

# git Tutorial

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Based on talk by Emanuele Olivetti [https://github.com/emanuele/introduction\\_to\\_Git](https://github.com/emanuele/introduction_to_Git)



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# Motivation to use Version Control

## Problem 1

“Help! my code worked yesterday, but I can’t recall what I changed.”

- ▶ track modifications
- ▶ access old version

## Problem 2

“We would like to work together, but we don’t know how!”

- ▶ concurrent editing
- ▶ merging
- ▶ development versions

# Outline

## Introduction

### Single developer + local repository

Demo/Exercise: single+local

### Multiple developers + remote central repository

Demo/Exercise: multi+remote/central

## Behind the Scenes

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## Behind the Scenes

# Survey: Version Control

- ▶ Q1: Have you heard about *version control*?
- ▶ Q2: Do you use a version control software (cvs, svn, hg, bzd, git)?
- ▶ Q3: How much experience do you have with git?

# Survey: Version Control

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- ▶ Q3: How much experience do you have with git?

# Survey: Version Control

- ▶ Q1: Have you heard about *version control*?
- ▶ Q2: Do you use a version control software (cvs, svn, hg, bzd, git)?
- ▶ Q3: How much experience do you have with git?

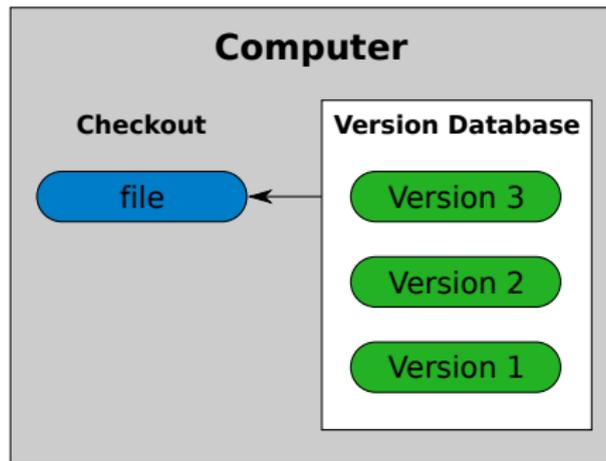
# Uses for git

“*Version control* is a system that records changes to a file or set of files over time so that you can recall specific versions later.”

– <https://git-scm.com/book>

- ▶ checkpoints/backups/releases
- ▶ document developer effort
- ▶ collaboration across the globe
  
- ▶ for anything that's text
  - ▶ code
  - ▶ thesis/papers
  - ▶ system config files ([vcsh](#))
  
- ▶ ... and everything else ( "[gitify your life](#)", [git-annex](#) )

## Version Control: Local

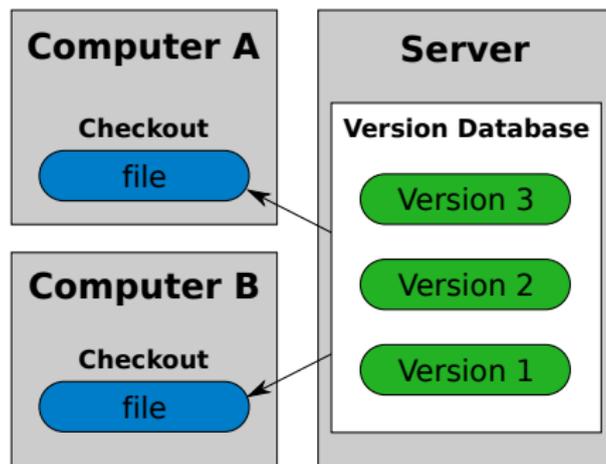


checkout working directory

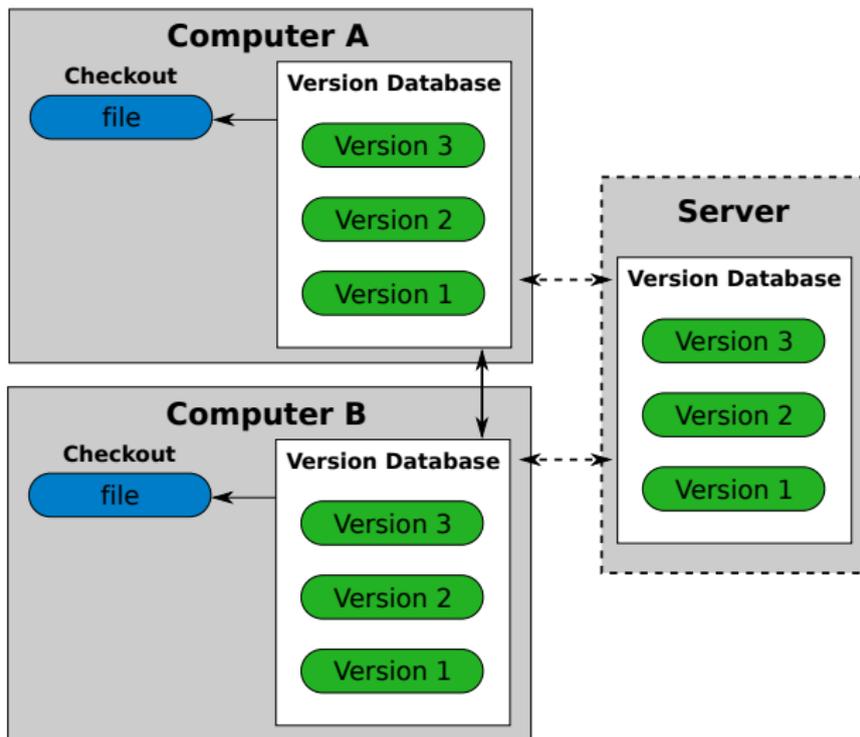
version database repository

There is always only one version of a file present in the working directory. Version Control allows you to change that file to different versions stored in the repository.

# Version Control: Central



# Version Control: Distributed



# git: Help

```
usage: git [...]
       <command> [<args>]
```

These are common Git commands used in various situations:

[...]

'git help -a' and 'git help -g' list available subcommands and some concept guides. See 'git help <command>' or 'git help <concept>' to read about a specific subcommand or concept.

## The Glossary

git help glossary explains many words that might be puzzling to new users..

## git: Introduce yourself

```
git config --global user.name "Nicola Chiapolini"
```

```
git config --global user.email "nchiapol@physik.uzh.ch"
```

# Outline

Introduction

**Single developer + local repository**

Demo/Exercise: single+local

Multiple developers + remote central repository

Demo/Exercise: multi+remote/central

Behind the Scenes

## single+local: Init

```
git init
```

- ▶ Creates an empty git repository.
- ▶ Creates the git directory: `.git/`
- ▶ Your prompt may change.  
(If you added `$(__git_ps1)`)



- ▶ does not change your files

## single+local: Init

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git init
```

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- ▶ Your prompt may change.  
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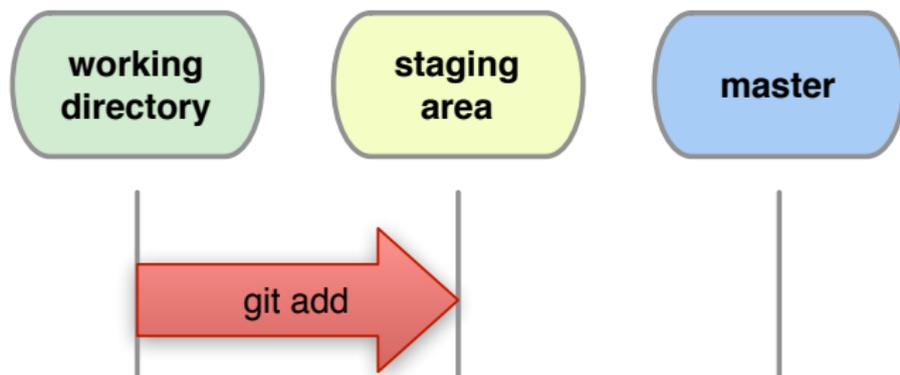


- ▶ does not change your files

## single+local: Add

```
git add file1 [file2 ...]
```

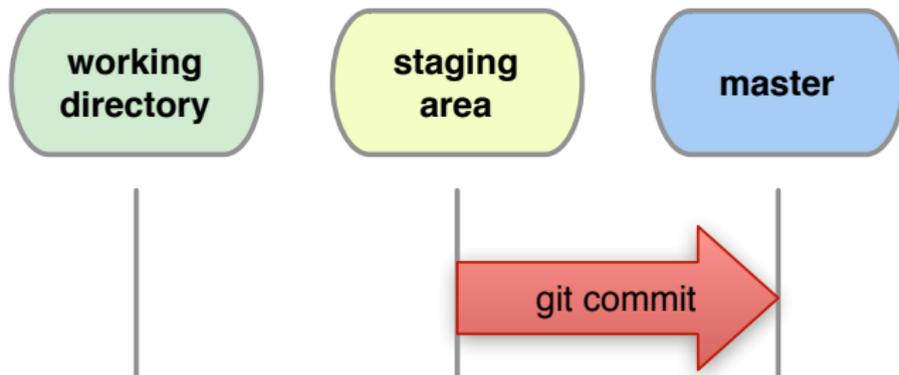
- ▶ Adds new files to be tracked by git
- ▶ Adds changes from working dir for next commit (**Confusion!**)
- ▶ DOES NOT add info on file permissions other than *exec/noexec*
- ▶ DOES NOT add directories *per se*.



## single+local: Commit

```
git commit [-m "Commit message."]
```

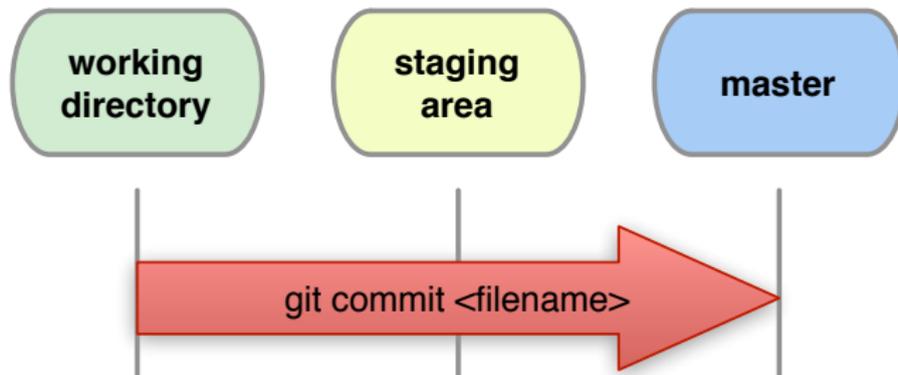
Records changes from the staging area to master.



## single+local: Direct Commit

```
git commit file1 file2 [-m "Commit message."]
```

Records all changes of `file1`, `file2` from working dir and staging area to master.



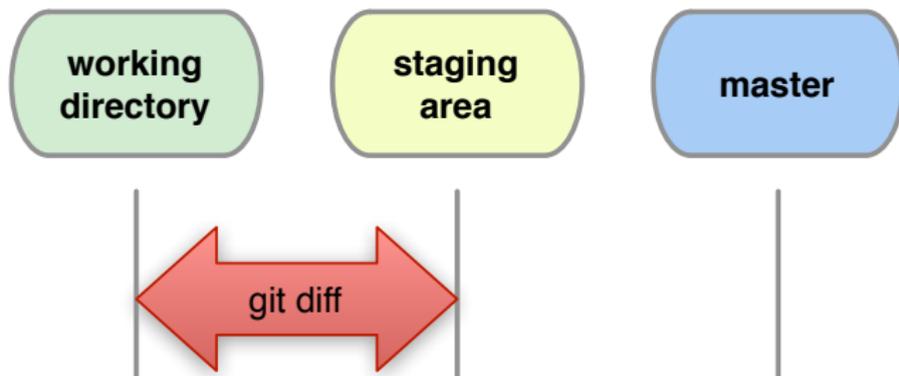
```
git commit -a[m "Commit message."]
```

Records all changes in working dir and staging area. *Be Careful!*

## single+local: Diff

```
git diff [filename|...]
```

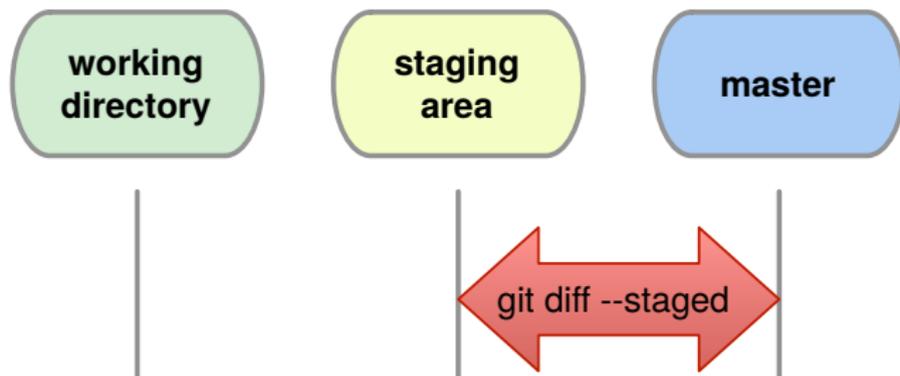
Shows changes between *working directory* and *staging area*



## single+local: Diff Staged

How do I see what is staged?

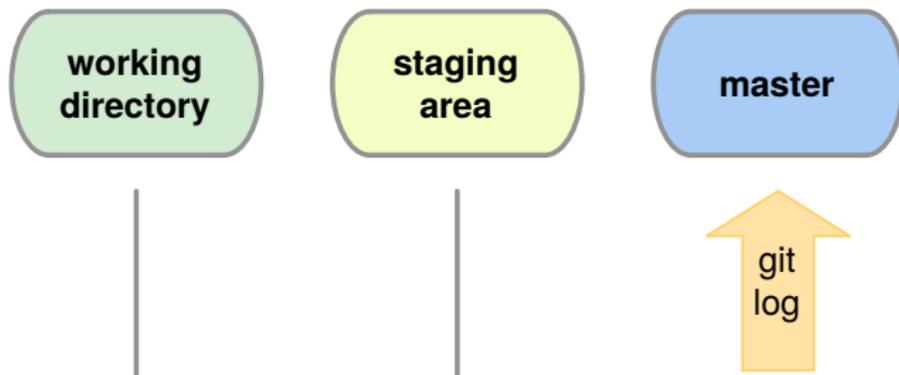
`git diff --staged` shows differences between staging area and last commit.



## single+local: Commit History

```
git log [--oneline] [--patch] [--graph] [file|branch]
```

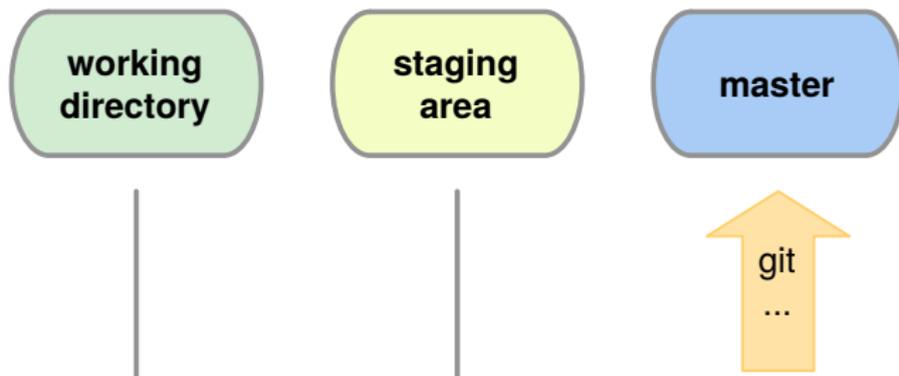
Shows the history of a file or branch.



## single+local: Old Changes

```
git diff <commit A> <commit B>  
git show <commit>
```

Shows the changes stored in commits.



# single+local: Graphic Logs

qgit (or gitg or ...)

GUI to browse the git repository.

The screenshot shows the qgit interface. On the left, a graphical diff view displays colored lines representing file changes. The main window shows a commit log entry:

```

Merge rsync://rsync.kernel.org/pub/scm/linux/kernel/git/g
Merge rsync://rsync.kernel.org/pub/scm/linux/kernel/git/g
[PATCH] USB: fdi_sio: avoid losing received data in tty-
[PATCH] USB: fix ub issues
[PATCH] PCI Hotplug: fix CPCI reference counting bug
[A64] Fix race condition in the rt_sigprocmask fastcall
Merge master.kernel.org:/home/rmk/linux-2.6-arm
[PATCH] sg traverse fix for __ata_pi_bytes()
[PATCH] sata_sil: Fix FIFO PCI Bus Arbitration kernel oo
[PATCH] ARM: Remove zero-byte sized file
Merge rsync://rsync.kernel.org/pub/scm/linux/kernel/git/daven
[PKT_SCHED]: Fix numeric comparison in meta ematch
  
```

Below the log, the SHA1 ID is displayed as `9f793d2c77ec5818679e4747c554d9333cec4f46`. The commit details show:

```

Author: Pete Zaitcev <zaitcev@redhat.com> 2005-06-06 14:54:59
Committer: Greg Kroah-Hartman <gregkh@suse.de> 2005-06-09 02:38:11

[PATCH] USB: fix ub issues

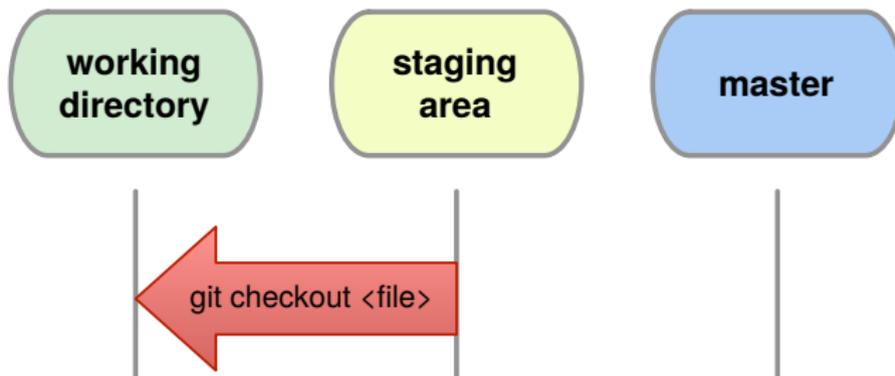
This smoothes two imperfections:
- Increase number of LUNs per device from 4 to 9. The best solution
  would be to remove this limit altogether, but that has to wait until
  the time when more than 26 hosts are allowed.
- Replace mdelay with msleep in a probing routine.

Signed-off-by: Pete Zaitcev <zaitcev@yahoo.com>
Signed-off-by: Greg Kroah-Hartman <gregkh@suse.de>
  
```

On the right side, a file browser shows the path `drivers/block/ub.c`.

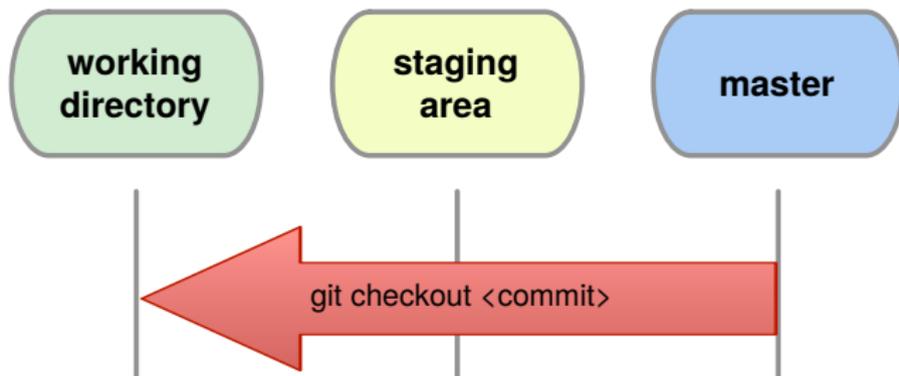
## single+local: Changing Version

```
git checkout <file|commit>
```



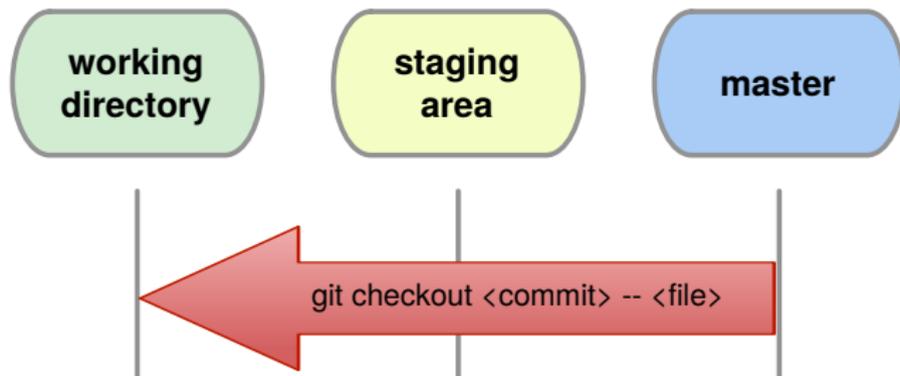
## single+local: Changing Version

```
git checkout <file|commit>
```



## single+local: Changing Version

```
git checkout <commit> -- <file>
```



**Warning:** The old file is immediately staged for the next commit.

## single+local: (Re)move.

**Warning:** whenever you want to *remove*, *move* or *rename* a tracked file use git:

```
git rm <filename>
```

```
git mv <oldname> <newname>
```

Remember to `commit` these changes!

```
git commit -m "File (re)moved."
```

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### Multiple developers + remote central repository

Demo/Exercise: multi+remote/central

## Behind the Scenes

# Outline

Introduction

Single developer + local repository

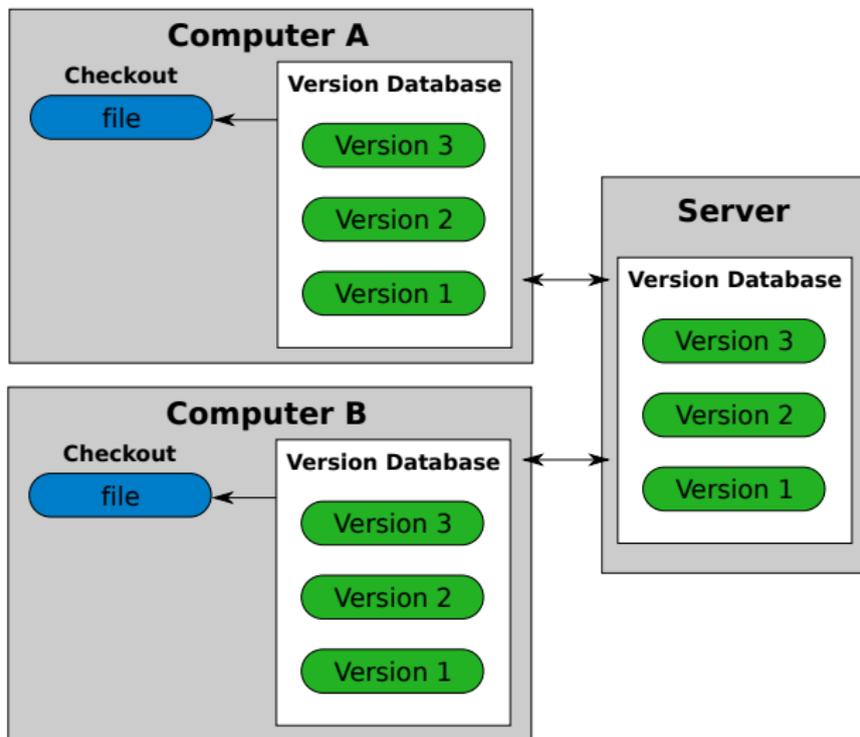
Demo/Exercise: single+local

Multiple developers + remote central repository

Demo/Exercise: multi+remote/central

Behind the Scenes

# multi+remote/central: Setup

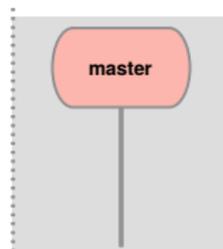


## multi+remote/central: Clone

```
git clone <URL>
```

Creates **two** local copies of the **whole** remote repository.

**Remote (Server)**



**Version Database**

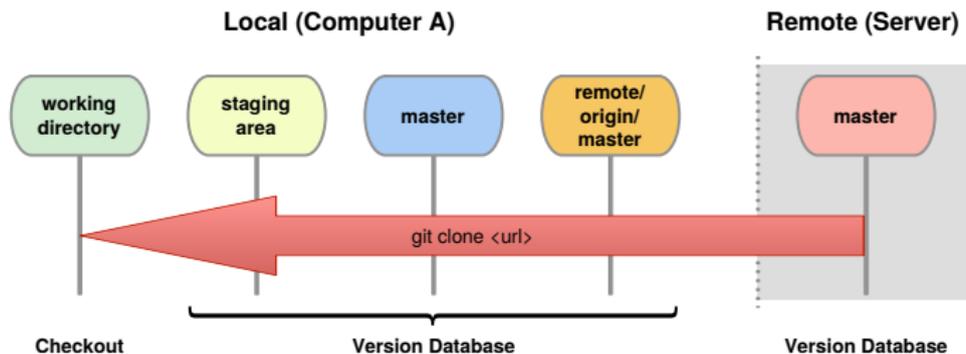
### Hint

`git remote -v` shows **name** and URL of the remote repository.

## multi+remote/central: Clone

```
git clone <URL>
```

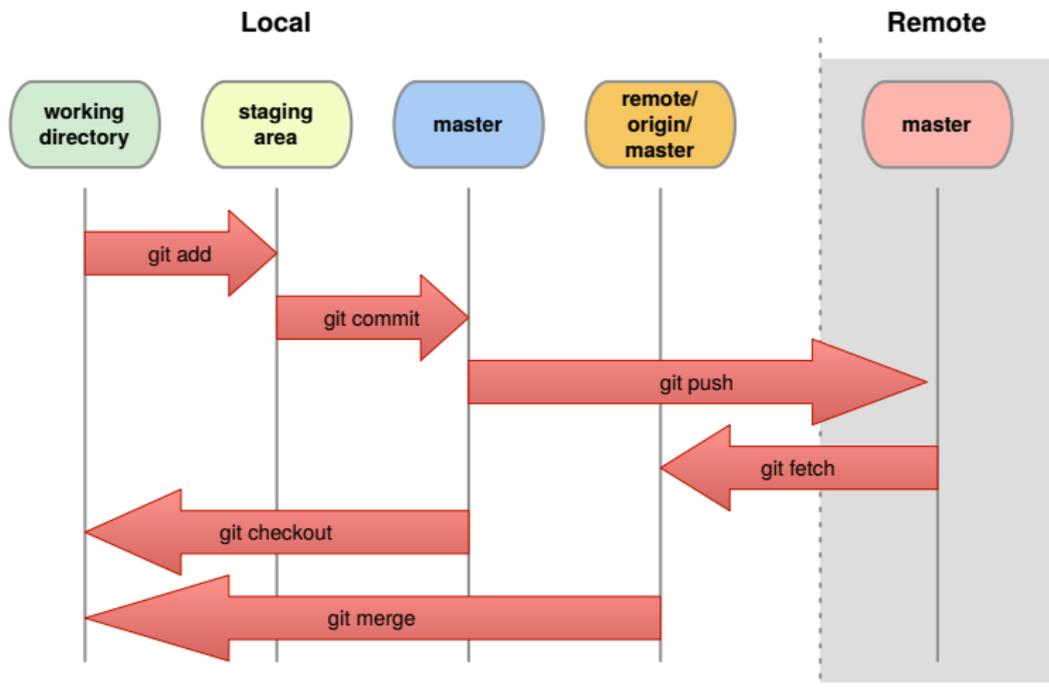
Creates **two** local copies of the **whole** remote repository.



### Hint

`git remote -v` shows **name** and URL of the remote repository.

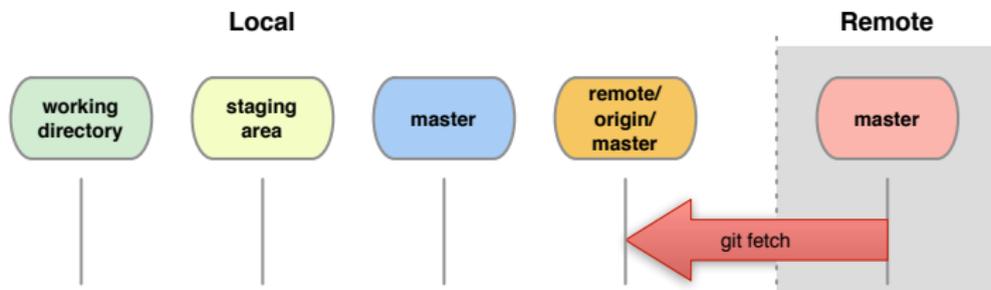
# multi+remote/central: Commands



## multi+remote/central: Fetch

```
git fetch
```

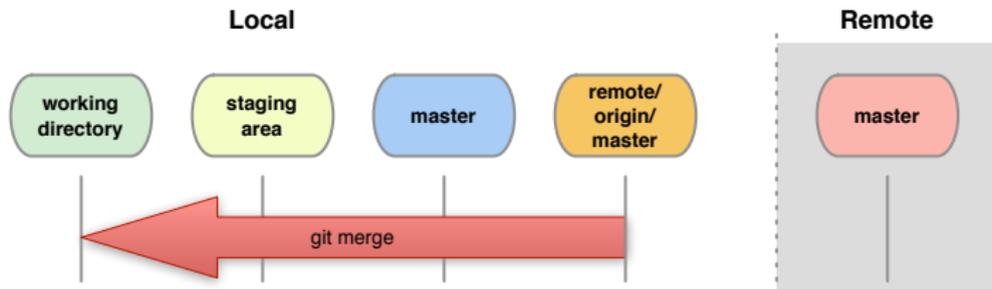
- ▶ Updates origin master from remote master
- ▶ local master, staging area and working dir not changed



## multi+remote/central: Merge

```
git merge
```

- ▶ combines changes from both sources
- ▶ **Warning**: can generate *conflicts*!



```
git fetch + git merge = git pull
```

## multi+remote/central: Conflicts

### Conflict!

```
...
<<<<<< yours:sample.txt
Conflict resolution is hard;
let's go shopping.
=====
Git makes conflict resolution easy.
>>>>>> theirs:sample.txt
...
```

## multi+remote/central: Resolving Conflicts

1. See where conflicts are:

```
git diff
```

2. Edit conflicting lines.

3. Add changes to the staging area:

```
git add file1 [...]
```

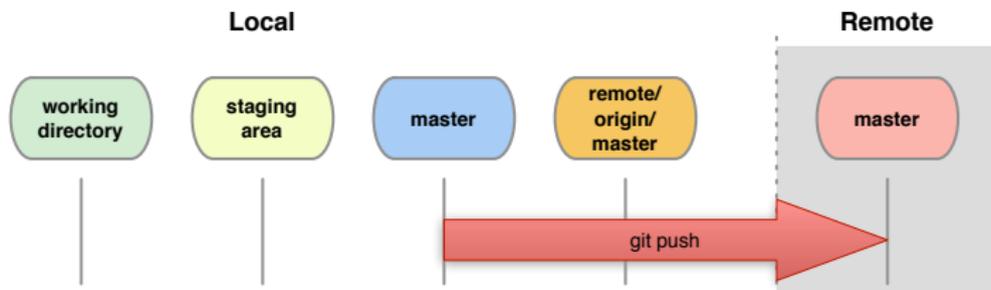
4. Commit changes:

```
git commit -m "Conflicts solved."
```

## multi+remote/central: Push

```
git push
```

- ▶ Updates *remote master*.
- ▶ Requires `fetch+merge` first.



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Behind the Scenes

## Lessons Learned

- ▶ pushing to a central server can be problematic  
→ a setup where everybody pulls can help here
- ▶ be careful, what you commit  
(no `git add *`)

## Reference: Setting up a central remote repository.

access to repository via `ssh`

On *remote* server create **bare+shared** repository:

- ▶ `mkdir newproject`
- ▶ set up proper *group* permissions: `chmod g+rws newproject`
- ▶ `cd newproject`
- ▶ `git --bare init --shared=group`

Everybody clones:

```
git clone ssh://remote.example.com/path/newproject
```

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## Behind the Scenes: Setup

```
git init; git add [...]; git commit -m "A: init"
```

a

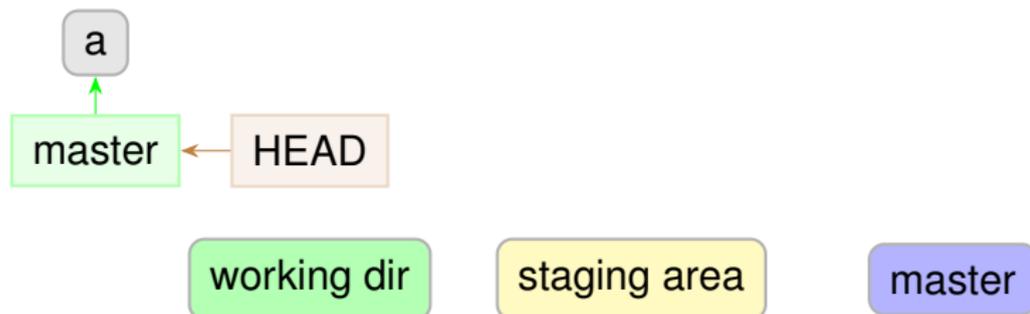
working dir

staging area

master

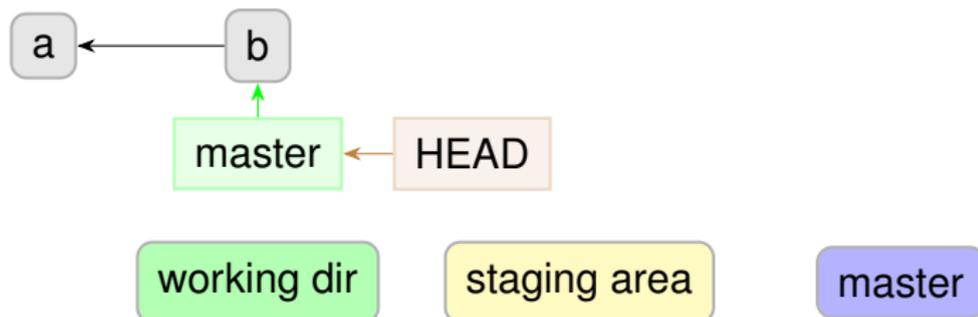
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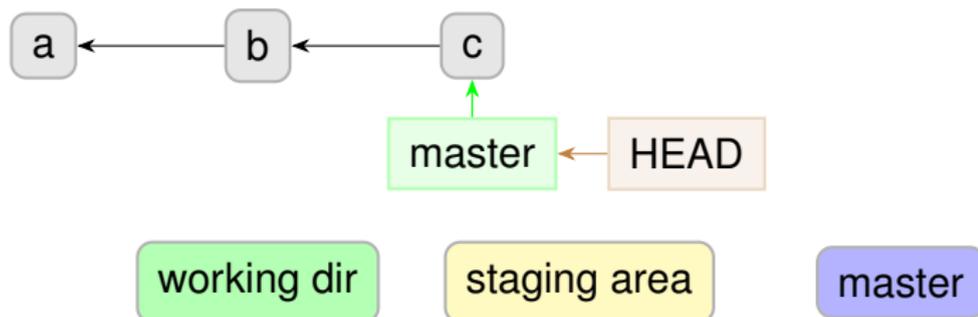
## Behind the Scenes: Setup

```
git commit -am "B"
```



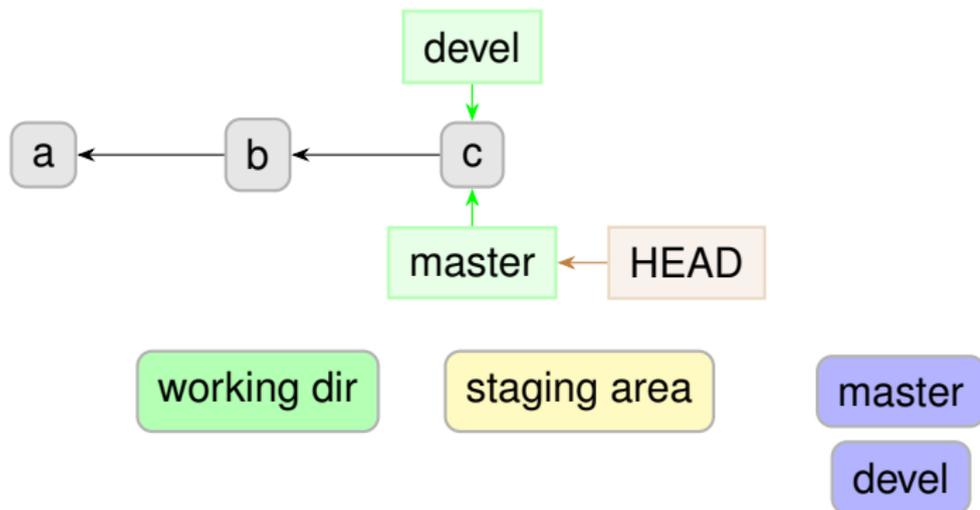
## Behind the Scenes: Setup

```
git commit -am "C"
```



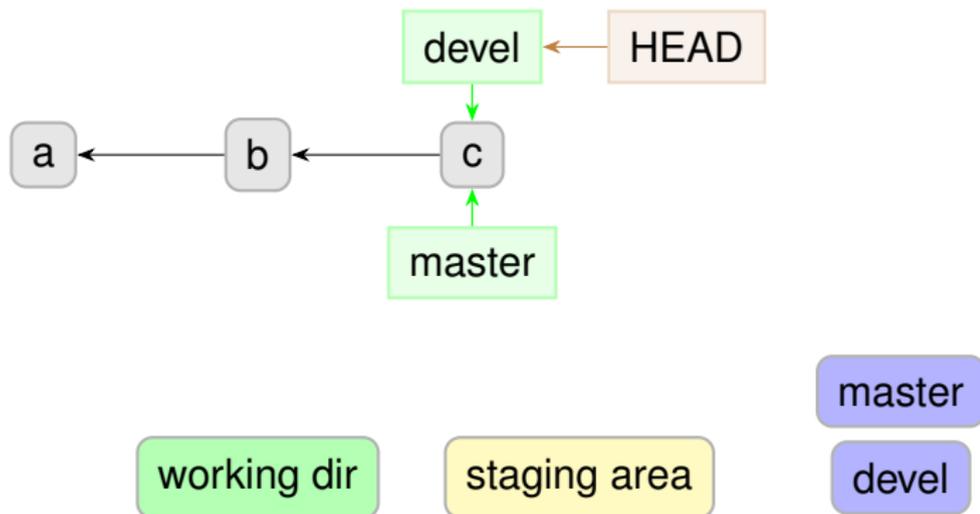
# Behind the Scenes: Branches

git branch devel



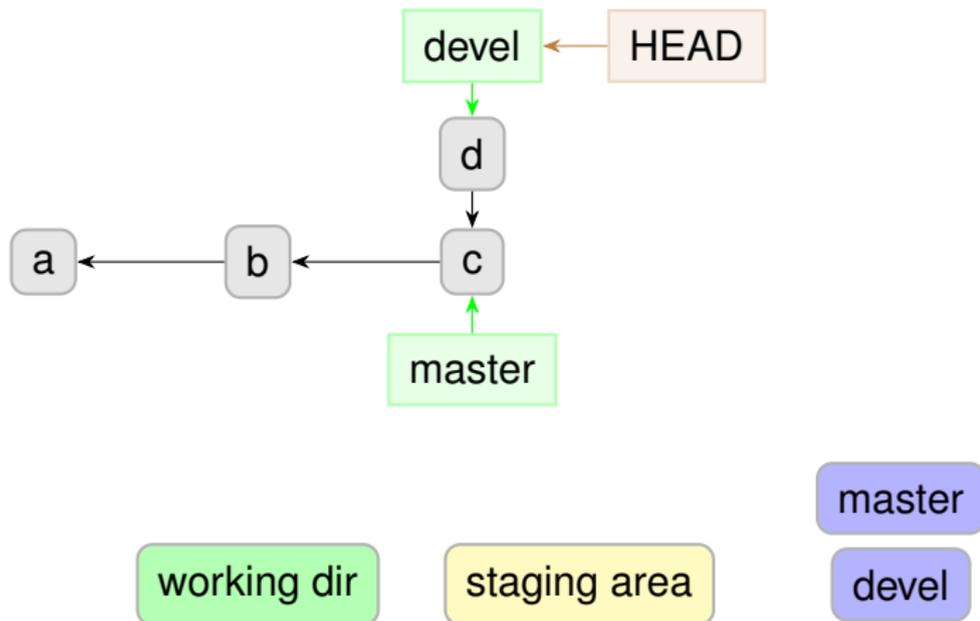
# Behind the Scenes: Branches

git checkout devel



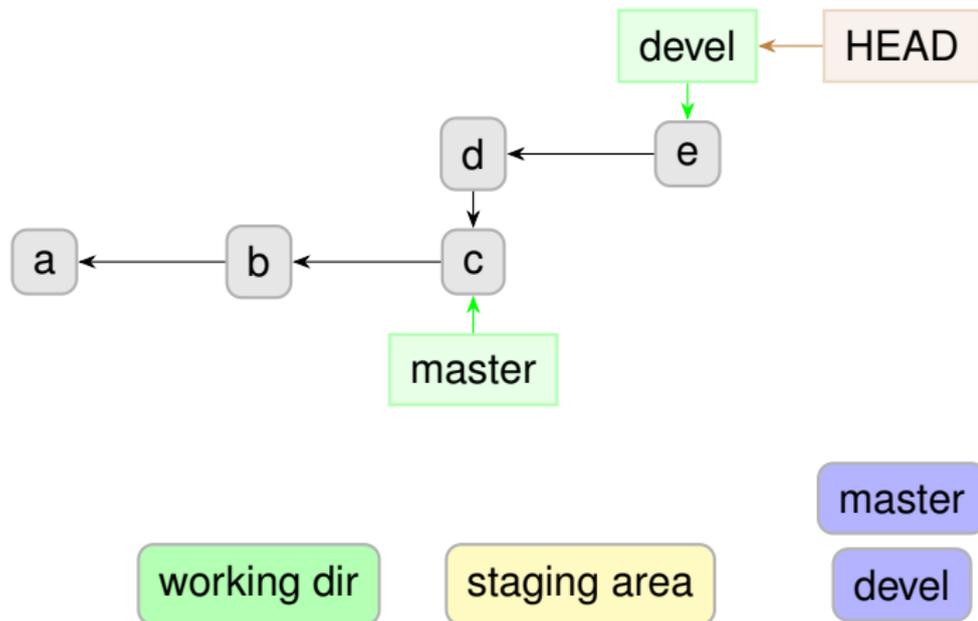
# Behind the Scenes: Branches

```
git commit -am "D"
```



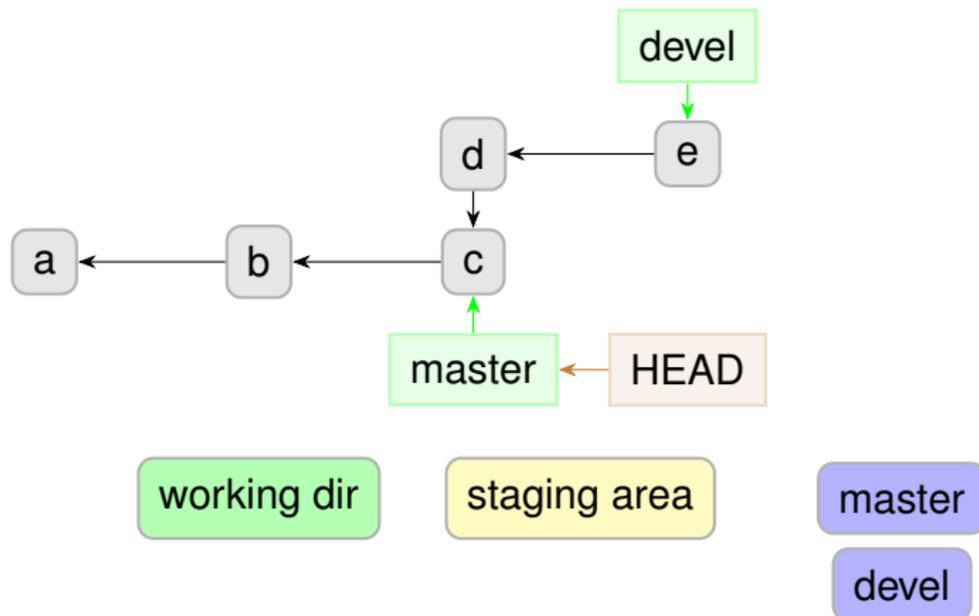
# Behind the Scenes: Branches

```
git commit -am "E"
```



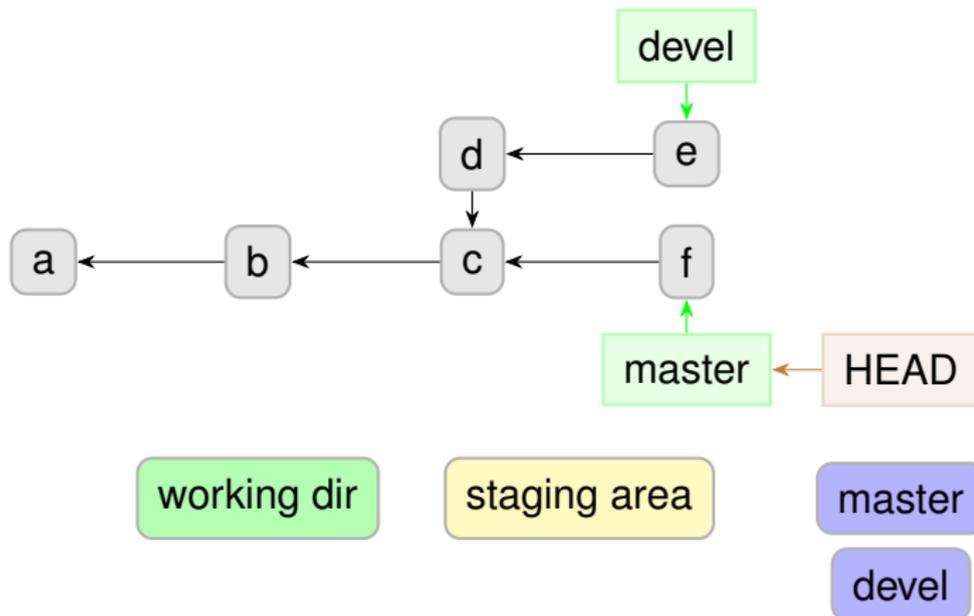
# Behind the Scenes: Branches

```
git checkout master
```



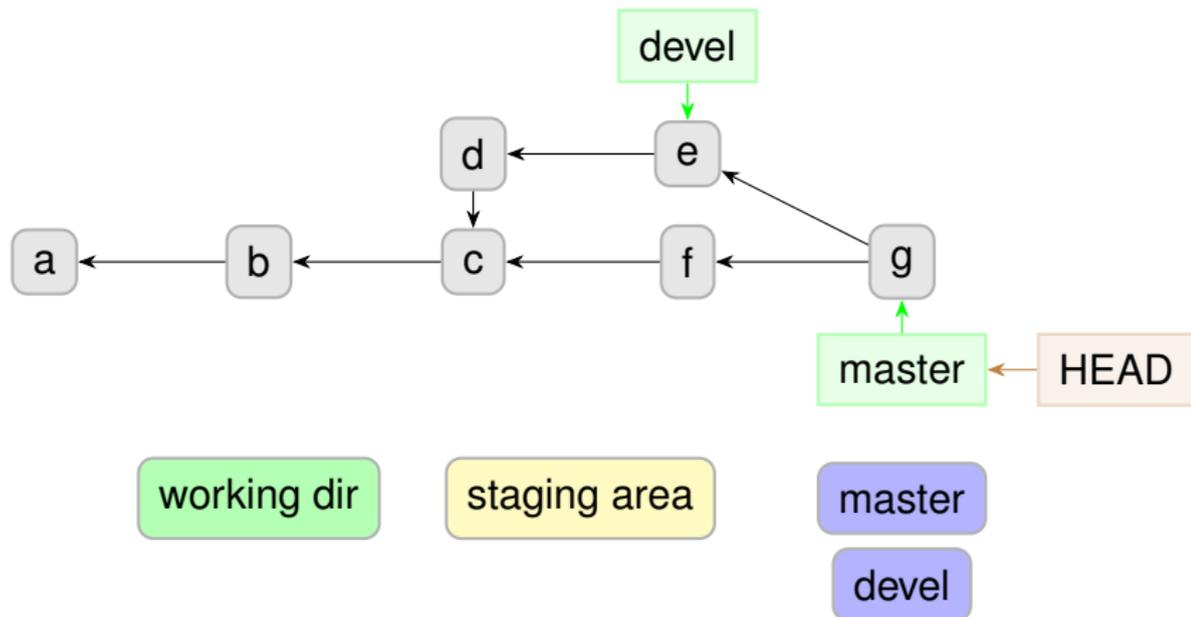
# Behind the Scenes: Branches

```
git commit -am "F"
```



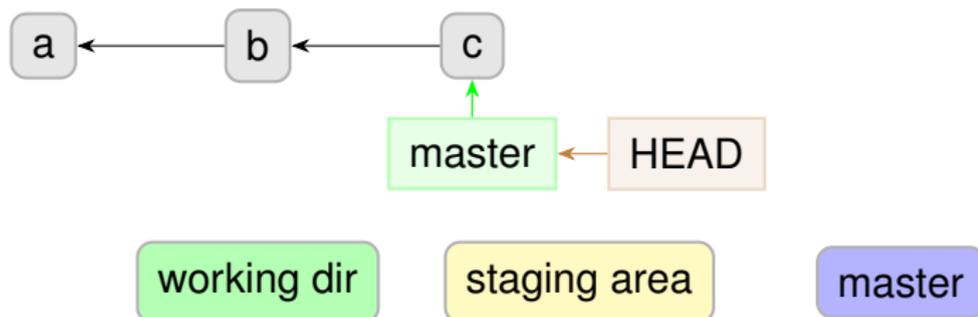
# Behind the Scenes: Branches

git merge devel



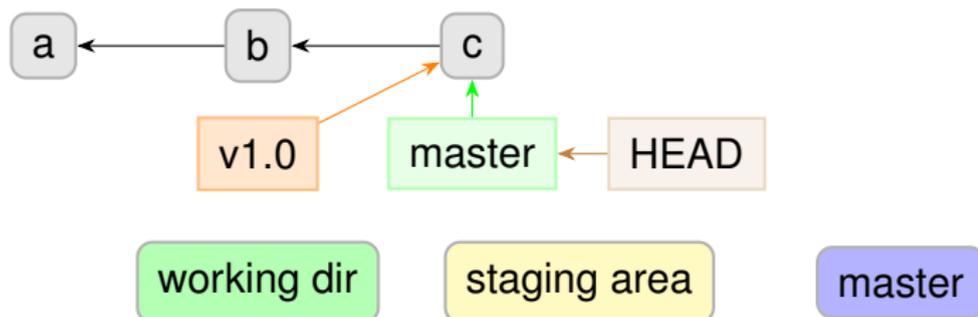
## Behind the Scenes: Setup

```
git commit -am "C"
```



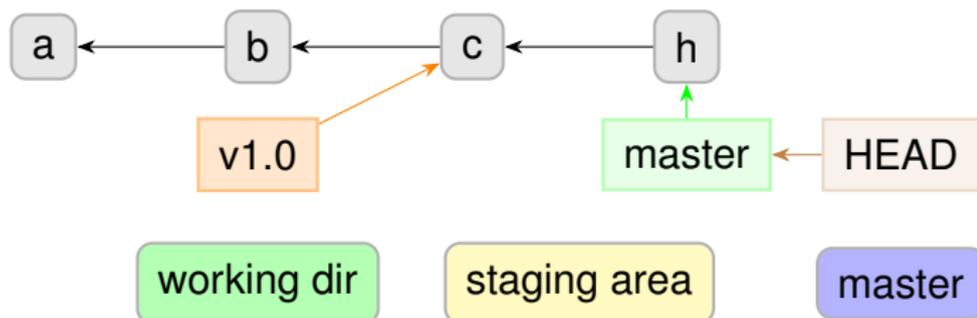
## Behind the Scenes: Tags

```
git tag [-m "my message"] v1.0
```



# Behind the Scenes: Tags

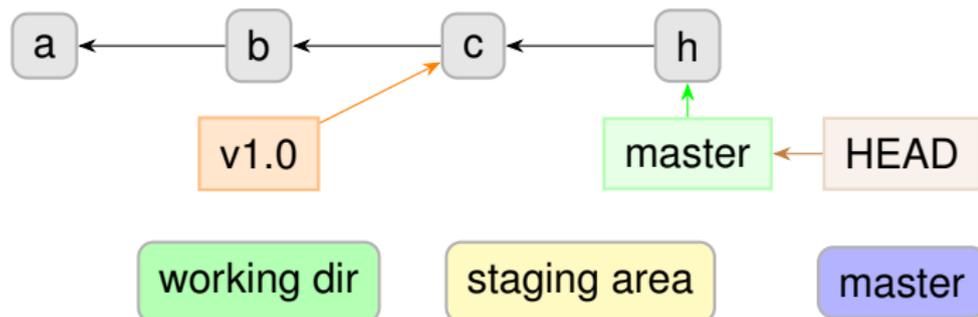
```
git commit -am "H"
```



## Behind the Scenes: Tags

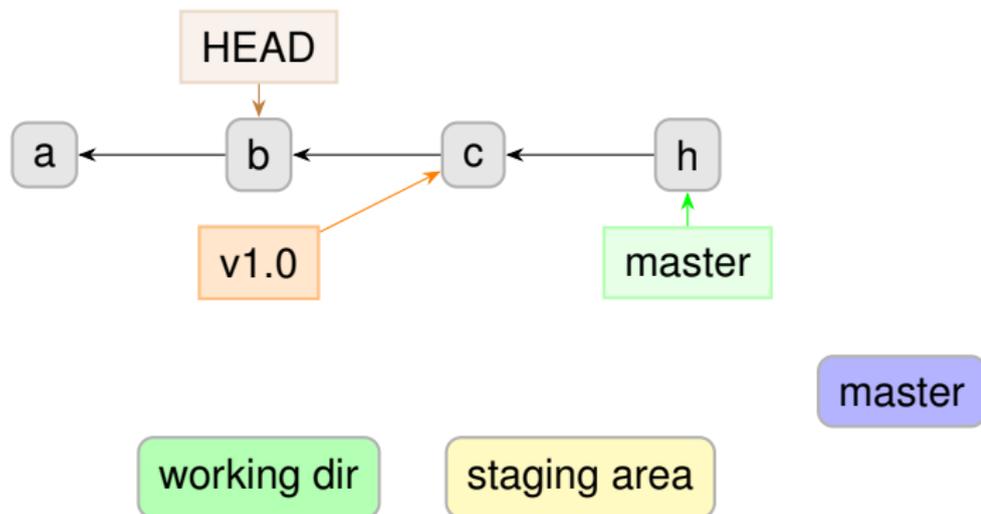
```
git commit -am "H"
```

to **share** tags: `git push origin <tag>` or `git push --tags`



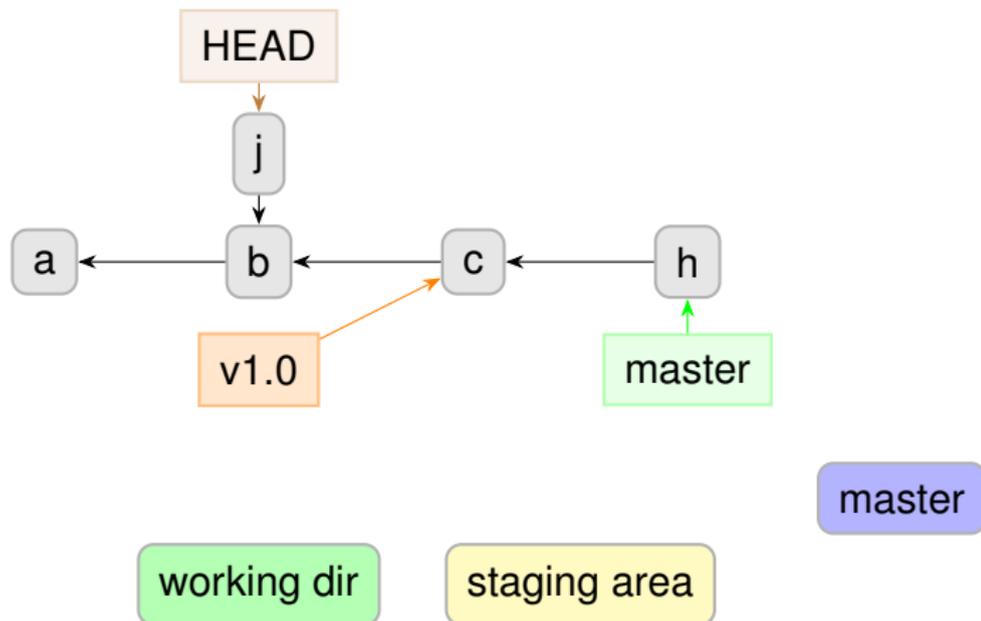
# Behind the Scenes: Detached HEAD

```
git checkout b
```



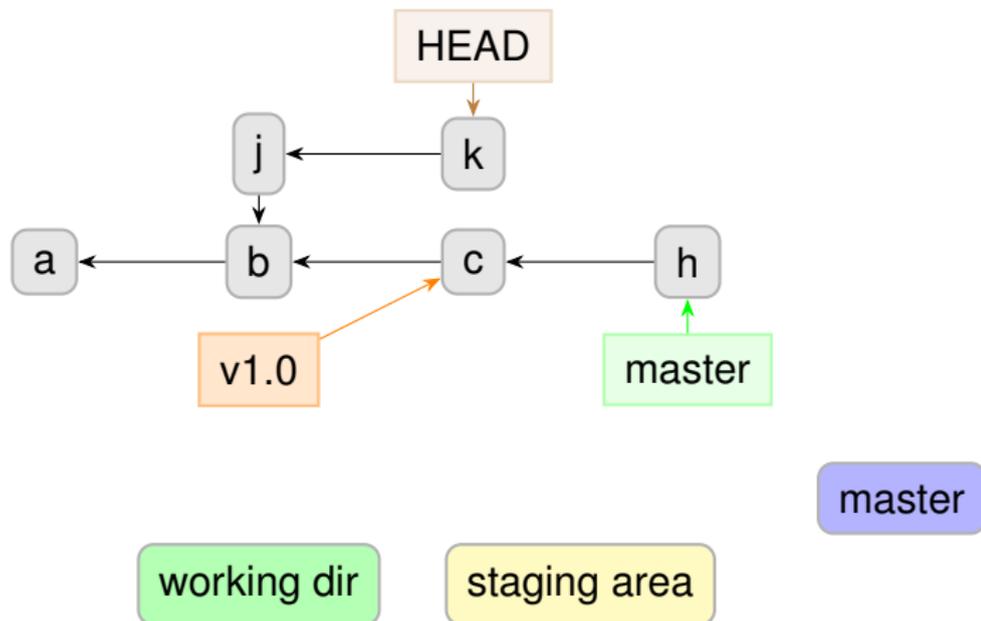
# Behind the Scenes: Detached HEAD

```
git commit -am "J"
```



# Behind the Scenes: Detached HEAD

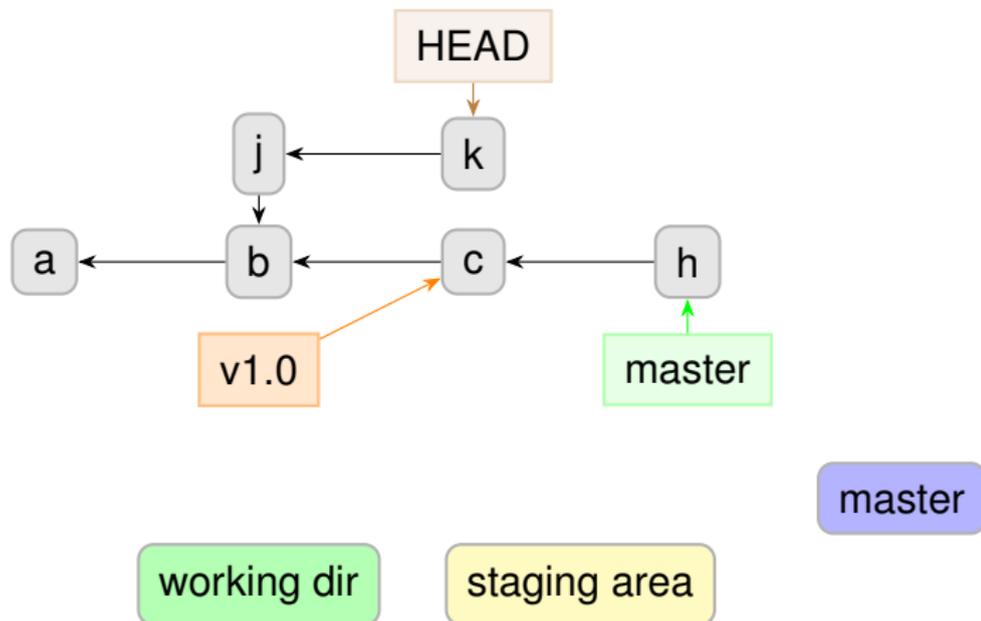
```
git commit -am "K"
```





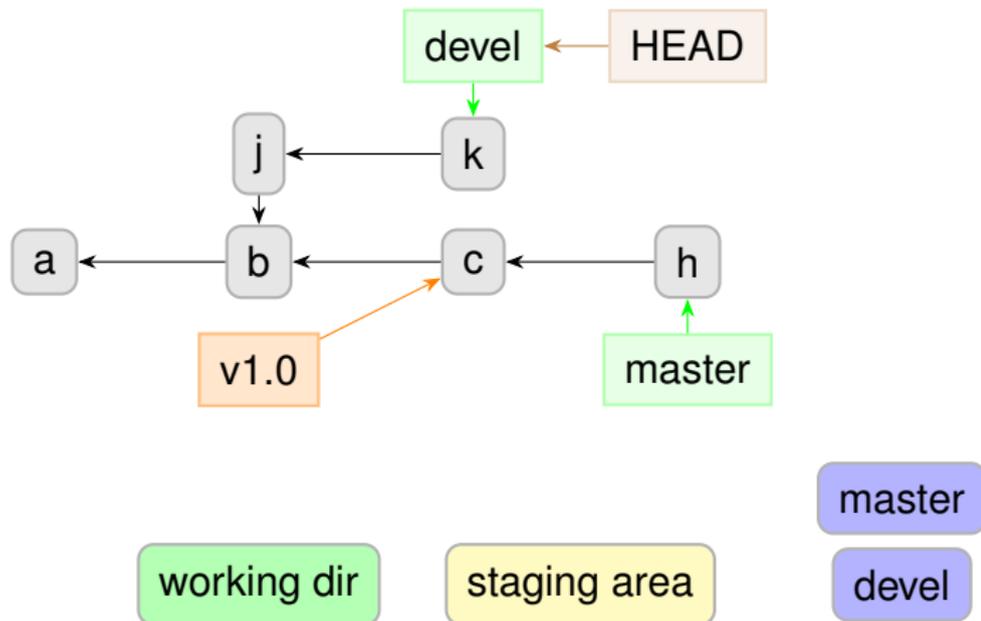
# Behind the Scenes: Detached HEAD

```
git commit -am "K"
```



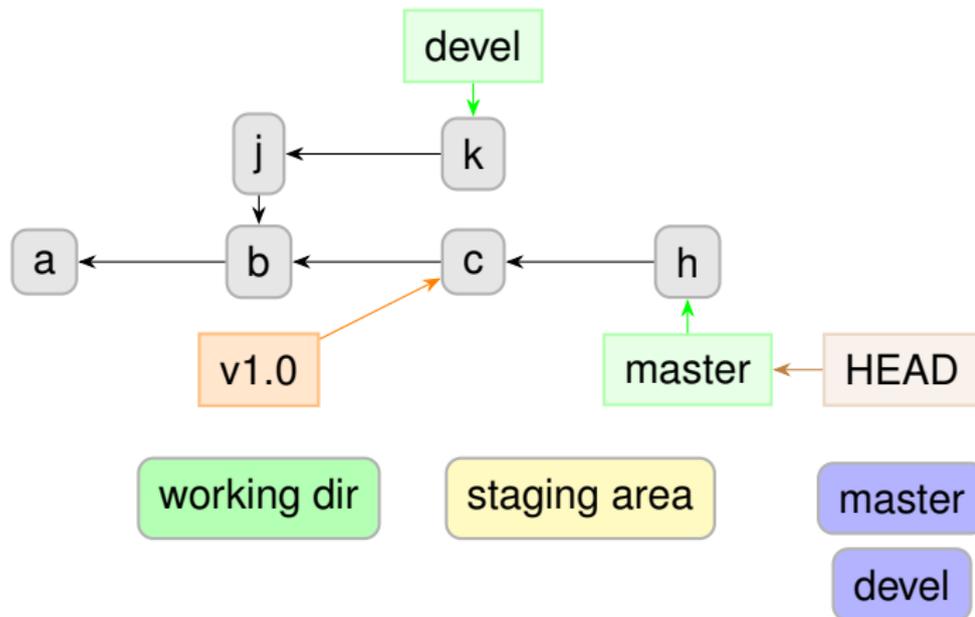
# Behind the Scenes: Detached HEAD

```
git checkout -b devel
```



# Behind the Scenes: Detached HEAD

git checkout master



# Questions?

Understanding how git works:

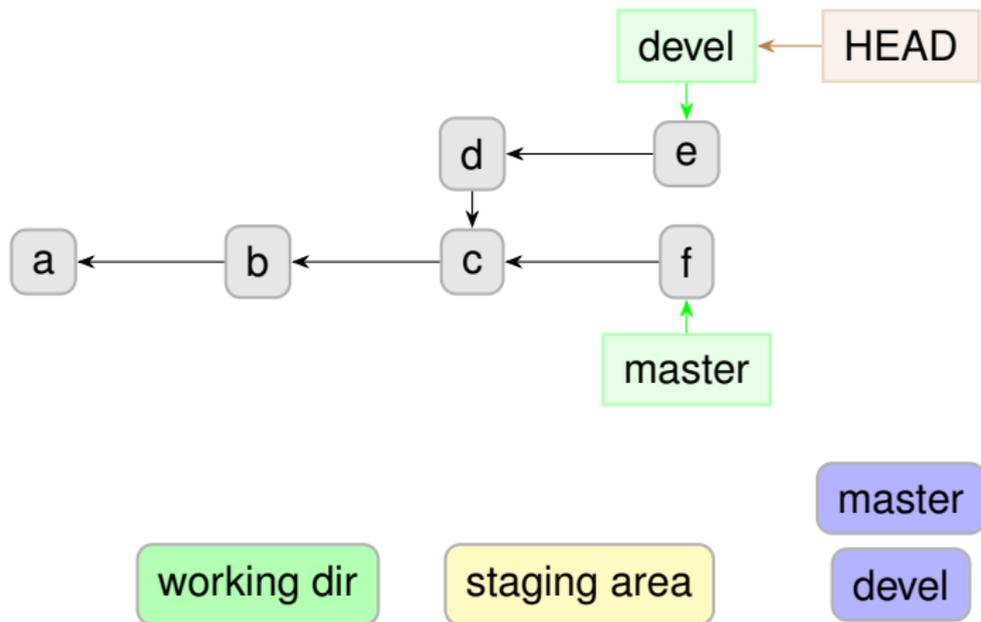
- ▶ git foundations, by Matthew Brett:  
<http://matthew-brett.github.io/pydagogue/foundation.html>
- ▶ The git parable, by Tom Preston-Werner: <http://tom.preston-werner.com/2009/05/19/the-git-parable.html>

Excellent guides:

- ▶ “Pro Git” book: <https://git-scm.com/book/en/v2> (FREE)
- ▶ git magic:  
<http://www-cs-students.stanford.edu/~blynn/gitmagic/>

# Behind the Scenes: Rebase

git checkout devel



# Behind the Scenes: Rebase

```
git rebase master
```

