git Tutorial

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Based on talk by Emanuele Olivetti https://github.com/emanuele/introduction_to_Git

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

Outline

Survey: Version Control

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

Survey: Version Control

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Survey: Version Control

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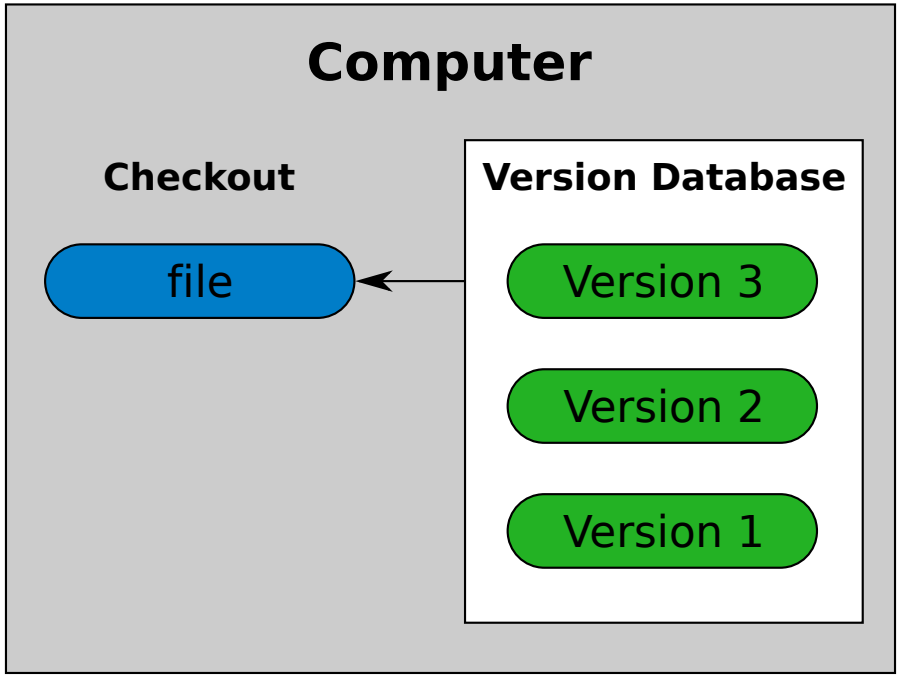
- Q3: How much experience do you have with git?

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)

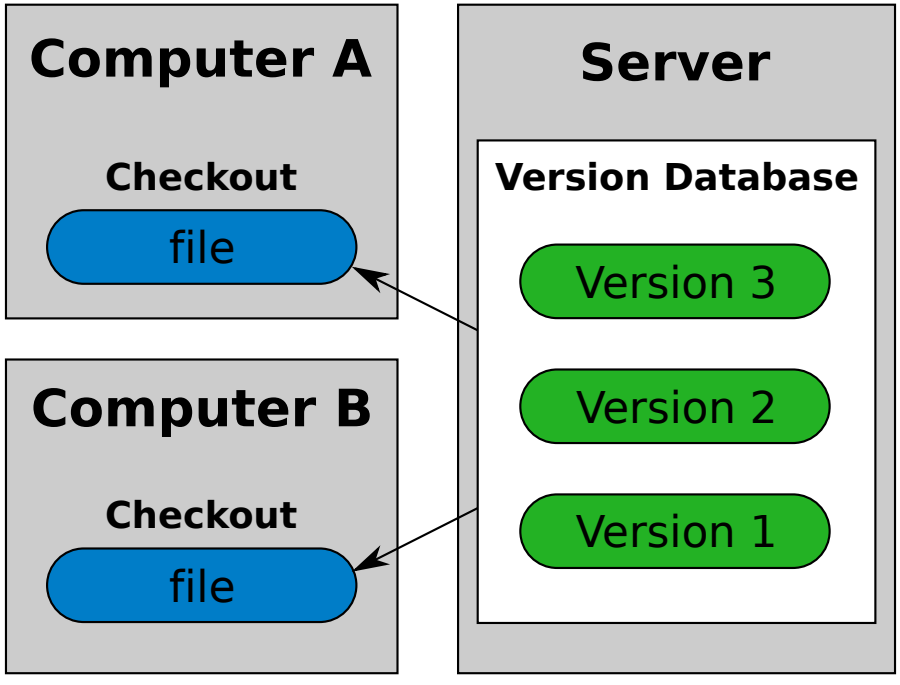
Version Control: Local



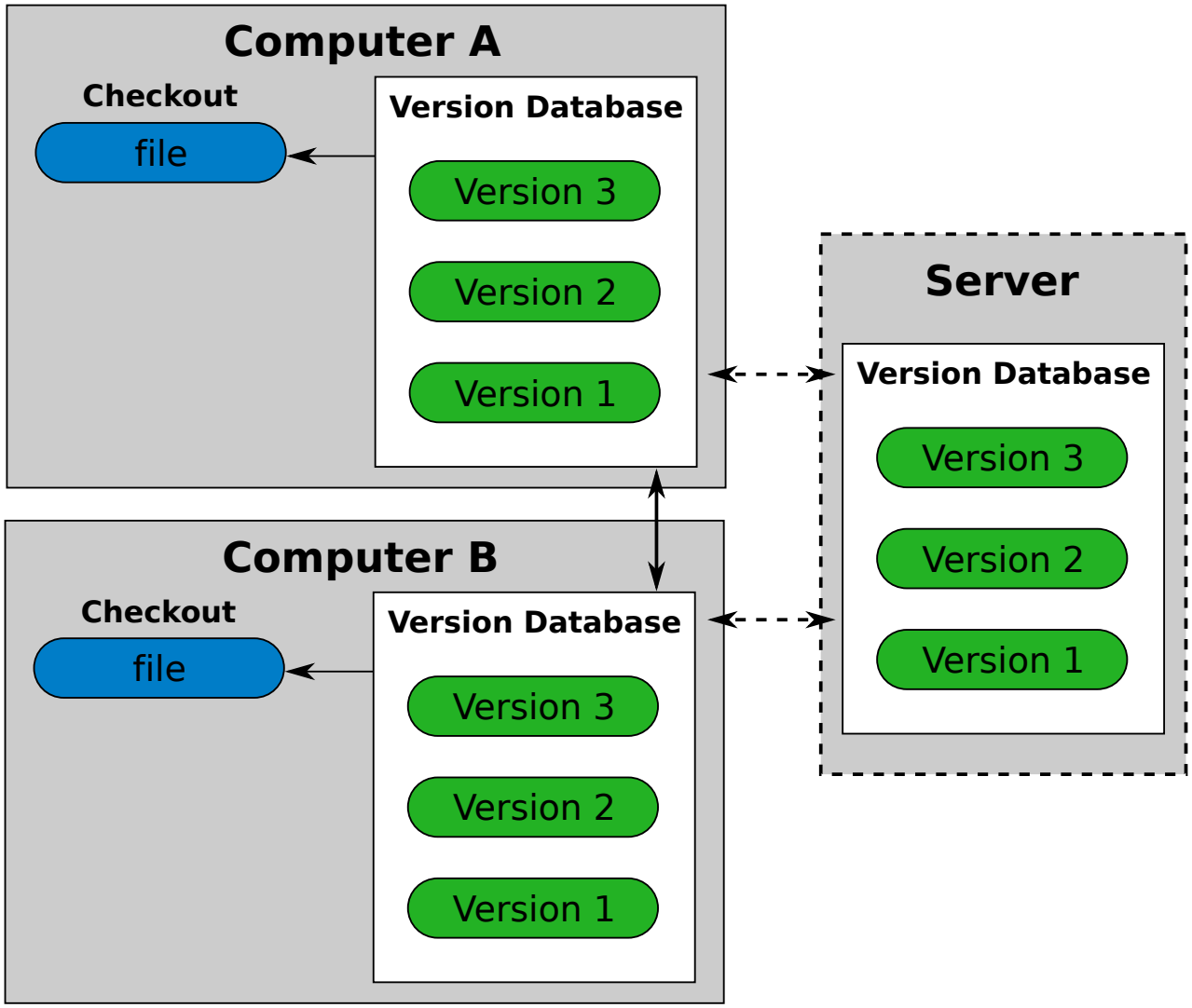
checkout working directory

version database repository

Version Control: Central



Version Control: Distributed



git: Help

```
usage: git [OPTIONS] COMMAND [ARGS]

The most commonly used git commands are:
   add         Add file contents to the index
   commit      Record changes to the repository
   diff        Show changes between commits, commit and working tree, etc
   ...
```

```
git help <command>
git help <concept>

git status
```

git: Introduce yourself

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

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

Outline

single+local: Init

```
git init
```

- Creates an empty git repository.
- Creates the git directory: `.git/`

- does not change your files

single+local: Init

```
git init
```

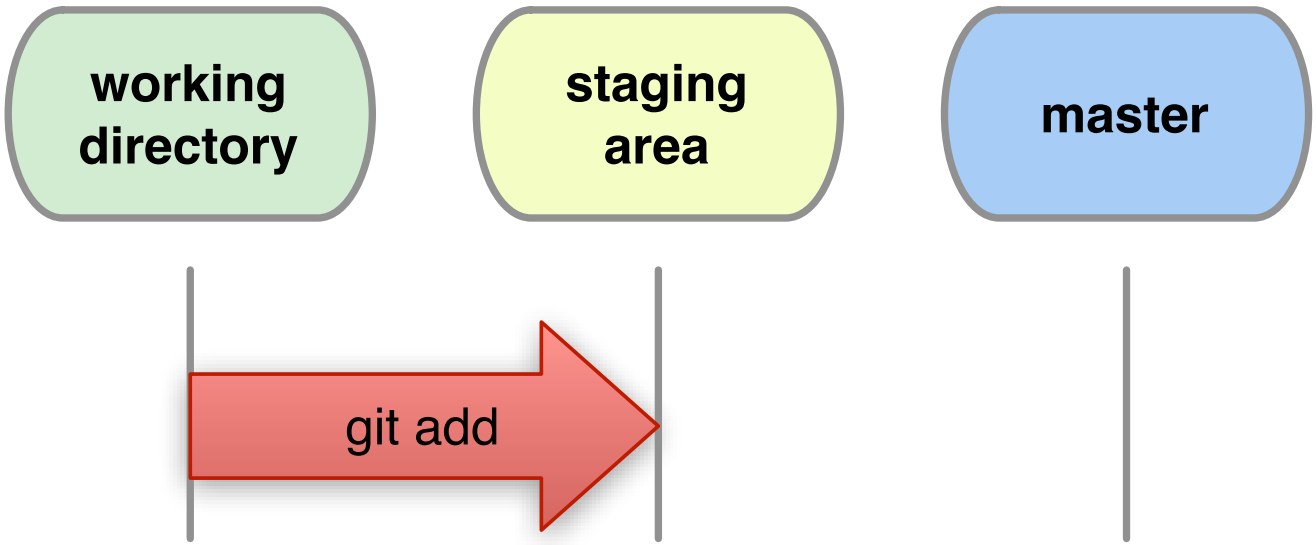
- Creates an empty git repository.
- Creates the git directory: `.git/`

- does not change your files

single+local: Add

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

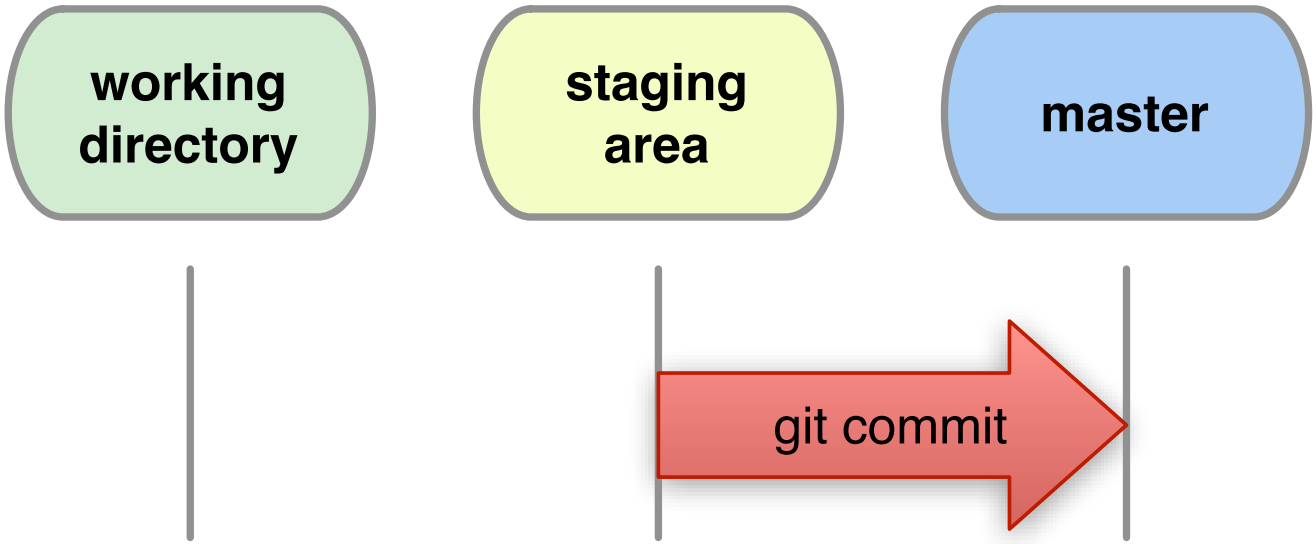
- Adds new files to be tracked by git
- Adds changes from working dir for next commit
- DOES NOT add info on file permissions other than *exec/noexec*
- DOES NOT add directories *per se*.



single+local: Commit

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

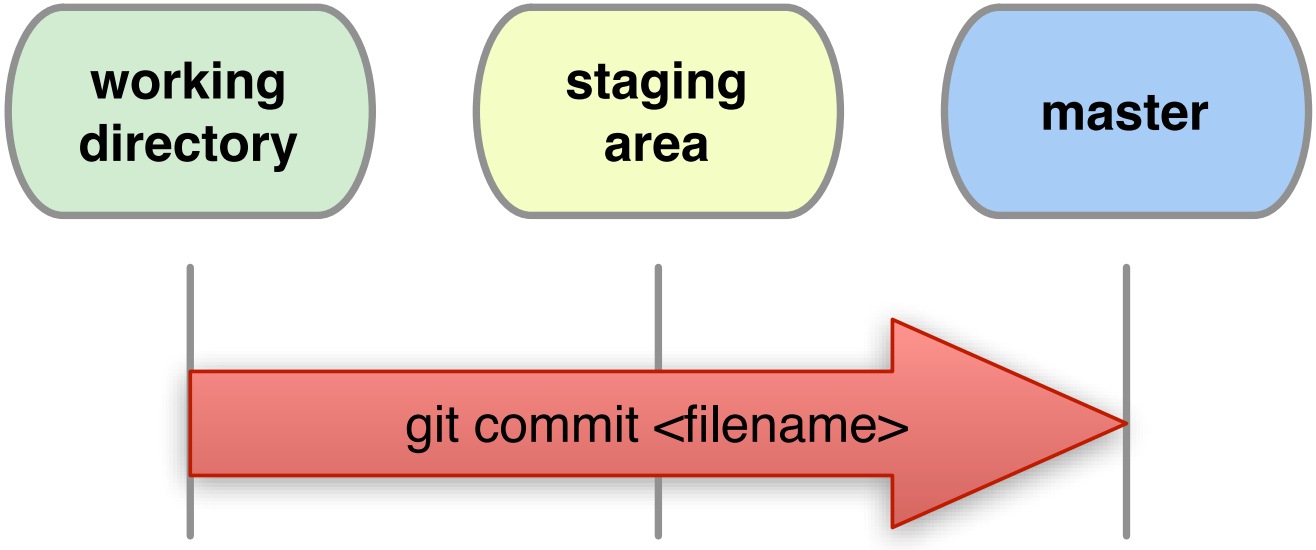
Records changes from the staging area to master.



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.



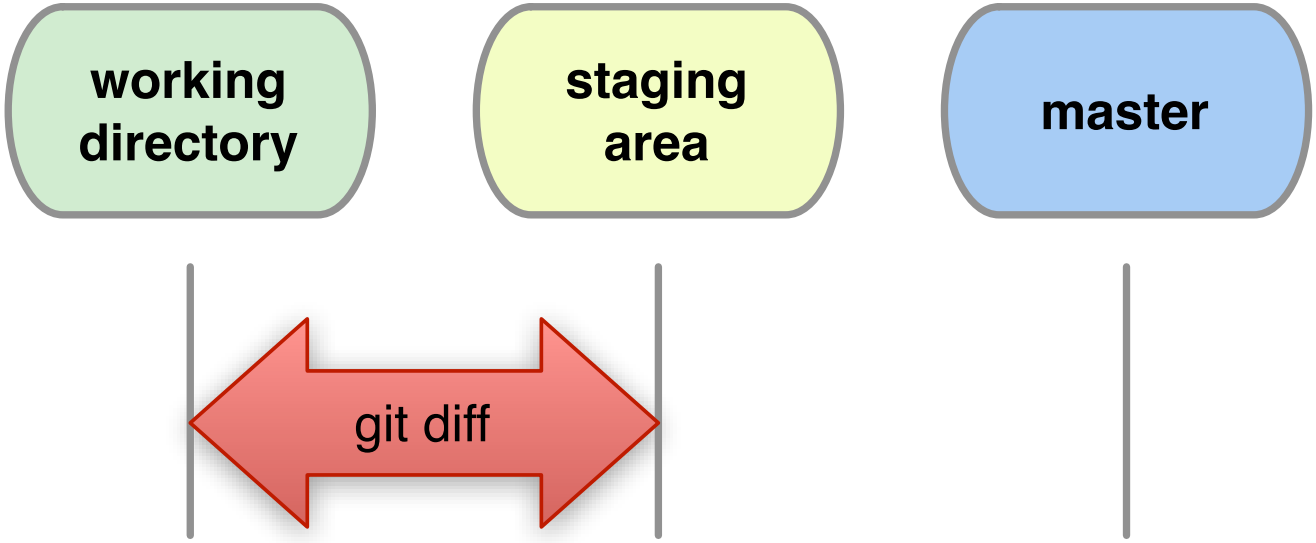

```
git commit -a[m "Commit message."]
```

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

single+local: Diff

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

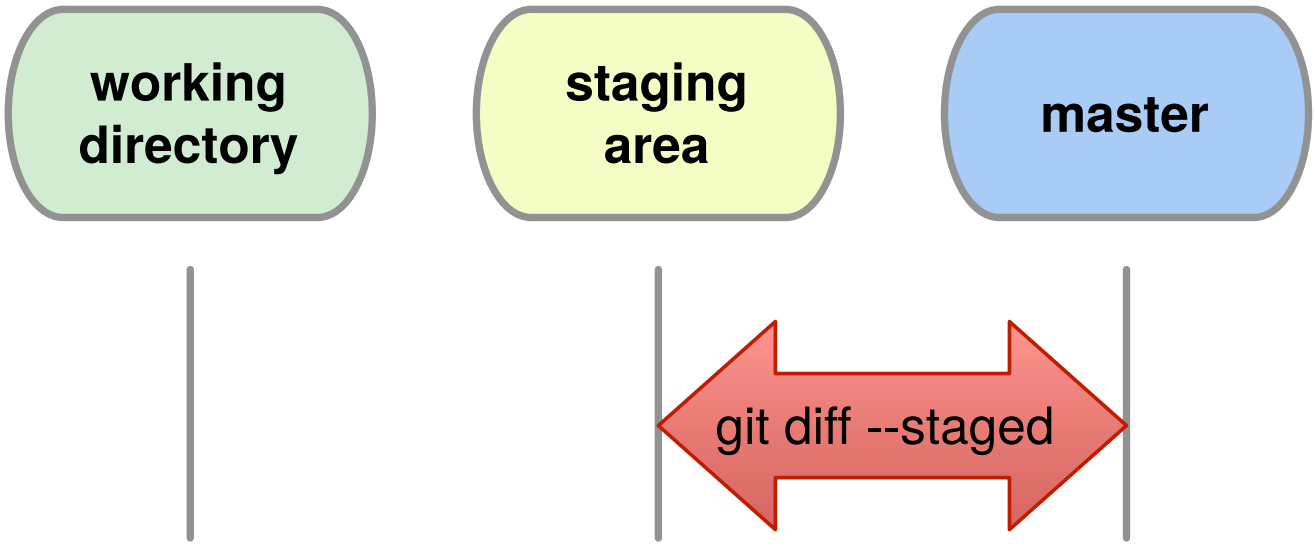
Shows changes between *working directory* and *staging area*



single+local: Diff Staged

How do I see what is staged?

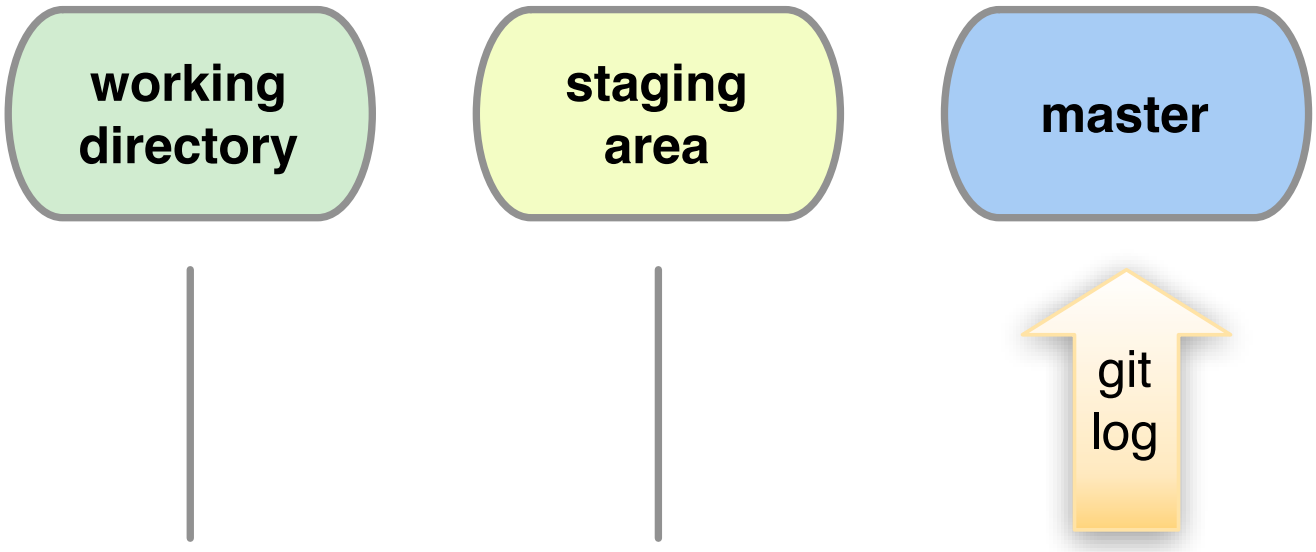
`git diff --staged` shows differences between staging area and last commit.



single+local: Logs

```
git log [--oneline]
```

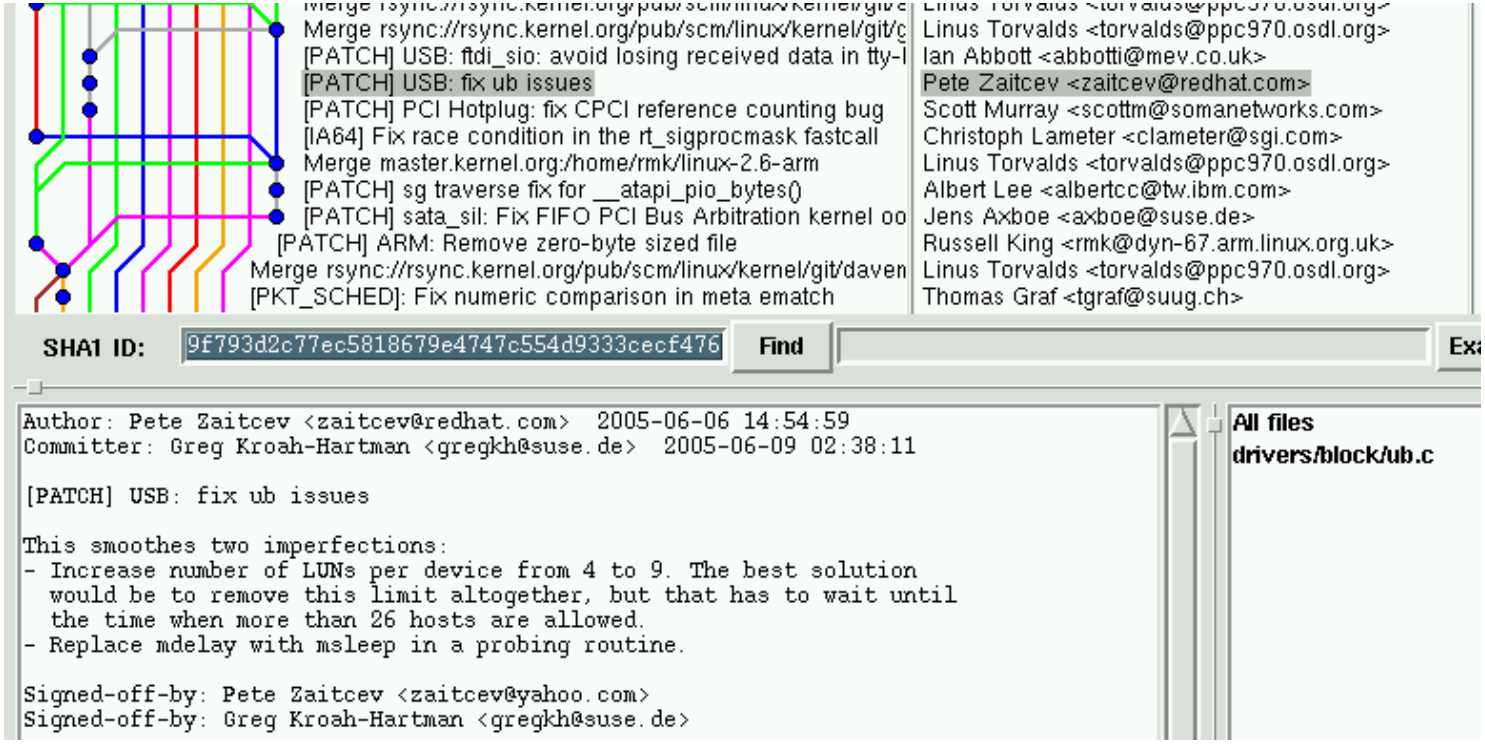
Shows details of the commits.



single+local: Graphic Logs

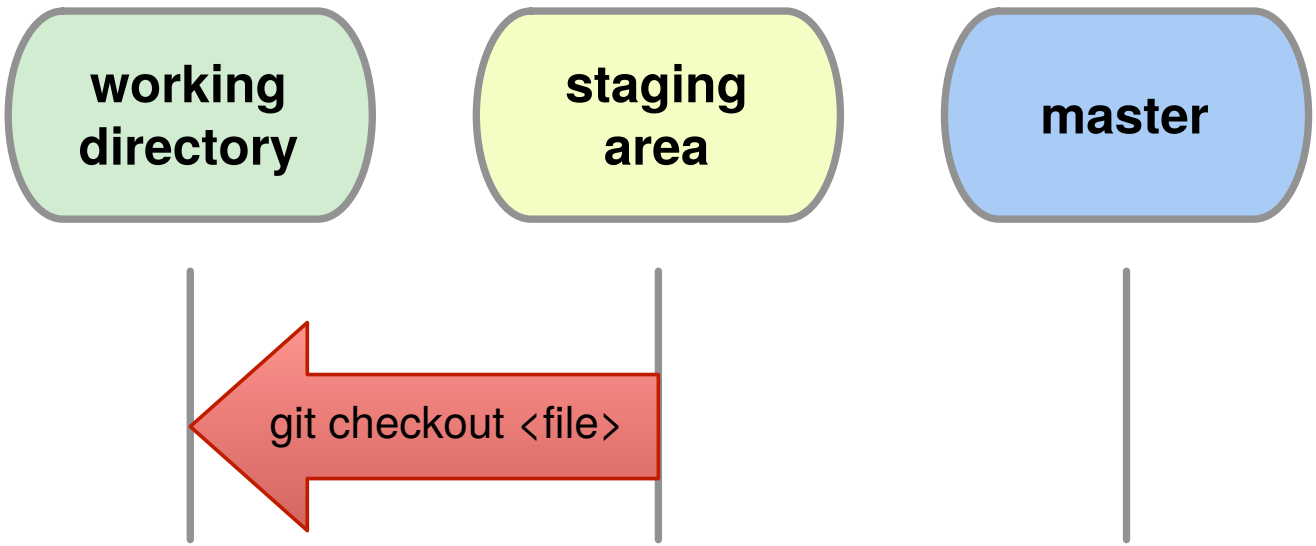
`gitk` / `gitg`

GUI to browse the git repository.



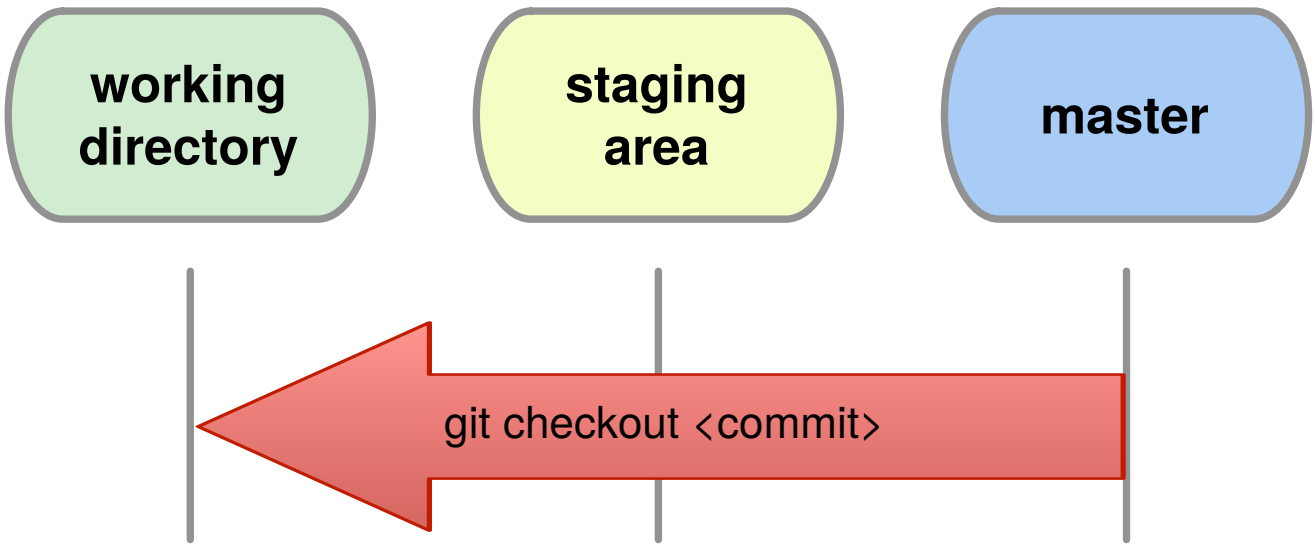
single+local: Changing Version

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



single+local: Changing Version

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

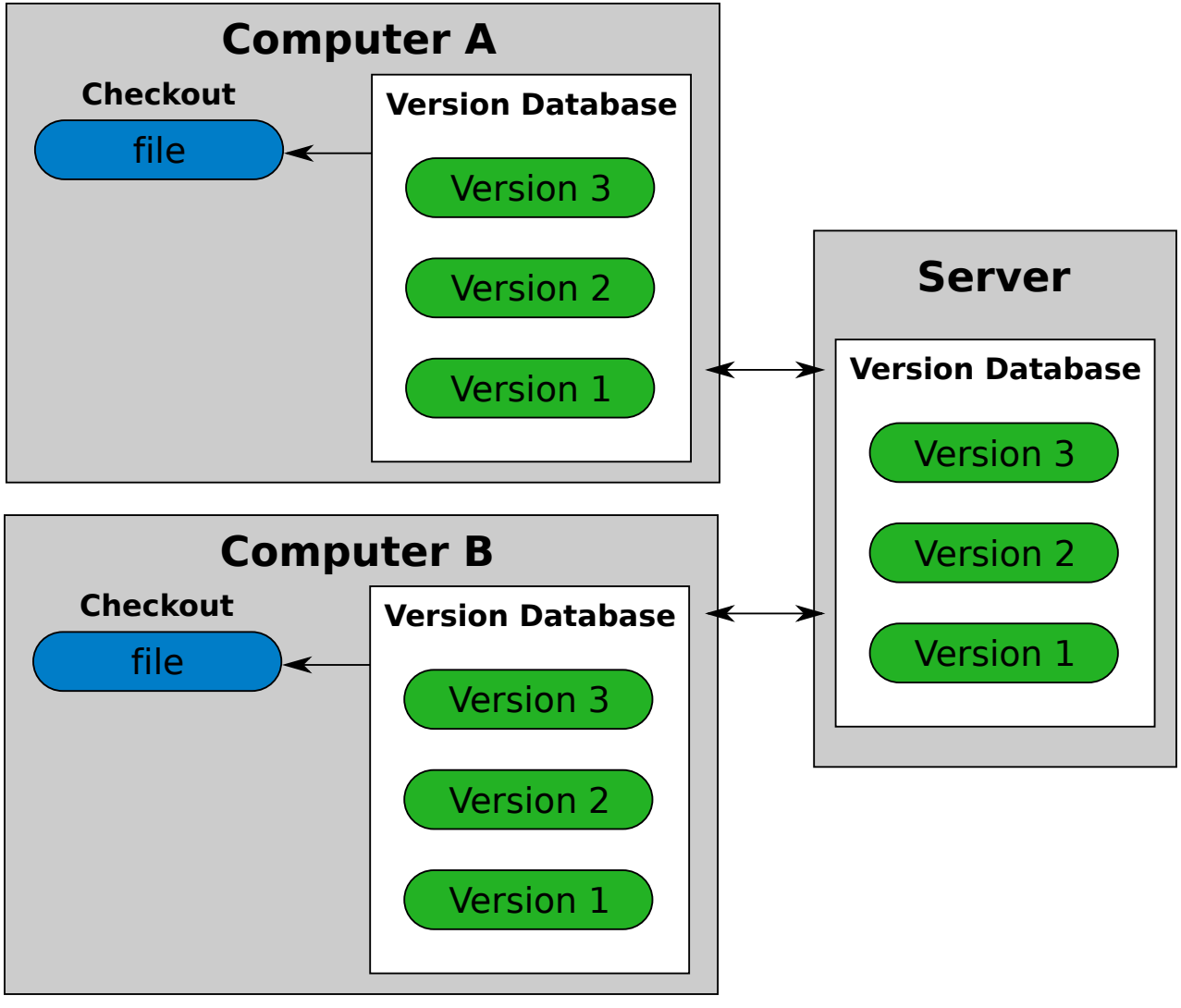
Remember to `commit` these changes!

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

Outline

Outline

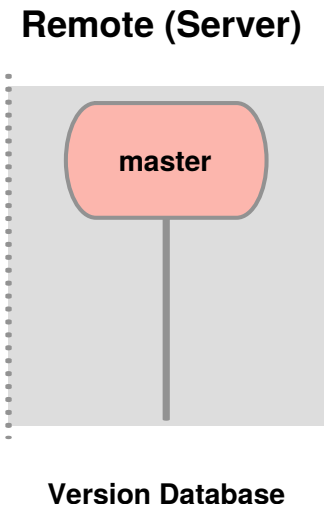
multi+remote/central: Setup



multi+remote/central: Clone

```
git clone <URL>
```

Creates two local copies of the whole remote repository.



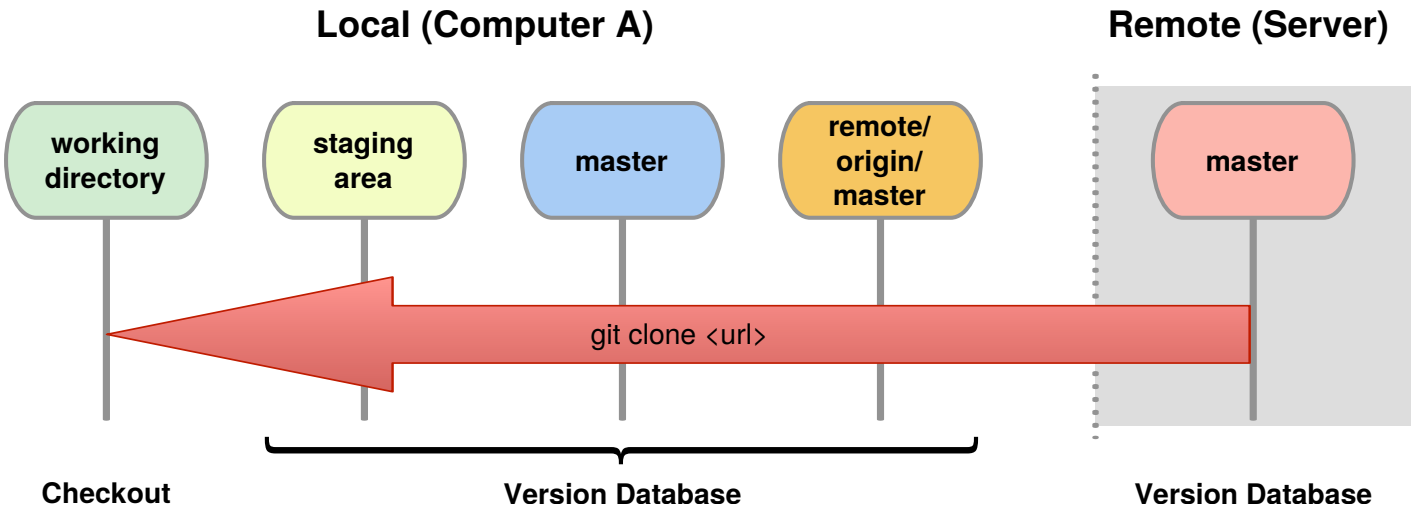
Hint

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

multi+remote/central: Clone

```
git clone <URL>
```

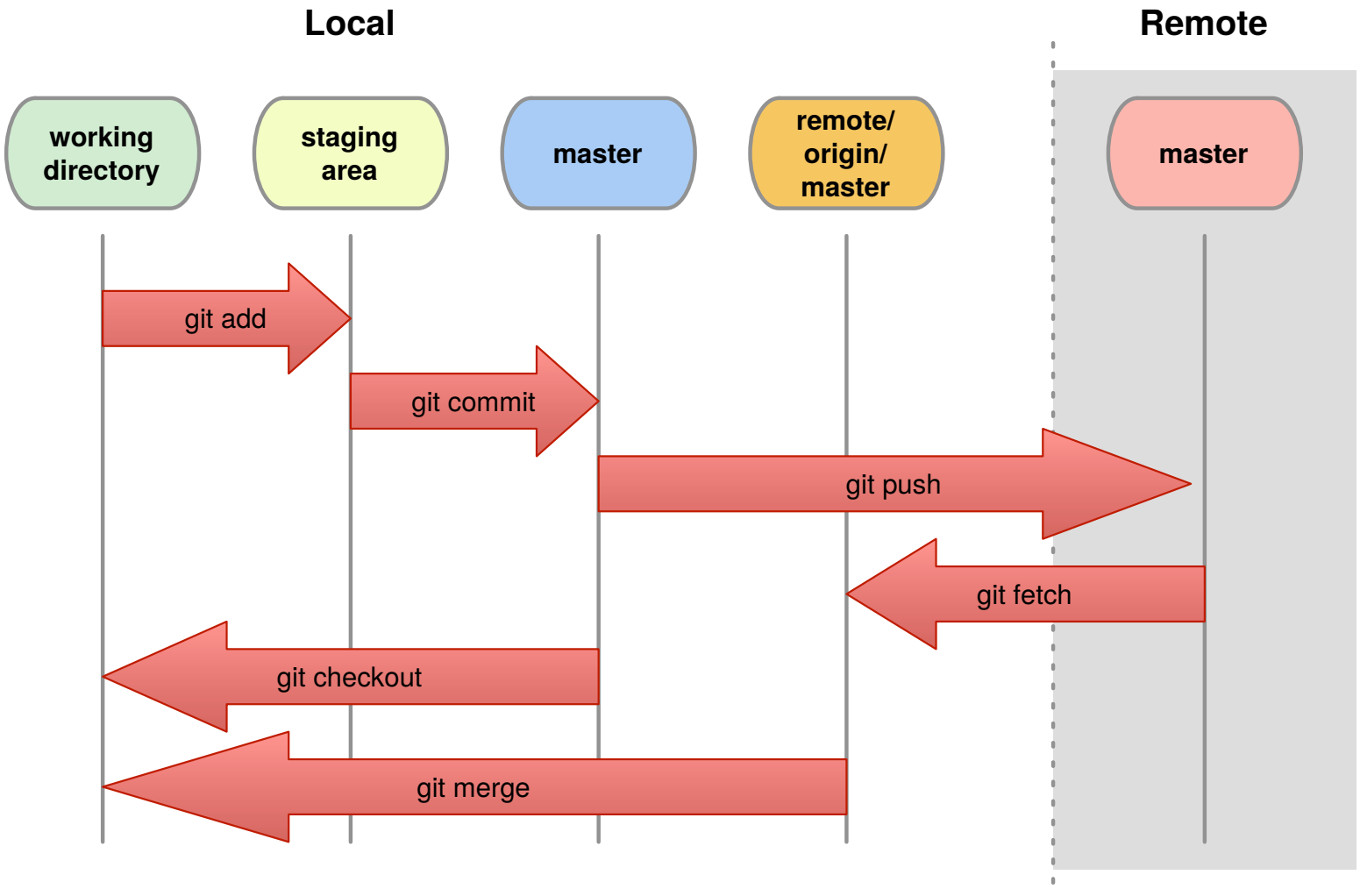
Creates two local copies of the whole remote repository.



Hint

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

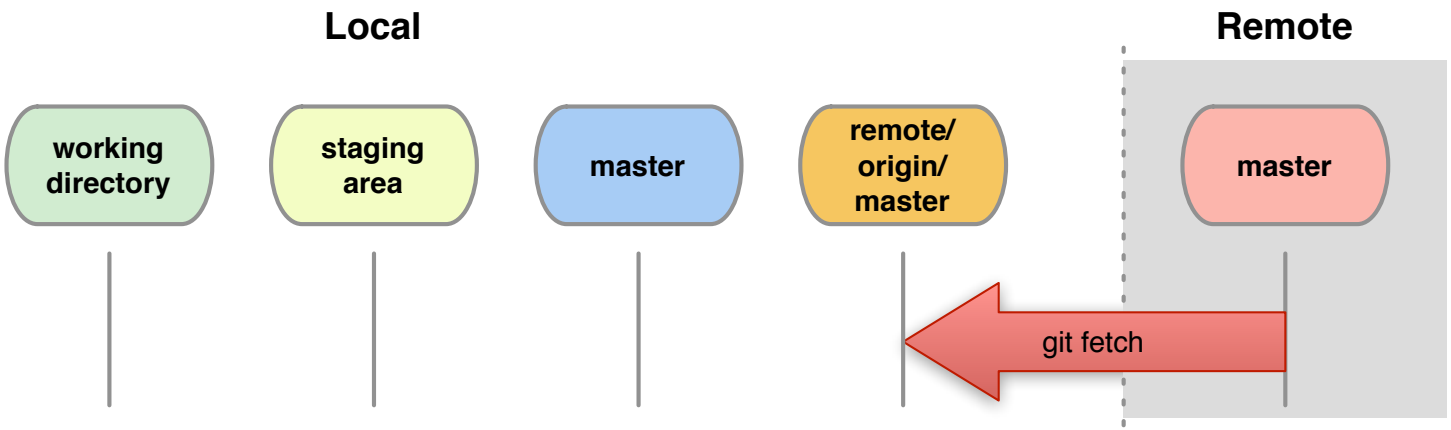
multi+remote/central: Commands



multi+remote/central: Fetch

`git fetch`

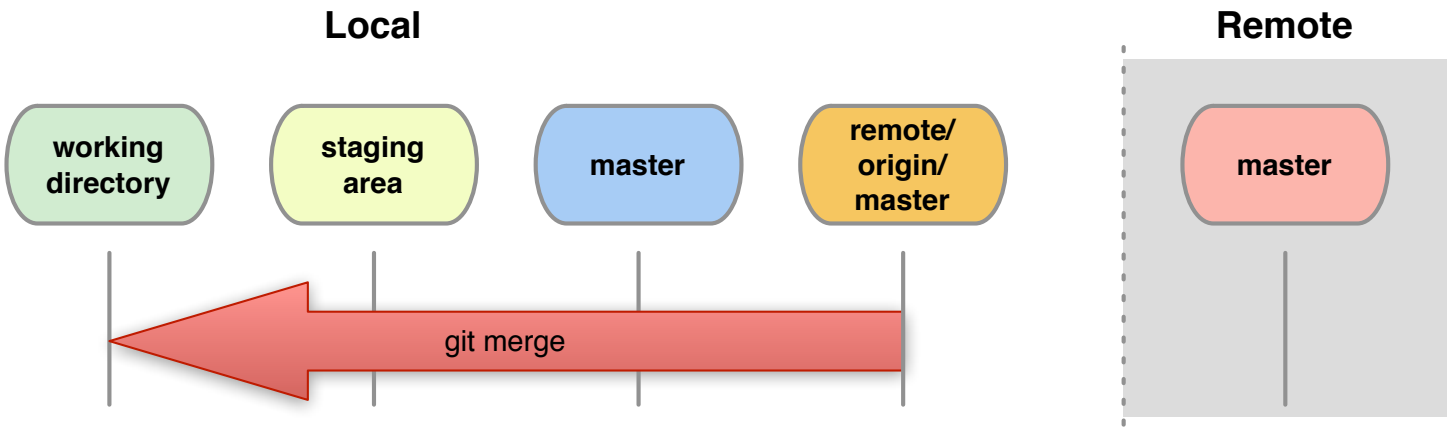
- Updates origin master from remote master
- local master, staging area and working dir not changed



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 [...]
```

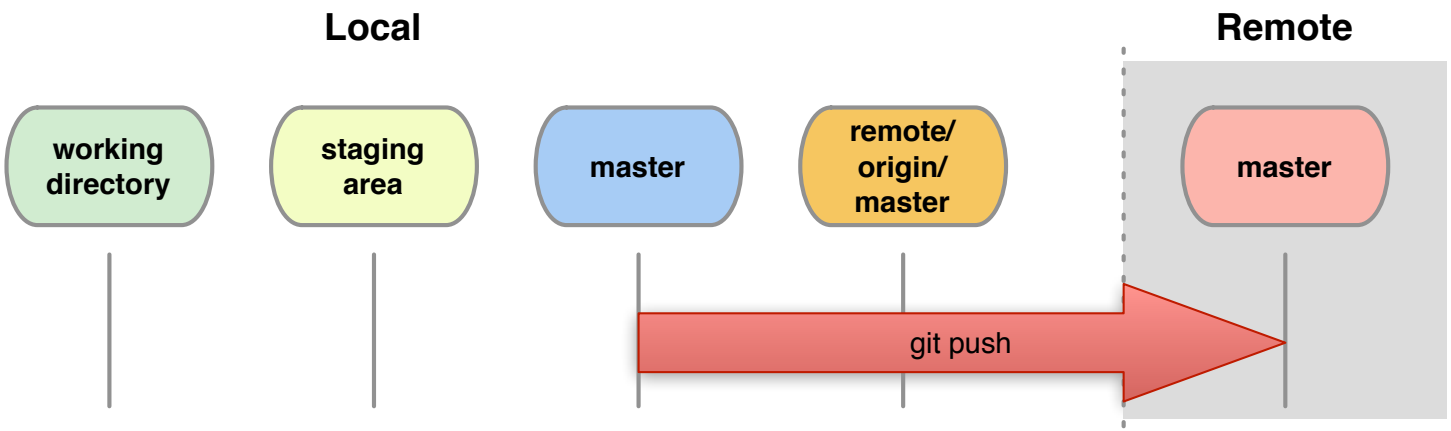
4. Commit changes:

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

multi+remote/central: Push

```
git push
```

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



Outline

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`

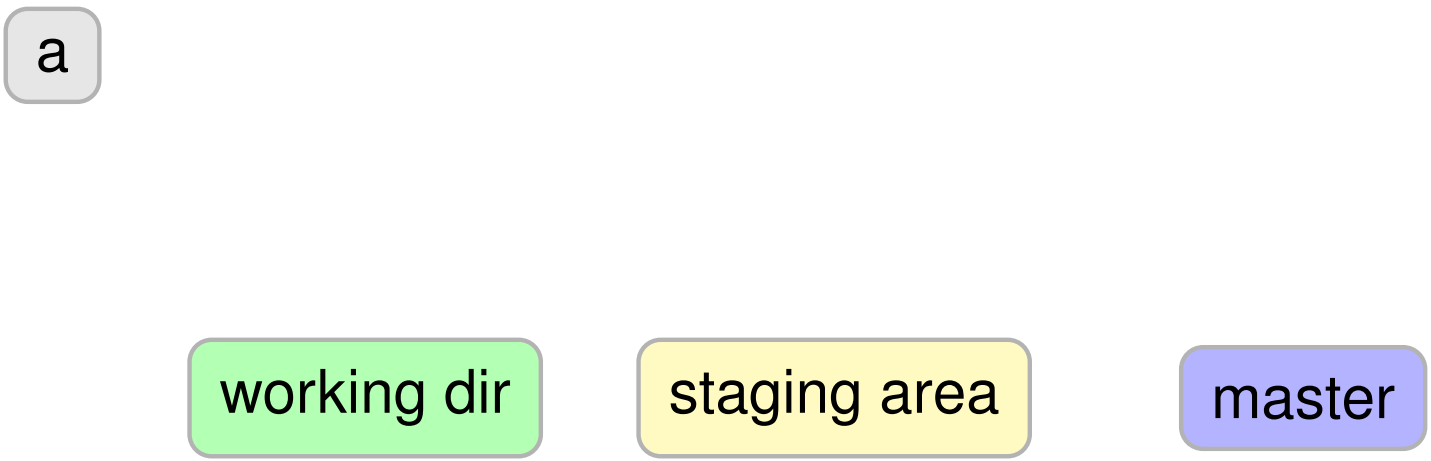
Everybody clones:

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

Outline

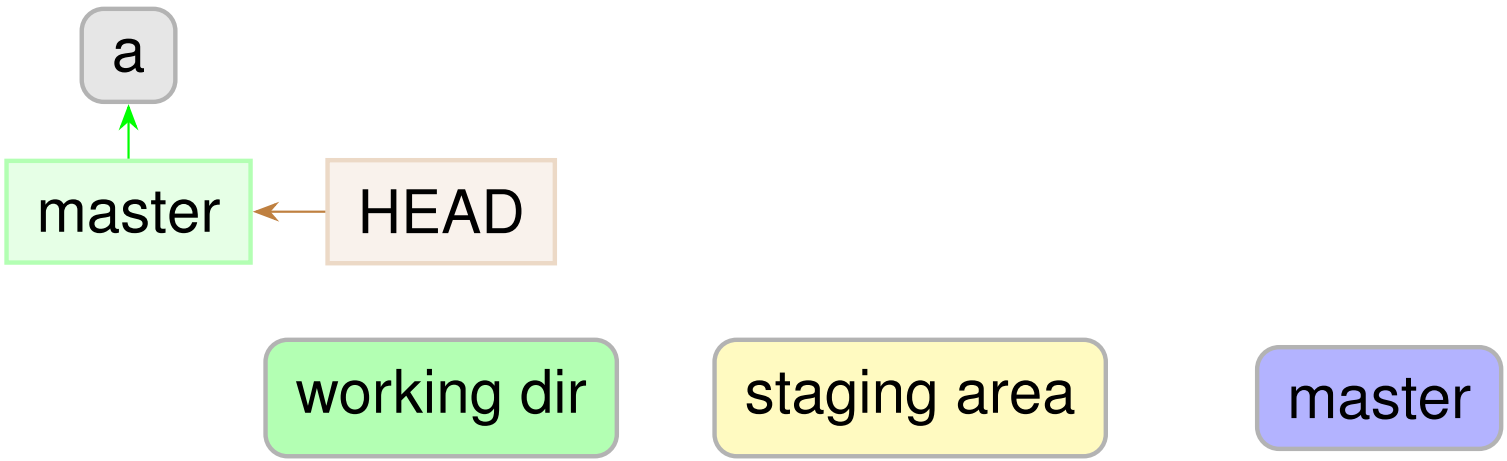
Behind the Scenes: Setup

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



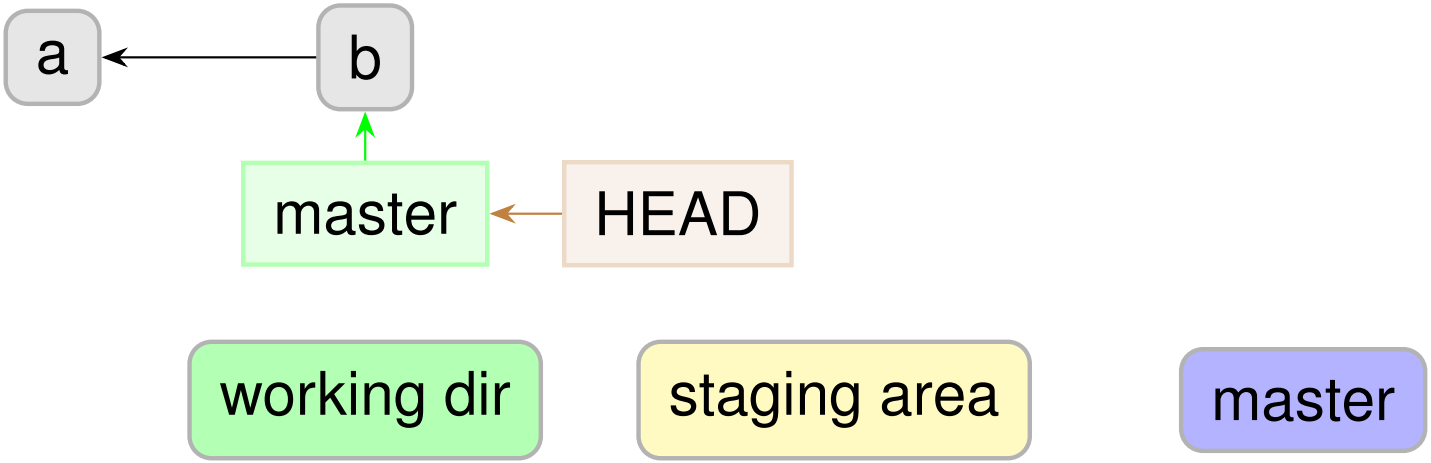
Behind the Scenes: Setup

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



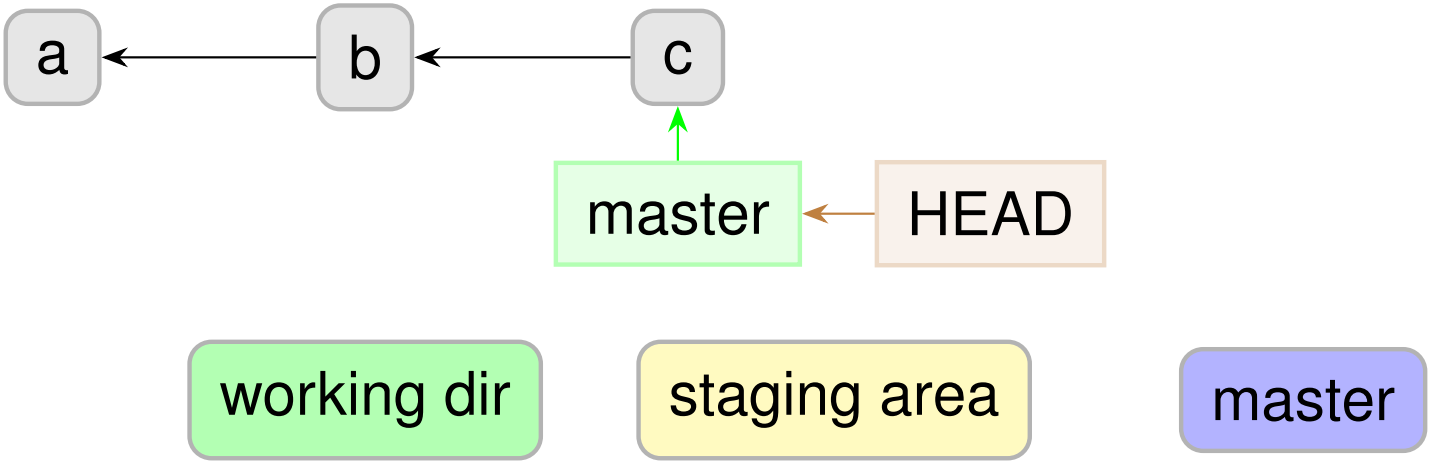
Behind the Scenes: Setup

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



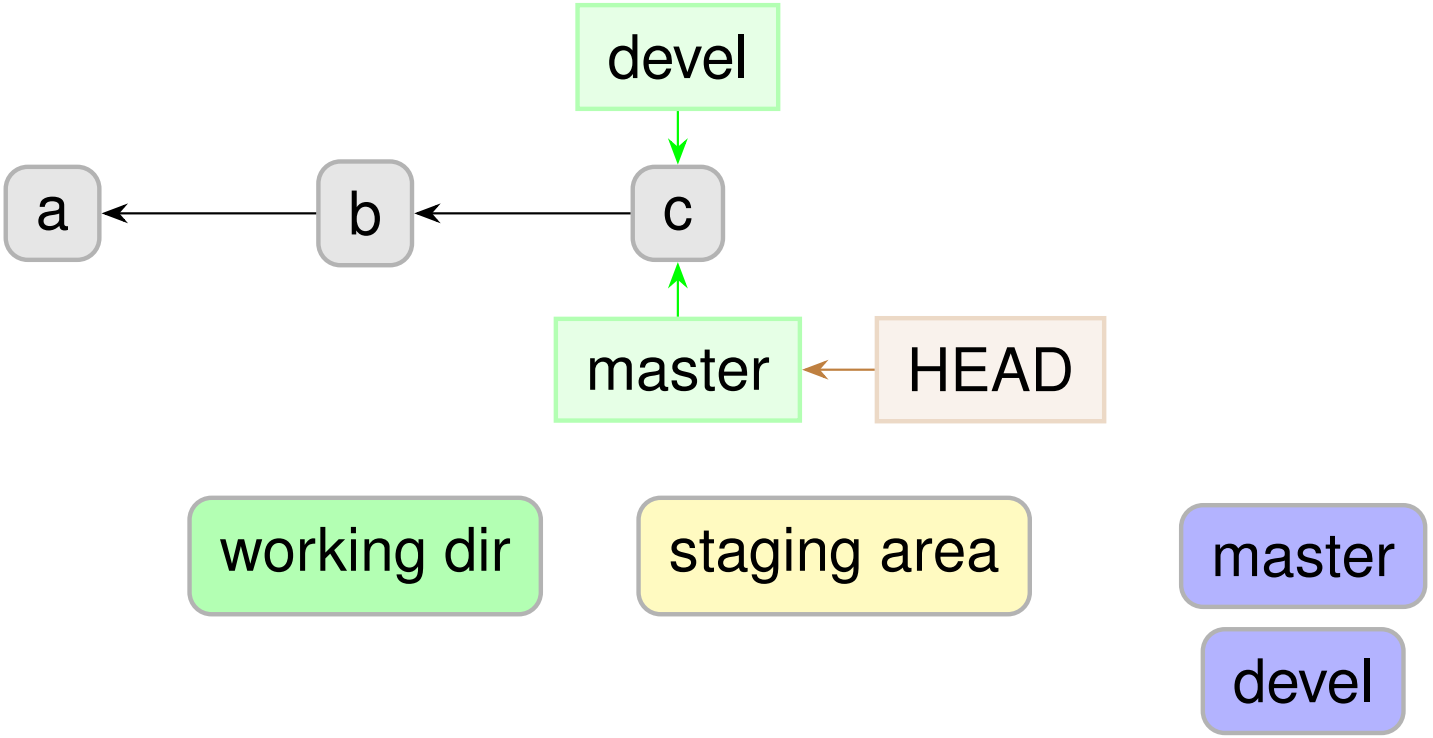
Behind the Scenes: Setup

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



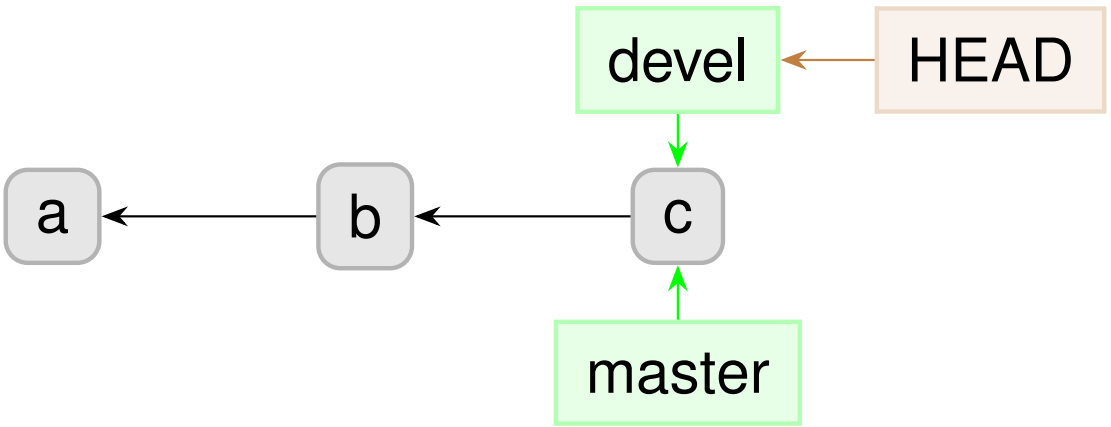
Behind the Scenes: Branches

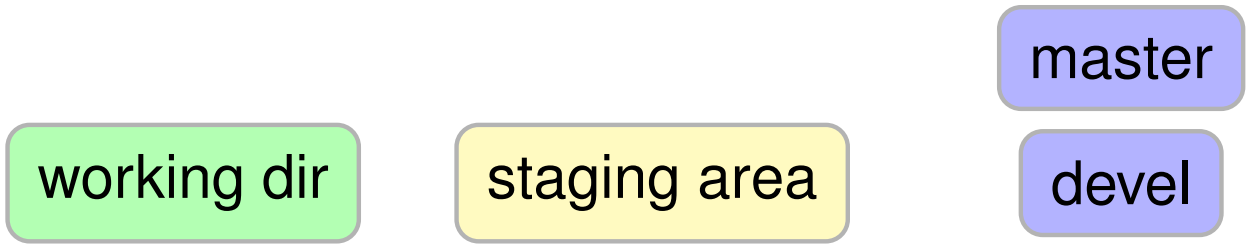
```
git branch devel
```



Behind the Scenes: Branches

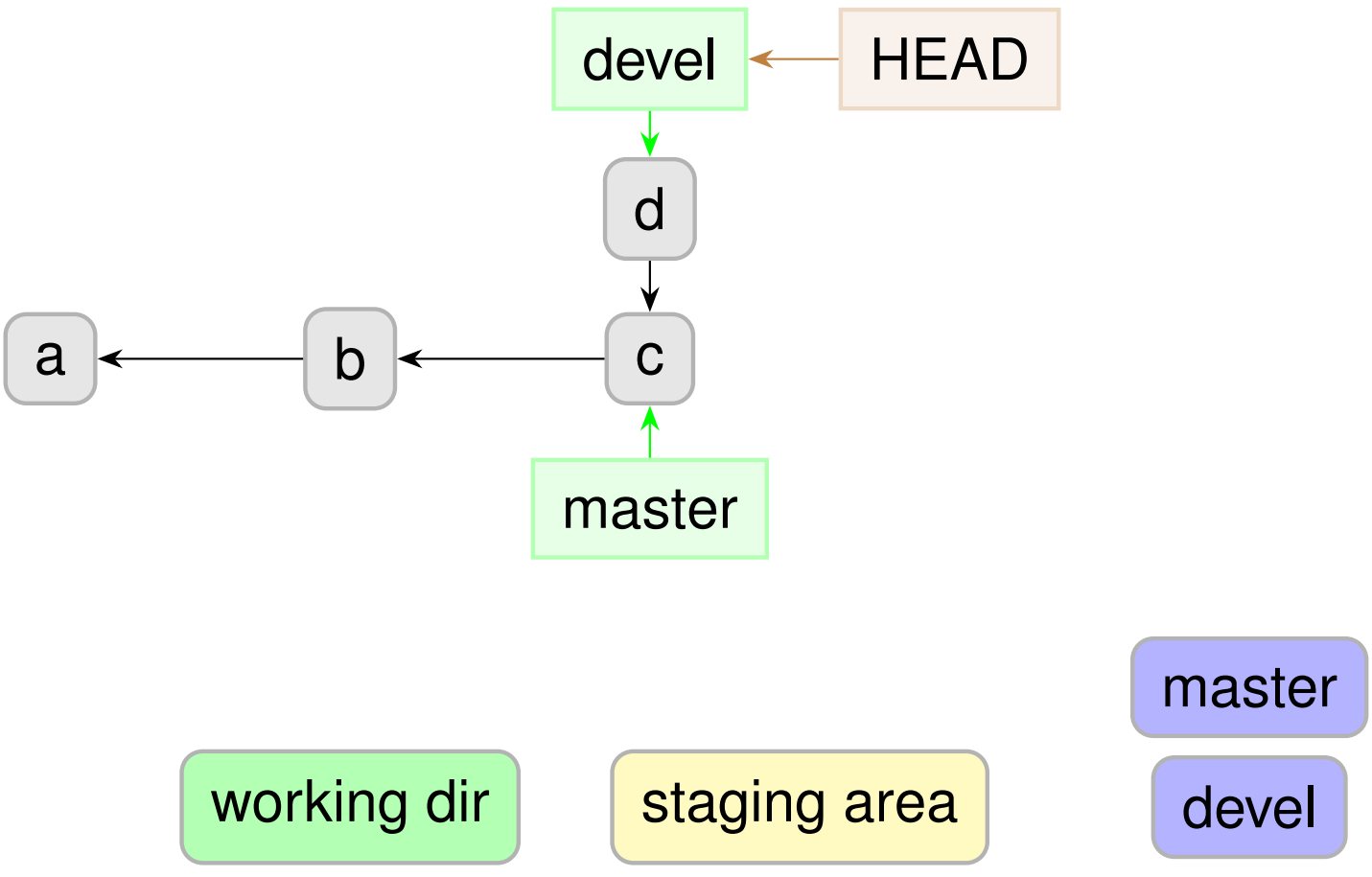
```
git checkout devel
```





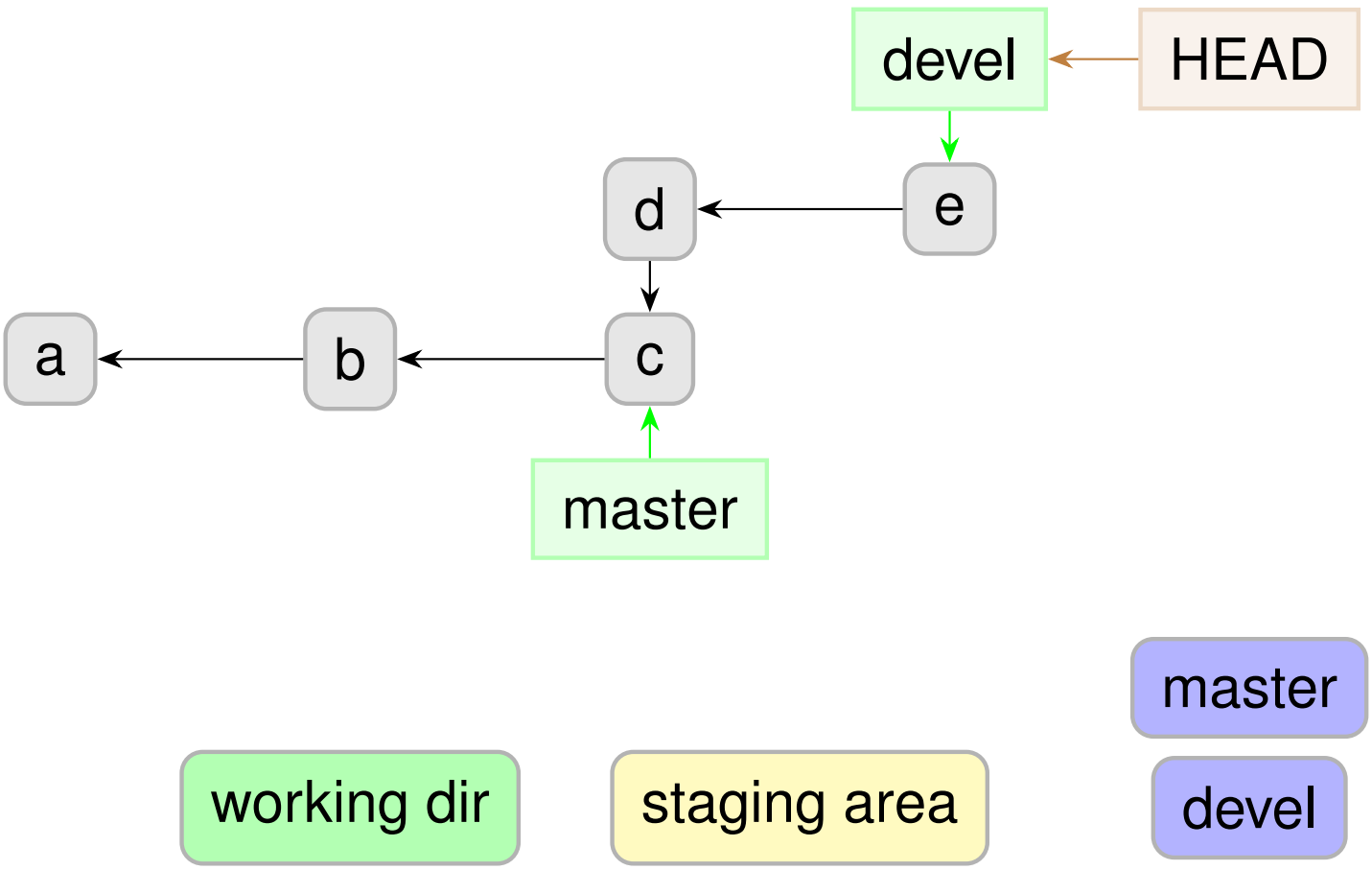
Behind the Scenes: Branches

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

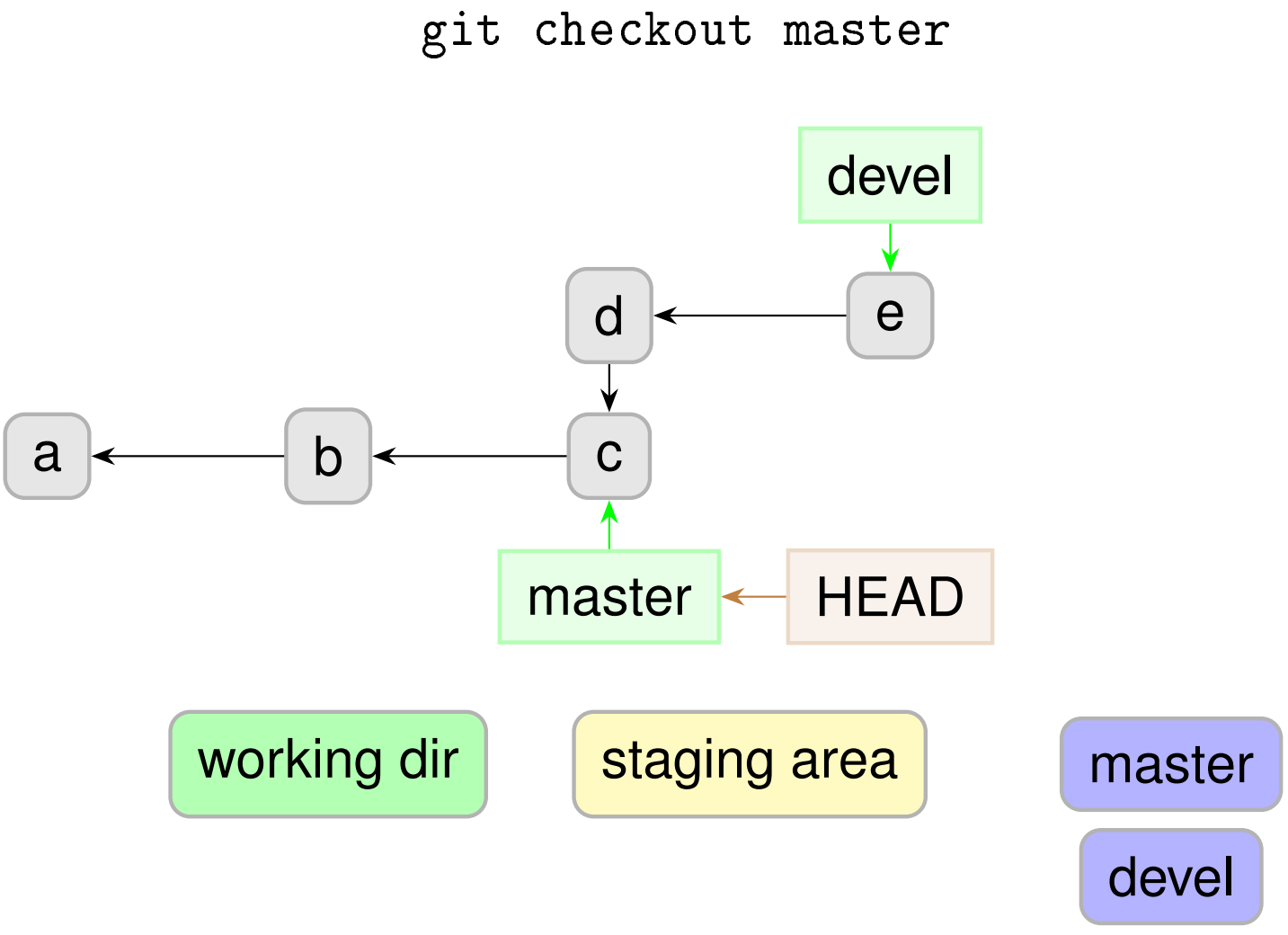


Behind the Scenes: Branches

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

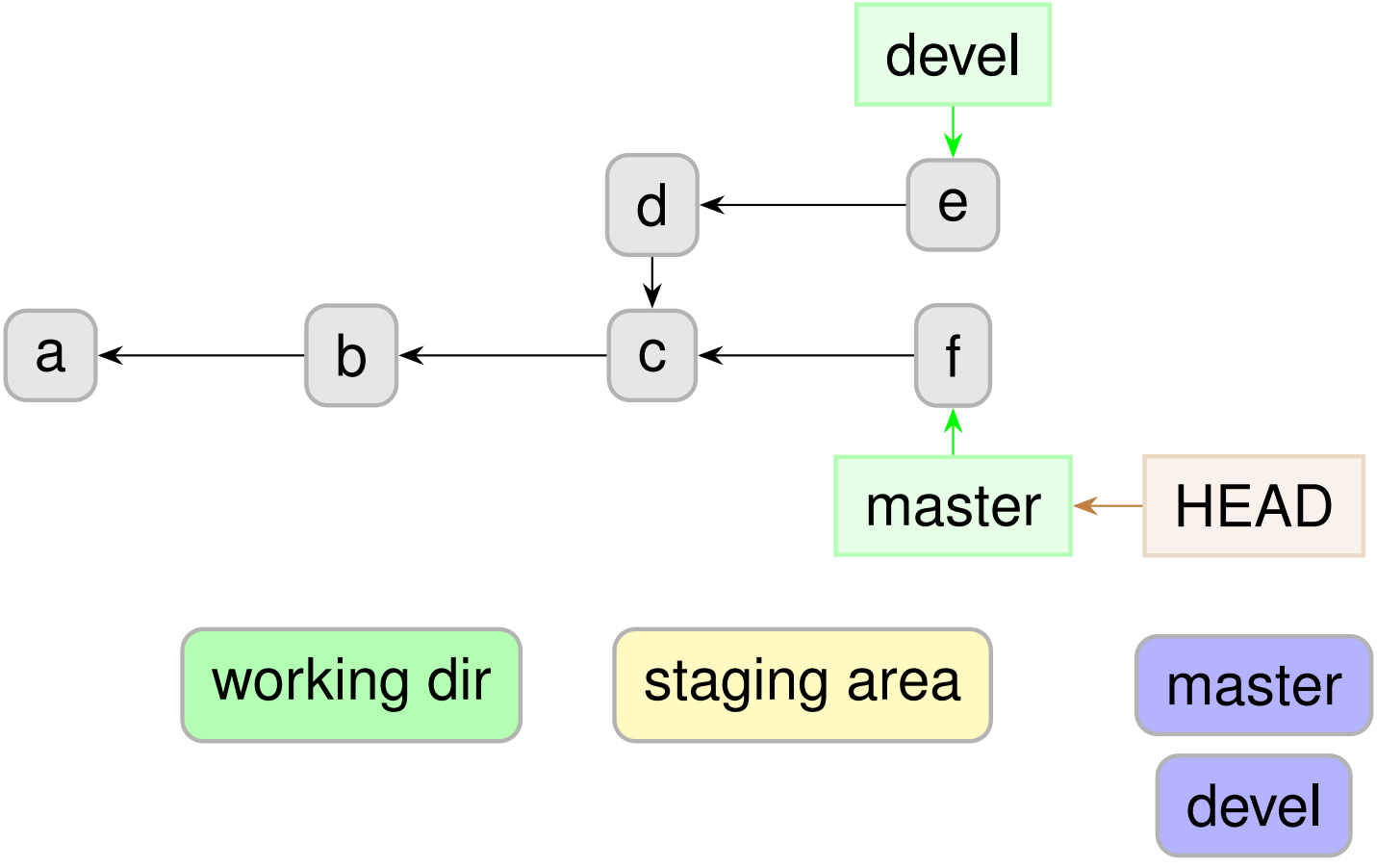


Behind the Scenes: Branches

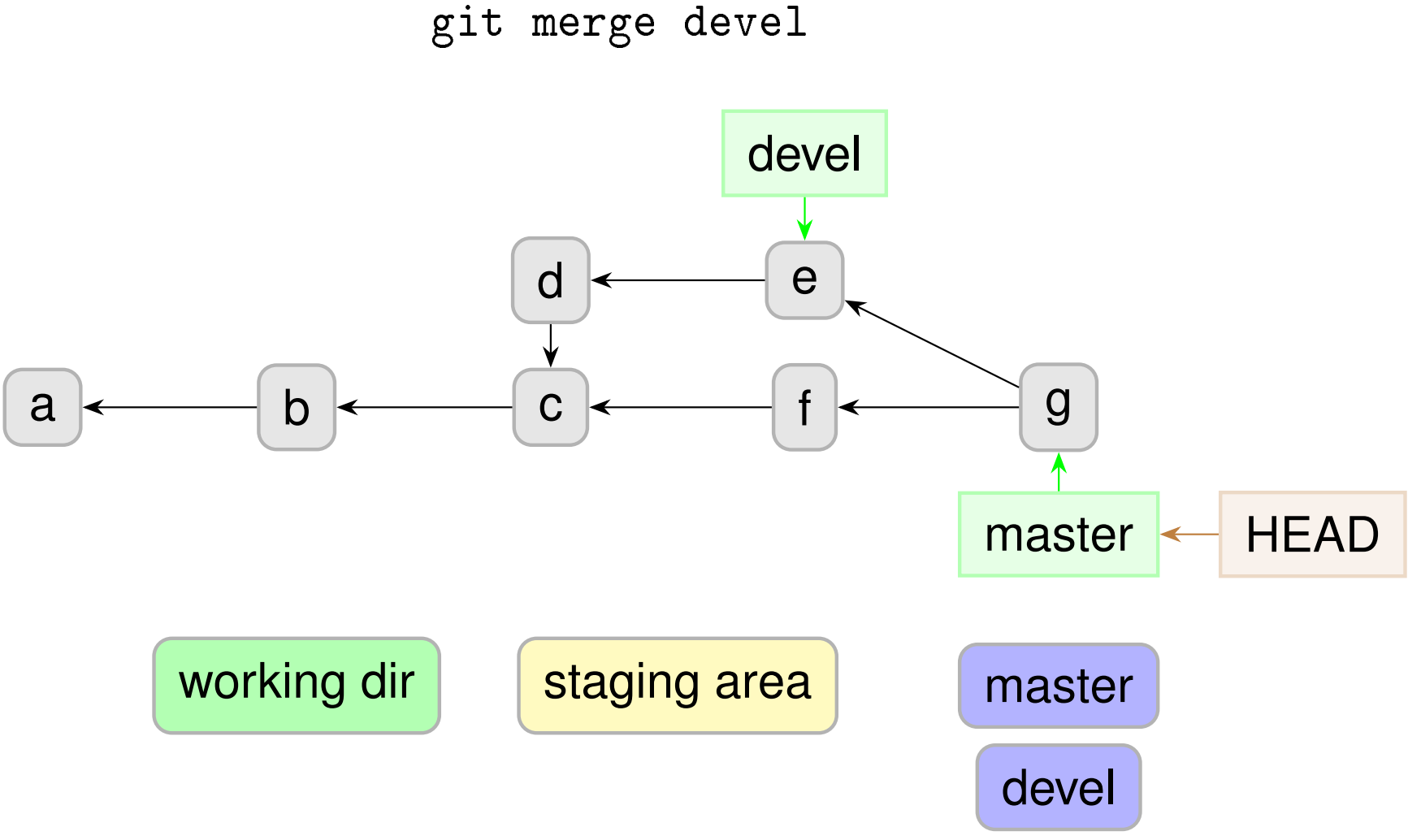


Behind the Scenes: Branches

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

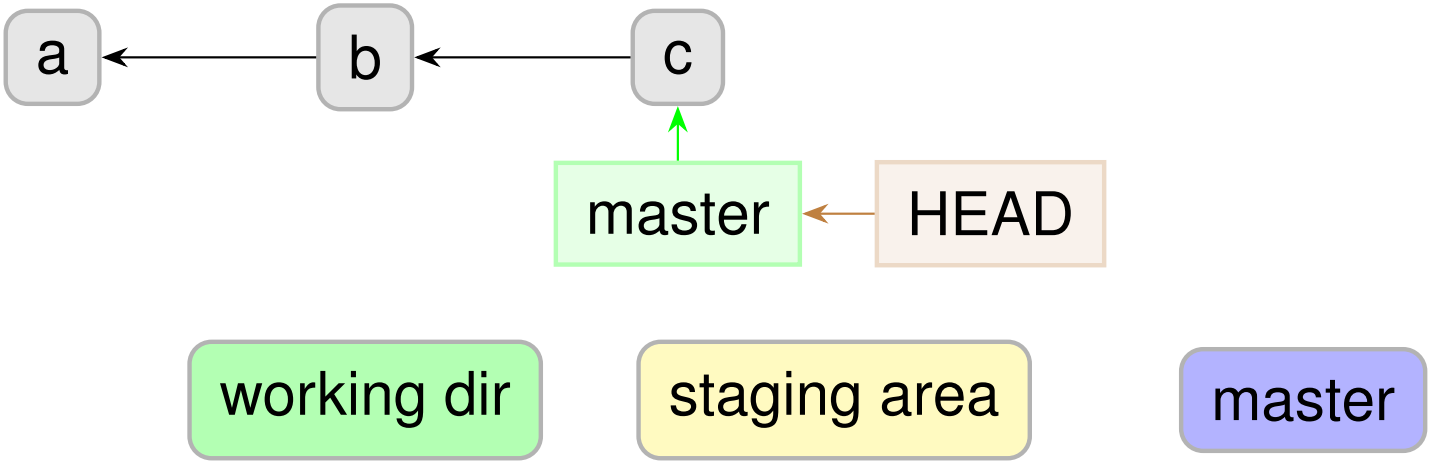


Behind the Scenes: Branches



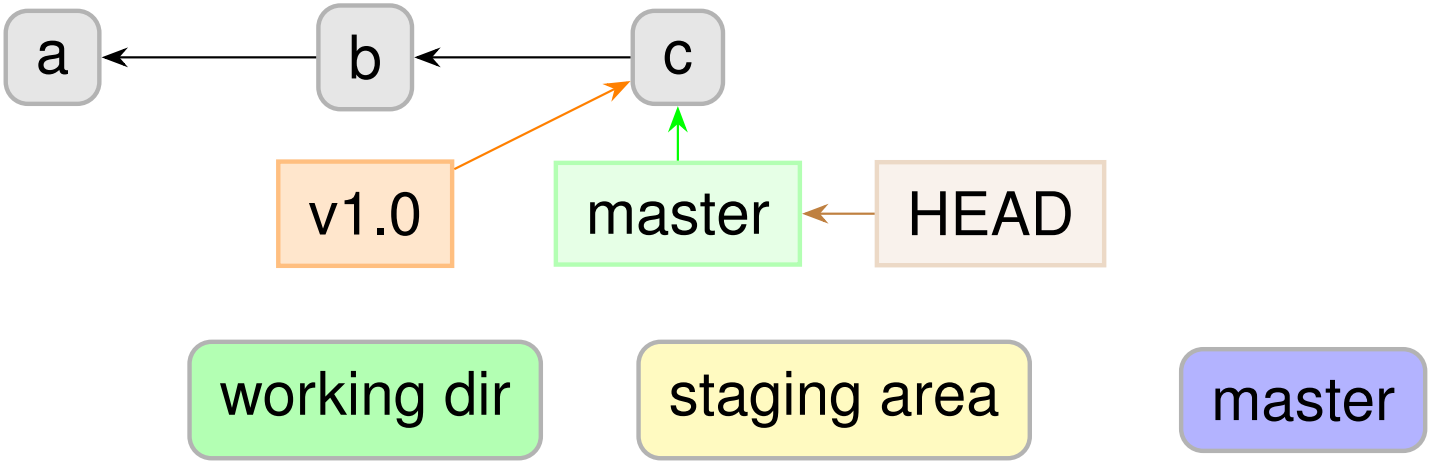
Behind the Scenes: Setup

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



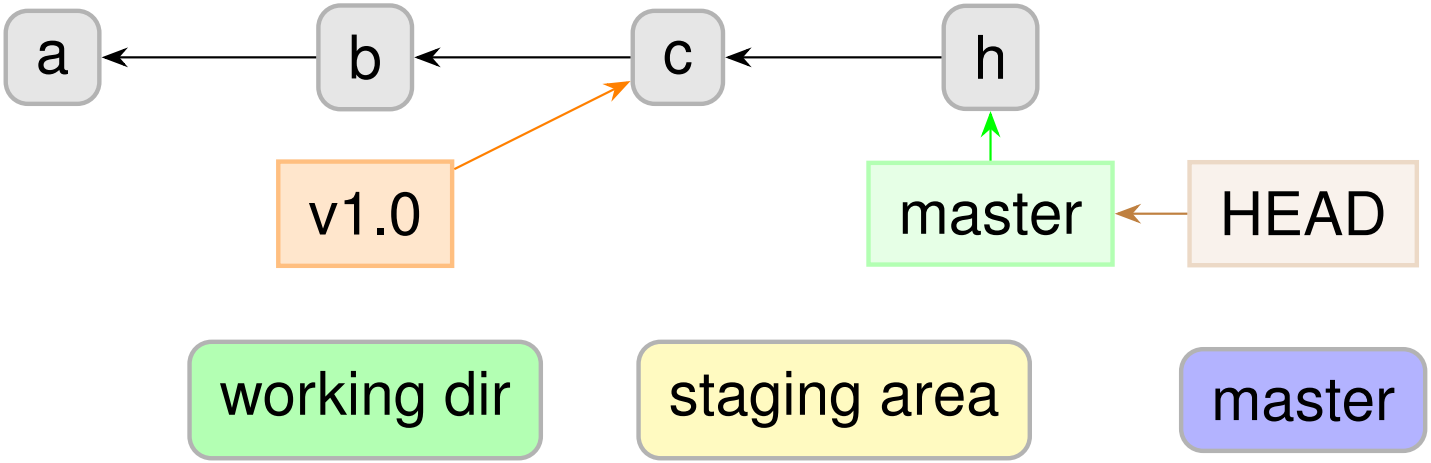
Behind the Scenes: Tags

```
git tag v1.0
```



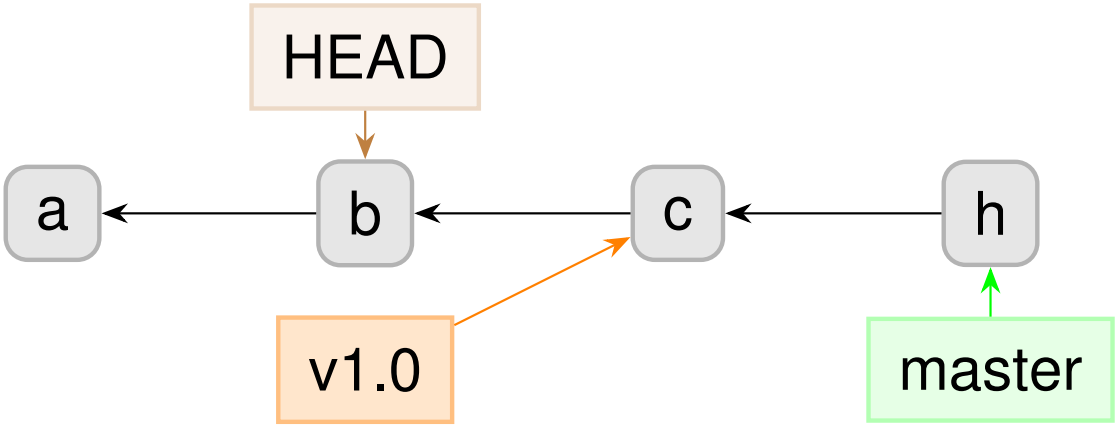
Behind the Scenes: Tags

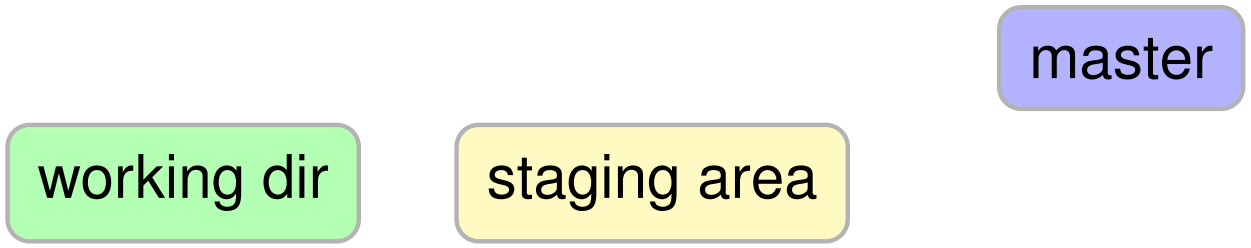
```
git commit -am "H"
```



Behind the Scenes: Detached HEAD

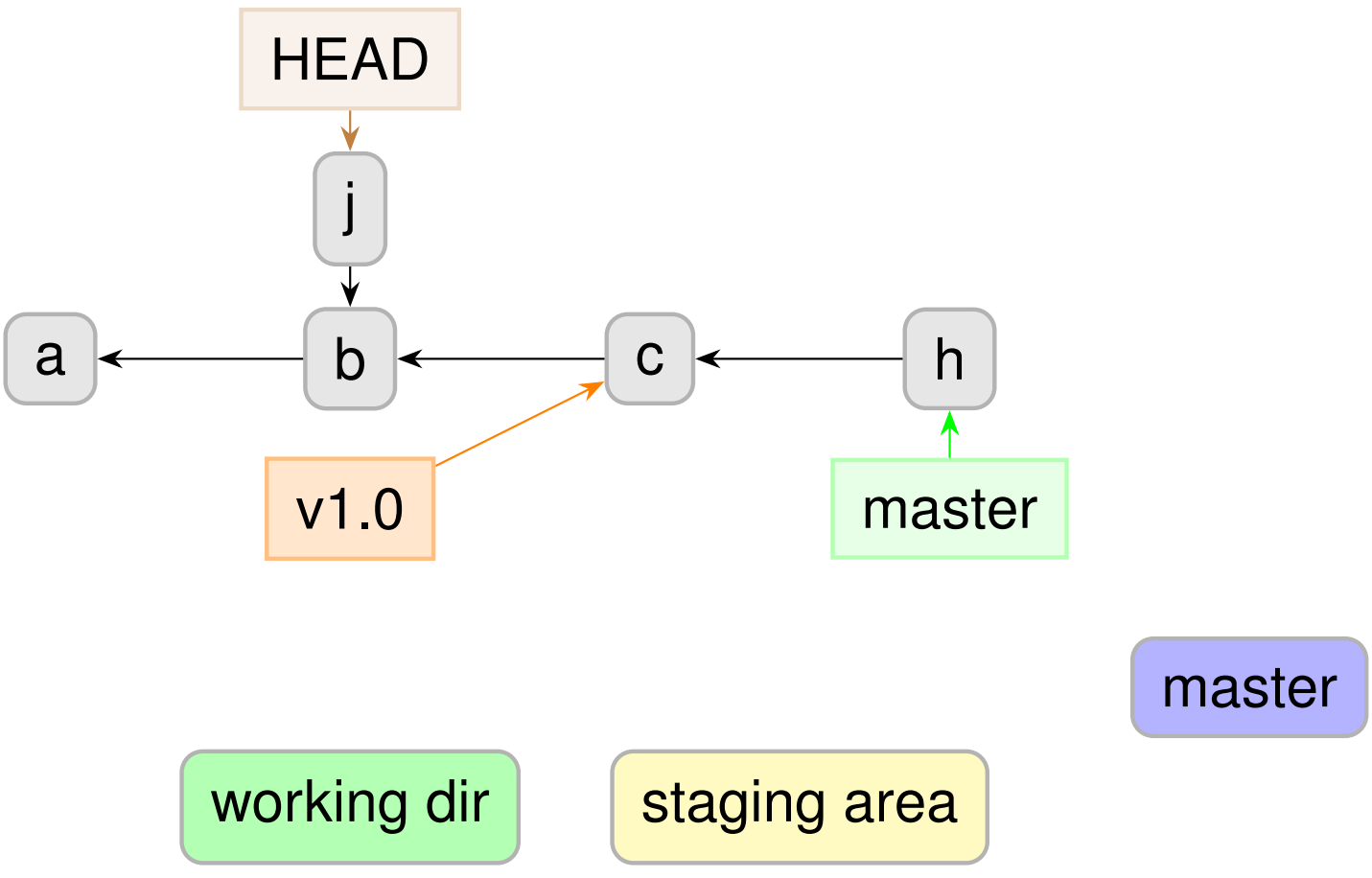
```
git checkout b
```





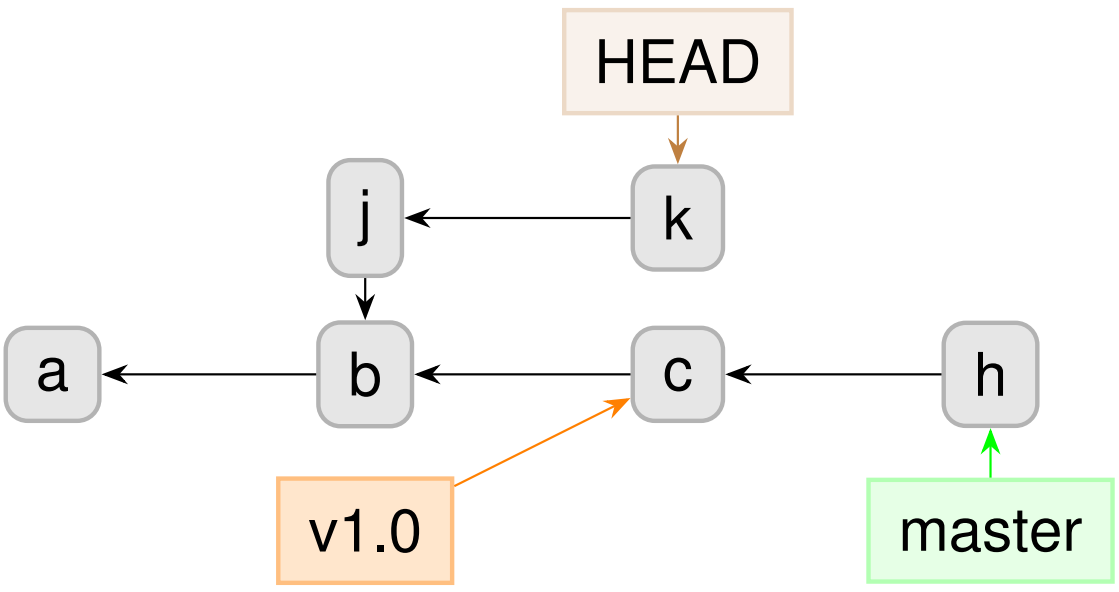
Behind the Scenes: Detached HEAD

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



Behind the Scenes: Detached HEAD

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



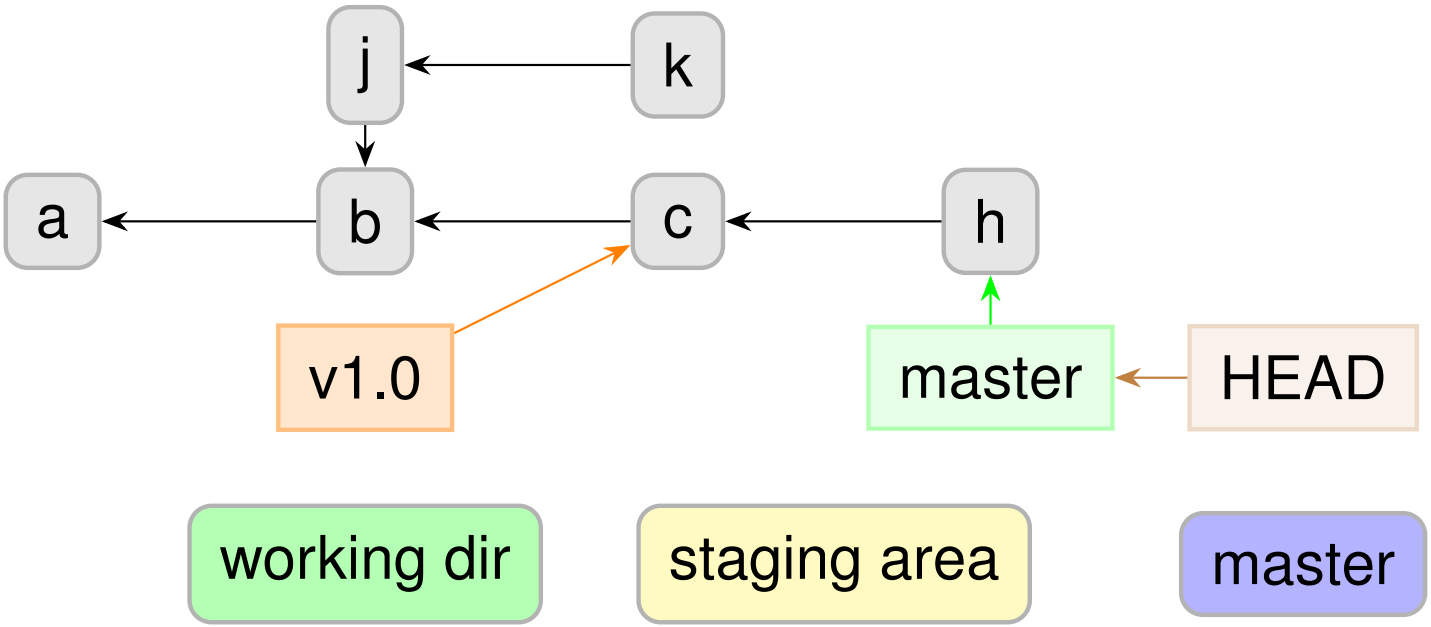
master

working dir

staging area

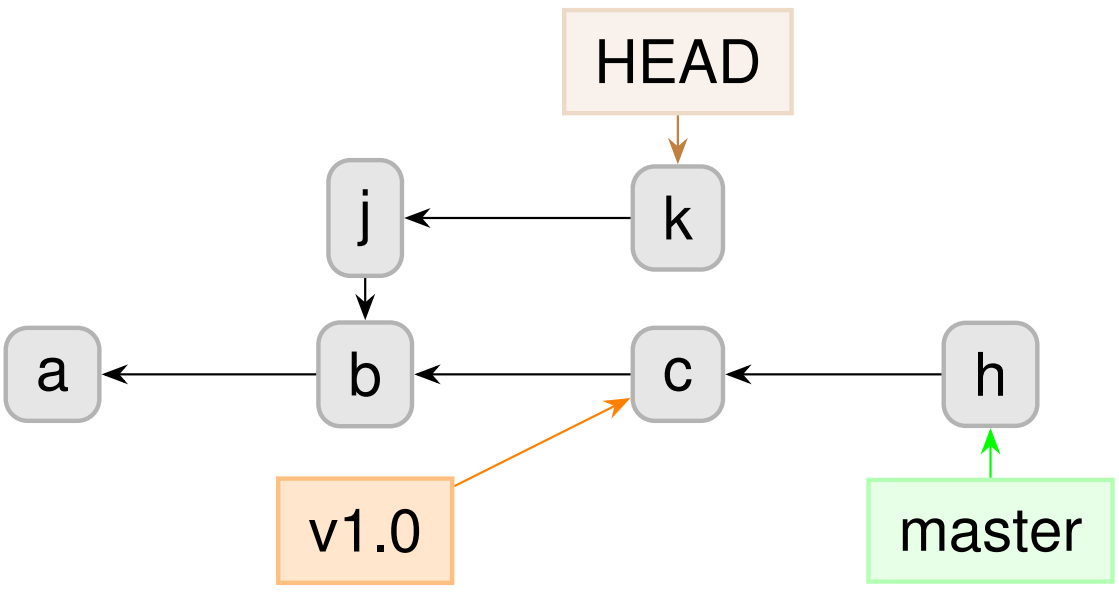
Behind the Scenes: Detached HEAD

```
git checkout master
```



Behind the Scenes: Detached HEAD

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



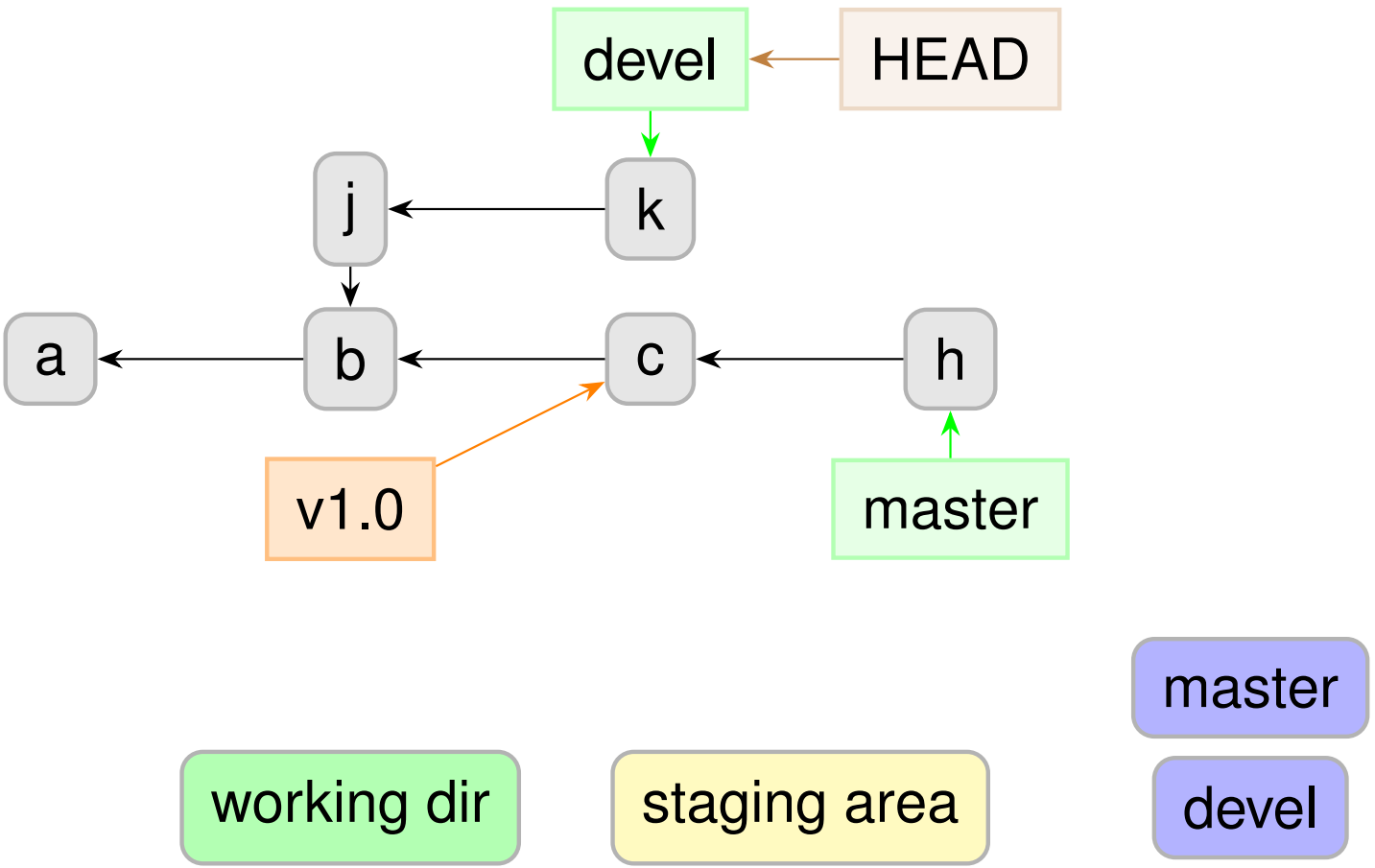
master

working dir

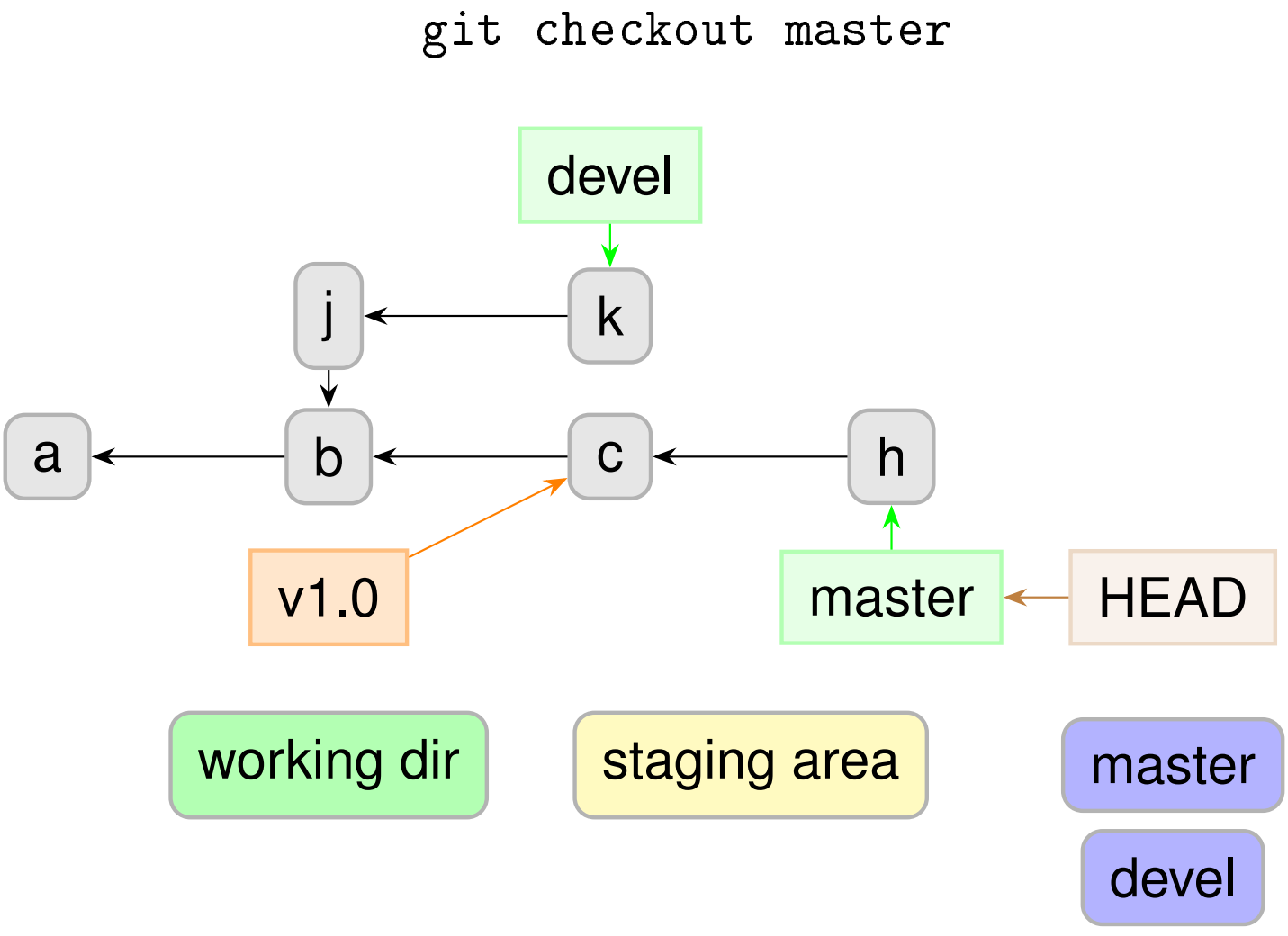
staging area

Behind the Scenes: Detached HEAD

```
git checkout -b devel
```



Behind the Scenes: Detached HEAD



Questions?

Understanding how git works:

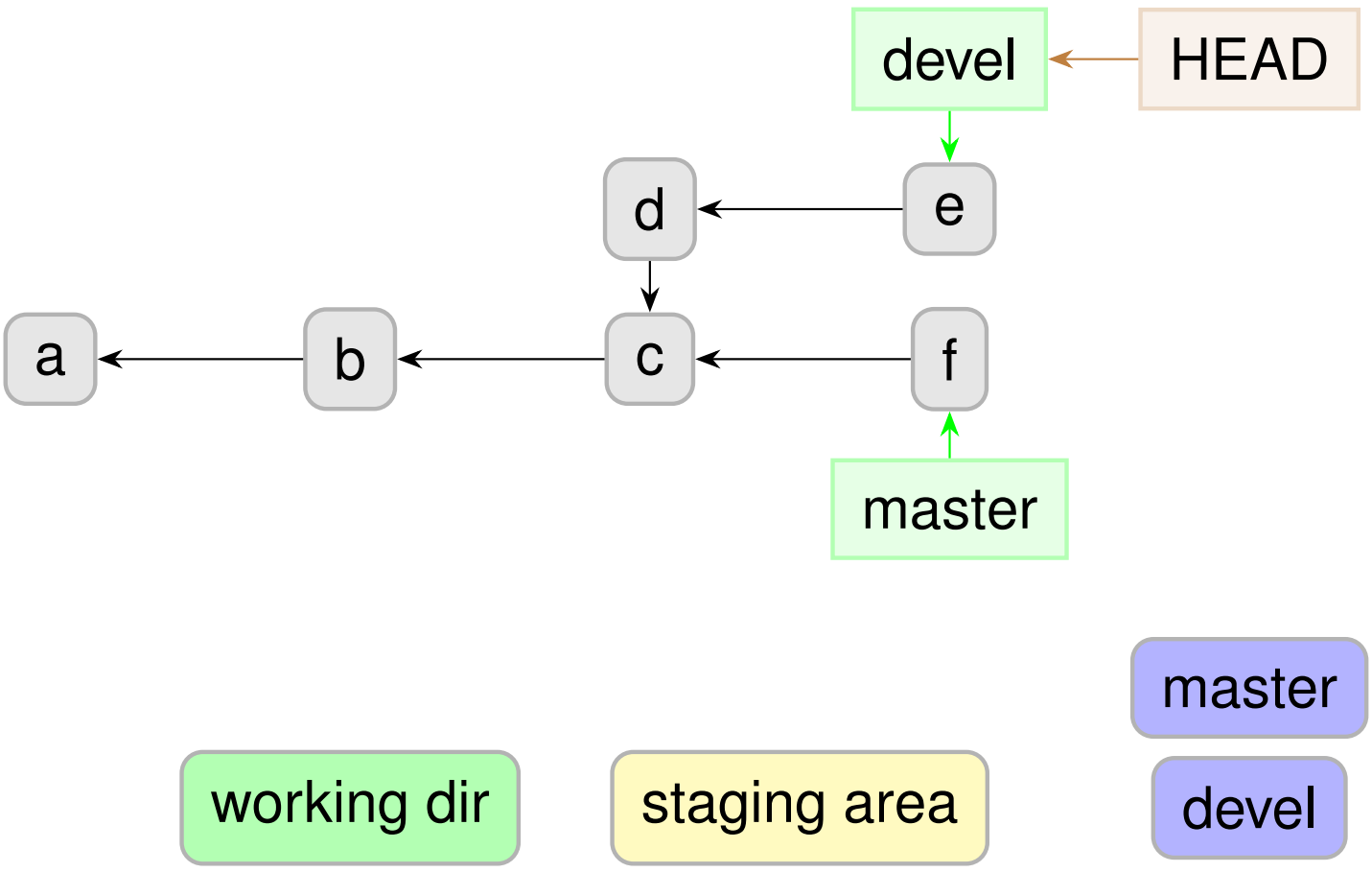
- git foundations, by Matthew Brett: http://matthew-brett.github.io/pydagogue/foundation.html
- The git parable, by Tom Preston-Werner: http://tom.preston-werner.com/2009/05/19/the-git-parable.html

Excellent guides:

- "Pro Git" book: http://git-scm.com/book (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
```