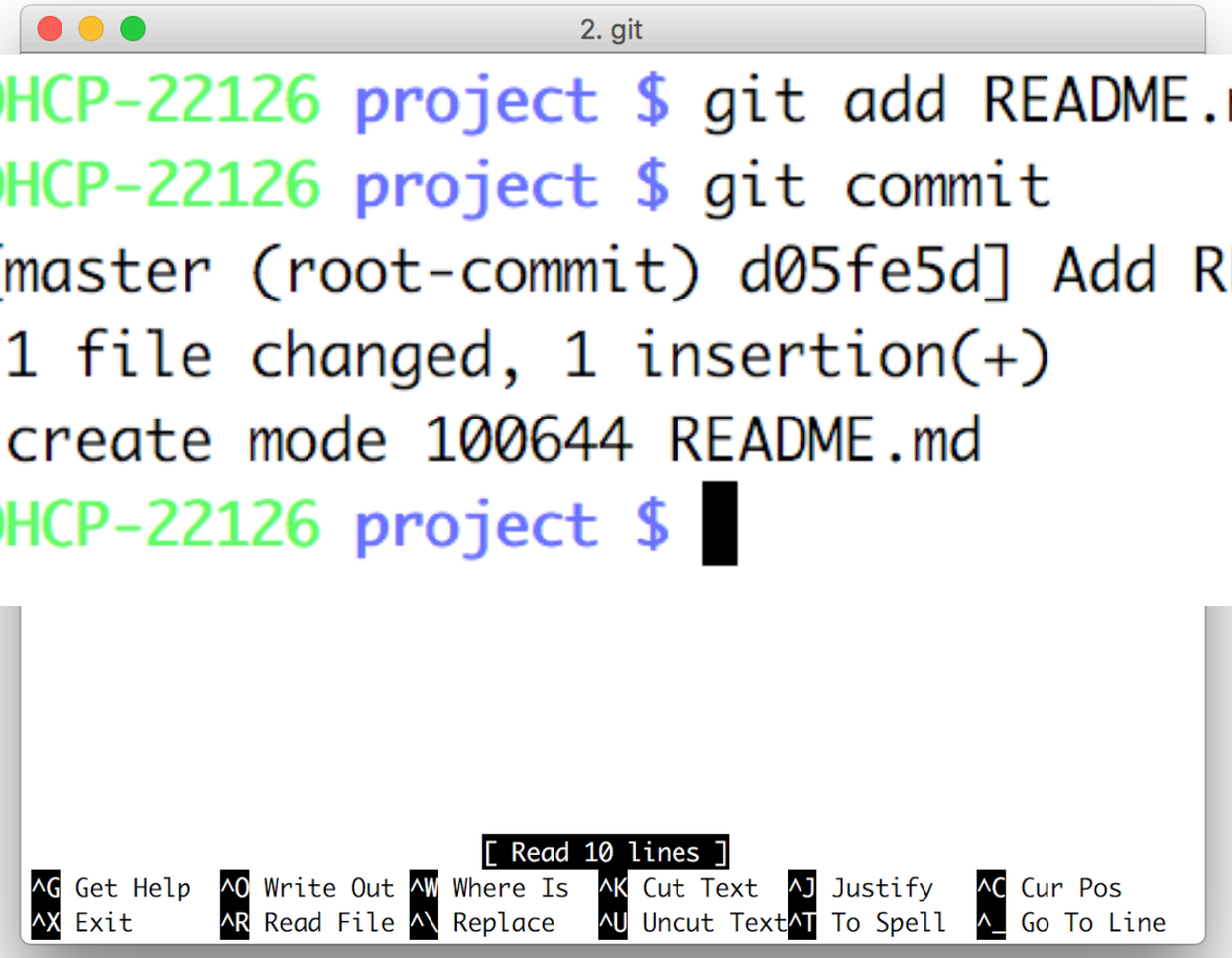


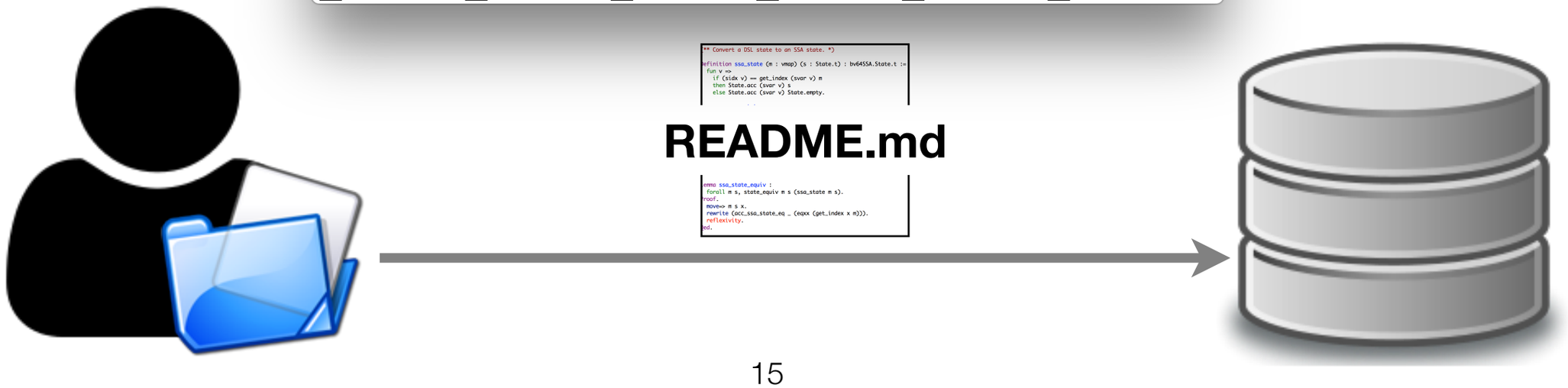
Add Commit


2. git
GNU nano 2.8.5 File: /Users/mht208/project/.git/COMMIT_EDITMSG Modified
Add README.md.
Please enter the commit message for your changes. Lines starting
with '#' will be ignored, and an empty message aborts the commit.
On branch
#
Initial commit
#
Changes to be committed:
new file: README.md
#
[Read 10 lines]
^G Get Help ^O Write Out ^W Where Is ^K Cut Text ^J Justify ^C Cur Pos
^X Exit ^R Read File ^\ Replace ^U Uncut Text ^T To Spell ^_ Go To Line


README.md

Add Commit

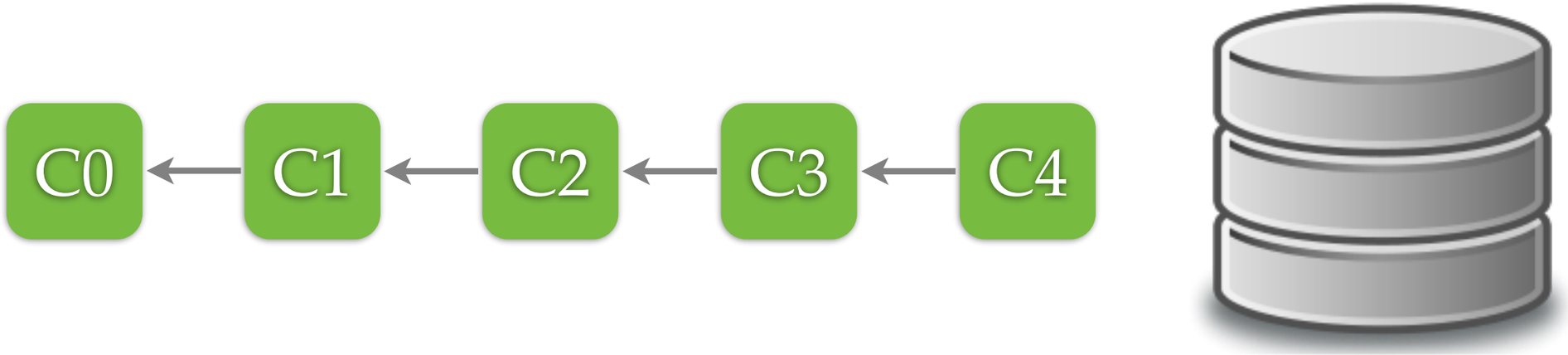

2. git
DHCP-22126 project $ git add README.md
DHCP-22126 project $ git commit
[master (root-commit) d05fe5d] Add README.md.
1 file changed, 1 insertion(+)
create mode 100644 README.md
DHCP-22126 project $
[Read 10 lines]
^G Get Help ^O Write Out ^W Where Is ^K Cut Text ^J Justify ^C Cur Pos
^X Exit ^R Read File ^\ Replace ^U Uncut Text ^T To Spell ^_ Go To Line


README.md

Add VS Commit

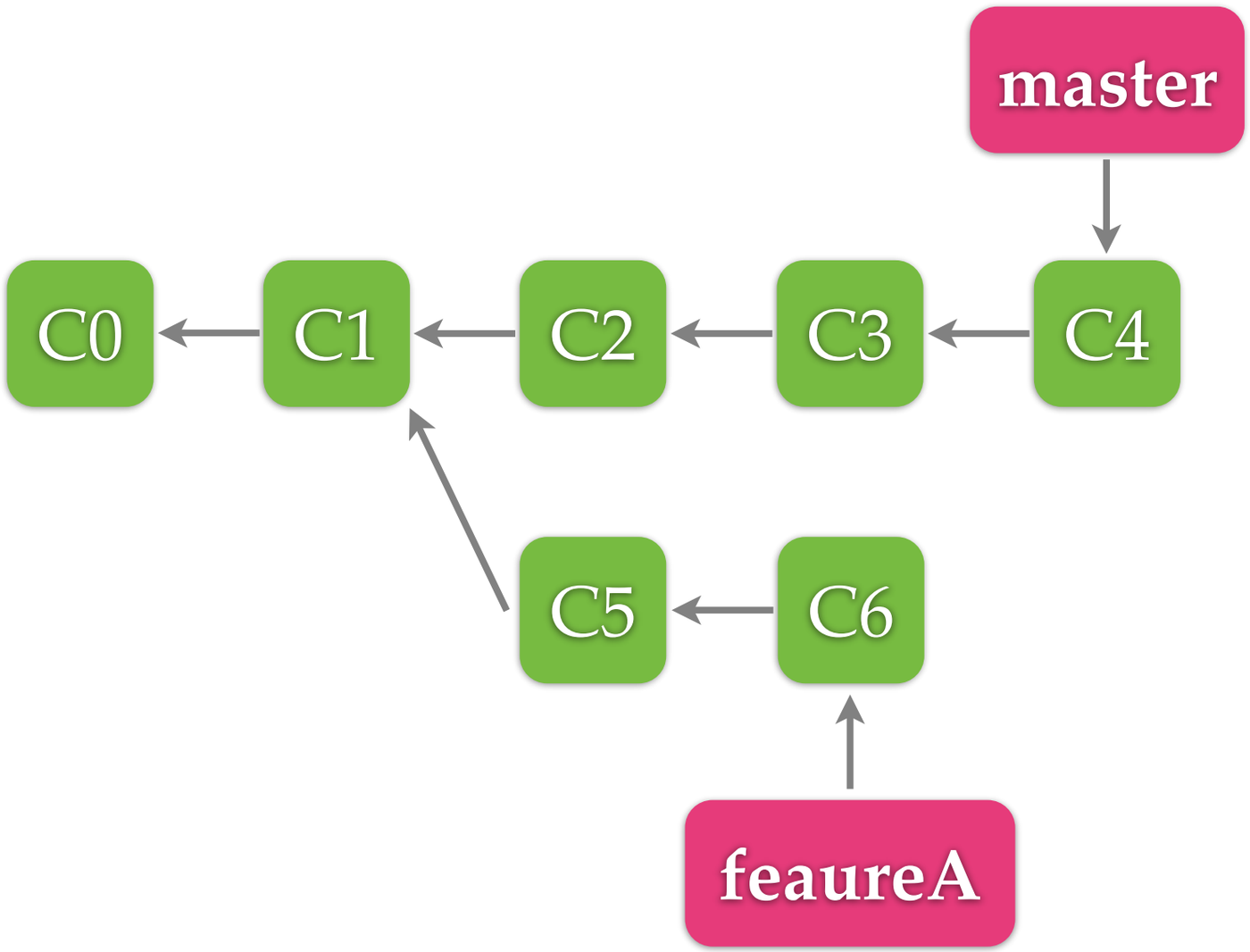
- git add
  - Add files to the staging area
  - The files may be new or modified
- git commit
  - Add files in the staging area to the repository as a new version

Add More Commits



A commit has pointers back to its parents

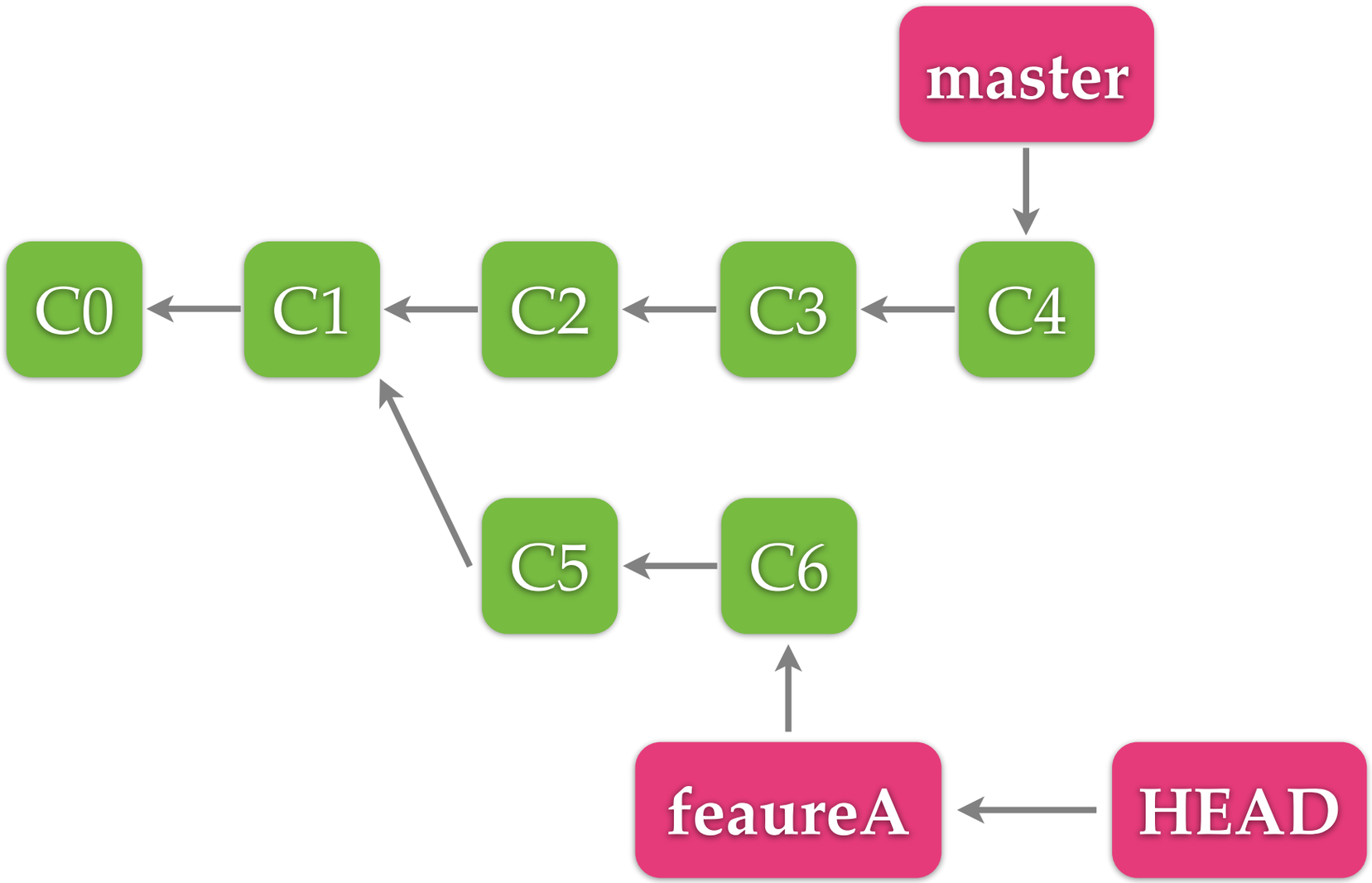
Branches



A branch is used to track a line of development

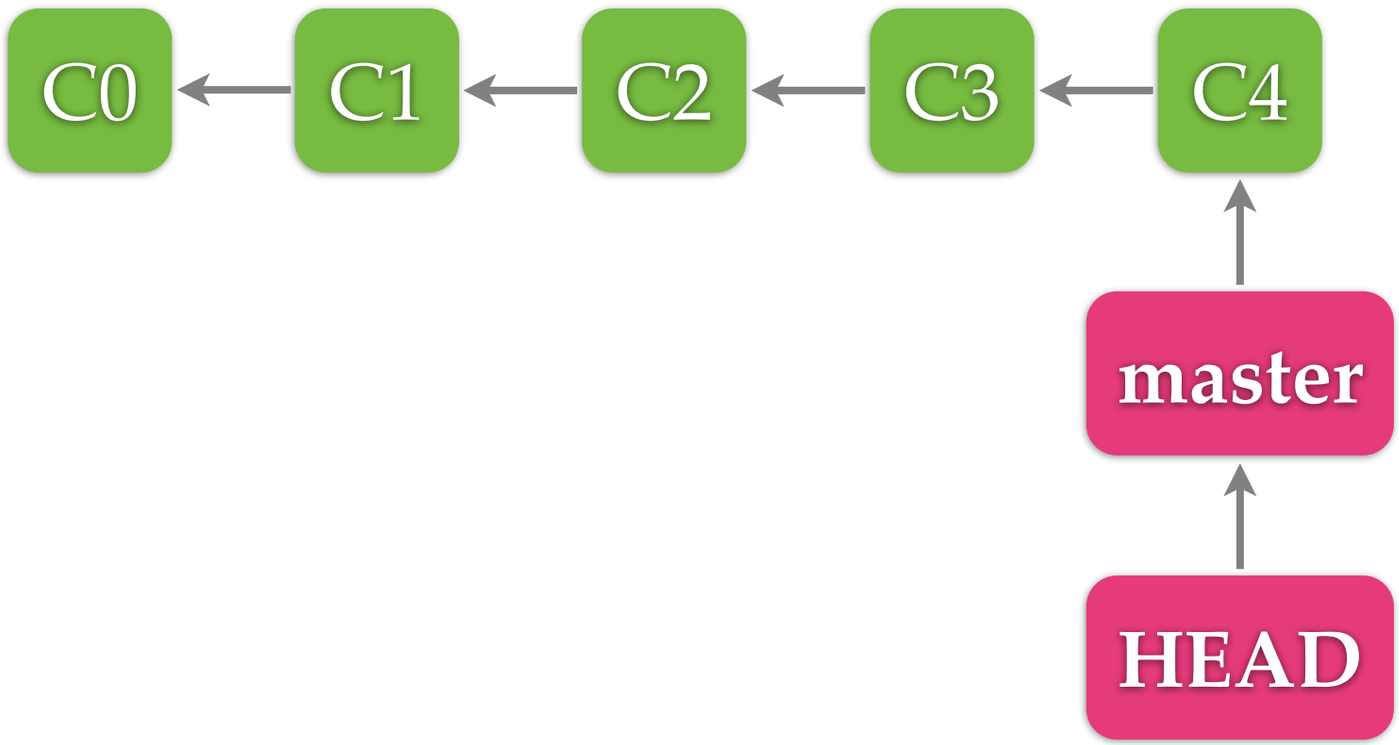
master is the default branch

Head



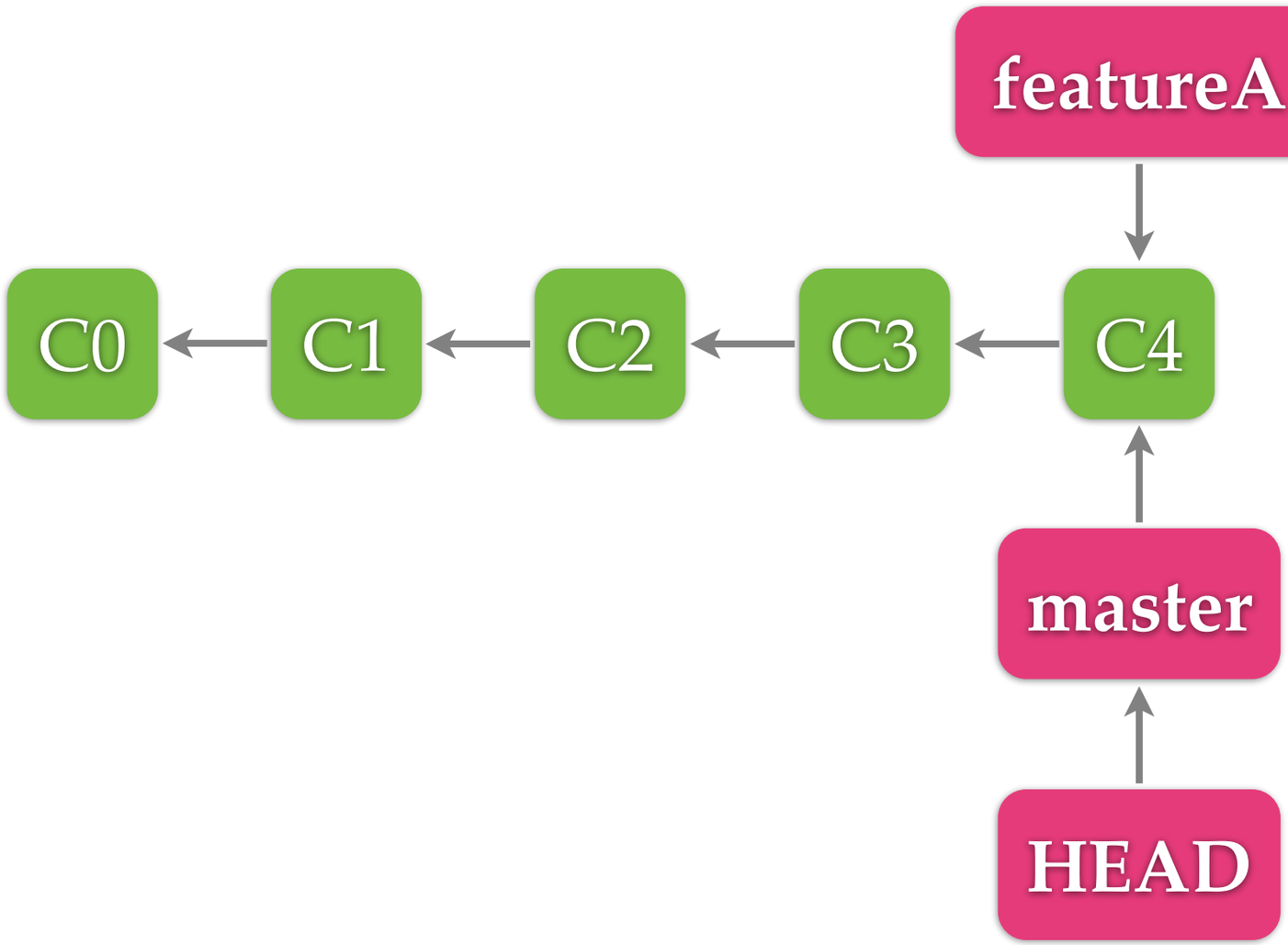
HEAD points to the branch or the commit of the working area

Create Branches



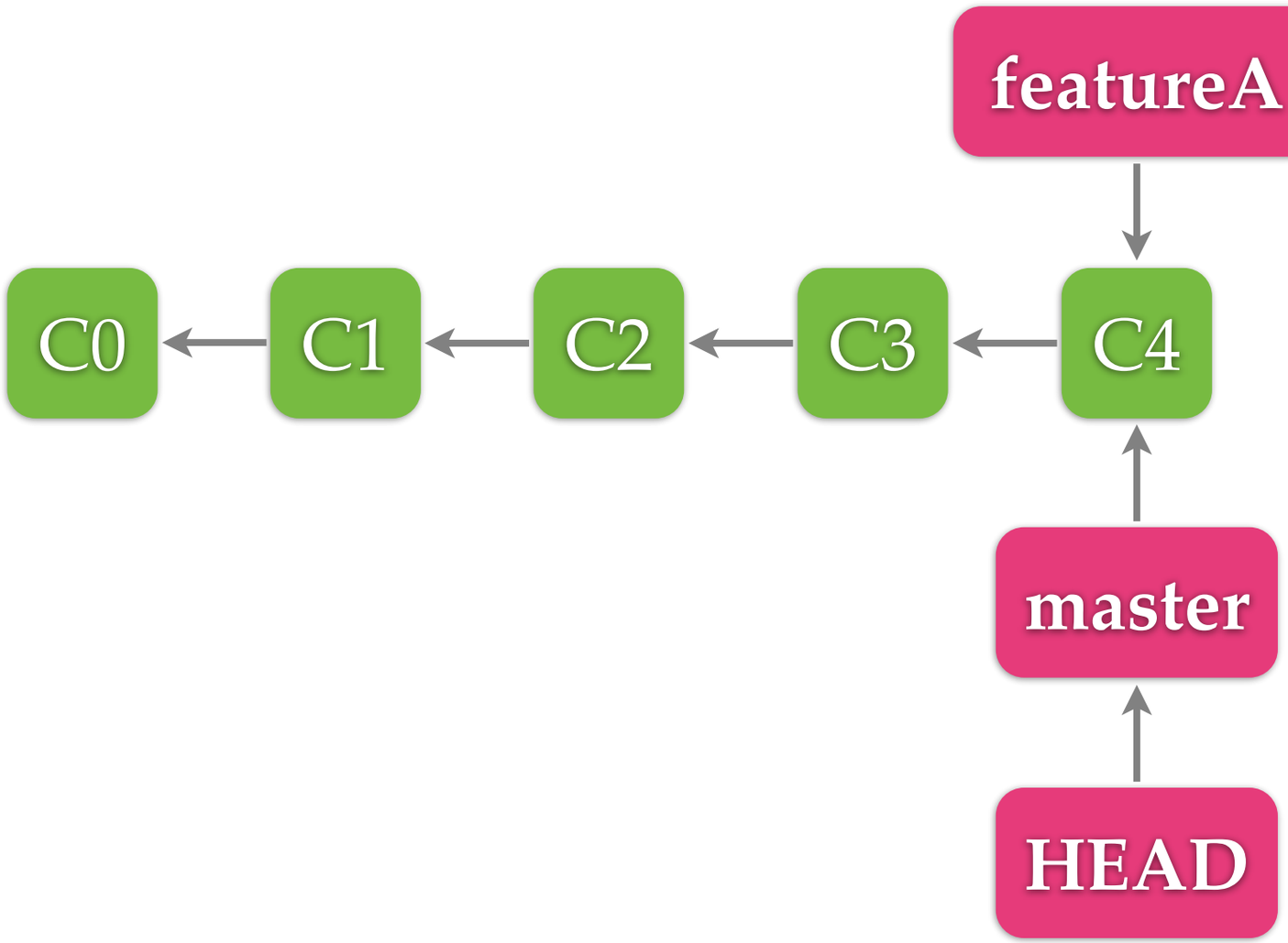
$ git branch featureA

Create Branches



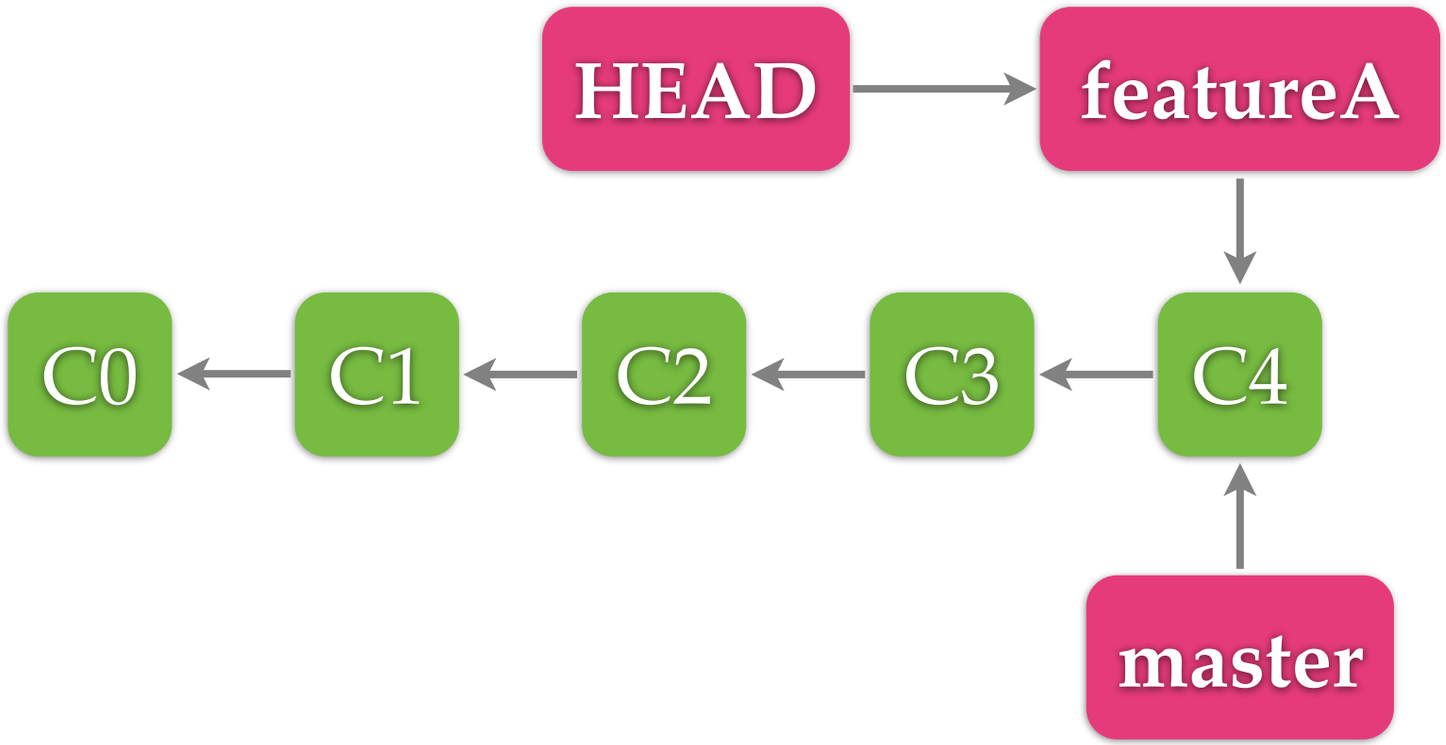
$ git branch featureA

Switch Branches



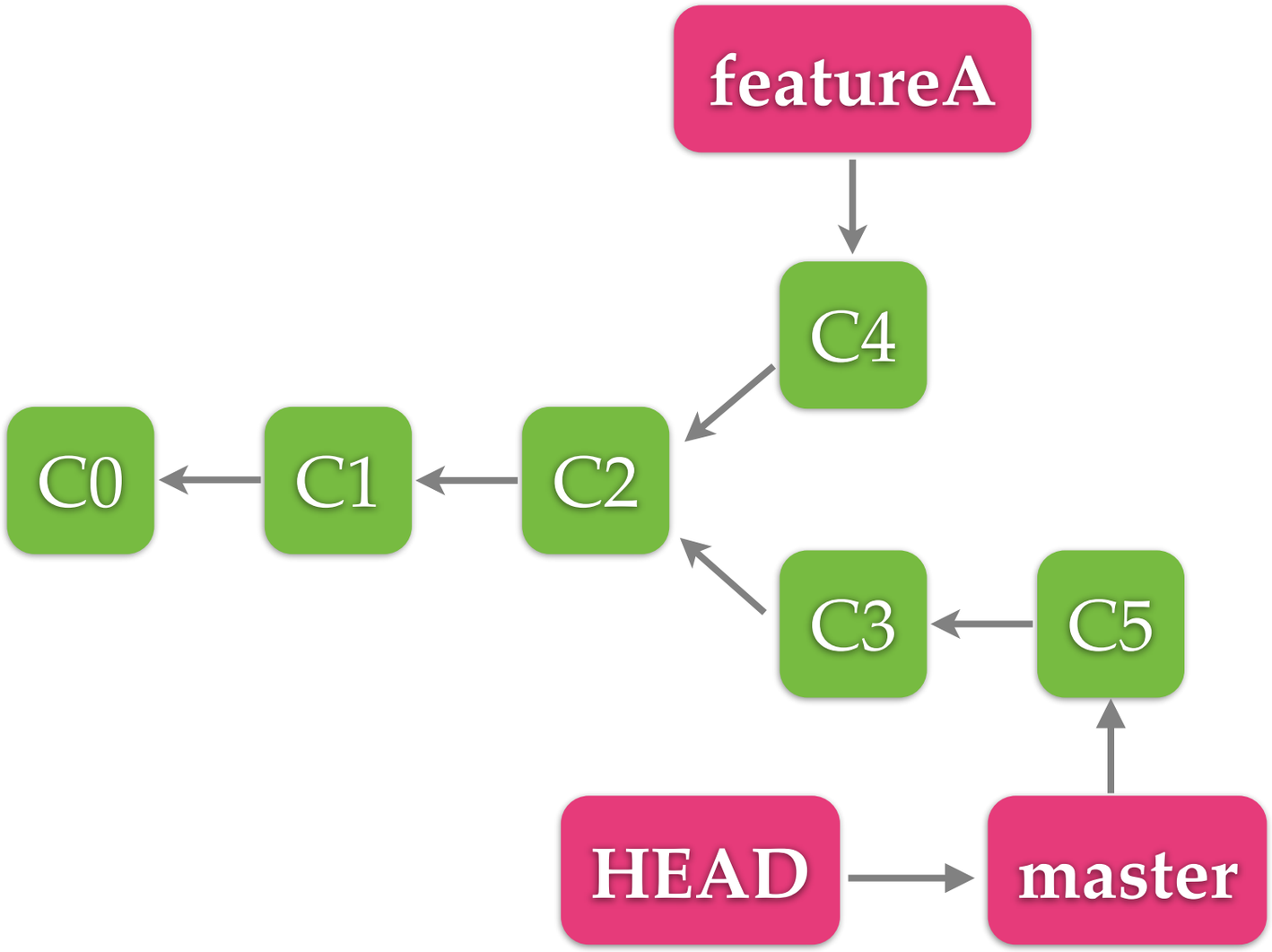
$ git checkout featureA

Switch Branches



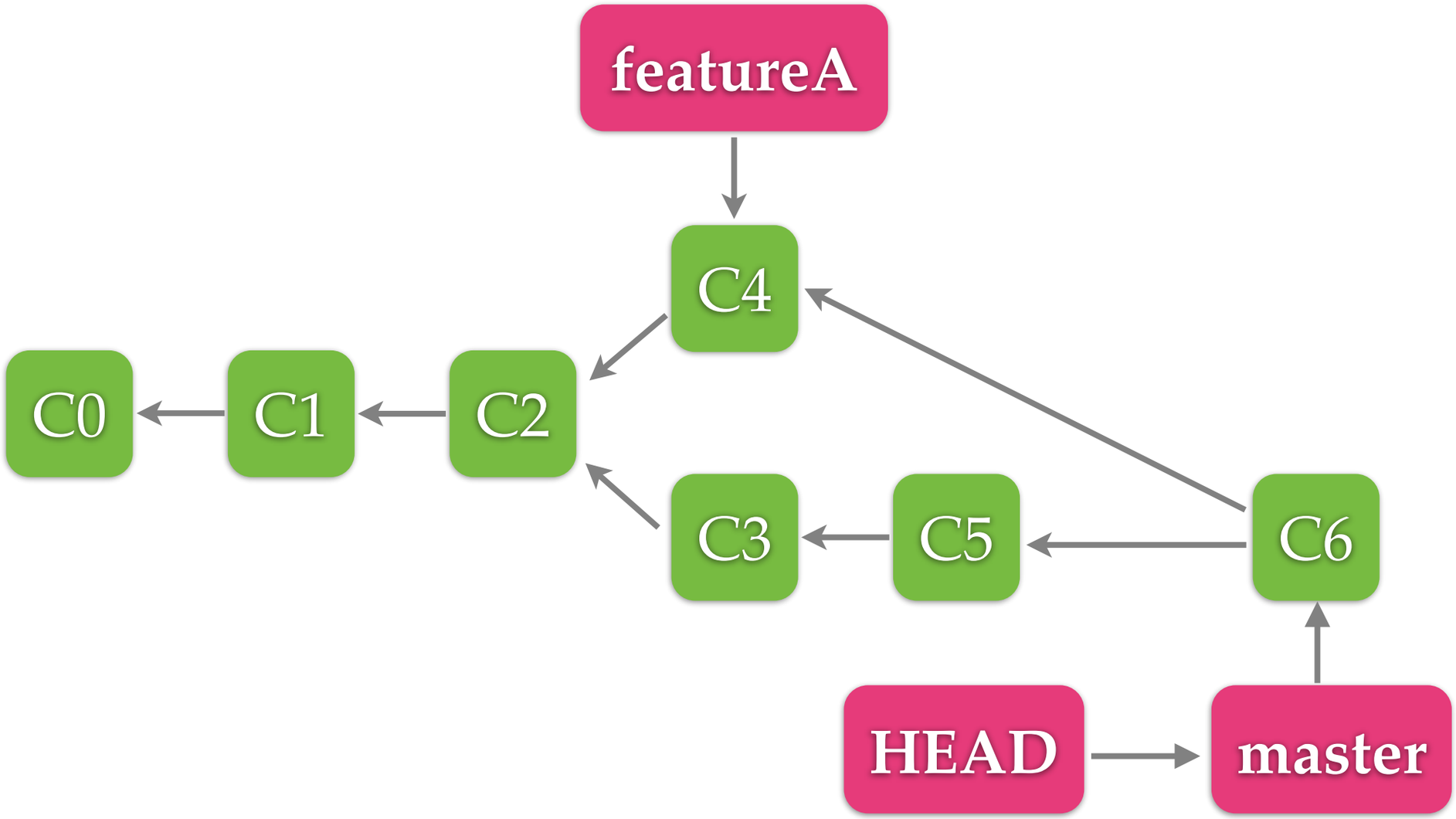
$ git checkout featureA

Merge



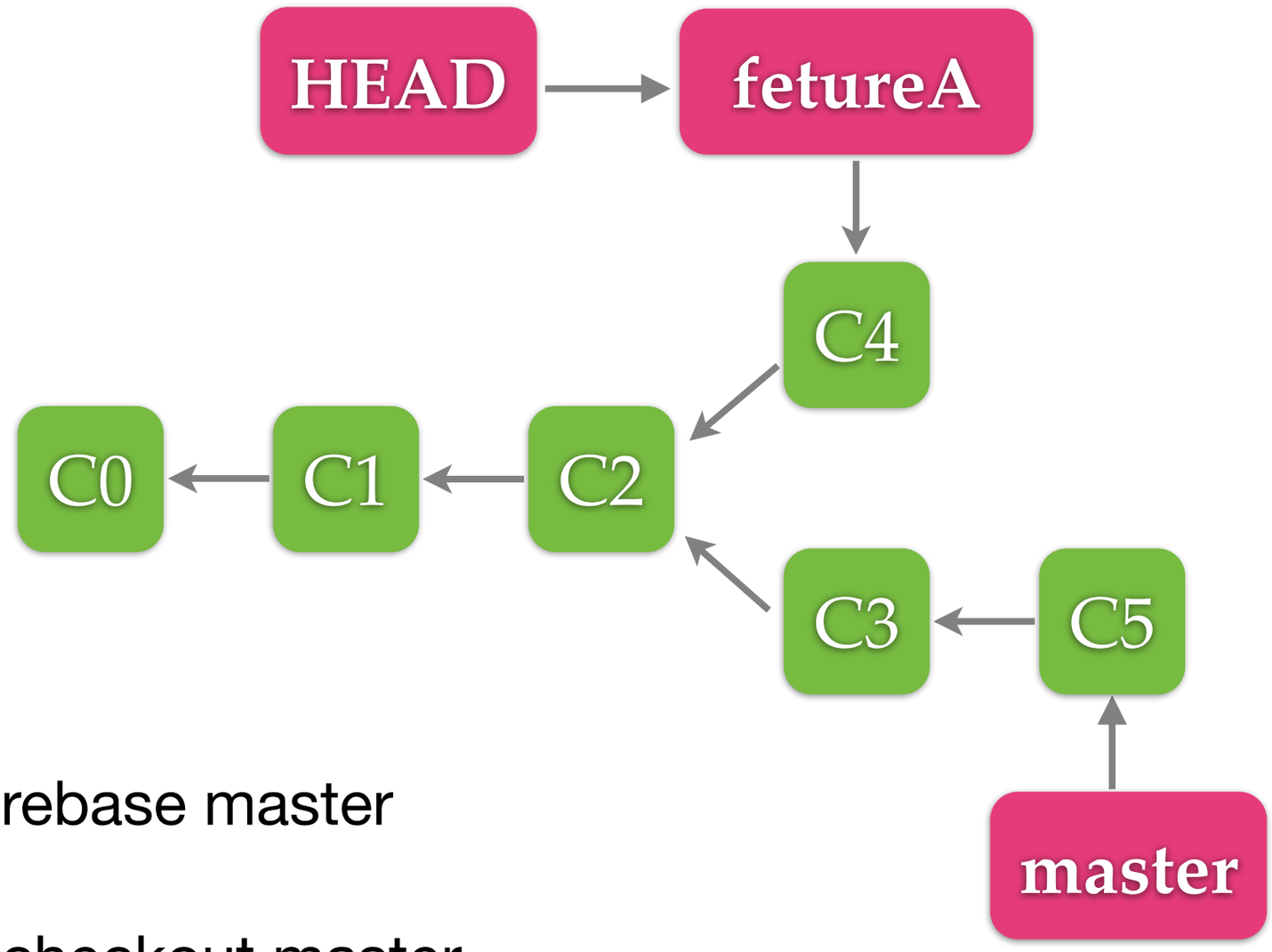
$ git merge featureA

Merge



$ git merge featureA

Rebase

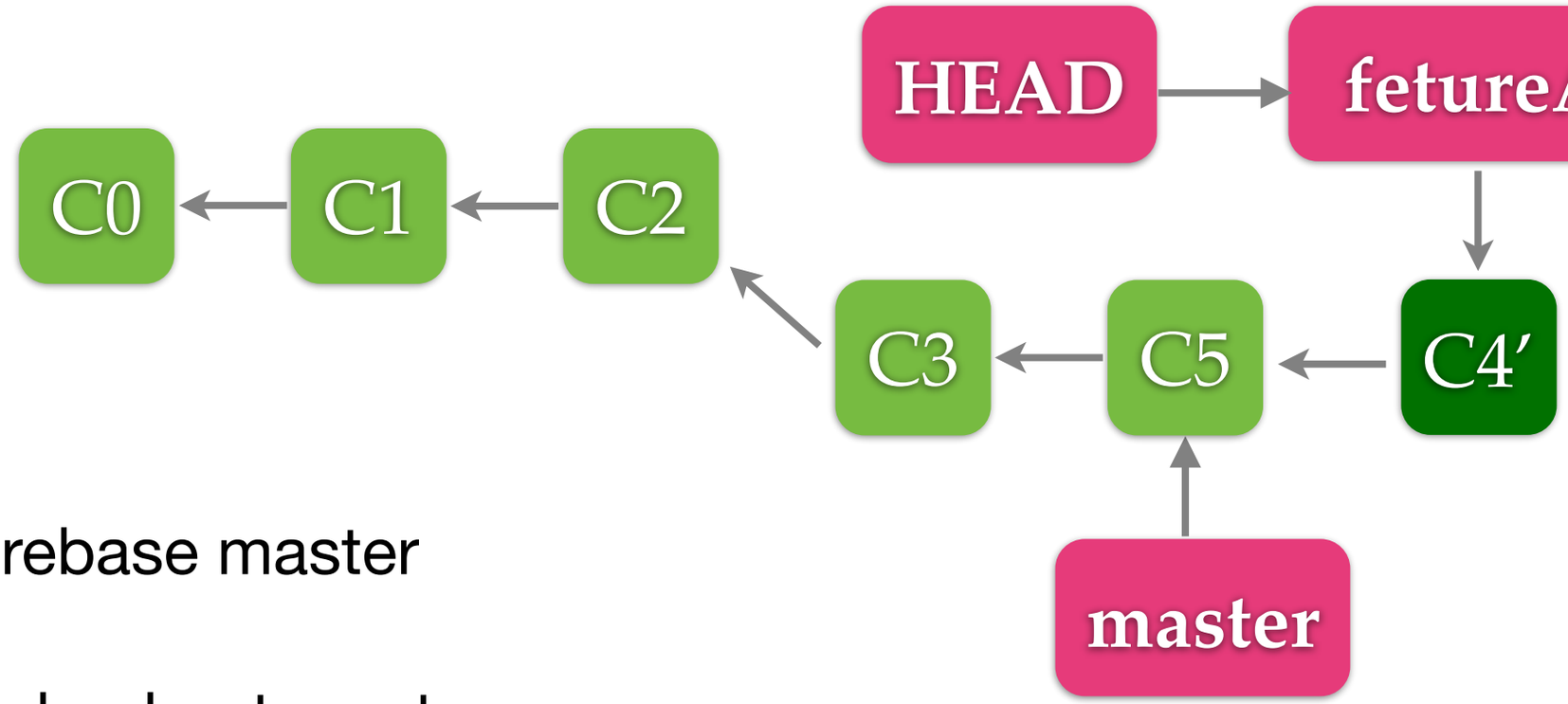


$ git rebase master

$ git checkout master

$ git rebase featureA

Rebase

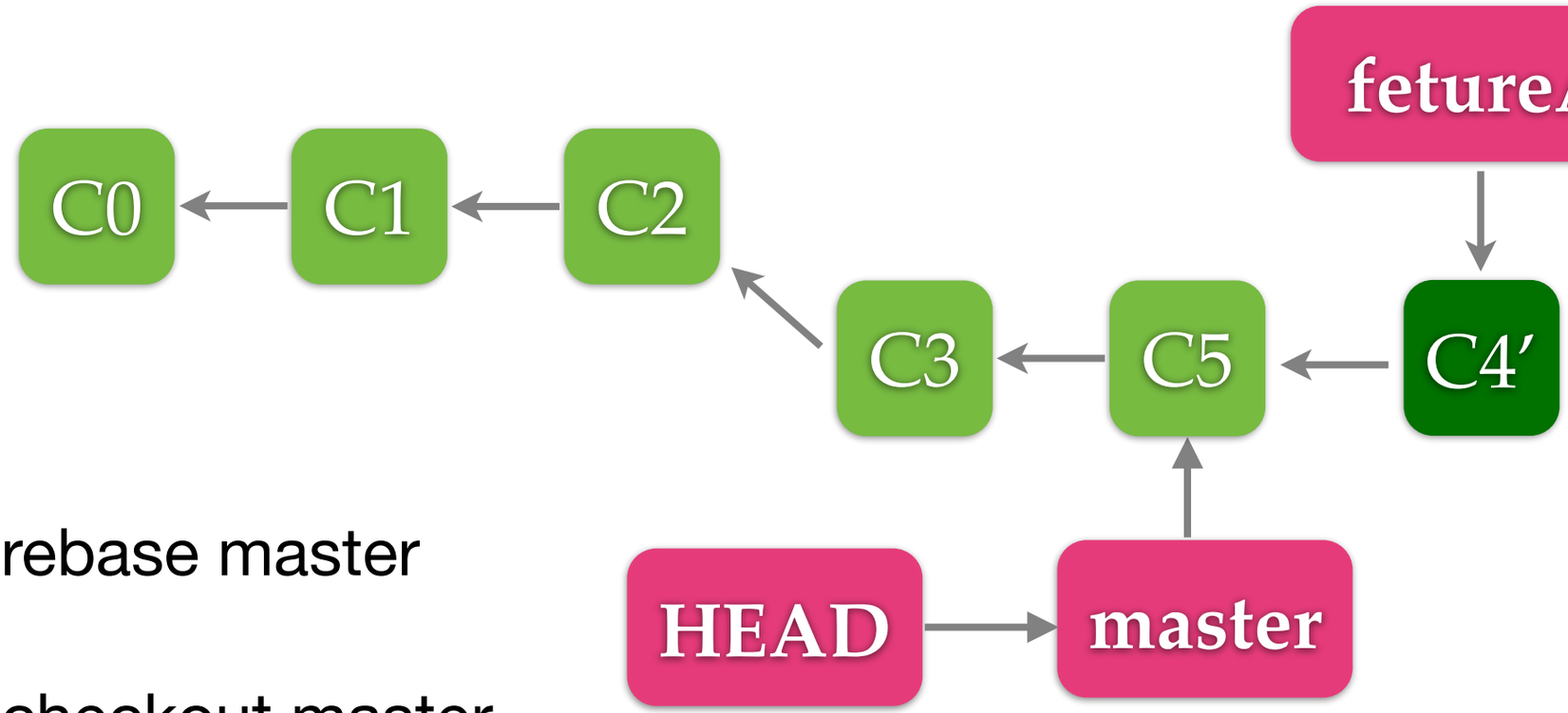


- $ git rebase master

$ git checkout master

$ git rebase featureA

Rebase

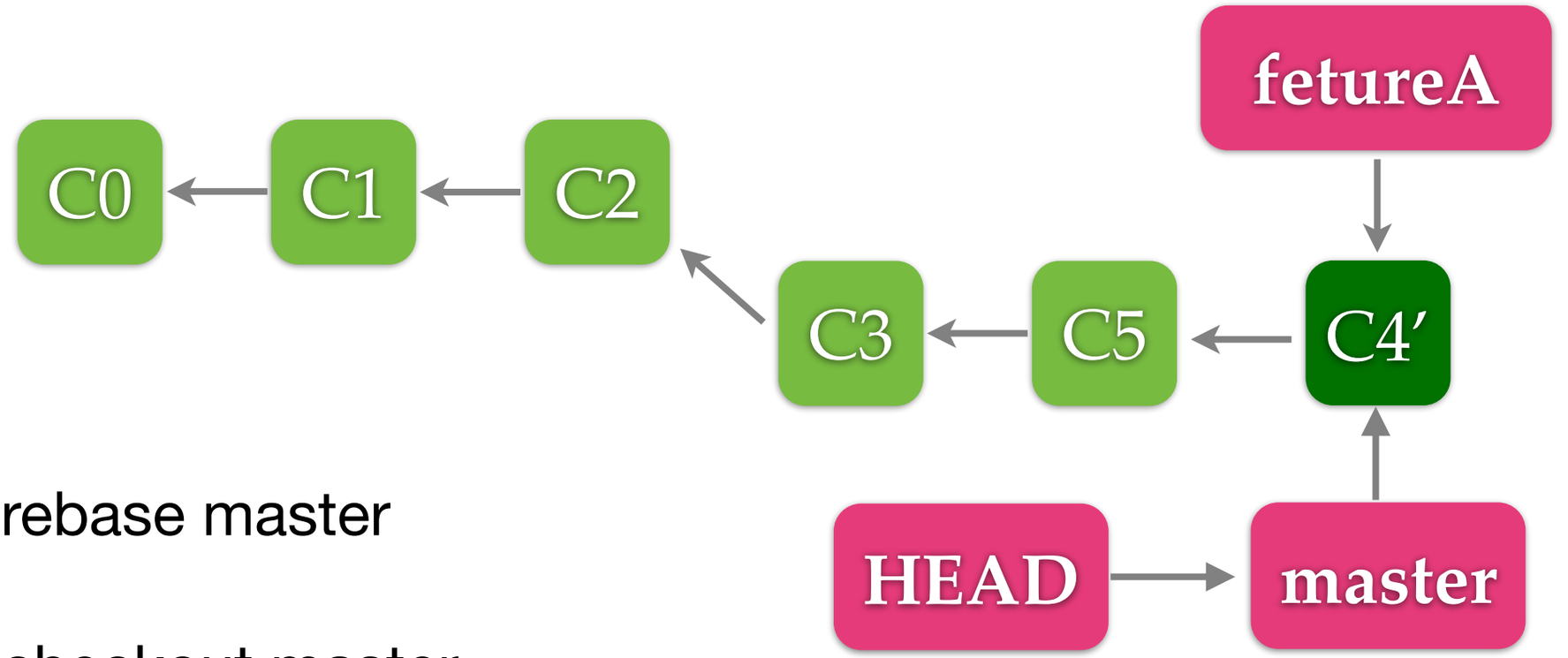


$ git rebase master

$ git checkout master

$ git rebase featureA

Rebase



$ git rebase master

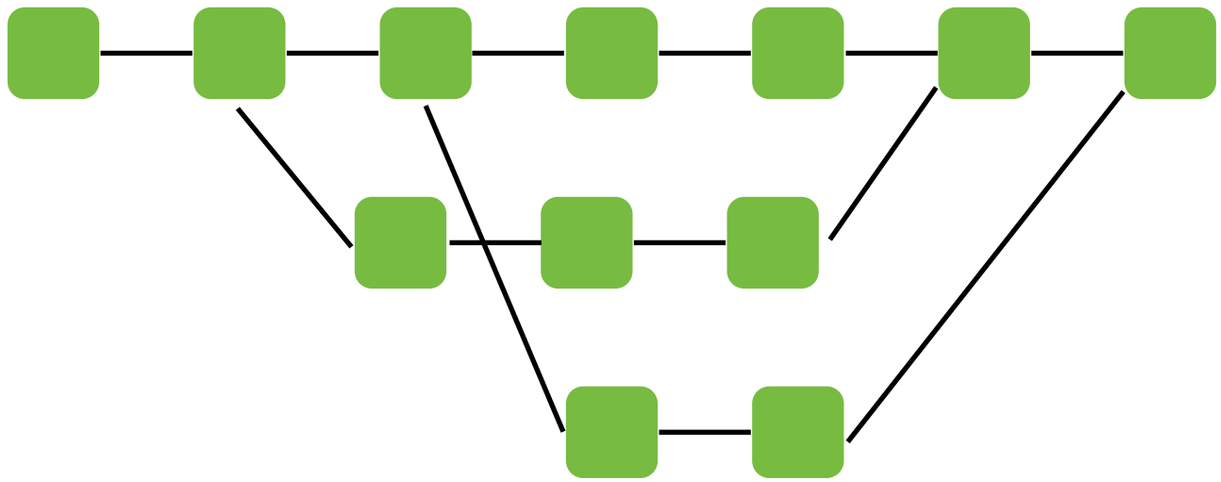
$ git checkout master

$ git rebase featureA

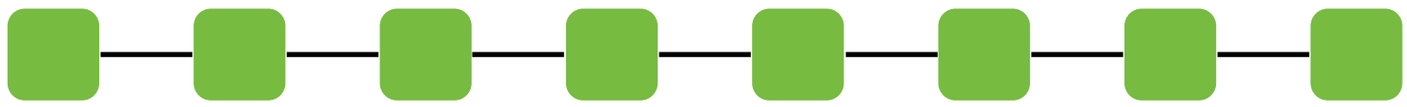
Fast Forward

Merge VS Rebase

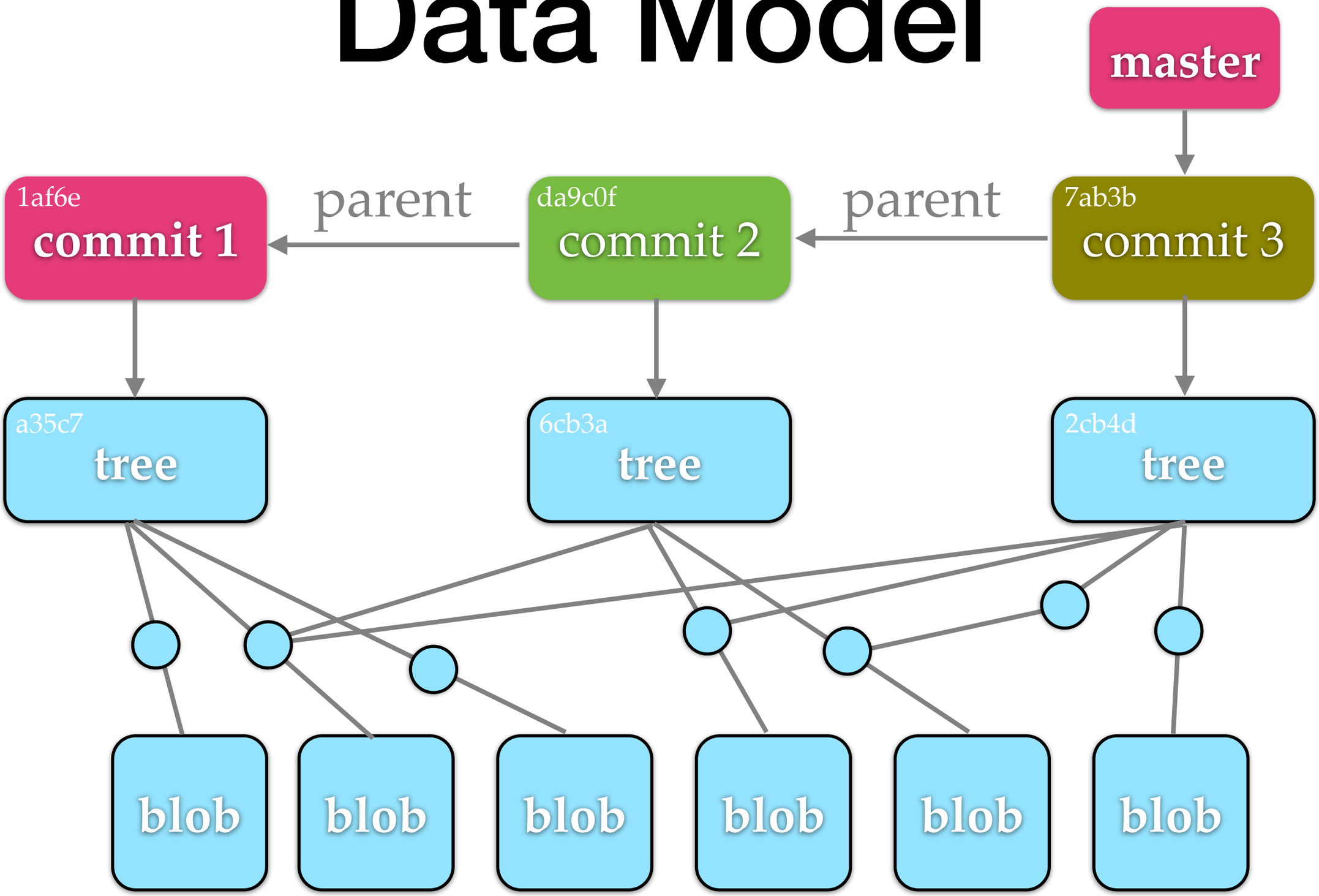
Merge



Rebase



Data Model



Data compressed by ZLIB

SHA1 hash of data as file name

History

this is the ID of the version

```
DHCP-22126 project $ git log
commit d05fe5d5bb03bd42abb662e45284020b1c6d85f9
Author: Ming-Hsien Tsai <mhtsai208@gmail.com>
Date:   Tue Sep 12 14:07:39 2017 +0800

    Add README.md.
DHCP-22126 project $
```

History

4. git

```
commit 0119516da8f2d96da0695ed9c1a0045616fca9ca
Author: Ming-Hsien Tsai <mhtsai208@gmail.com>
Date:   Tue Jun 27 16:58:41 2017 +0800

    Add bvSubC, bvSbb, and bvSbbC.

commit f5313f6f9174e781e544198fd7ccbb0be4e502f9
Author: Bow-Yaw <bowyaw@bitbucket.org>
Date:   Thu Jun 22 13:31:10 2017 +0800

    add succ_instr and succ_program

commit 886c57392c65723e2741dbe61f79b25e68aa04a1
Author: Bow-Yaw <bowyaw@bitbucket.org>
Date:   Fri Jun 16 08:57:55 2017 +0800

    a script to identify addition chains

commit 0e25d1e7d7ca1c45ce9270c8681056f649865705
Author: Ming-Hsien Tsai <mhtsai208@gmail.com>
Date:   Tue Jun 13 11:54:35 2017 +0800

    Fix a bug where ule in Coq becomes ult in OCaml.

commit c9d360dc5609bb9bca06c3dfd0018a59ef59ca08
Author: Bow-Yaw <bowyaw@bitbucket.org>
Date:   Tue Jun 13 11:10:07 2017 +0800

    return exit code from verification

commit 7228396b0dc5e7c71722716cbf52a2b28988bf9e
Merge: c1009c5 372c29a
Author: Bow-Yaw Wang <bywang@iis.sinica.edu.tw>
:
```

is is the ID of the version

```
5284020b1c6d85f9
208@gmail.com>
7 +0800
```

History

4. git

```
commit 0119516da8f2d96da0695ed9c1a0045616fca9ca
Author: Ming-Hsien Tsai <mhtsai208@gmail.com>
Date:   Tue Jun 27 16:58:41 2017 +0800

    Add bvSubC, bvSbb, and bvSbbC.

commit f5313f6f9174e781e544198fd7ccbb0be4e502f9
Author: Bow-Yaw <bowyaw@bitbucket.org>
Date:   Thu Jun 22 13:31:10 2017 +0800

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Author: Bow-Yaw <bowyaw@bitbucket.org>
Date:   Fri Jun 16 08:57:55 2017 +0800

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Date:   Tue Jun 13 11:54:35 2017 +0800

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commit c9d360dc5609bb9bca06c3dfd0018a59ef59ca08
Author: Bow-Yaw <bowyaw@bitbucket.org>
Date:   Tue Jun 13 11:10:07 2017 +0800

    return exit code from verification

commit 7228396b0dc5e7c71722716cbf52a2b28988bf9e
Merge: c1009c5 372c29a
Author: Bow-Yaw Wang <bywang@iis.sinica.edu.tw>
:
```

4. less

```
* f6fbbf4 (HEAD -> nondet) Add value type as an argument of store functors.
* 3cdda6c Move conversion betwen VS and SSAVS to DSL2SSACommons.
* 5be9e28 Add bvDSLRel.
* a479a2a (origin/nondet) Simplify some proofs.
* 4ea01b5 Improve dp_mem and dp_subset.
* a6b4a99 Add SsrFSet to avoid redundant declarations of variable sets.
* 4136533 Remove useless code in bvDSL. Simplify some proofs in bvDSL.
* 73cbe0b Add Equal to Store.
*   a73c784 Merge branch 'master' into nondet
|\
| * 1b7952e Add a buggy implementation of fe25519_mul with radix 2^64 representa
tion.
| * 34b2c45 Add simple decision procedures for mem and subset.
| * 0119516 (subtraction) Add bvSubC, bvSbb, and bvSbbC.
* | f5313f6 add succ_instr and succ_program
|/
* 886c573 (origin/ccs17) a script to identify addition chains
* 0e25d1e Fix a bug where ule in Coq becomes ult in OCaml.
* c9d360d return exit code from verification
*   7228396 Merge branch 'master' of fm1.iis.sinica.edu.tw:/home/git/certified_q
hasm_vcg
|\
| * 372c29a Remove unused admitted lemmas in bvSSA2QFBV.
| * 4de5f10 Proved admitted lemmas in bvSSA2zSSA.
| * ca71d71 Add more lemmas.
* | c1009c5 refer to modified gbarith
|/
* c4e55f6 add to_bvdsl.py and rename to_dsl.py
* a5e23c4 allow configurations in comments
* b78c849 Fix a typo.
* 5fd989f Fix a problem in rewrite_zpower_nat.
* 5092d34 Update specifications.
* e7159cd Use Z for equality assertions.
* af5e257 Fix a bug in rewrite_assign2_with.
:
```

File Difference

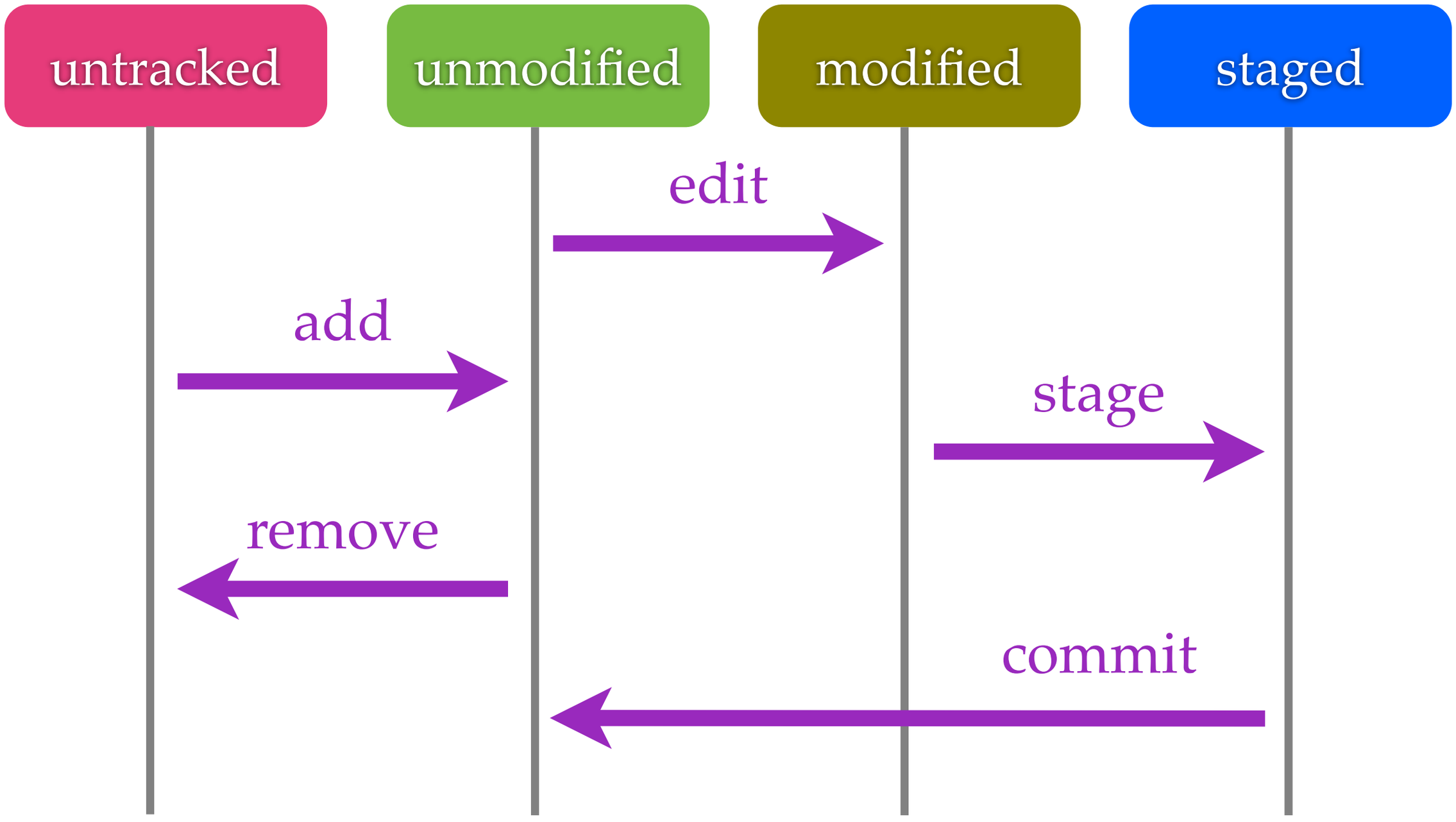
```
DHCP-22126 project $ git diff
diff --git a/README.md b/README.md
index 52cb6cd..eb99592 100644
--- a/README.md
+++ b/README.md
@@ -1 +1,3 @@
+===== About =====
+
 This is readme.
DHCP-22126 project $
```

File Restore (Checkout)

```
DHCP-22126 project $ cat README.md
===== About =====

This is readme.
DHCP-22126 project $ git checkout README.md
Updated 1 path from the index
DHCP-22126 project $ cat README.md
This is readme.
DHCP-22126 project $
```

README.md

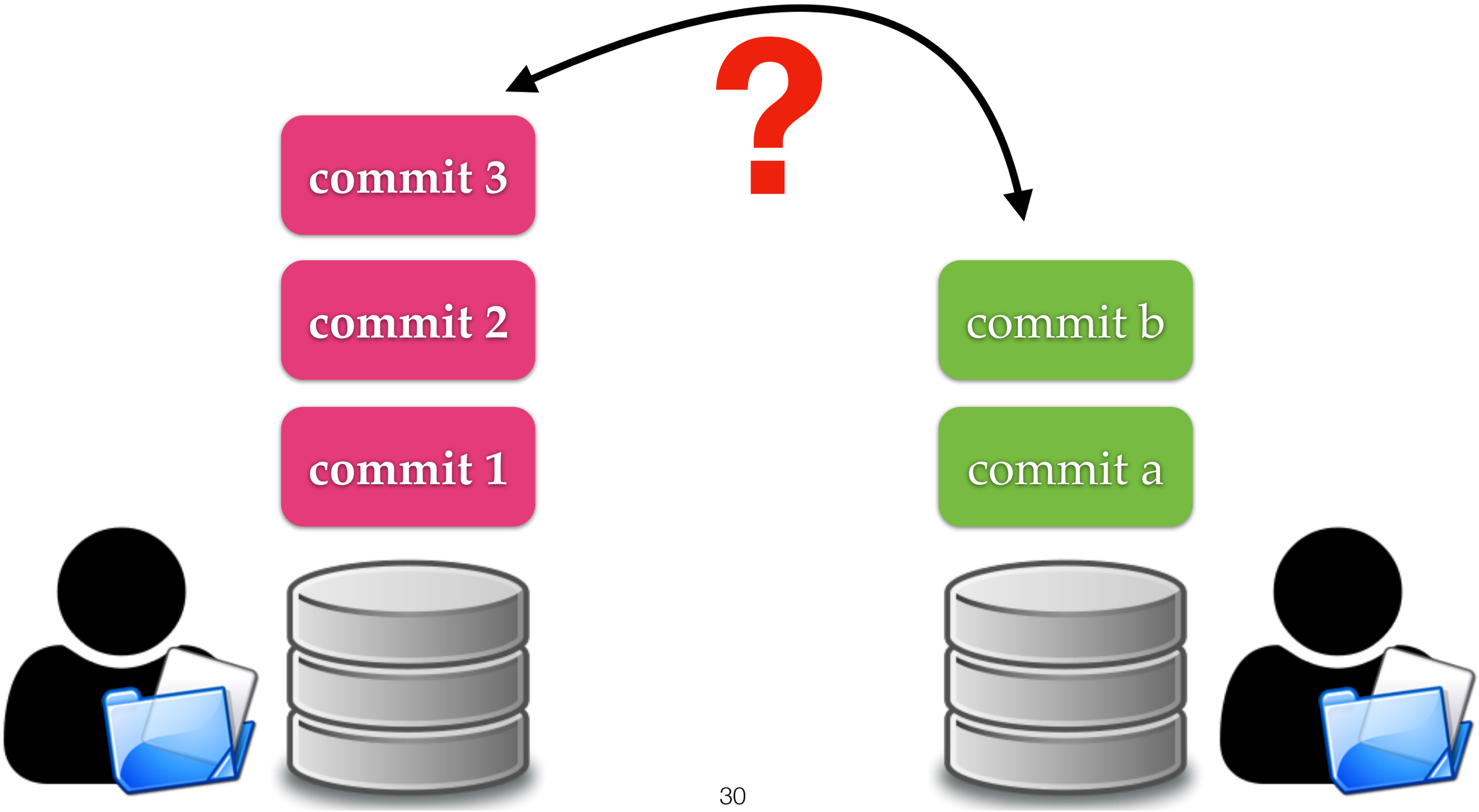
File Status


untracked
unmodified
modified
staged
edit
add
stage
remove
commit

File Status

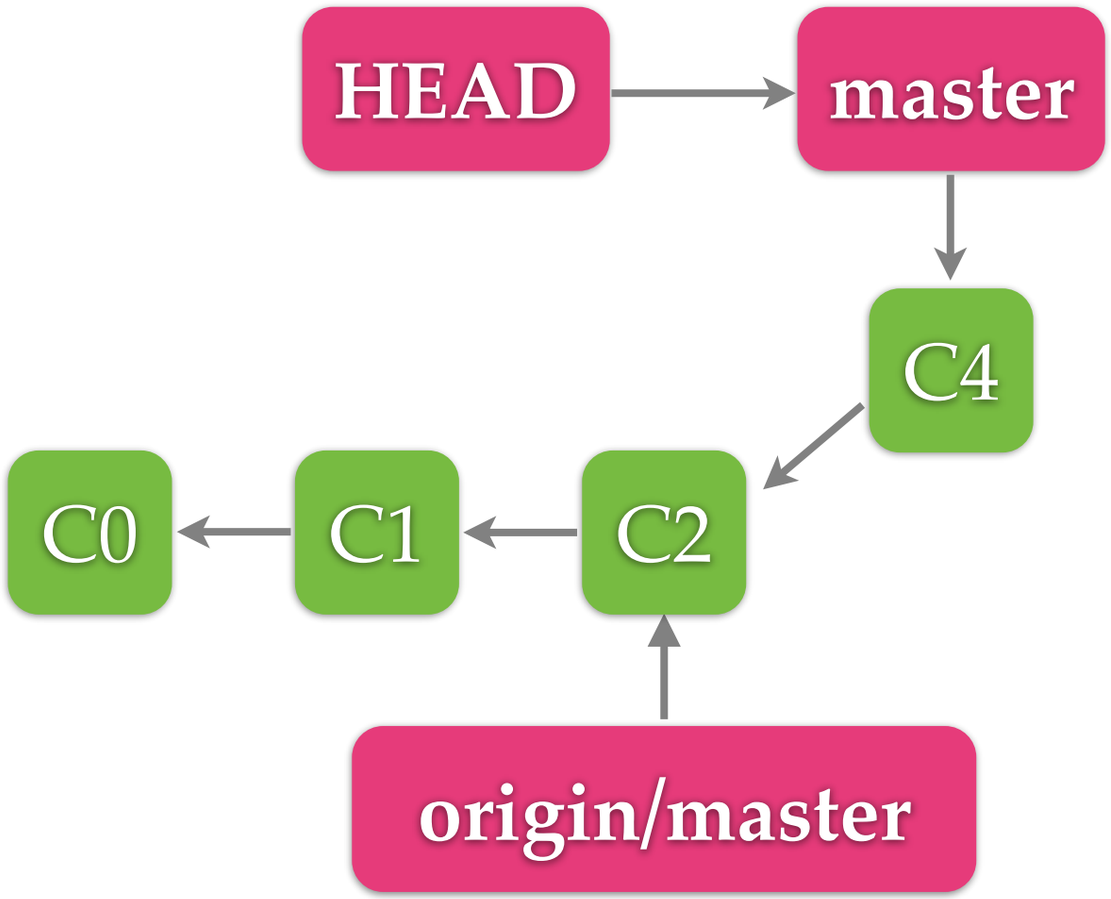
```
DHCP-22126 project1 $ git status
On branch master
Your branch is ahead of 'origin/master' by 3 commits.
  (use "git push" to publish your local commits)
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

        modified:   B.c

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working directory)

        modified:   A.c
        modified:   README.md

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

        D.java
```

Synchronization



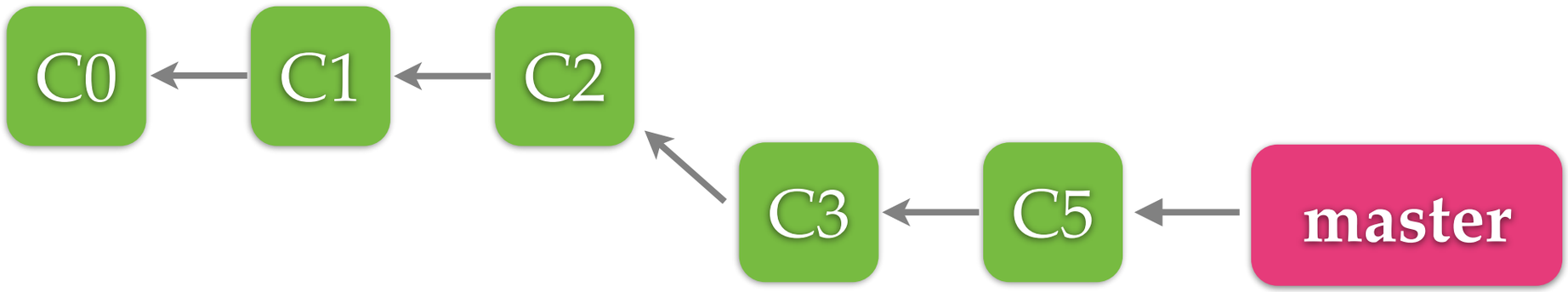
Fetch

Local

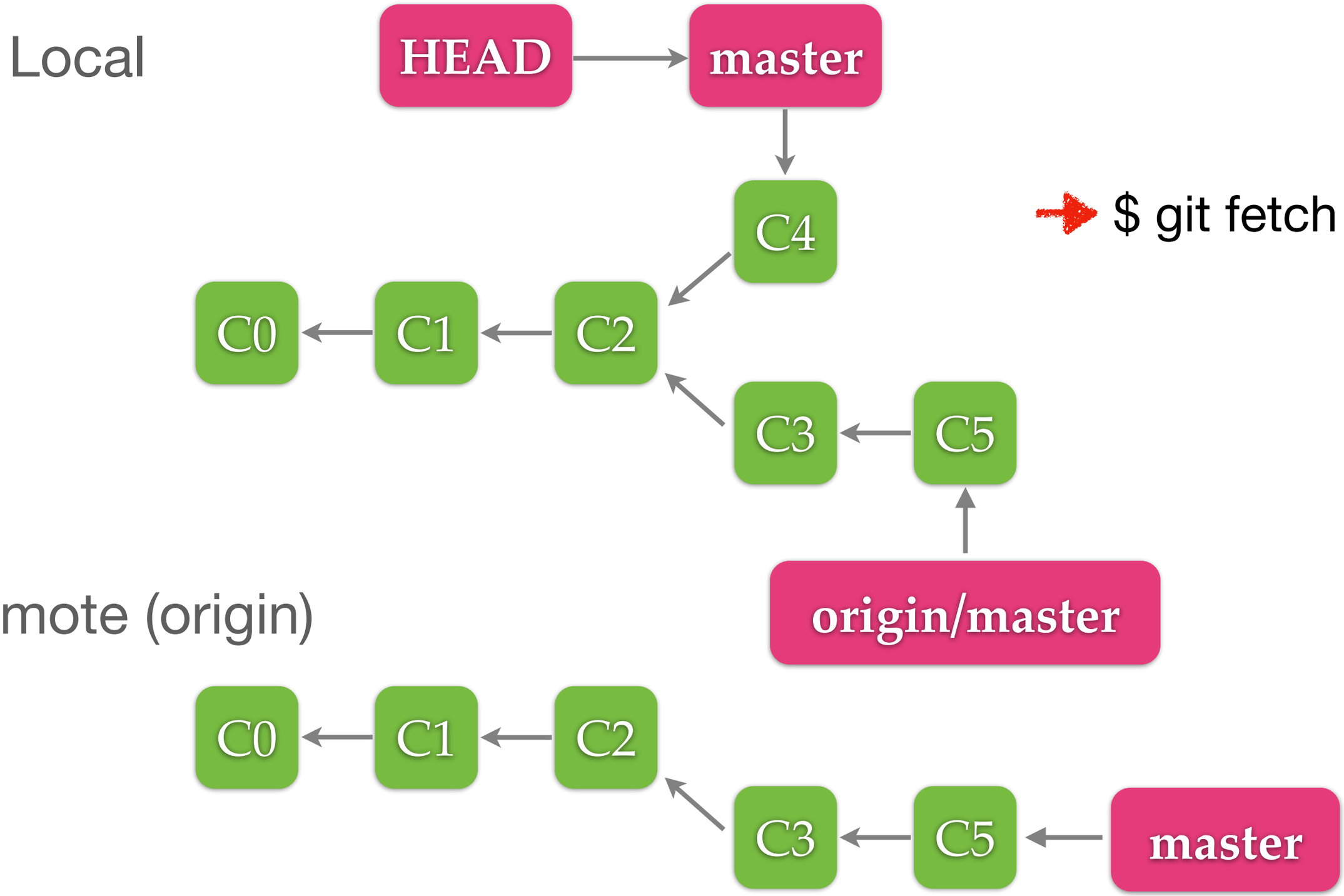


$ git fetch

Remote (origin)

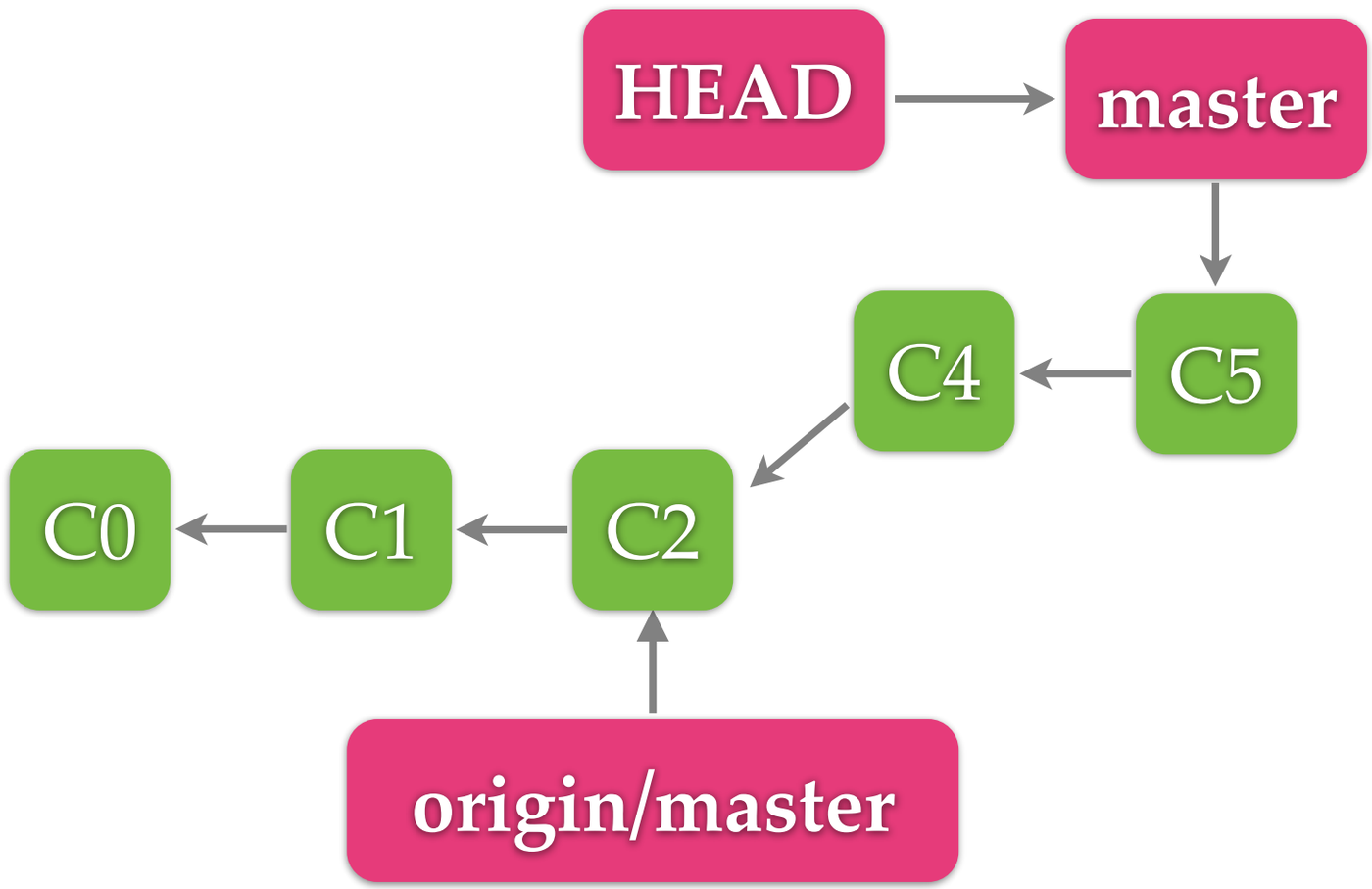


Fetch


Local
HEAD
master
C4
C0
C1
C2
C3
C5
$ git fetch
Remote (origin)
origin/master
C0
C1
C2
C3
C5
master

Push

Local

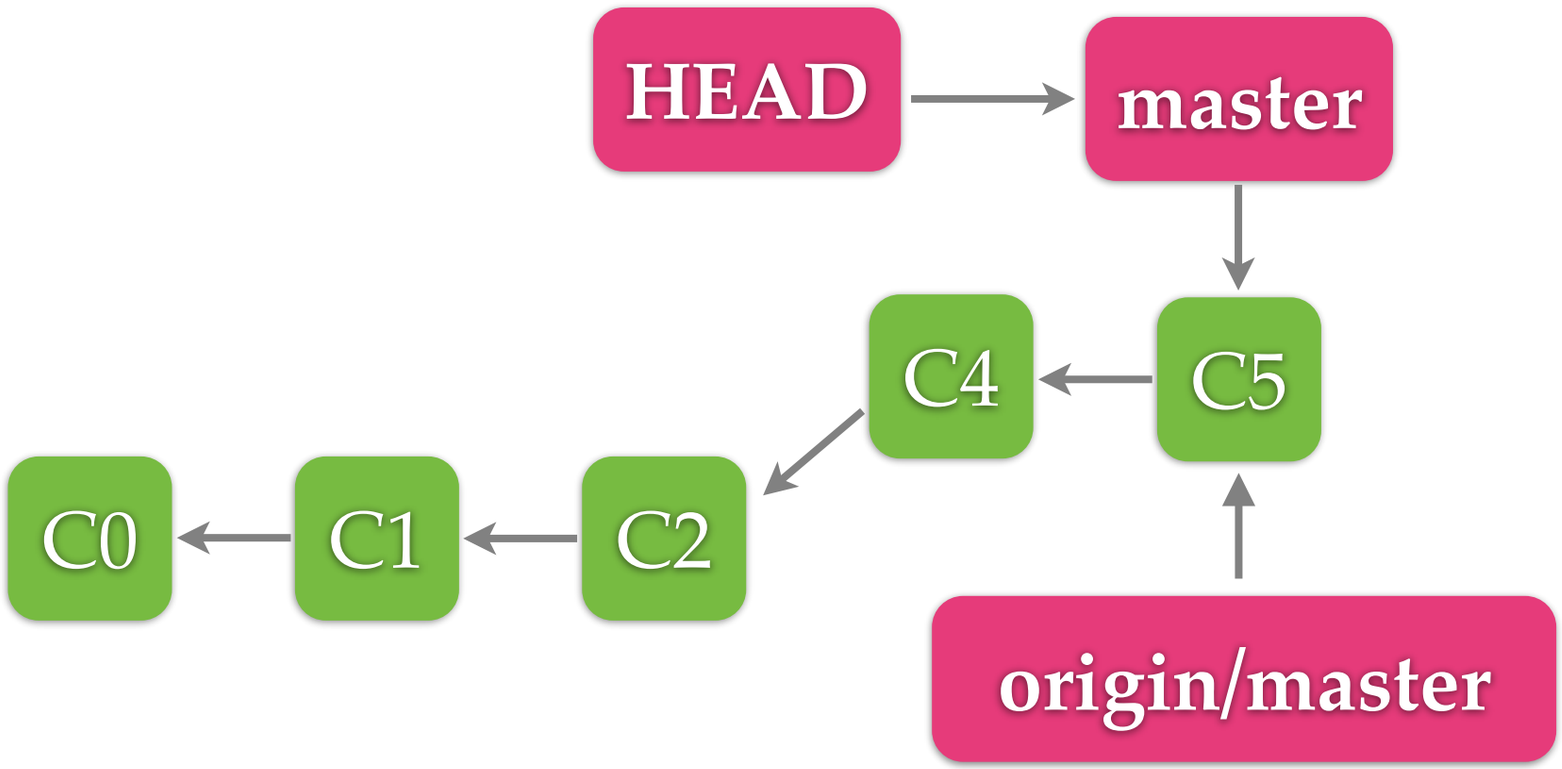


Remote (origin)

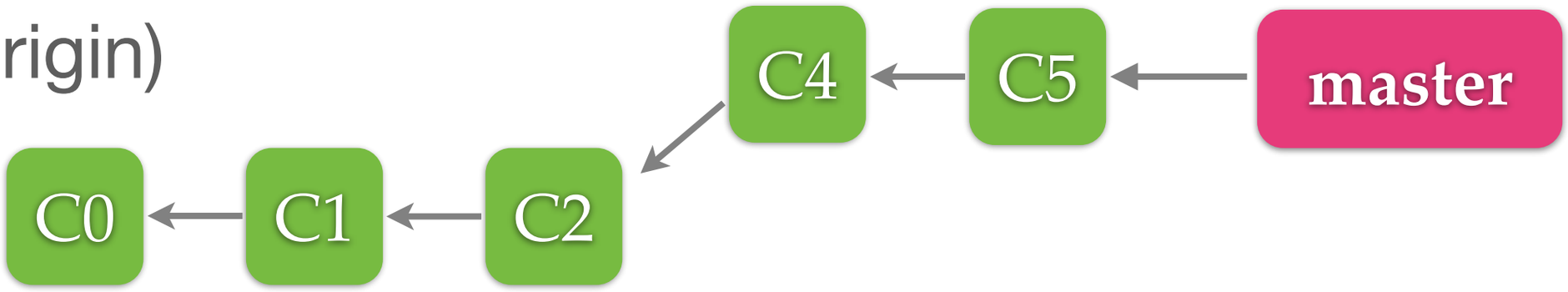
$ git push origin master

Push

Local



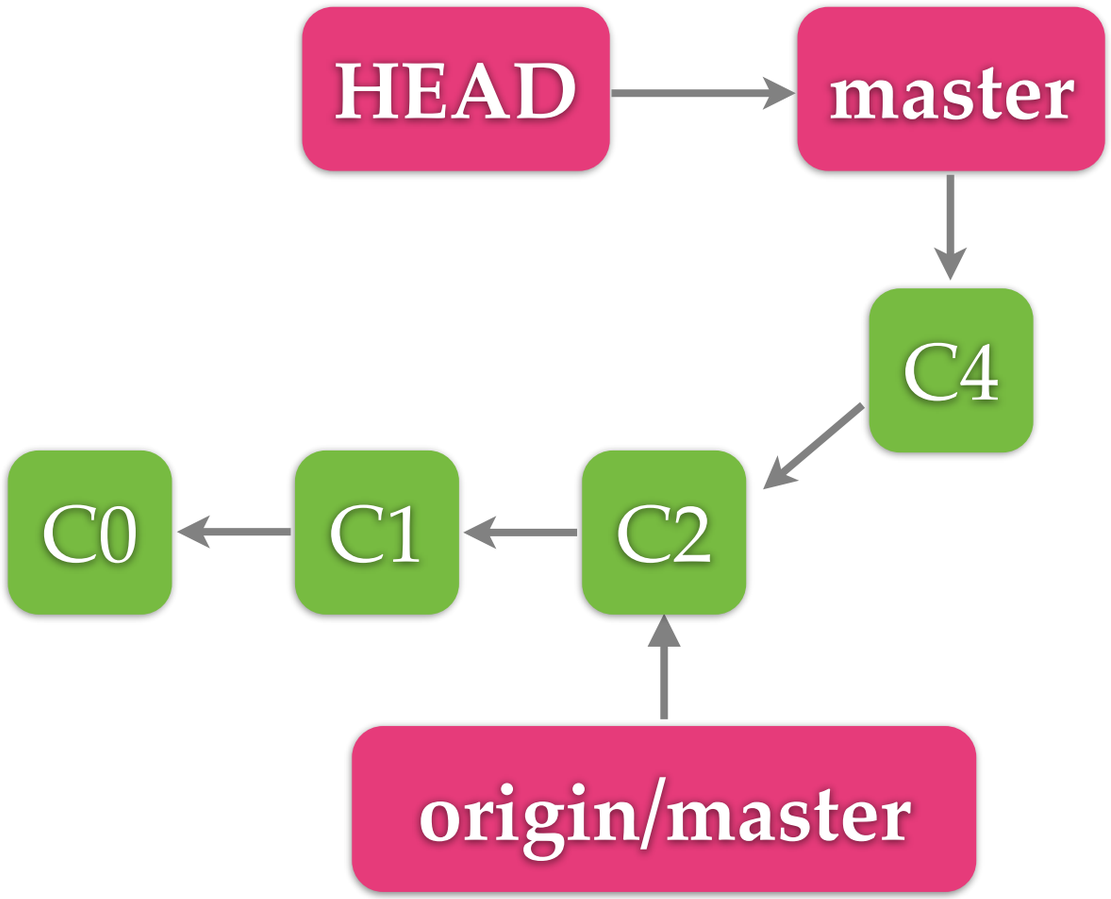
Remote (origin)



$ git push origin master

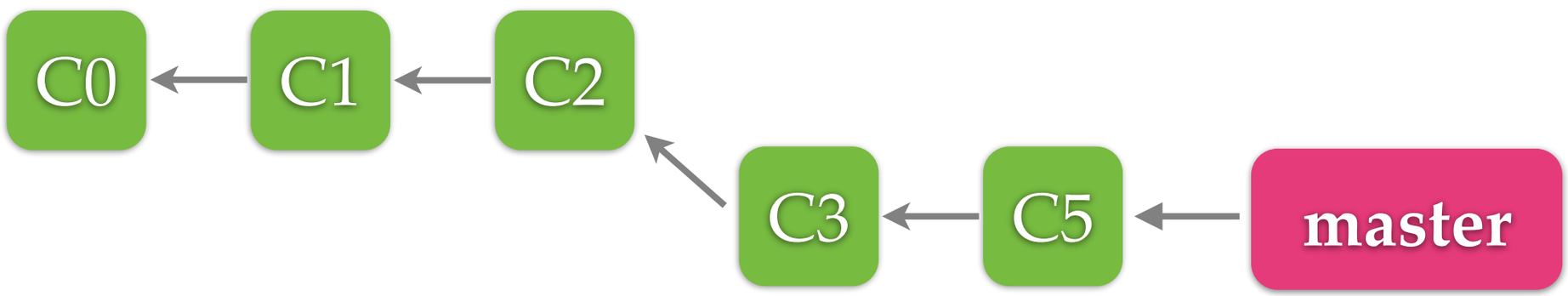
Pull

Local



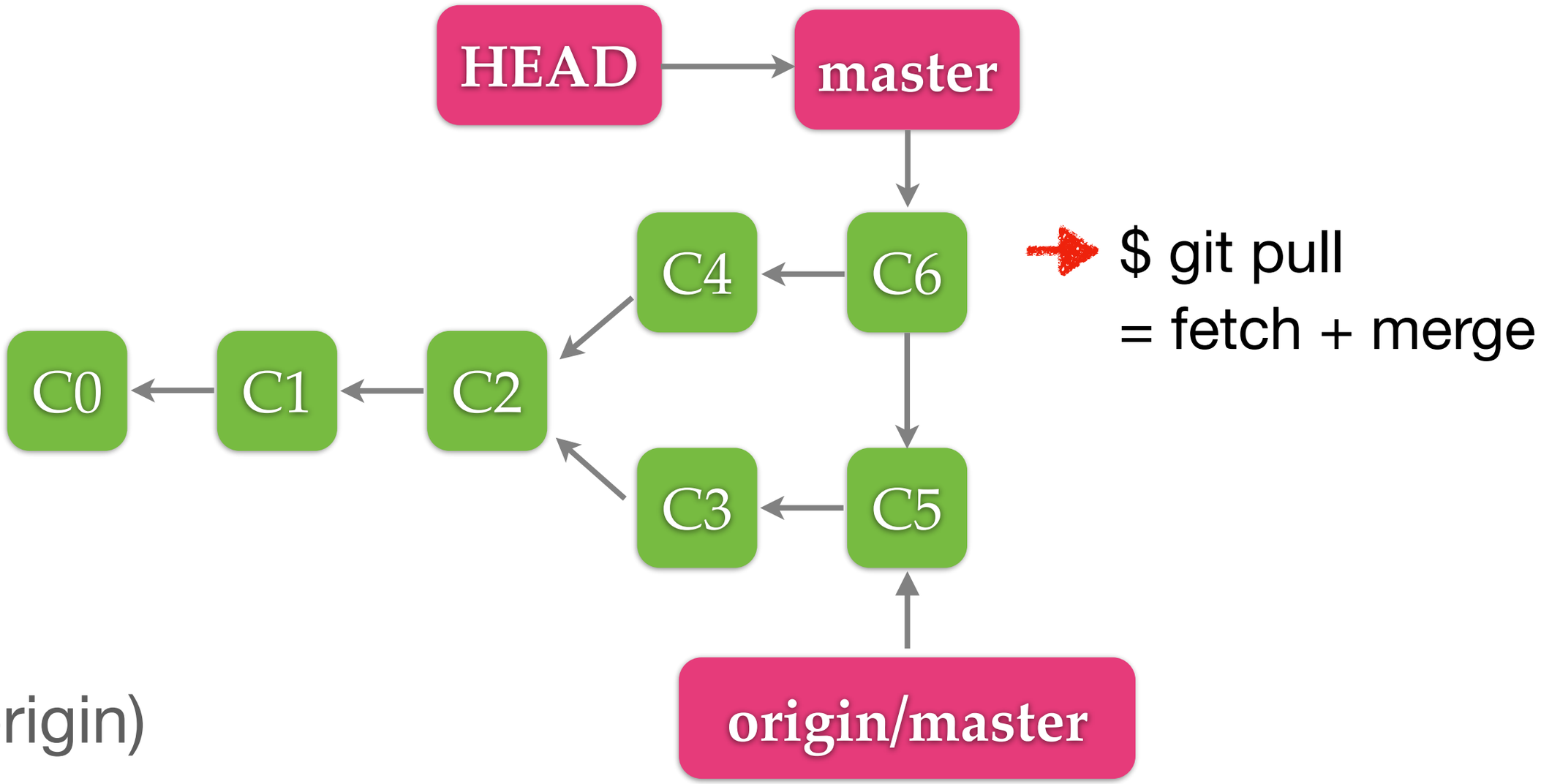
$ git pull
= fetch + merge

Remote (origin)



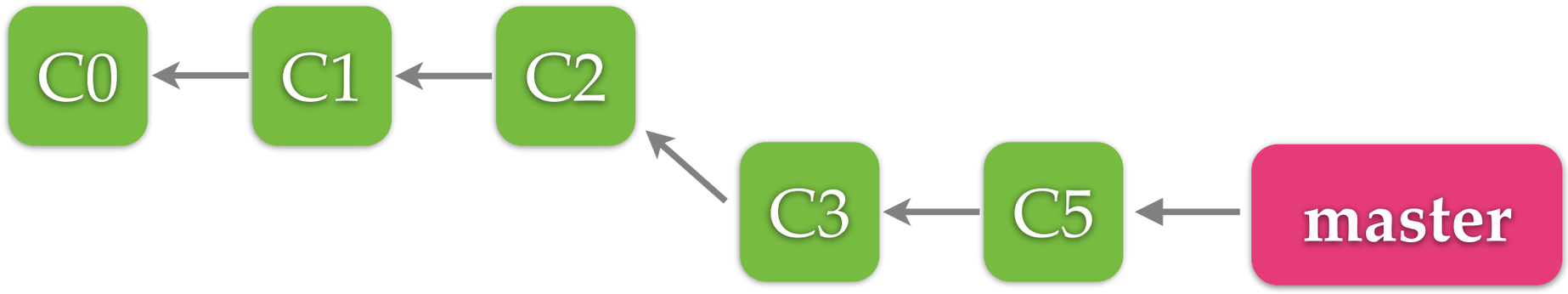
Pull

Local



$ git pull
= fetch + merge

Remote (origin)



Resolve Conflicts

```
DHCP-22126 project1 $ git fetch
remote: Counting objects: 3, done.
remote: Total 3 (delta 0), reused 0 (delta 0)
Unpacking objects: 100% (3/3), done.
From /Users/mht208/demo/server
   3691b0d..57d4f6e  master     -> origin/master
DHCP-22126 project1 $ git merge
Auto-merging README.md
CONFLICT (content): Merge conflict in README.md
Automatic merge failed; fix conflicts and then commit the result.
DHCP-22126 project1 $
```

Resolve Conflicts

1. Edit files with conflicts

```
<<<<<<< HEAD
===== About Project A =====
=======
===== About Me =====
>>>>>>> refs/remotes/origin/master

This is readme.
```

Resolve Conflicts

1. Edit files with conflicts
2. git add

```
<<<<<<< HEAD
===== About Project A =====
=======
===== About Me =====
>>>>>>> refs/remotes/origin/master
```

This is readme.

Resolve Conflicts

1. Edit files with conflicts
2. git add
3. git commit

Resolve Conflicts

1. Edit files with conflicts
2. git add
3. git commit

```
DHCP-22126 project1 $ git add README.md
DHCP-22126 project1 $ git commit
[master 3e5947f] Merge remote-tracking branch 'refs/remotes/origin/master'
DHCP-22126 project1 $
```

2. git

```
File: /Users/mht208/demo/project1/.git/COMMIT_EDITMSG

Merge remote-tracking branch 'refs/remotes/origin/master'

# Conflicts:
#       README.md
#
# with '#' will be ignored, and an empty message aborts the commit.
# On branch
# Your branch and 'origin/master' have diverged,
# and have 1 and 1 different commits each, respectively.
#   (use "git pull" to merge the remote branch into yours)
#
# All conflicts fixed but you are still merging.
#
                              [ Read 20 lines ]
^G Get Help  ^O Write Out ^W Where Is  ^K Cut Text  ^J Justify   ^C Cur Pos
^X Exit      ^R Read File ^\ Replace   ^U Uncut Text^T To Spell  ^_ Go To Line
```

Resolve Conflicts

1. Edit files with conflicts
2. git add
3. git commit

2. git

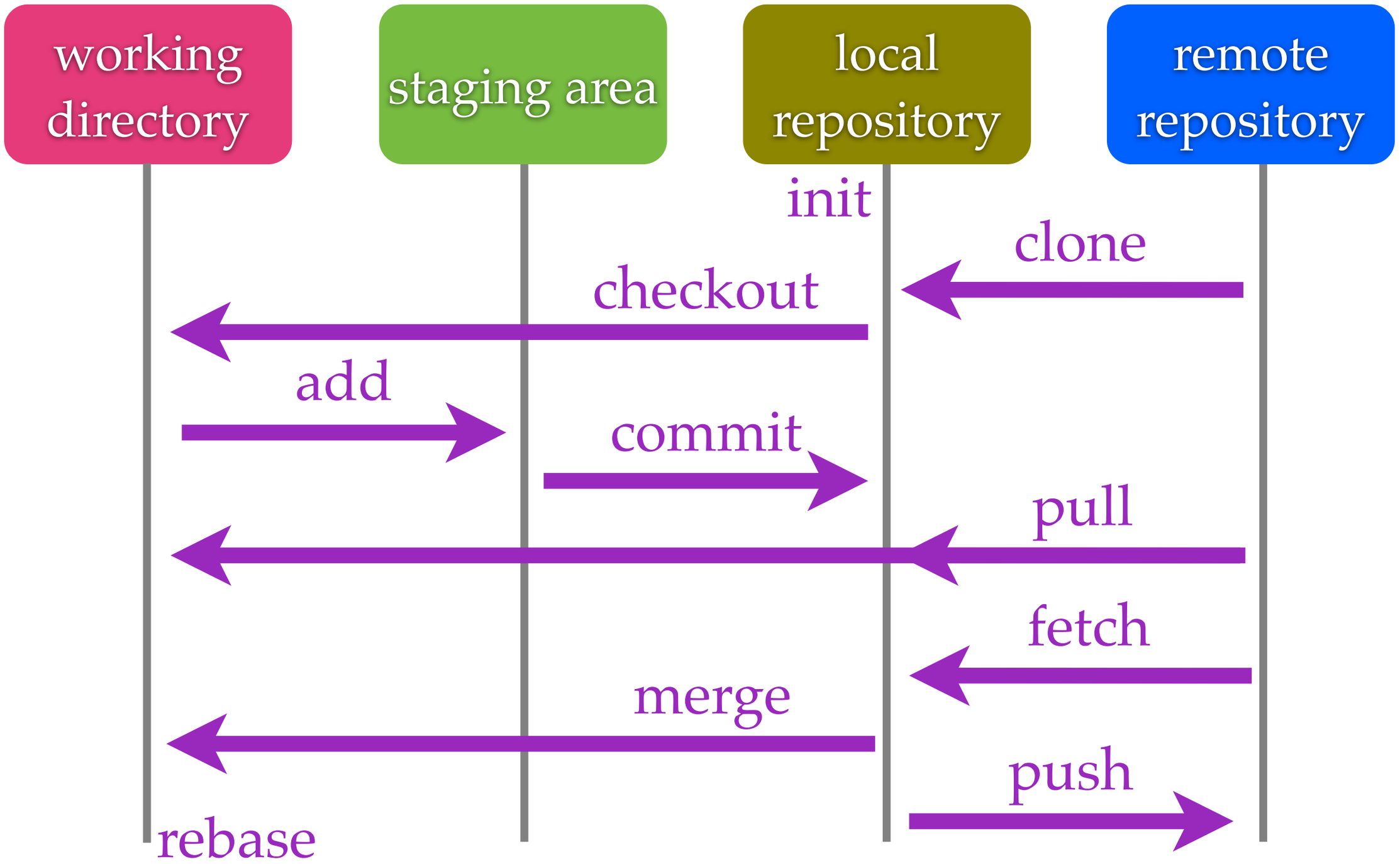
```
File: /Users/mht208/demo/project1/.git/COMMIT_EDITMSG

Merge remote-tracking branch 'refs/remotes/origin/master'

# Conflicts:
#       README.md
#
```

```
DHCP-22126 project1 $ git add README.md
DHCP-22126 project1 $ git commit
[master 3e5947f] Merge remote-tracking branch 'refs/remotes/origin/master'
DHCP-22126 project1 $
```

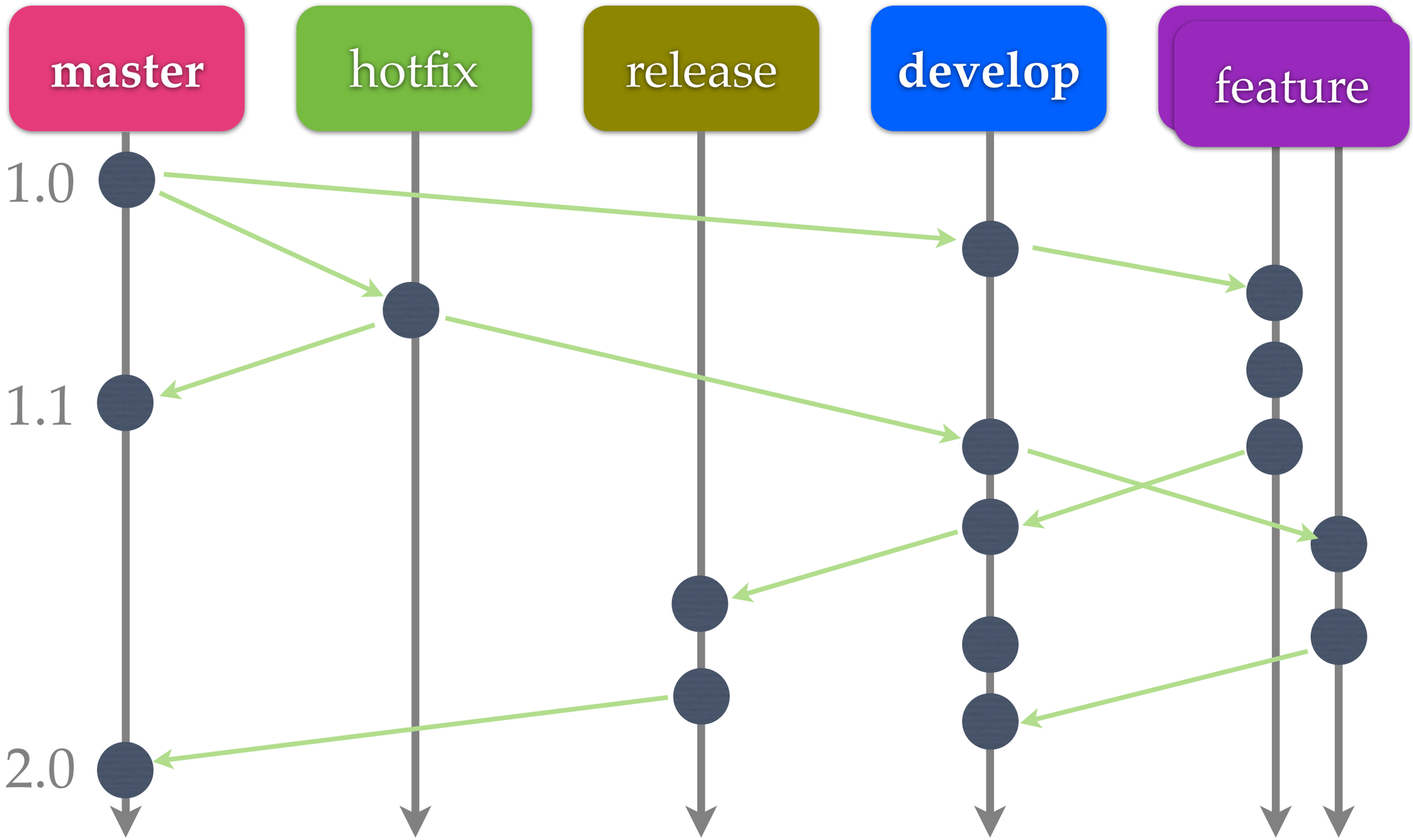
```
# with '#' will be ignored, and an empty message aborts the commit.
# On branch
```

```
*   3e5947f (HEAD -> master) Merge remote-tracking branch 'refs/remotes/origin/m
aster'
|\
| * 57d4f6e (origin/master) Modify README.md.
* | 22804d8 Modify README.md.
|/
* 3691b0d Add README.md.
```

Summary

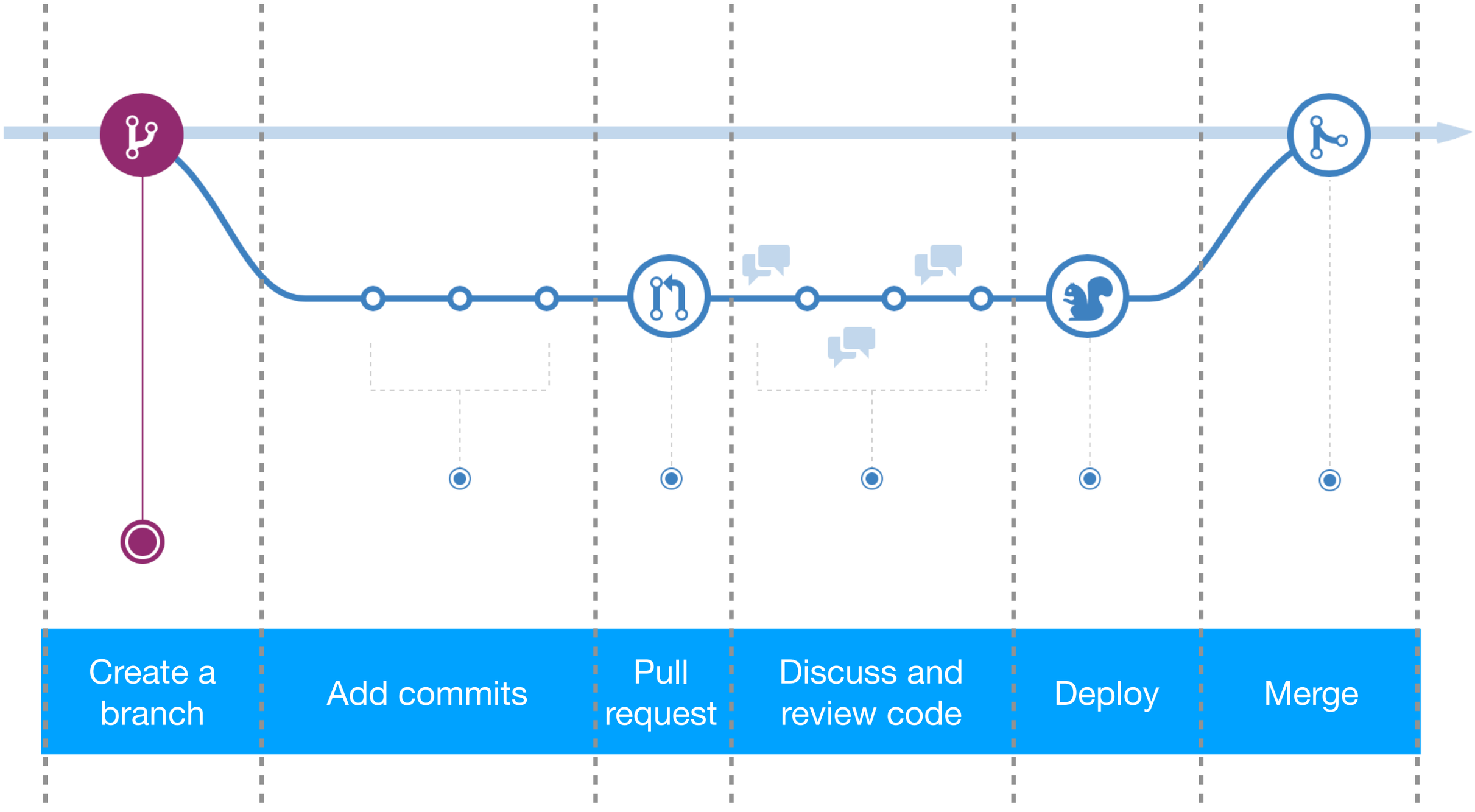

working directory
staging area
local repository
remote repository
init
clone
checkout
add
commit
pull
fetch
merge
push
rebase

Git Flow



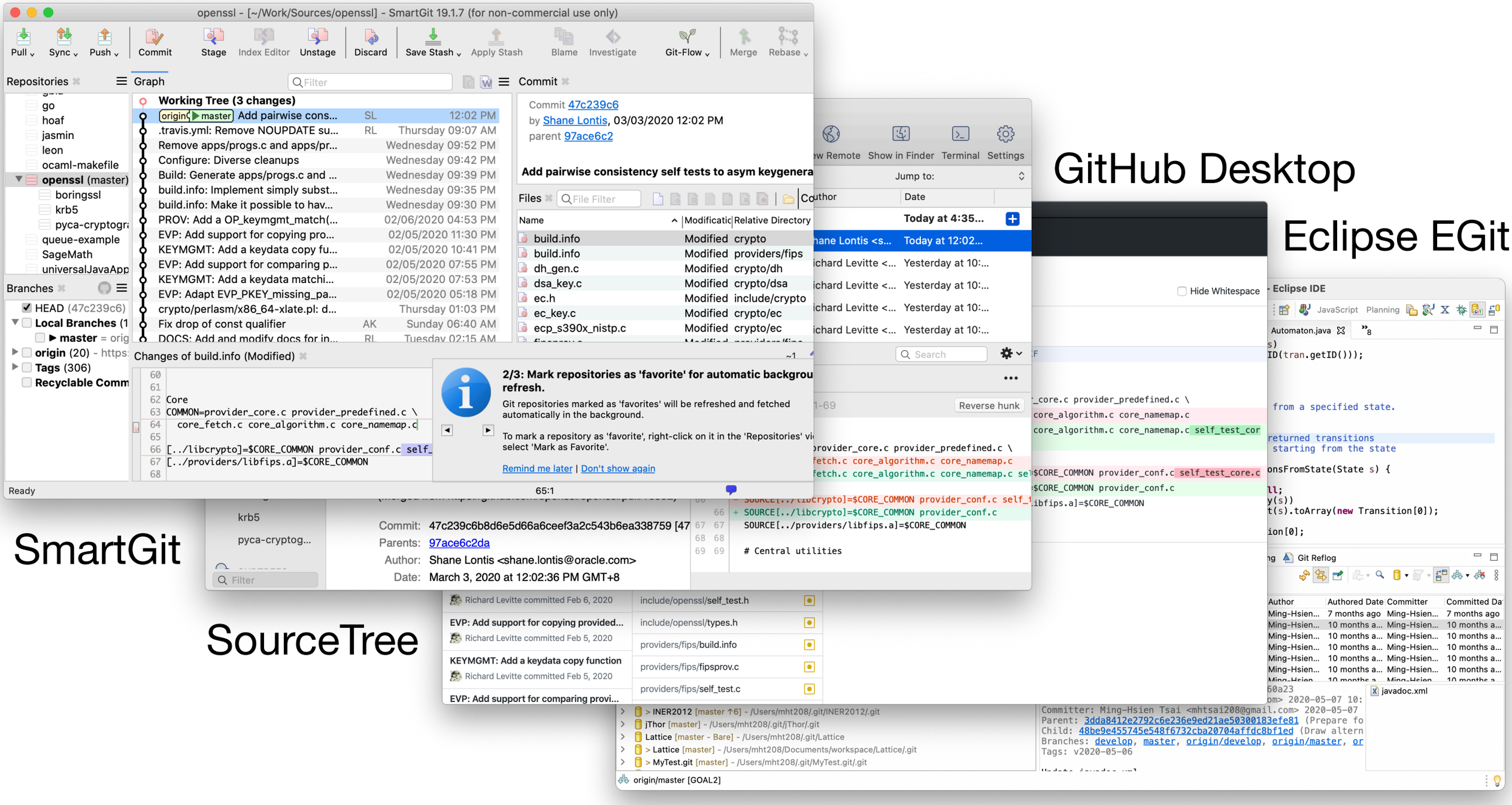
 http://nvie.com/posts/a-successful-git-branching-model/

GitHub Flow



https://guides.github.com/introduction/flow/

GUI Clients


openssl - [~/Work/Sources/openssl] - SmartGit 19.1.7 (for non-commercial use only)
Pull
Sync
Push
Commit
Stage
Index Editor
Unstage
Discard
Save Stash
Apply Stash
Blame
Investigate
Git-Flow
Merge
Rebase
Repositories
Graph
Commit
Working Tree (3 changes)
origin master Add pairwise cons... SL 12:02 PM
.travis.yml: Remove NOUPDATE su... RL Thursday 09:07 AM
Remove apps/progs.c and apps/pr... Wednesday 09:52 PM
Configure: Diverse cleanups Wednesday 09:42 PM
Build: Generate apps/progs.c and ... Wednesday 09:39 PM
build.info: Implement simply subst... Wednesday 09:35 PM
build.info: Make it possible to hav... Wednesday 09:30 PM
PROV: Add a OP_keymgmt_match(... 02/06/2020 04:53 PM
EVP: Add support for copying pro... 02/05/2020 11:30 PM
KEYMGMT: Add a keydata copy fu... 02/05/2020 10:41 PM
EVP: Add support for comparing p... 02/05/2020 07:55 PM
KEYMGMT: Add a keydata matchi... 02/05/2020 07:53 PM
EVP: Adapt EVP_PKEY_missing_pa... 02/05/2020 05:18 PM
crypto/perlasm/x86_64-xlate.pl: d... Thursday 01:03 PM
Fix drop of const qualifier AK Sunday 06:40 AM
go
hoaf
jasmin
leon
ocaml-makefile
openssl (master)
boringssl
krb5
pyca-cryptogr
queue-example
SageMath
universalJavaApp
Branches
HEAD (47c239c6)
Local Branches (1
master = orig
origin (20) - https:
Tags (306)
Recyclable Comm
Commit 47c239c6
by Shane Lontis, 03/03/2020 12:02 PM
parent 97ace6c2
Add pairwise consistency self tests to asym keygenera
Files
File Filter
Name
Modificatic
Relative Directory
build.info Modified crypto
build.info Modified providers/fips
dh_gen.c Modified crypto/dh
dsa_key.c Modified crypto/dsa
ec.h Modified include/crypto
ec_key.c Modified crypto/ec
ecp_s390x_nistp.c Modified crypto/ec
Changes of build.info (Modified)
60
61
62 Core
63 COMMON=provider_core.c provider_predefined.c \
64 core_fetch.c core_algorithm.c core_namemap.c
65
66 [../libcrypto]=$CORE_COMMON provider_conf.c self_
67 [../providers/libfips.a]=$CORE_COMMON
68
2/3: Mark repositories as 'favorite' for automatic backgrou
refresh.
Git repositories marked as 'favorites' will be refreshed and fetched automatically in the background.
To mark a repository as 'favorite', right-click on it in the 'Repositories' vi
select 'Mark as Favorite'.
Remind me later | Don't show again
Ready
65:1
GitHub Desktop
Eclipse EGit
SmartGit
SourceTree
Jump to:
Author
Date
Today at 4:35...
Today at 12:02...
Yesterday at 10:...
Search
Reverse hunk
Hide Whitespace
Eclipse IDE
JavaScript
Planning
Automaton.java
from a specified state.
returned transitions
starting from the state
Git Reflog
Author
Authored Date
Committer
Committed Da
Ming-Hsien... 7 months ago Ming-Hsien... 7 months ago
Ming-Hsien... 10 months a... Ming-Hsien... 10 months a...
javadoc.xml
krb5
pyca-cryptog...
Filter
Commit: 47c239c6b8d6e5d66a6ceef3a2c543b6ea338759 [47
Parents: 97ace6c2da
Author: Shane Lontis <shane.lontis@oracle.com>
Date: March 3, 2020 at 12:02:36 PM GMT+8
Richard Levitte committed Feb 6, 2020
include/openssl/self_test.h
EVP: Add support for copying provided...
include/openssl/types.h
Richard Levitte committed Feb 5, 2020
providers/fips/build.info
KEYMGMT: Add a keydata copy function
providers/fips/fipsprov.c
Richard Levitte committed Feb 5, 2020
providers/fips/self_test.c
EVP: Add support for comparing provi...
> INER2012 [master ↑6] - /Users/mht208/.git/INER2012/.git
jThor [master] - /Users/mht208/.git/jThor/.git
Lattice [master - Bare] - /Users/mht208/.git/Lattice
> Lattice [master] - /Users/mht208/Documents/workspace/Lattice/.git
> MyTest.git [master] - /Users/mht208/.git/MyTest.git/.git
origin/master [GOAL2]
Committer: Ming-Hsien Tsai <mhtsai208@gmail.com> 2020-05-07
Parent: 3dda8412e2792c6e236e9ed21ae50300183efe81 (Prepare fo
Child: 48be9e455745e548f6732cba20704affdc8bf1ed (Draw altern
Branches: develop, master, origin/develop, origin/master, or
Tags: v2020-05-06

References

- http://git-scm.com/book

- http://git-scm.com/docs