Fundamentals of Git

Outline

- History of Git
- Distributed V.S Centralized Version Control
- Getting started
- Branching and Merging
- Working with remote
- Summary

A Brief History of Git

- Linus uses BitKeeper to manage Linux code
- Ran into BitKeeper licensing issue
  - Liked functionality
  - Looked at CVS as how not to do things
- April 5, 2005 - Linus sends out email showing first version
- June 15, 2005 - Git used for Linux version control

Git is Not an SCM

Never mind merging. It's not an SCM, it's a distribution and archival mechanism. I bet you could make a reasonable SCM on top of it, though. Another way of looking at it is to say that it's really a content-addressable filesystem, used to track directory trees.

Linus Torvalds, 7 Apr 2005

http://lkml.org/lkml/2005/4/8/9

Centralized Version Control

- Traditional version control system
  - Server with database
  - Clients have a working version
- Examples
  - CVS
  - Subversion
  - Visual Source Safe
- Challenges
  - Multi-developer conflicts
  - Client/server communication

Distributed Version Control

- Authoritative server by convention only
- Every working checkout is a repository
- Get version control even when detached
- Backups are trivial

- Other distributed systems include
  - Mercurial
  - BitKeeper
  - Darcs
  - Bazaar

mercurial (hg)

bazaar

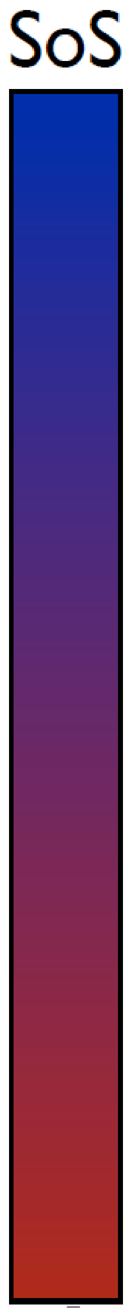
subversion (svn)

version control

concurrent version system (cvs)

perforce

visual source safe



mercurial (hg) “not bad”

bazaar

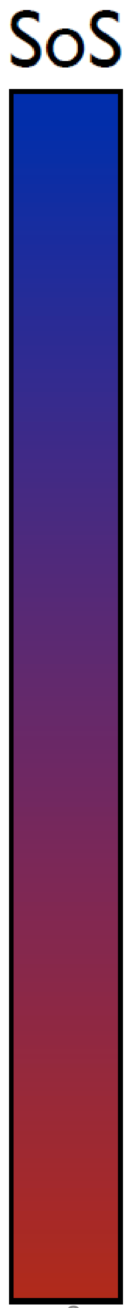
subversion (svn)

version control

concurrent version system (cvs)

perforce

visual source safe



mercurial (hg)

bazaar

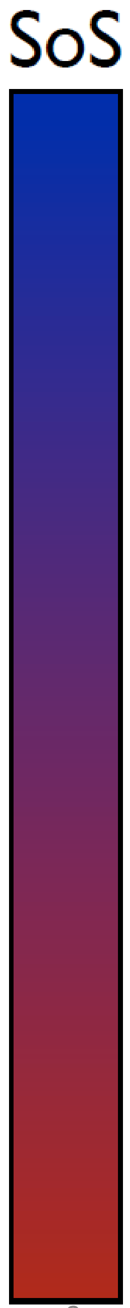
subversion (svn)

version control

concurrent version system (cvs)

perforce

visual source safe “kill self”



git

mercurial (hg)

bazaar

subversion (svn)

version control

concurrent version system (cvs)

perforce

visual source safe

Git Advantages

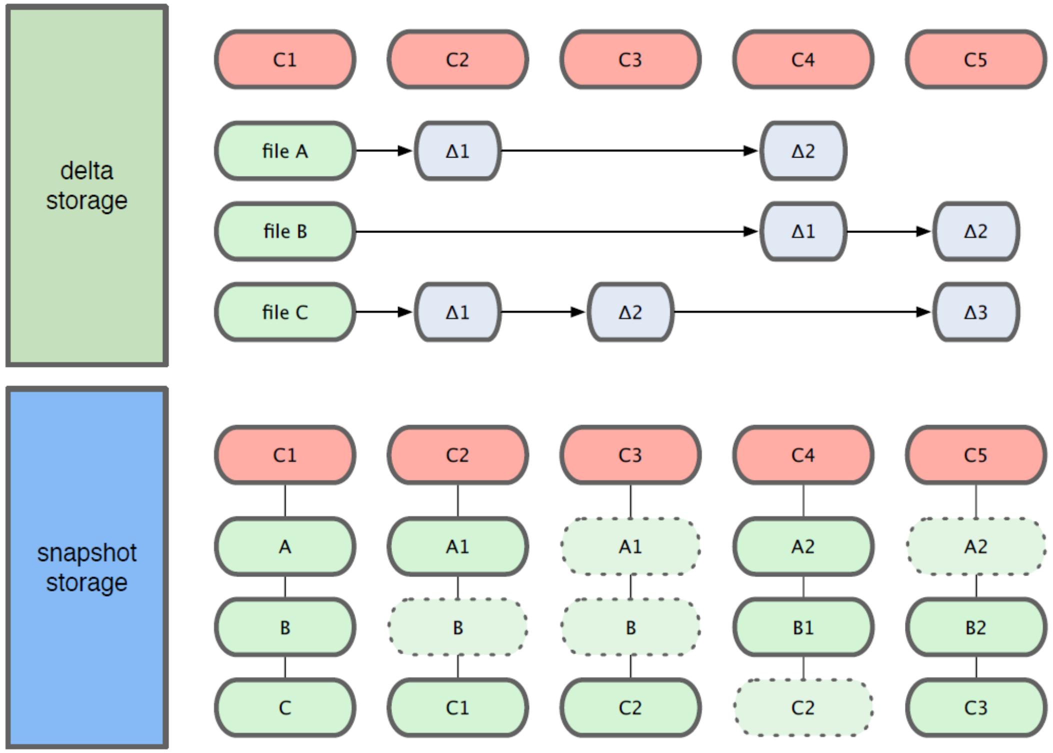
- Resilience
  - No one repository has more data than any other
- Speed
  - Very fast operations compared to other VCS (I’m looking at you CVS and Subversion)
- Space
  - Compression can be done across repository not just per file
  - Minimizes local size as well as push/pull data transfers
- Simplicity
  - Object model is very simple
- Large userbase with robust tools

Some GIT Disadvantages

- Definite learning curve, especially for those used to centralized systems
  - Can sometimes seem overwhelming to learn
    - Conceptual difference
    - Huge amount of commends

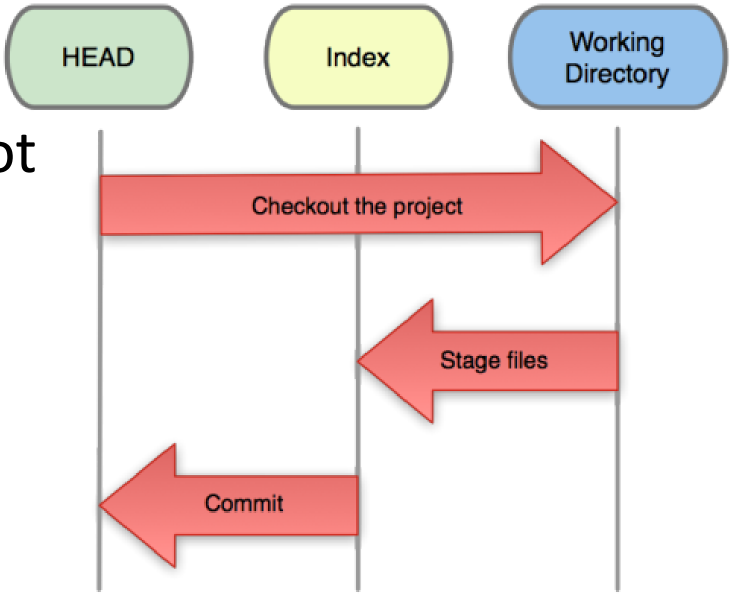
Getting Started

- Git use snapshot storage



Getting Started

- Three trees of Git
  - The HEAD
    - last commit snapshot, next parent
  - Index
    - Proposed next commit snapshot
  - Working directory
    - Sandbox



Getting Started

- A basic workflow
  - (Possible init or clone) Init a repo
  - Edit files
  - Stage the changes
  - Review your changes
  - Commit the changes

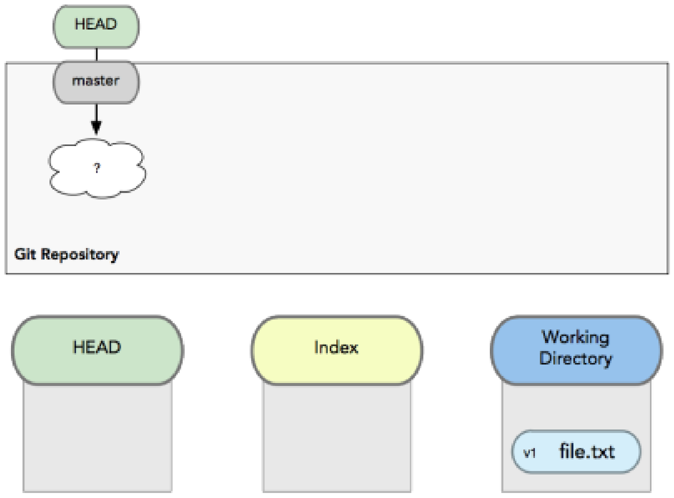
Getting Started

- Init a repository
- Git init

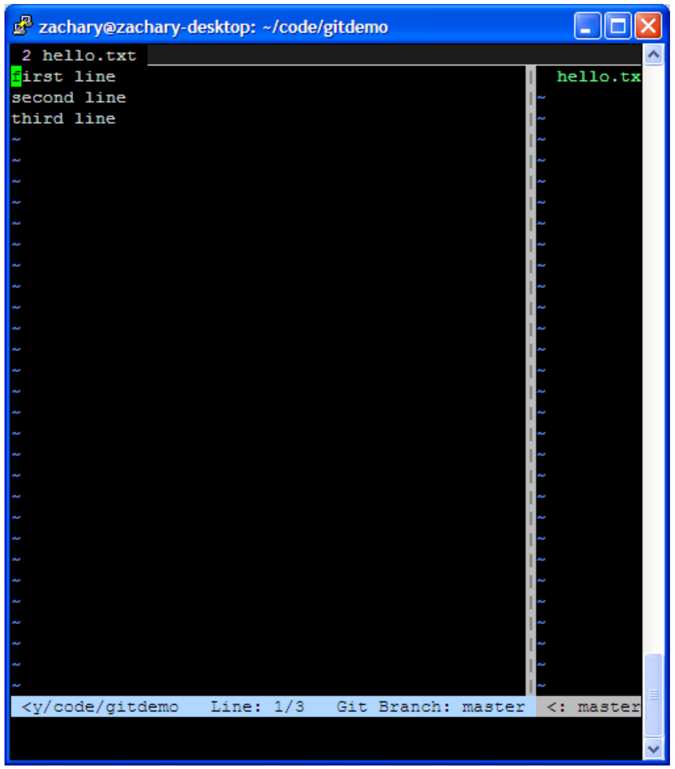
```
zachary@zachary-desktop:~/code/gitdemo$ git init
Initialized empty Git repository in /home/zachary/code/gitdemo/.git/


zachary@zachary-desktop:~/code/gitdemo$ ls -l .git/
total 32
drwxr-xr-x 2 zachary zachary 4096 2011-08-28 14:51 branches
-rw-r--r-- 1 zachary zachary   92 2011-08-28 14:51 config
-rw-r--r-- 1 zachary zachary   73 2011-08-28 14:51 description
-rw-r--r-- 1 zachary zachary   23 2011-08-28 14:51 HEAD
drwxr-xr-x 2 zachary zachary 4096 2011-08-28 14:51 hooks
drwxr-xr-x 2 zachary zachary 4096 2011-08-28 14:51 info
drwxr-xr-x 4 zachary zachary 4096 2011-08-28 14:51 objects
drwxr-xr-x 4 zachary zachary 4096 2011-08-28 14:51 refs
```

Getting Started

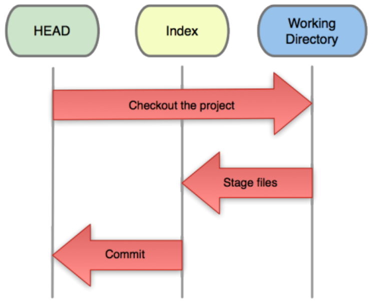
- A basic workflow
  - Edit files
  - Stage the changes
  - Review your changes
  - Commit the changes



- Use your favorite editor

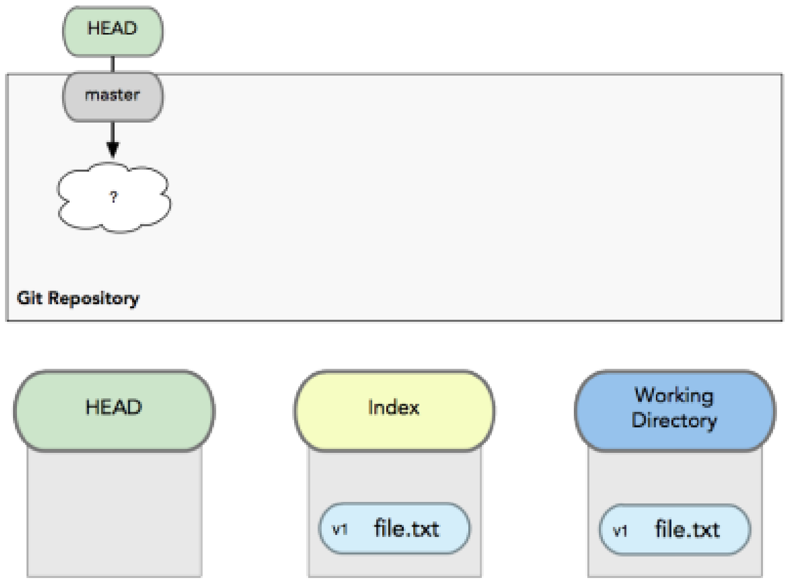


```
 2 hello.txt
first line                                   hello.tx
second line
third line
<y/code/gitdemo   Line: 1/3   Git Branch: master  <: master
```



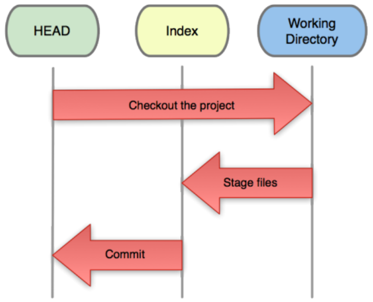
Getting Started

- A basic workflow
  - Edit files
  - Stage the changes
  - Review your changes
  - Commit the changes
- Git add filename



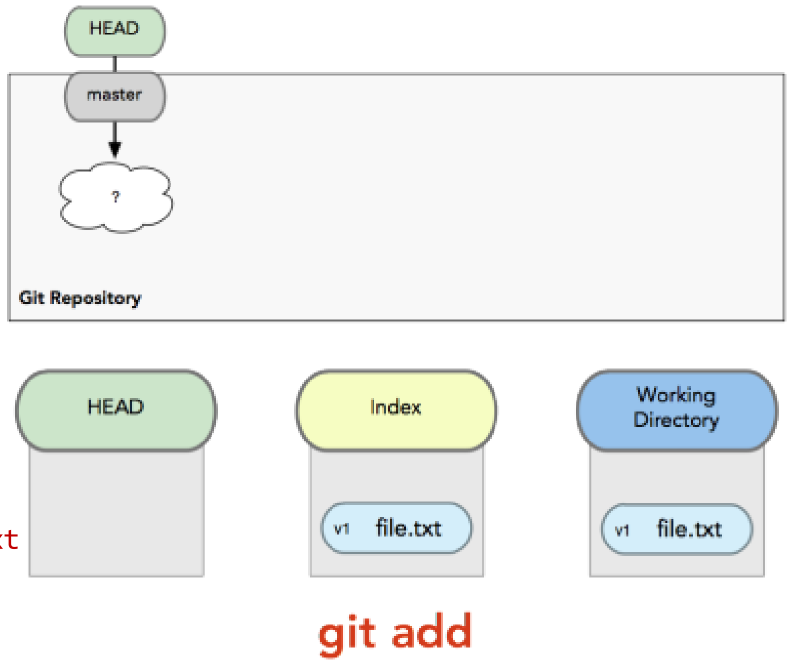
git add

```
zachary@zachary-desktop:~/code/gitdemo$ git status
# On branch master
# 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:   hello.txt
#
no changes added to commit (use "git add" and/or "git commit -a")
```

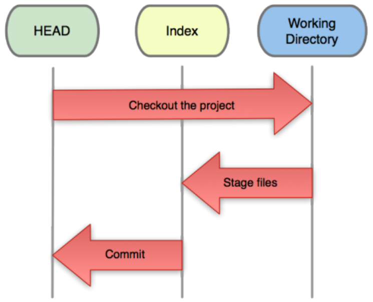


Getting Started

- A basic workflow
  - Edit files
  - Stage the changes
  - Review your changes
  - Commit the changes
- Git status



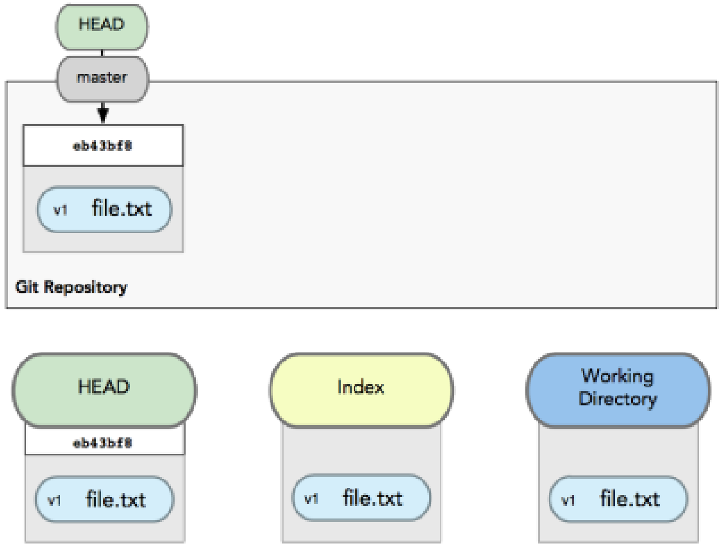
```
zachary@zachary-desktop:~/code/gitdemo$ git add hello.txt
zachary@zachary-desktop:~/code/gitdemo$ git status
# On branch master
# Changes to be committed:
#   (use "git reset HEAD <file>..." to unstage)
#
#       modified:   hello.txt
#
```



Getting Started

- A basic workflow
  - Edit files
  - Stage the changes
  - Review your changes
  - Commit the changes

- Git commit

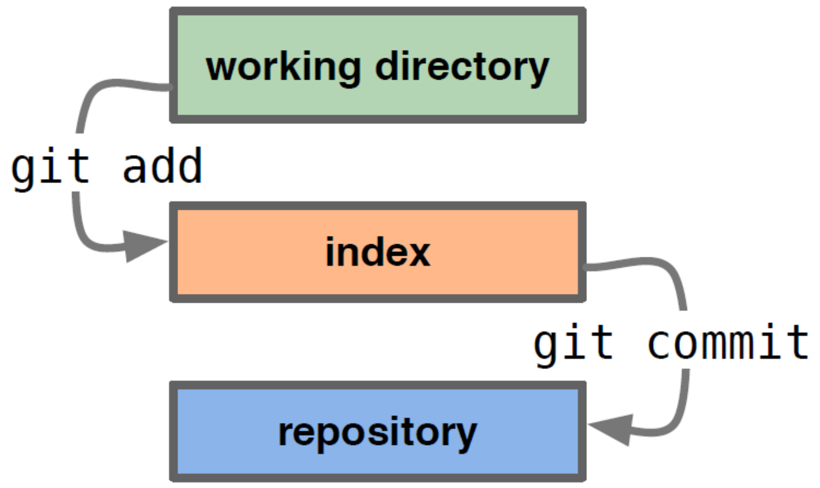


git commit

```
# Please enter the commit message for your changes. Lines starting
# with '#' will be ignored, and an empty message aborts the commit.
# On branch master
# Changes to be committed:
#   (use "git reset HEAD <file>..." to unstage)
#
#   modified:   hello.txt
#
```

Getting Started

- A basic workflow
  - Edit files
  - Stage the changes
  - Review your changes
  - Commit the changes



Getting Started

- View changes
- Git diff
  - Show the difference between working directory and staged
- Git diff --cached
  - Show the difference between staged and the HEAD

- View history
- Git log

```
zachary@zachary-desktop:~/code/gitdemo$ git log
commit efb3aeae66029474e28273536a8f52969d705d04
Author: Zachary Ling <zacling@gmail.com>
Date:   Sun Aug 28 15:02:08 2011 +0800

    Add second line

commit 453914143eae3fc5a57b9504343e2595365a7357
Author: Zachary Ling <zacling@gmail.com>
Date:   Sun Aug 28 14:59:13 2011 +0800

    Initial commit
```

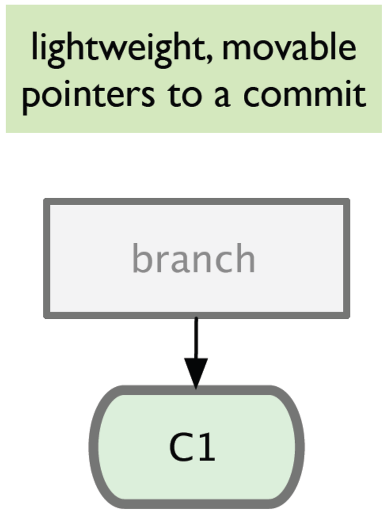
Getting Started

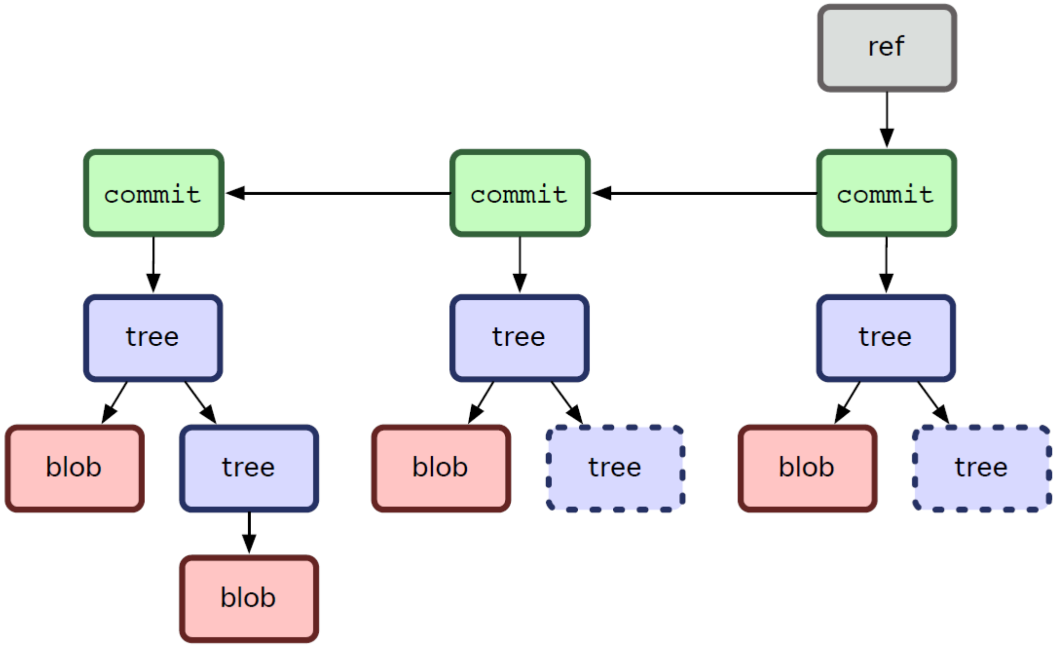
- Revert changes (Get back to a previous version)
  - Git checkout commit_hash

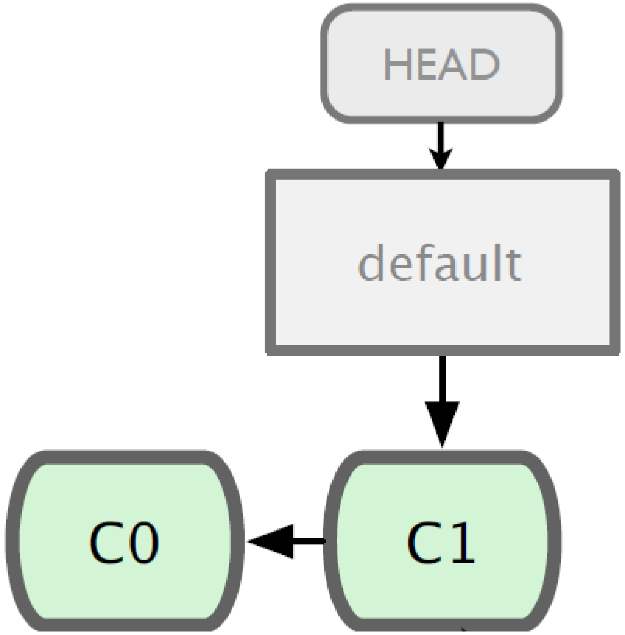
```
zachary@zachary-desktop:~/code/gitdemo$ git log
commit efb3aeae66029474e28273536a8f52969d705d04
Author: Zachary Ling <zacling@gmail.com>
Date:   Sun Aug 28 15:02:08 2011 +0800

    Add second line

commit 453914143eae3fc5a57b9504343e2595365a7357
Author: Zachary Ling <zacling@gmail.com>
Date:   Sun Aug 28 14:59:13 2011 +0800

    Initial commit
zachary@zachary-desktop:~/code/gitdemo$ git checkout 4539
Note: checking out '4539'.

You are in 'detached HEAD' state. You can look around, make experimental
changes and commit them, and you can discard any commits you make in this
state without impacting any branches by performing another checkout.

If you want to create a new branch to retain commits you create, you may
do so (now or later) by using -b with the checkout command again. Example:

  git checkout -b new_branch_name

HEAD is now at 4539141... Initial commit
```

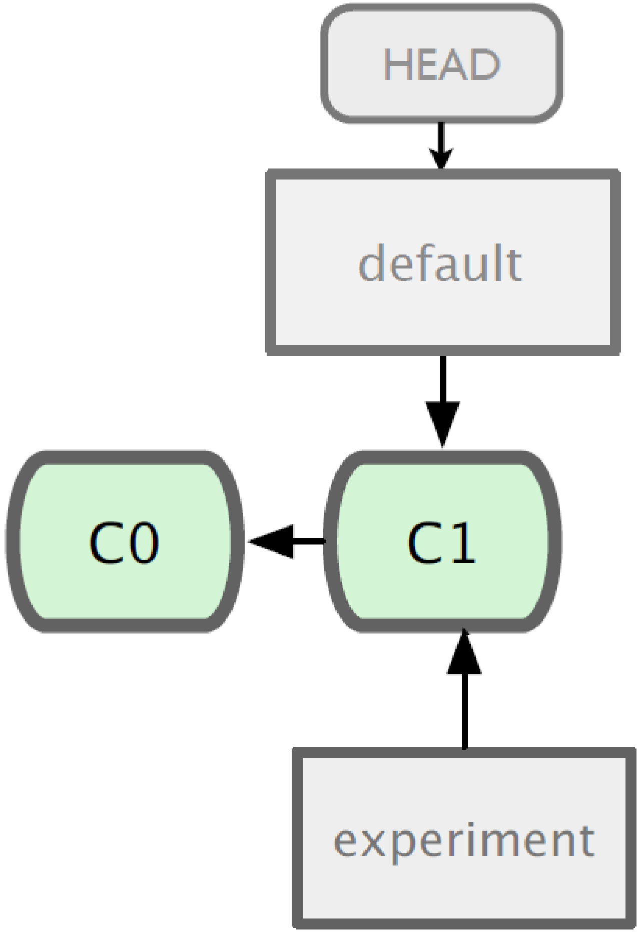
Branching

- Git sees commit this way…
- Branch annotates which commit we are working on

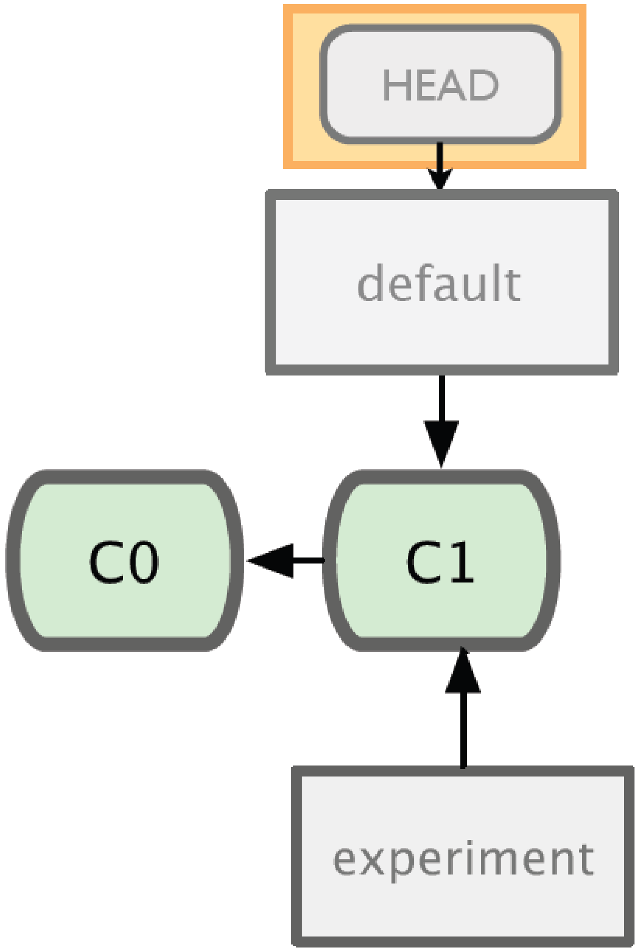




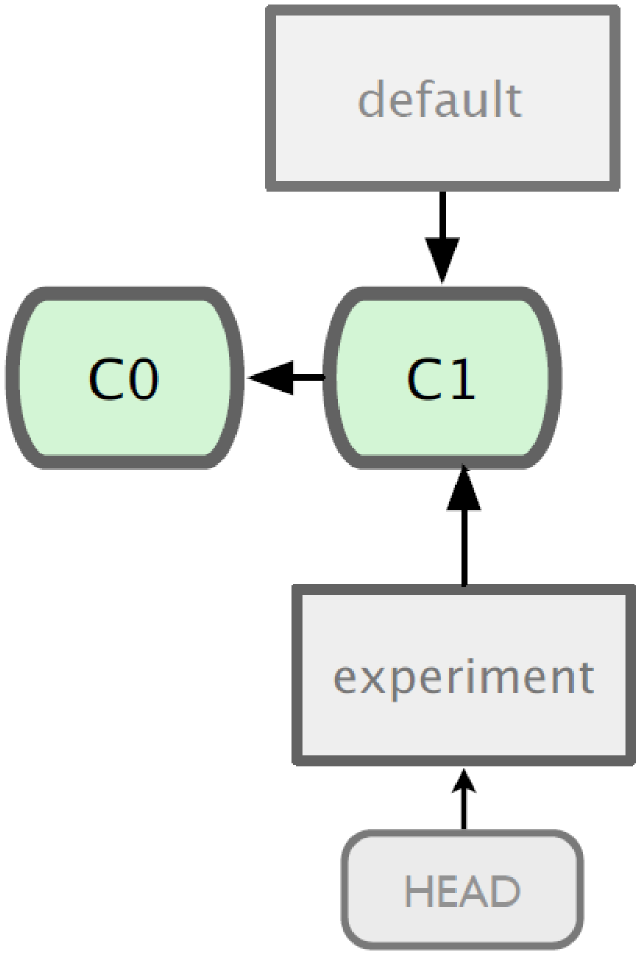

HEAD
default
C0
C1



git branch experiment

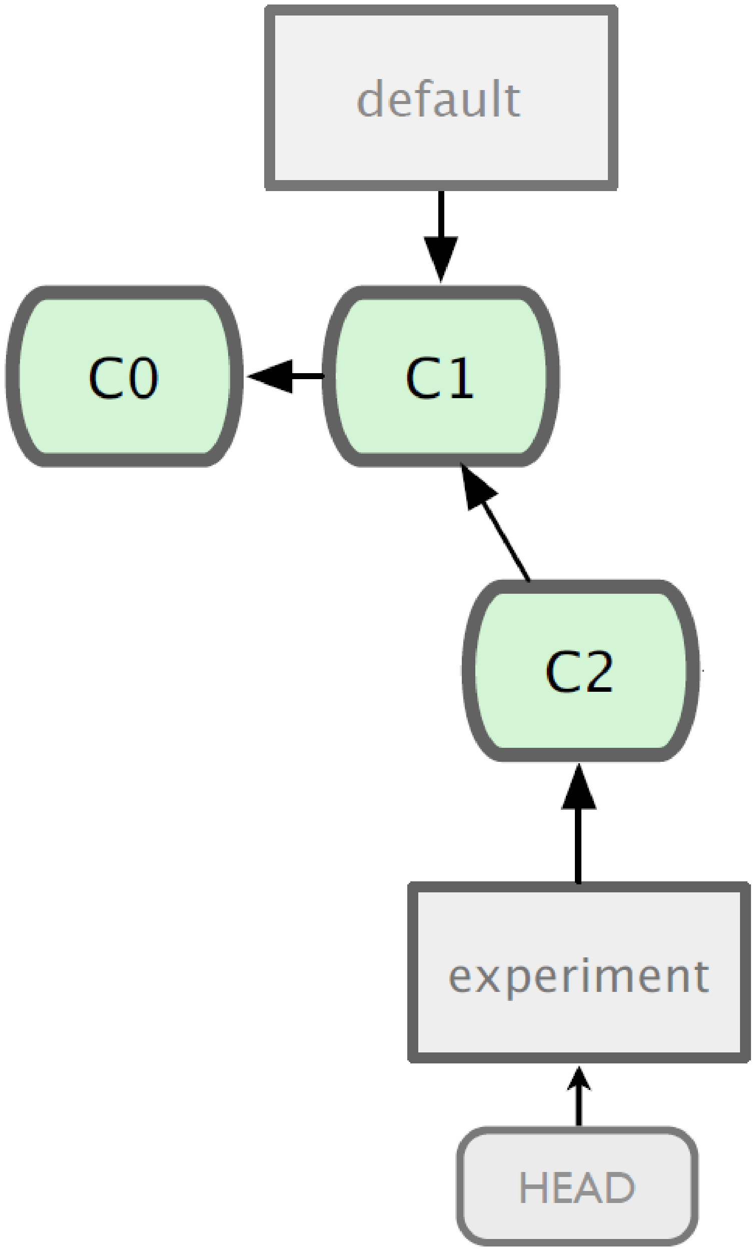


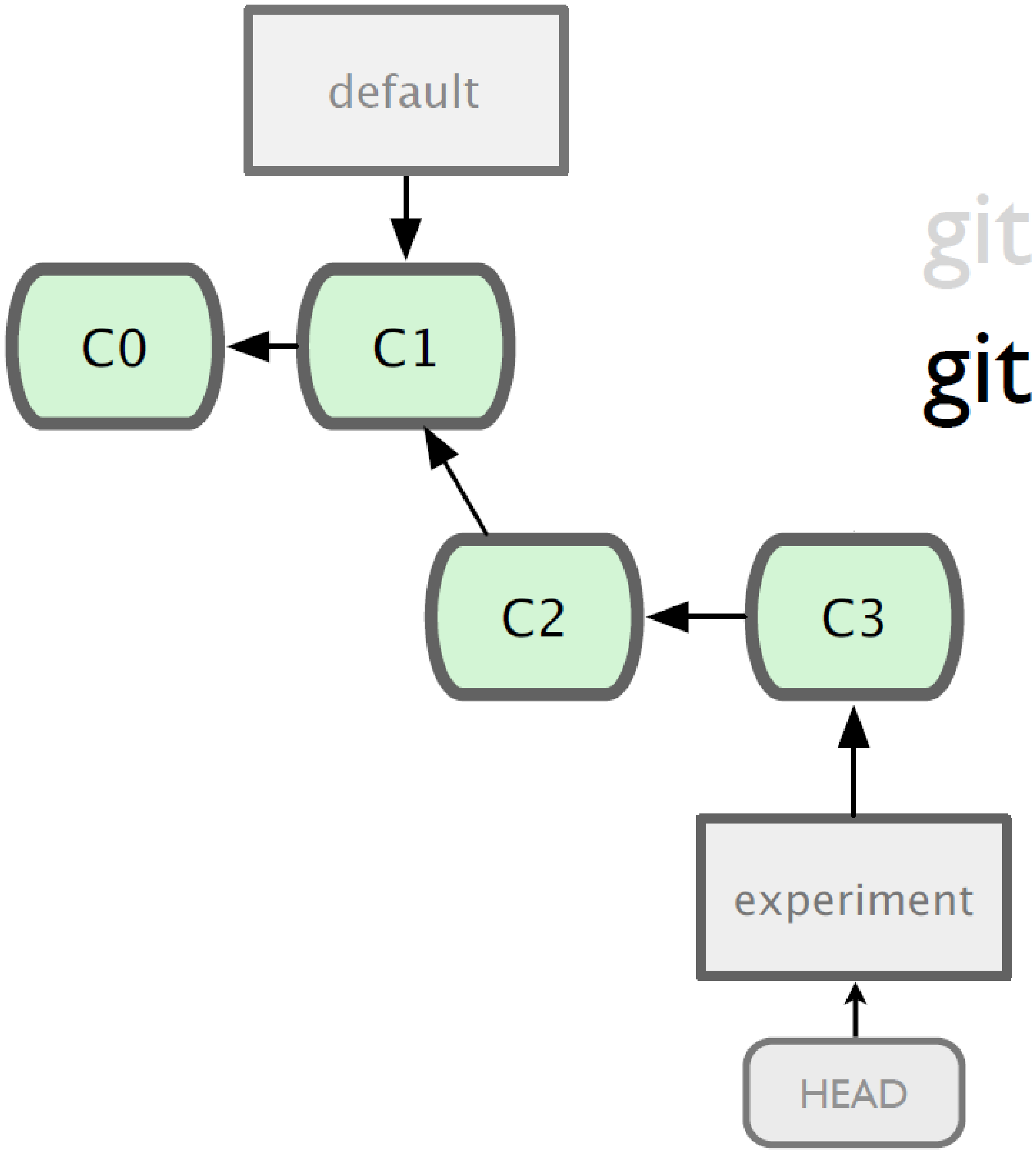
```
$ git branch
* default
  experiment
```



git checkout experiment

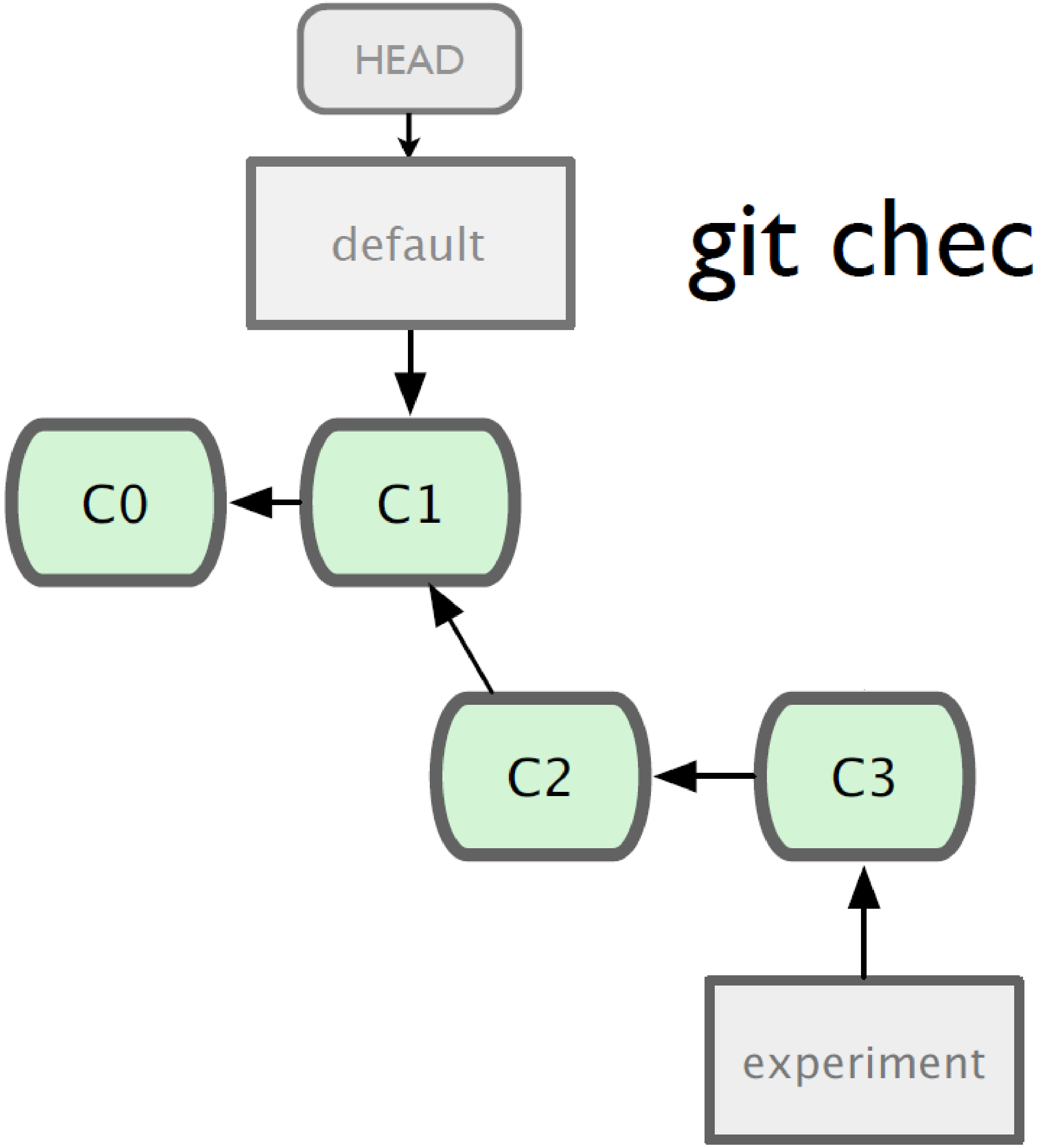
git commit



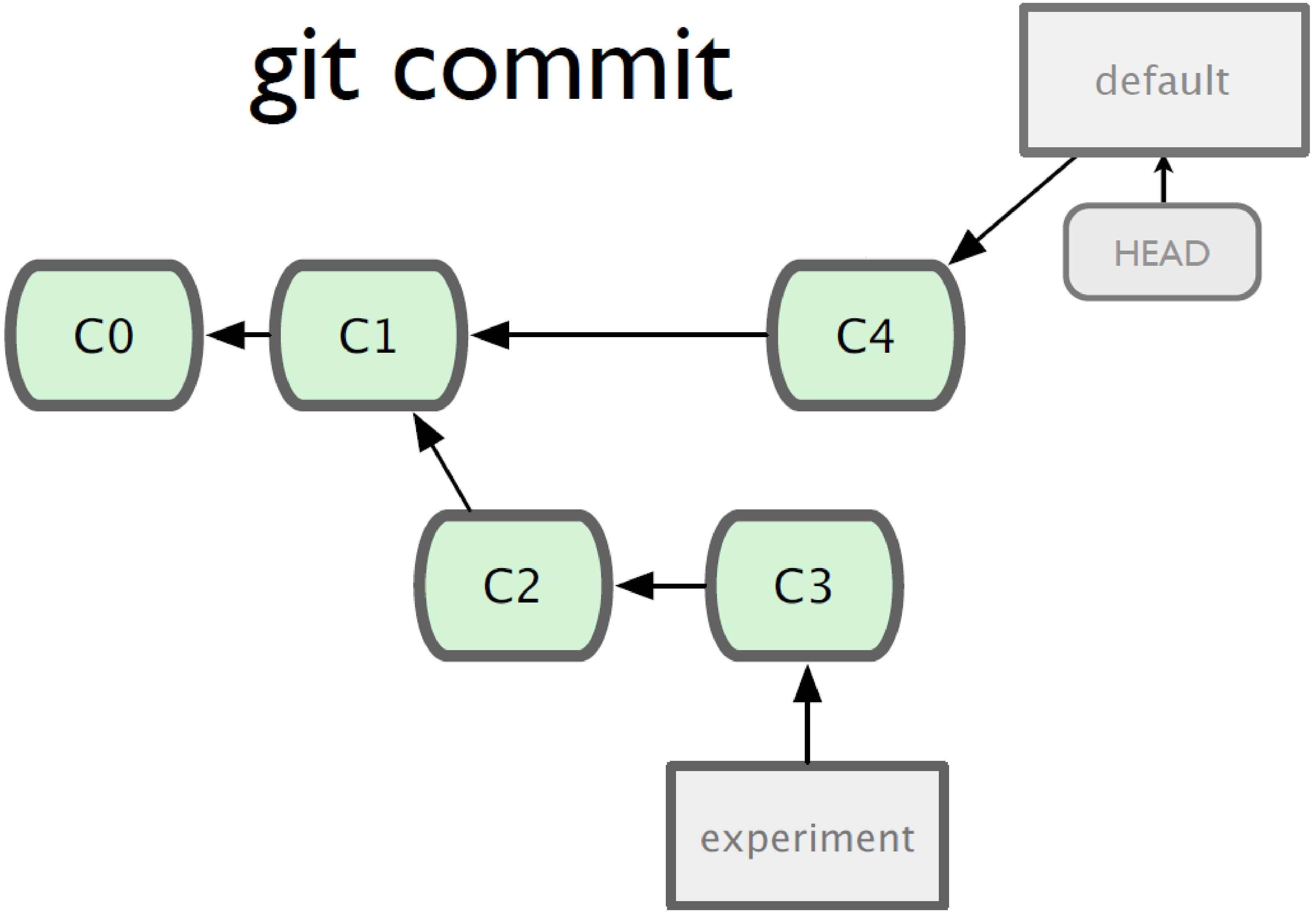


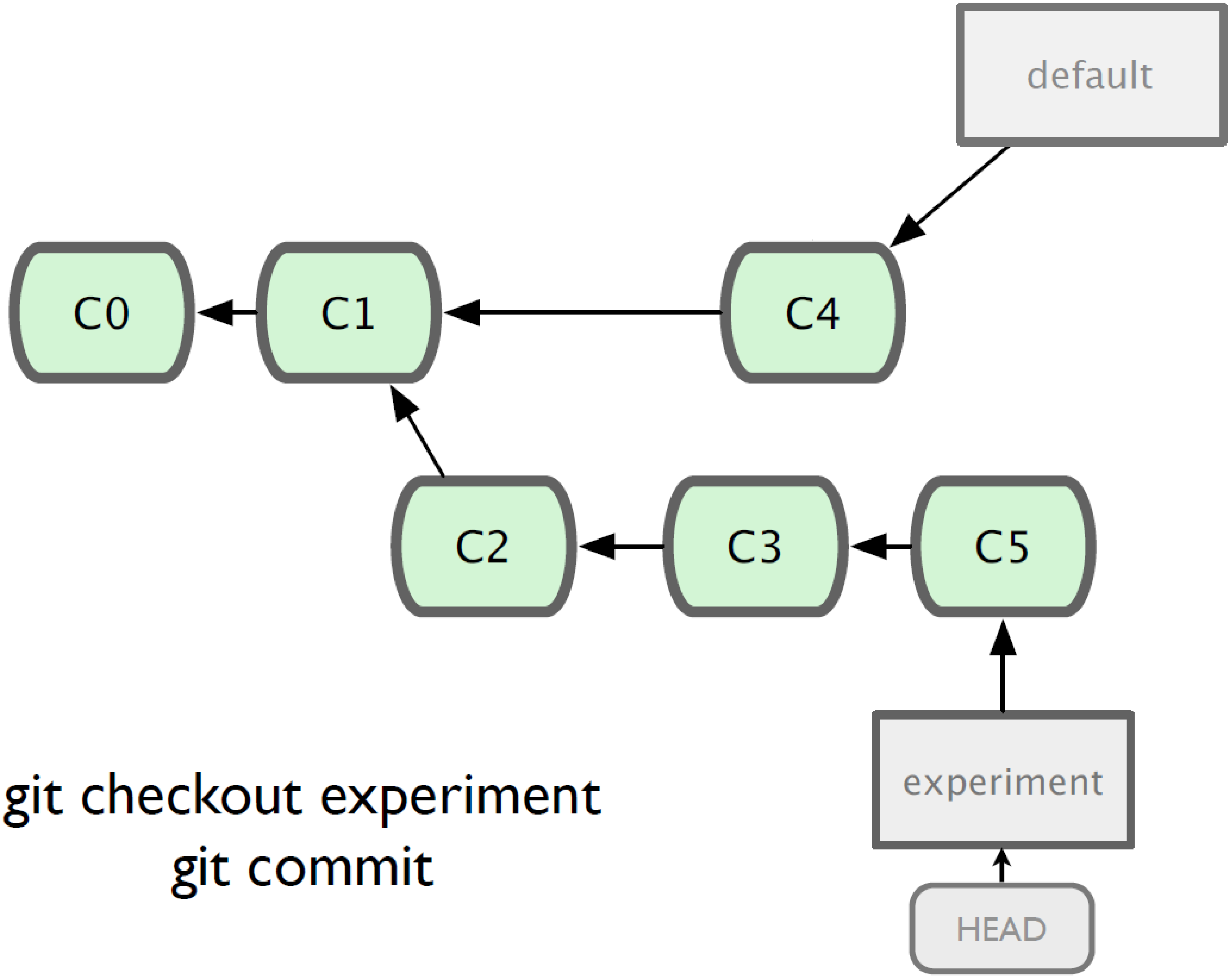
```
git commit
git commit
```

git checkout default



git commit

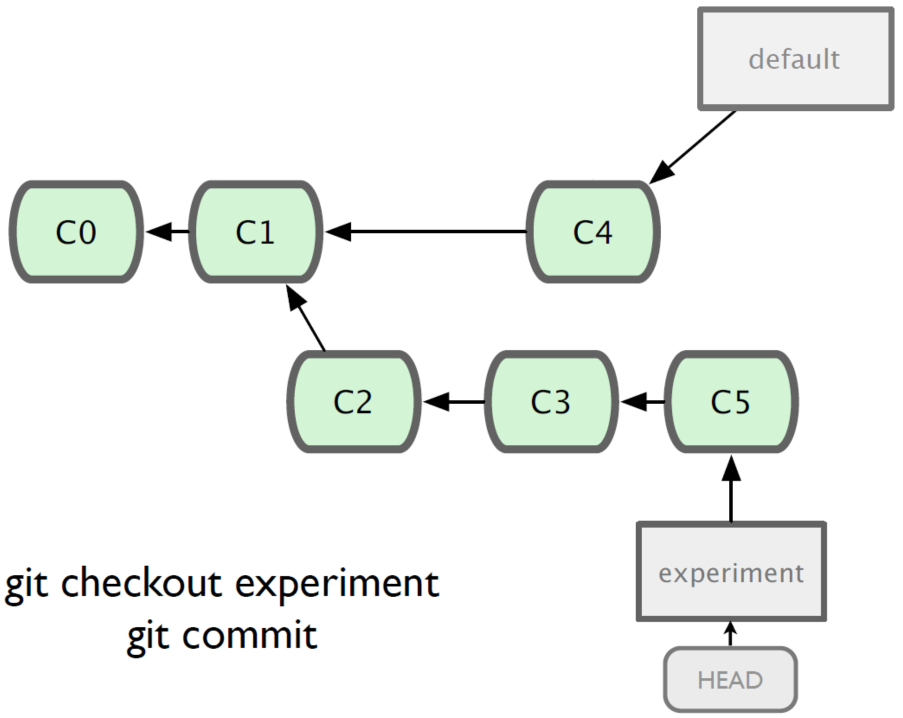




git checkout experiment
git commit

Merging

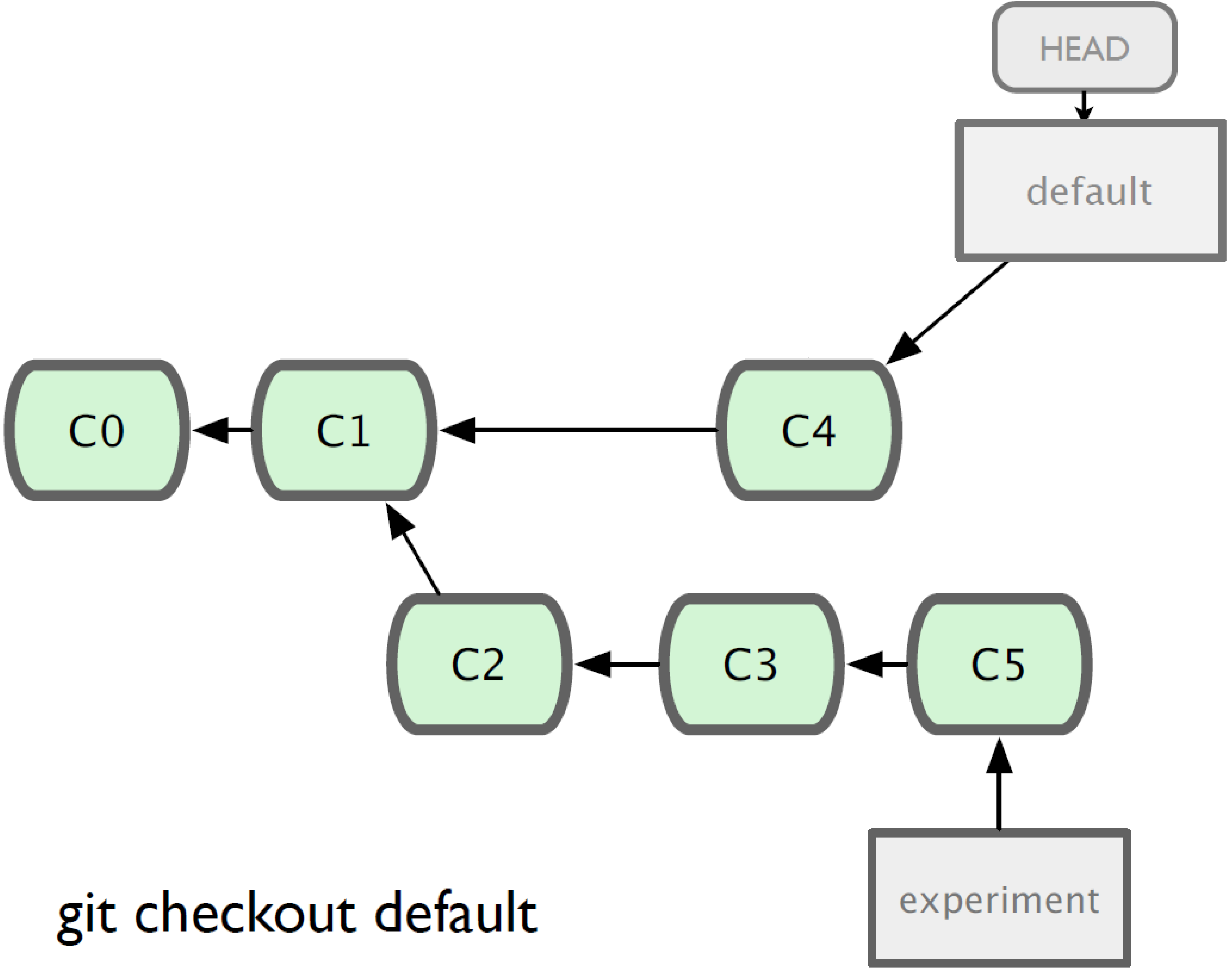
- What do we do with this mess?
  - Merge them



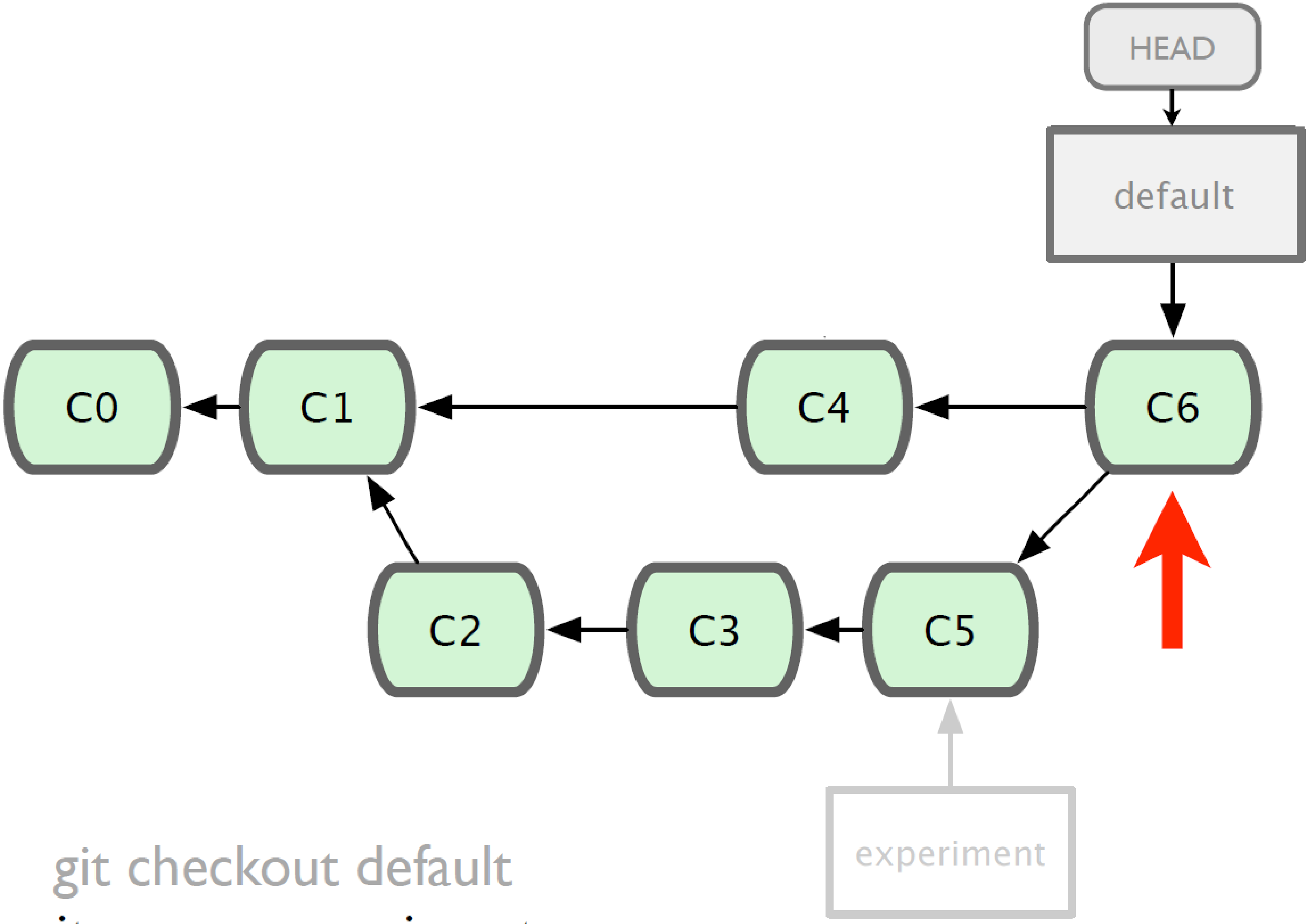
```
git checkout experiment
git commit
```

Merging

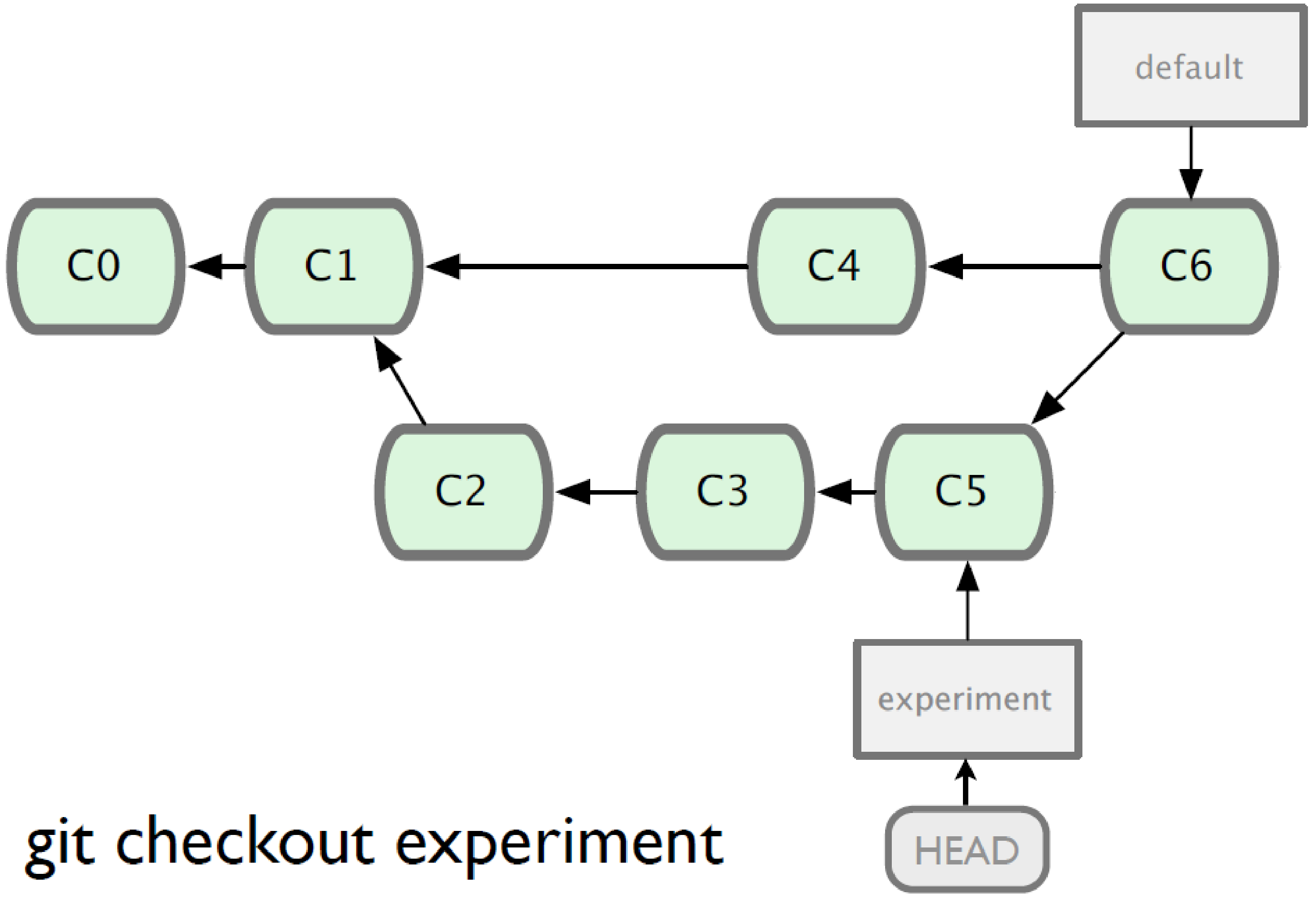
- Steps to merge two branch
  - Checkout the branch you want to merge onto
  - Merge the branch you want to merge



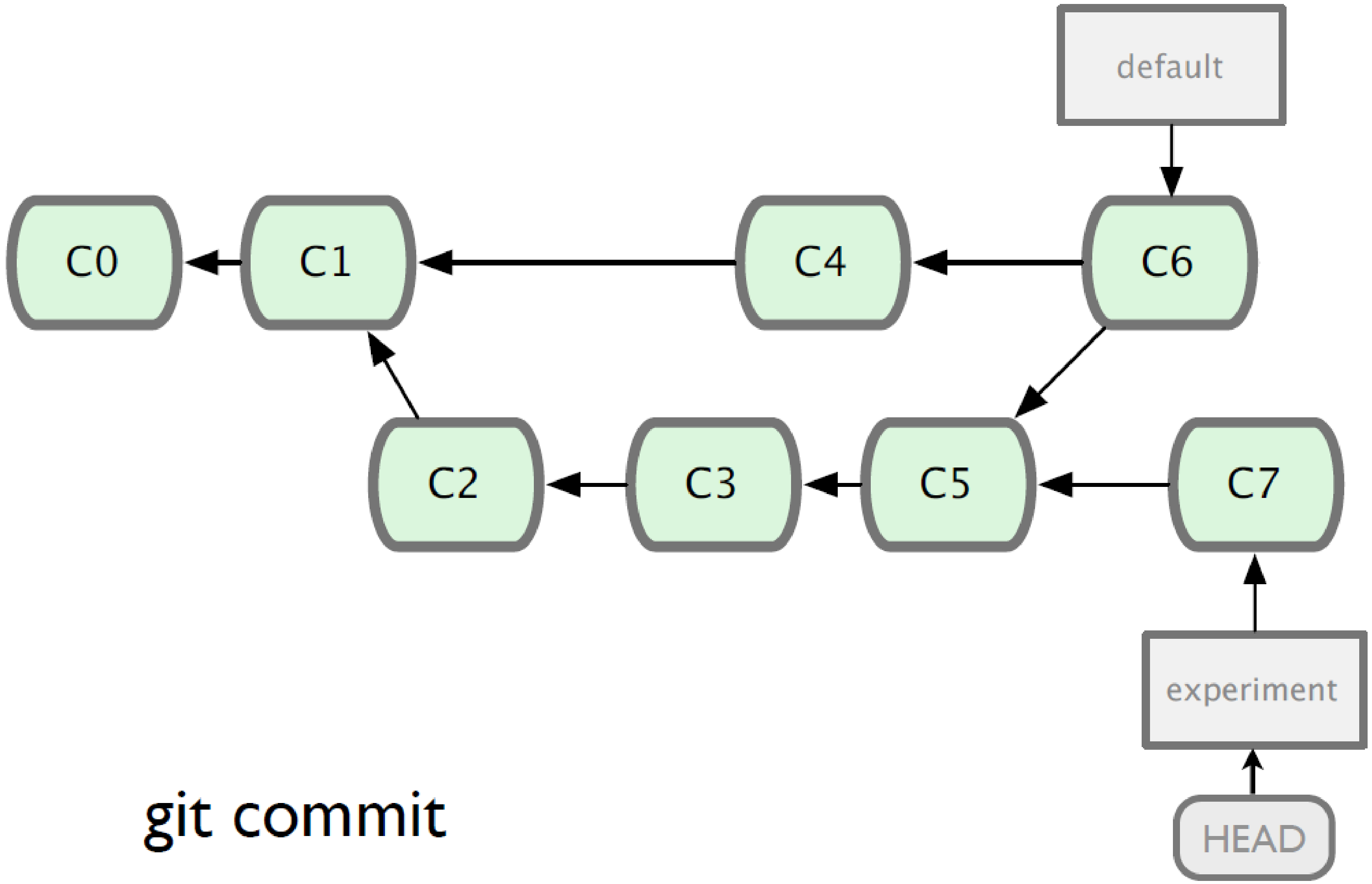
git checkout default



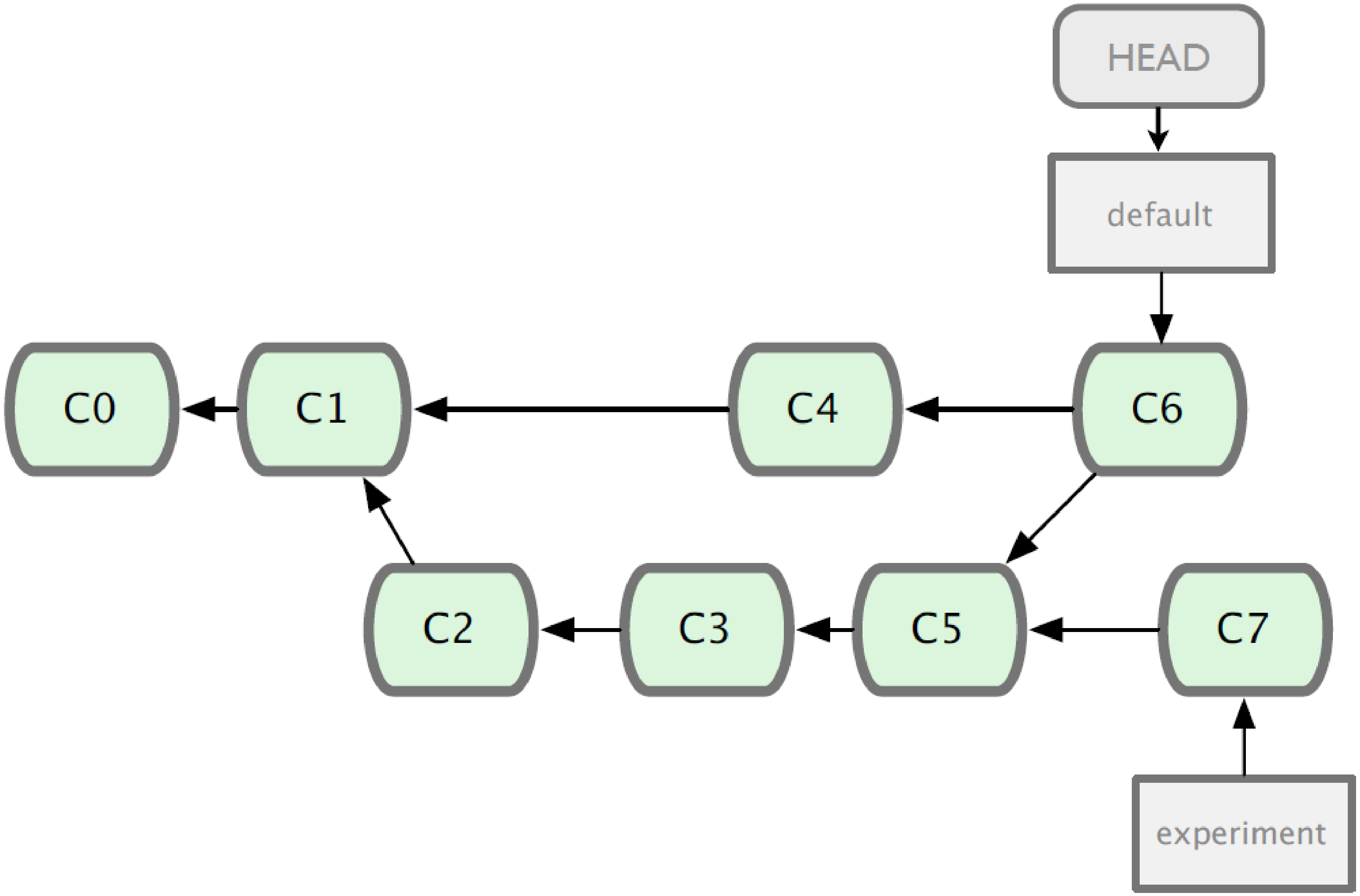
```
git checkout default
git merge experiment
```



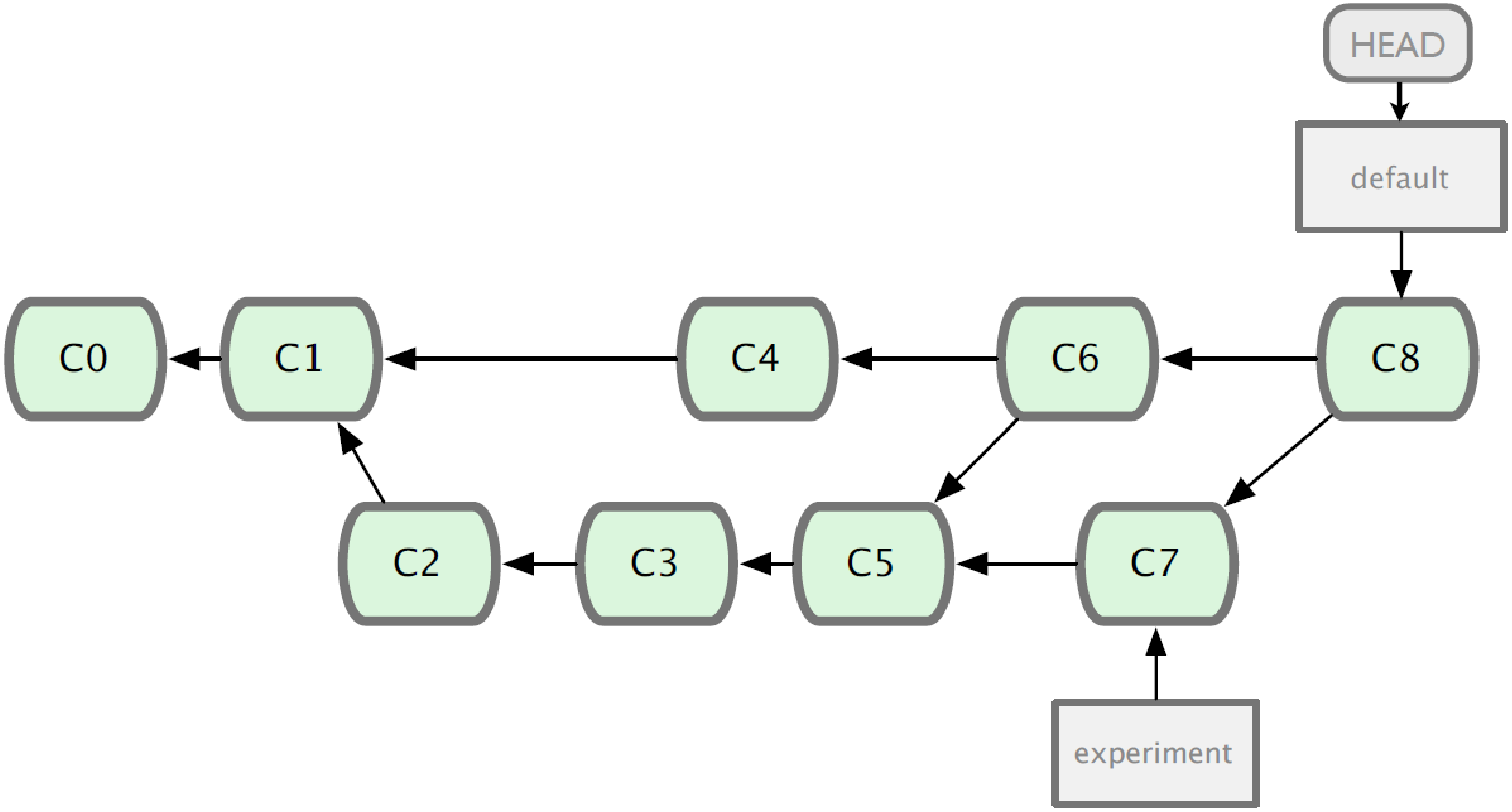
git checkout experiment



git commit



git checkout default



git merge experiment

Branching and Merging

- Why this is cool?
  - Non-linear development

```
clone the code that is in production
create a branch for issue #53 (iss53)
work for 10 minutes
someone asks for a hotfix for issue #102
checkout ‘production’
create a branch (iss102)
fix the issue
checkout ‘production’, merge ‘iss102’
push ‘production’
checkout ‘iss53’ and keep working
```

Working with remote

- Use git clone to replicate repository
- Get changes with
  - git fetch
  - git pull (fetches and merges)
- Propagate changes with
  - git push

- Protocols
  - Local filesystem (file://)
  - SSH (ssh://)
  - HTTP (http:// https://)
  - Git protocol (git://)

Working with remote Local filesystem

- Pros
  - Simple
  - Support existing access control
  - NFS enabled

- Cons
  - Public share is difficult to set up
  - Slow on top of NFS

Working with remote SSH

- Pros
  - Support authenticated write access
  - Easy to set up as most system provide ssh toolsets
  - Fast
    - Compression before transfer
- Cons
  - No anonymous access
    - Not even for read access

Working with remote GIT

- Pros
  - Fastest protocal
  - Allow public anonymous access
- Cons
  - Lack of authentication
  - Difficult to set up
  - Use port 9418
    - Not standard port
    - Can be blocked

Working with remote HTTP/HTTPS

- Pros
  - Very easy to set up
  - Unlikely to be blocked
    - Using standard port
- Cons
  - Inefficient

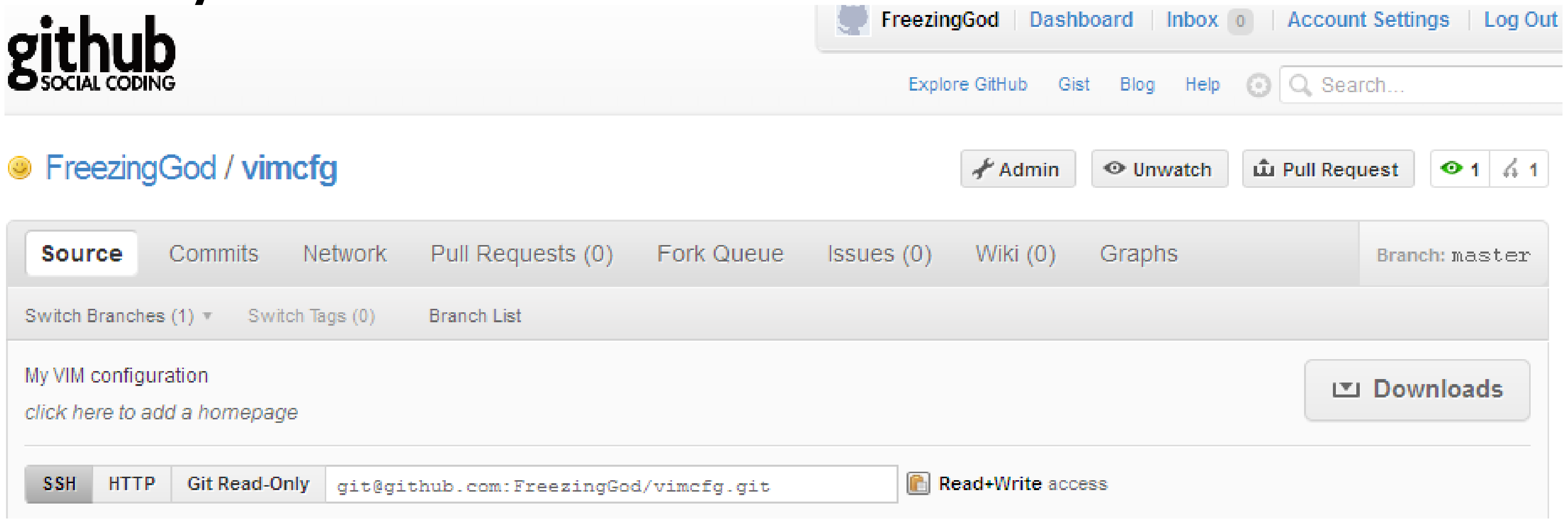
Working with remote

- One person project
  - Local repo is enough
  - No need to bother with remote

- Small team project
  - SSH write access for a few core developers
  - GIT public read access

Working with remote

- Use git remote add to add an remote repository


github SOCIAL CODING
FreezingGod | Dashboard | Inbox 0 | Account Settings | Log Out
Explore GitHub Gist Blog Help Search...
Admin
Unwatch
Pull Request
1
1
Source Commits Network Pull Requests (0) Fork Queue Issues (0) Wiki (0) Graphs
Branch: master
Switch Branches (1) Switch Tags (0) Branch List
Downloads
SSH HTTP Git Read-Only

FreezingGod / vimcfg

My VIM configuration

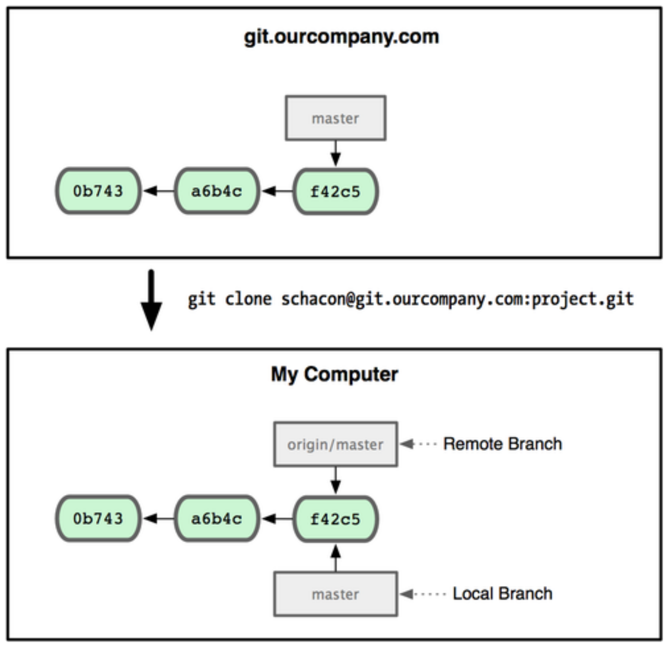
click here to add a homepage

git@github.com:FreezingGod/vimcfg.git Read+Write access

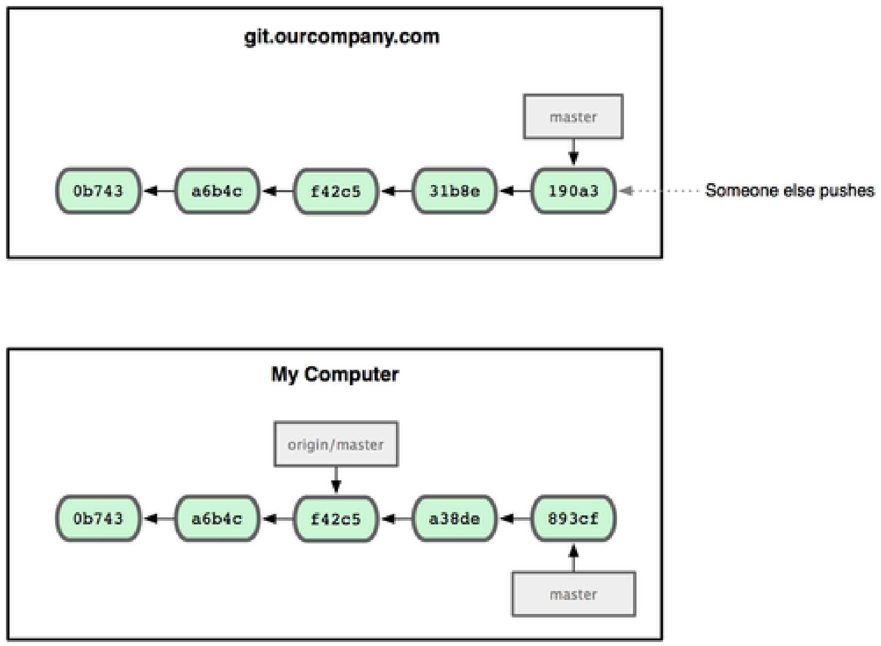
```
Git remote add origin git@github.com:FreezingGod/vimcfg.git
zachary@zachary-desktop:~/.vim_runtime$ git remote
origin
```

Working with remote

- Remote branching
  - Branch on remote are different from local branch

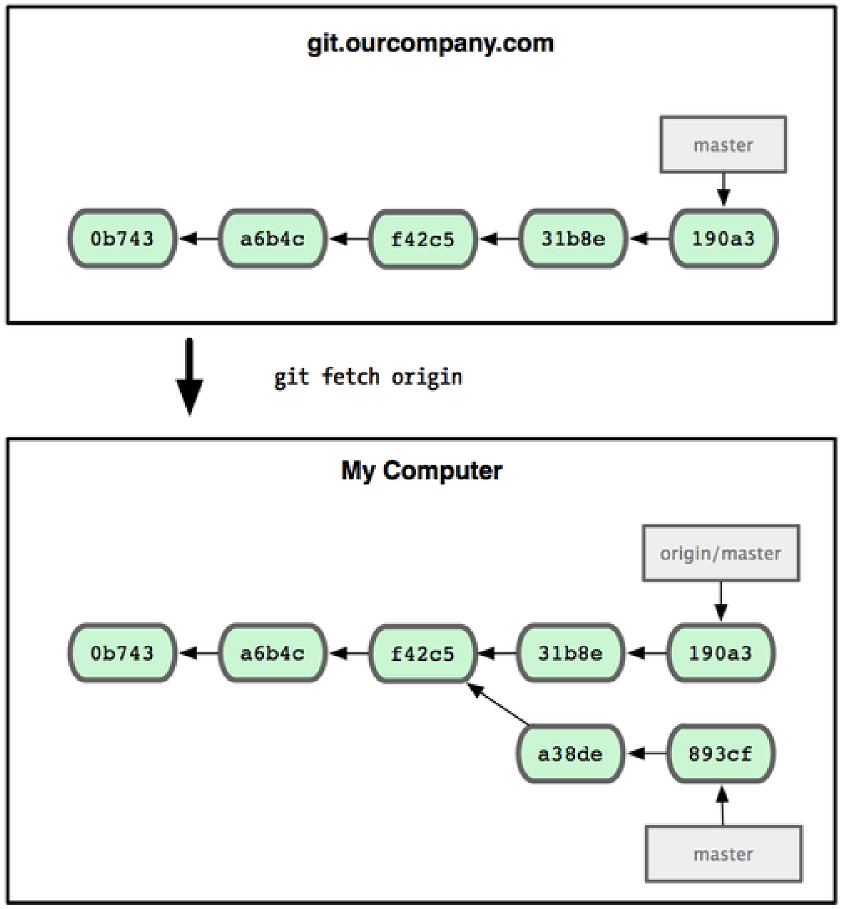


```
git clone schacon@git.ourcompany.com:project.git
```



Working with remote

- Remote branching
  - Branch on remote are different from local branch
  - Git fetch origin to get remote changes
  - Git pull origin try to fetch reomte changes and merge it onto current branch



Working with remote

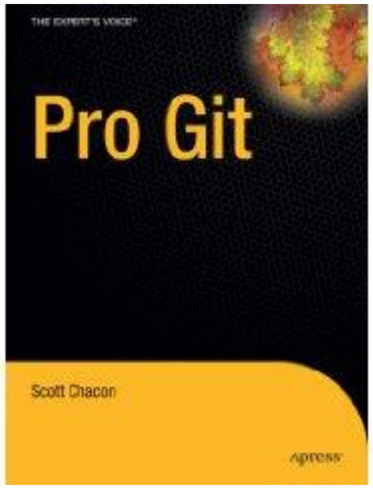
- Git push remote_name branch_name
  - Share your work done on branch_name to remote remote_name

Summary

- We covered fundamentals of Git
  - Three trees of git
    - HEAD, INDEX and working directory
  - Basic work flow
    - Modify, stage and commit cycle
  - Branching and merging
    - Branch and merge
  - Remote
    - Add remote, push, pull, fetch
  - Other commands
    - Revert change, history view

Summary

- However, this is by no means a complete portray of git, some advanced topics are skipped:
  - Rebasing
  - Commit amend
  - Distributed workflow
- For more information, consult
  - Official document
  - Pro Git
    - Free book available at http://progit.org/book/



Q&A

- Any questions?

References

- Some of the slides are adopted from "Introduction to Git" available at http://innovationontherun.com/presentation-files/Introduction%20To%20GIT.ppt
- Some of the figure are adopted from Pro GIT by Chacon, which is available at http://progit.org/book/
- Some of the slides are adopted from "Git 101" available at http://assets.en.oreilly.com/1/event/45/Git%20101%20Tutorial%20Presentation.pdf