A Practical Introduction to `git`

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Outline

- Version Control: `git`.
- Scenario 1: **single** developer, **local** repository.
  - Demo **single+local**
- Scenario 2: **Team** of developers, **central remote** repository. Minimalistic.
  - Demo **multi+remote**
- Branching.
- Scenario 3: Contributing to a Software Project hosted on **GitHub**.
- Extras: how to set up centralised repository, and more.

Version Control: Naming & Meaning

Wikipedia

"*Revision control*, also known as *version control*, *source control* or *software configuration management* (SCM), is the management of changes to documents, programs, and other information stored as computer files."

Popular Acronyms:

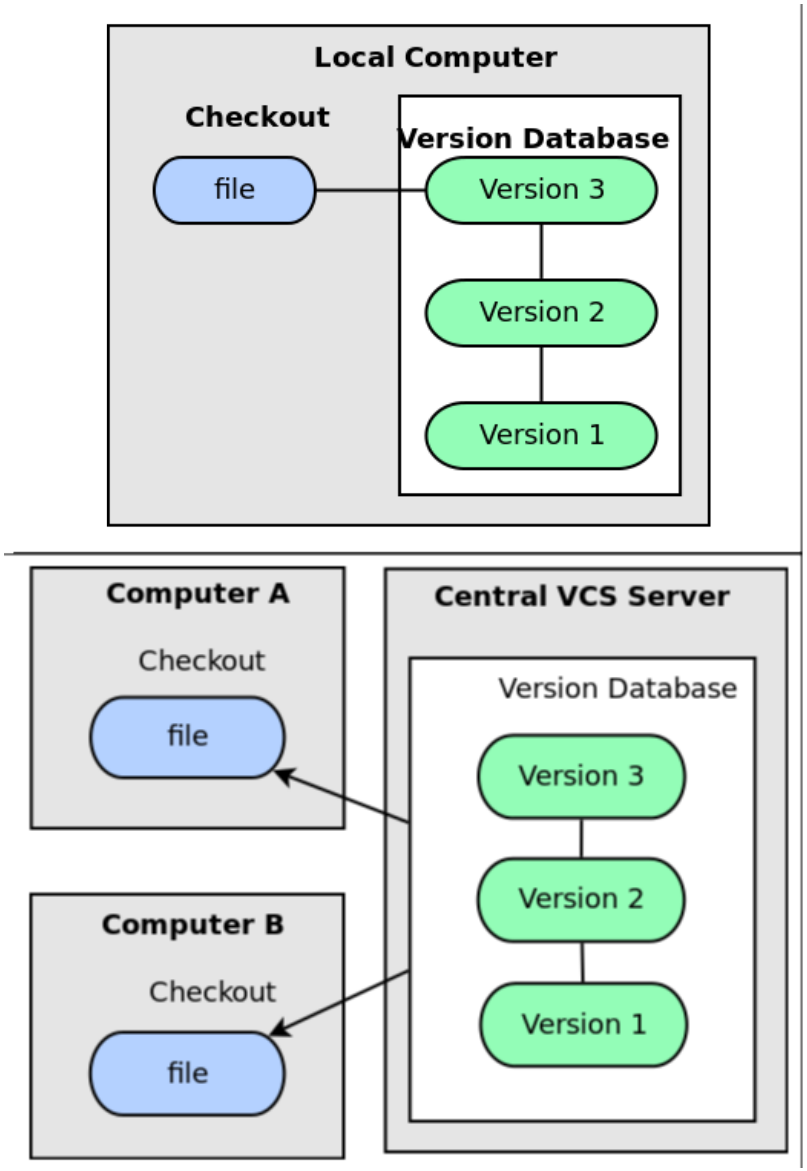
- VC
- SCM

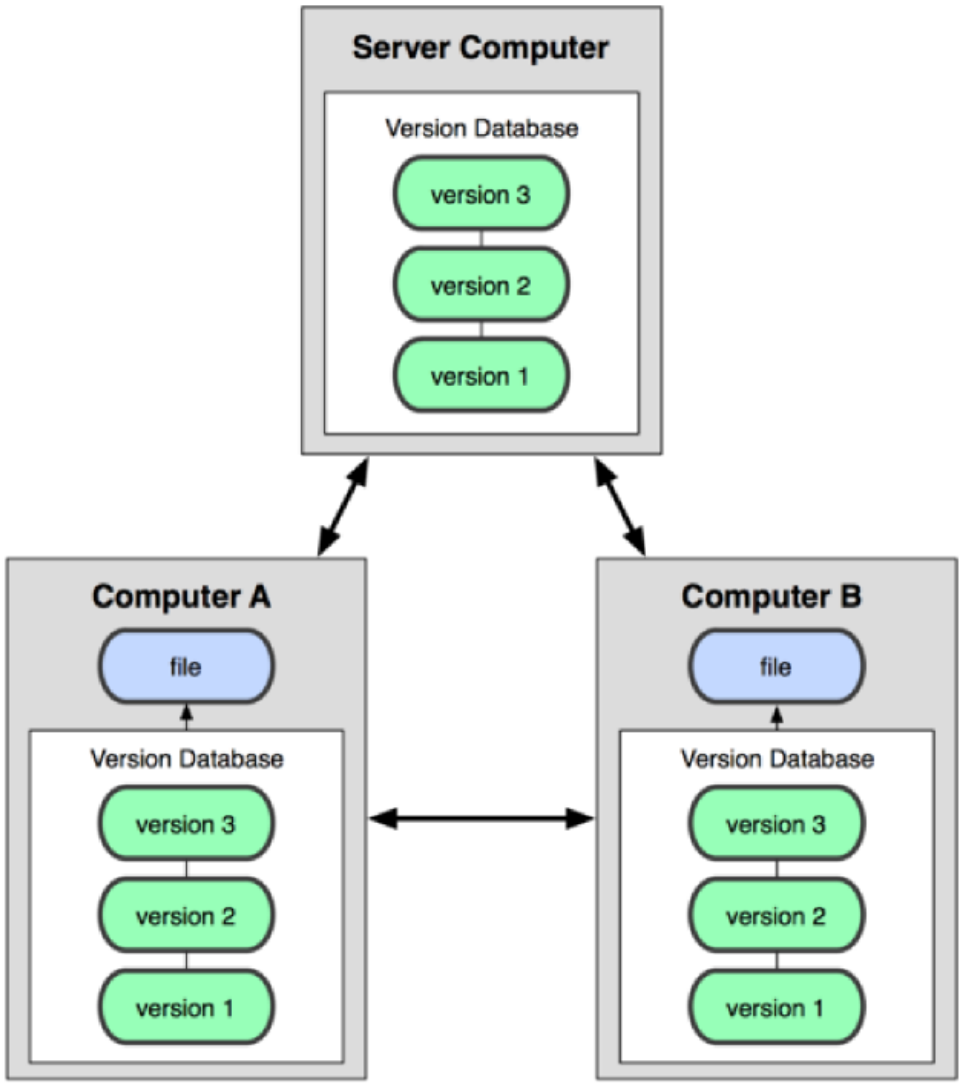
Misnomer:

- ~~Versioning~~

Q: have you ever used VC? (raise your hand = YES)

Version Control: Local, Centralized, Distributed





From *Pro Git*, S.Chacon 2009, CC 3.0 license.

Survey: `git`

- Q1: Have you heard about `git`?
- Q2: Do you use `git`?
- Q3: Why the "`git`" name? (from `git` FAQ)
  1. Random three-letter combination that is pronounceable.
  2. Acronym (global information tracker).
  3. Irony.

`git`? Why "`git`"?

Linus Torvalds: *"I name all my projects after myself. First Linux, now* ***`git`****."*

http://www.merriam-webster.com/dictionary/git

[1]git *noun* \'git\

Definition of GIT

British **:** a foolish or worthless person

Examples of GIT

- That *git* of a brother of yours has ruined everything!
- <oh, don't be such a silly *git*, of course your mates want you around>

Origin of GIT

variant of *get*, term of abuse, from [2]*get*

First Known Use: 1929

Related to GIT

Synonyms: berk [*British*], booby, charlie (*also* charley) [*British*], cuckoo, ding-a-ling, dingbat, ding-dong, dipstick, doofus [*slang*], featherhead, fool [*British*], goose, half-wit, jackass, lunatic, mooncalf, nincompoop, ninny, ninnyhammer, nit [*chiefly British*], nitwit, nut, nutcase, simp,

git

git

```
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
   ...
```

git help <command>

git status

git

Introduce yourself to **`git`**:

```
git config --global user.name "Emanuele Olivetti"
```

```
git config --global user.email "olivetti@fbk.eu"
```

`git`. Single developer + local repository.

Scenario 1: single developer + local repository.

Single+Local `git`. Motivations.

- **Q:** do you use VC for local repo?
- Why VC for single developer + local repository?
  - First step towards a shared project.
  - Backup.
  - To keep the memory of your work.

Single+Local `git`. Init.

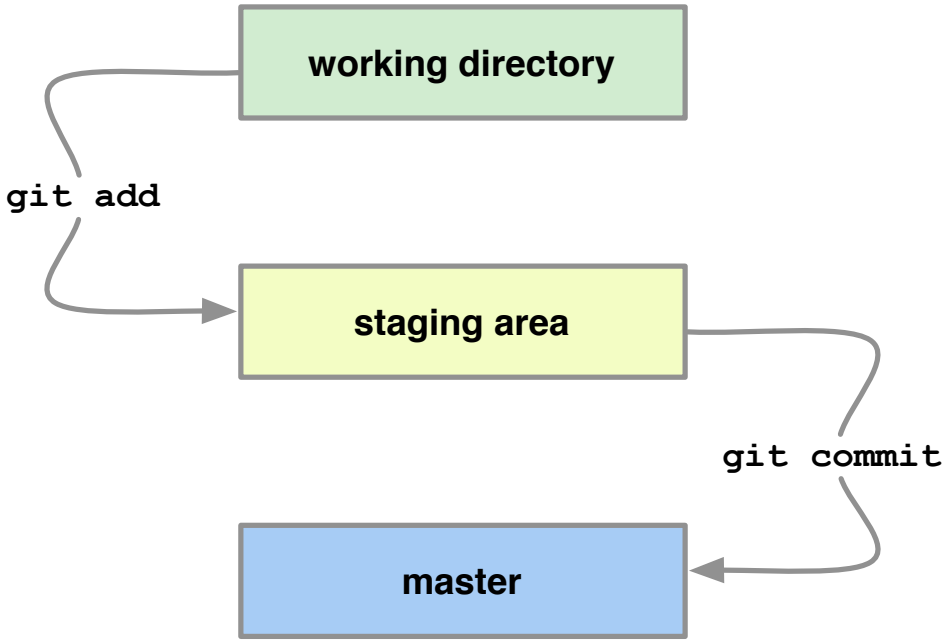
```
git init
```

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

Note: it is **safe**. It does not change your pre-existing files.

Single+Local `git`. The tracking process.

```
git add <filename>
```




```
git commit -m "Let us begin."
```

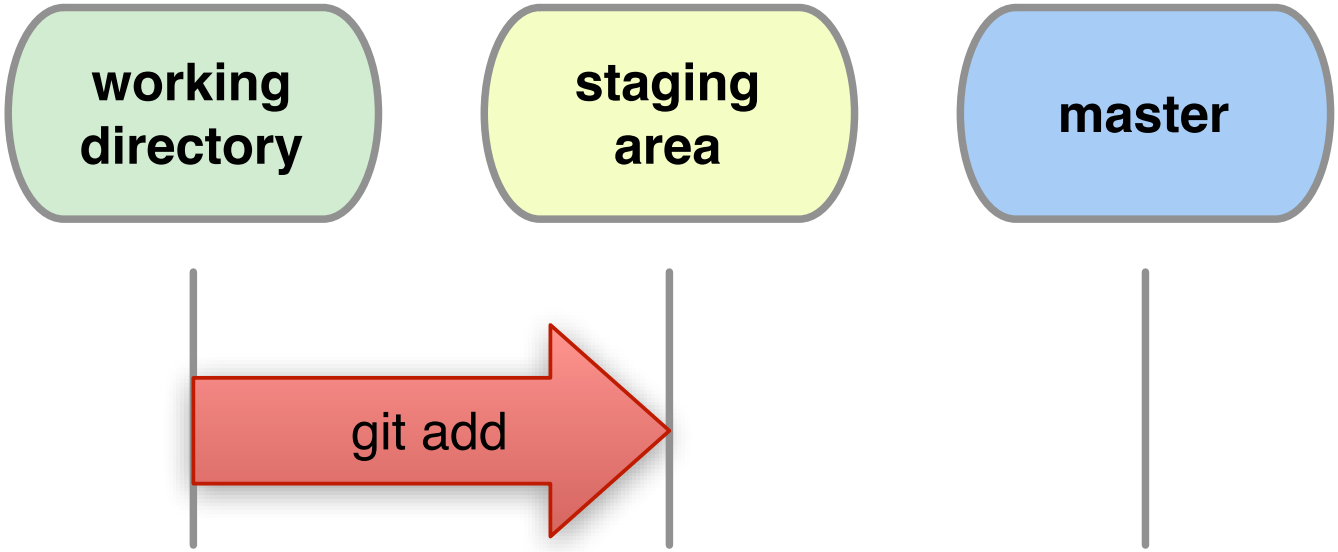
Wikipedia

"A *staging area* is a location where organisms, people, vehicles, equipment or material are assembled before use".

Single+Local `git`. Add.

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

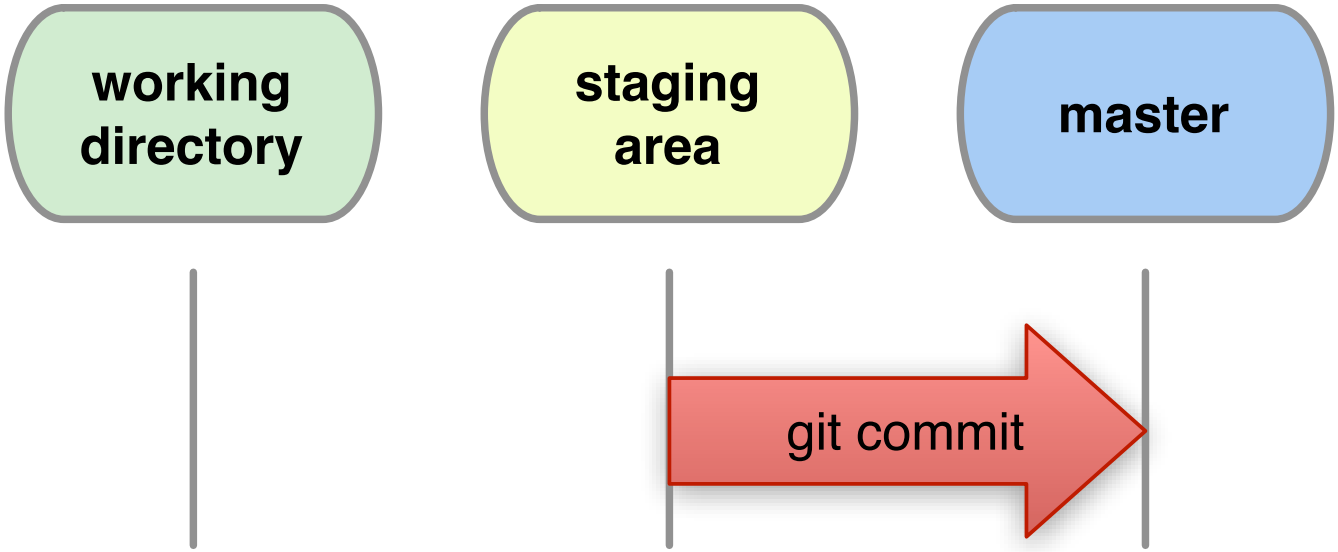
- Adds new files for next commit.
- Adds content from working dir to the staging area (index) for next commit.
- DOES NOT add info on file permissions other than *exec/noexec* (755 / 644).
- DOES not add directories *per se*.



Single+Local `git`. Commit.

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

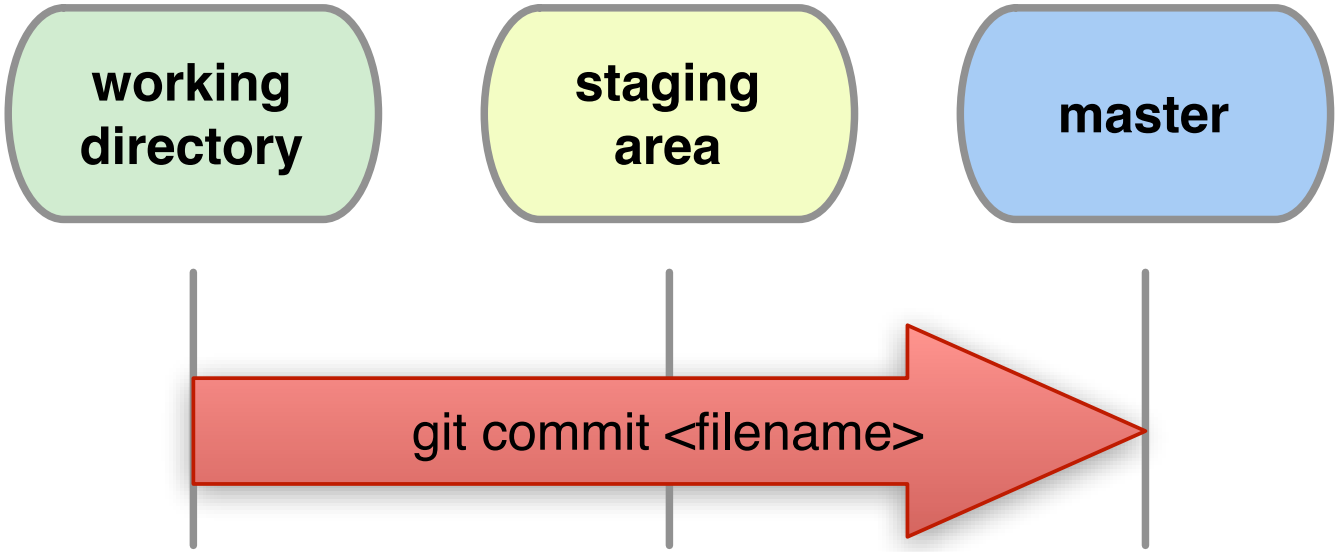
Records changes from the staging area to master.



Single+Local `git`. Commit.

`git commit file1 file2`

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



`git commit -a`

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

Single+Local `git`. Commit names. OPTIONAL

- Every *commit* is a **`git`**-object.
- The history of a project is a graph of objects referenced by a 40-digit **`git`**-name: *SHA*1(*object*).
- *SHA*1(*object*) = 160-bit Secure Hash Algorithm.
- Examples:

```
$ git commit README -m "Added README."
[master dbb4929] Added README.
1 files changed, 1 insertions(+), ...
```

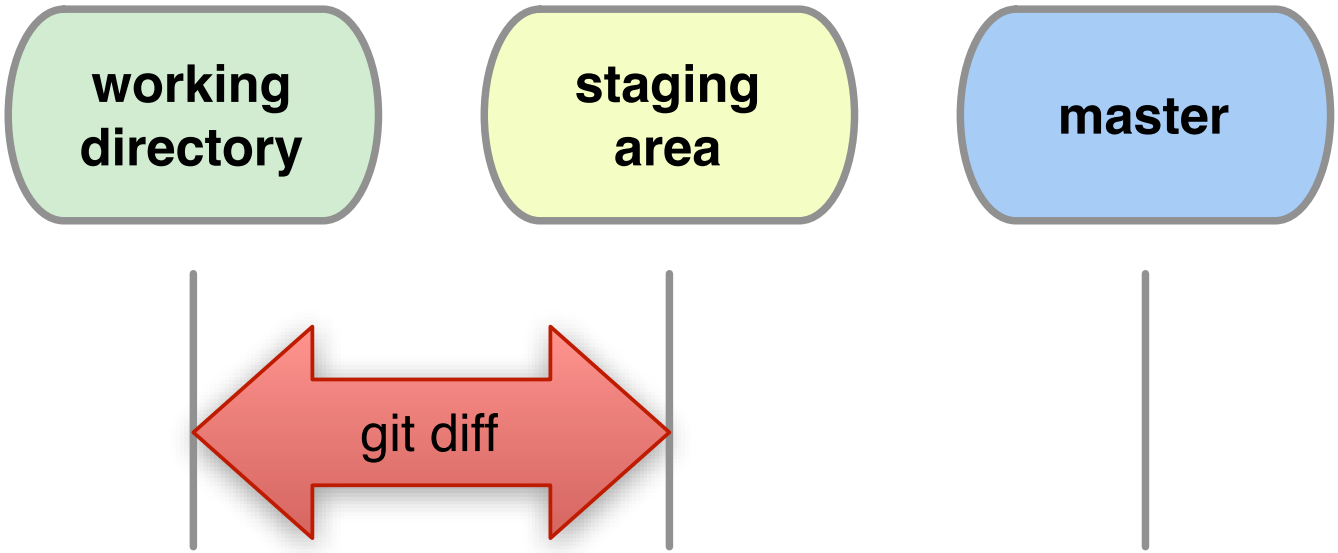
or

```
$ git log
commit dbb49293790b84f0bdcd74fd9fa5cab0...
Author: Emanuele Olivetti <olivetti@fbk.eu>
Date:   Wed Sep 15 00:08:46 2010 +0200
...
```

Single+Local `git`. Diff.

`git diff`

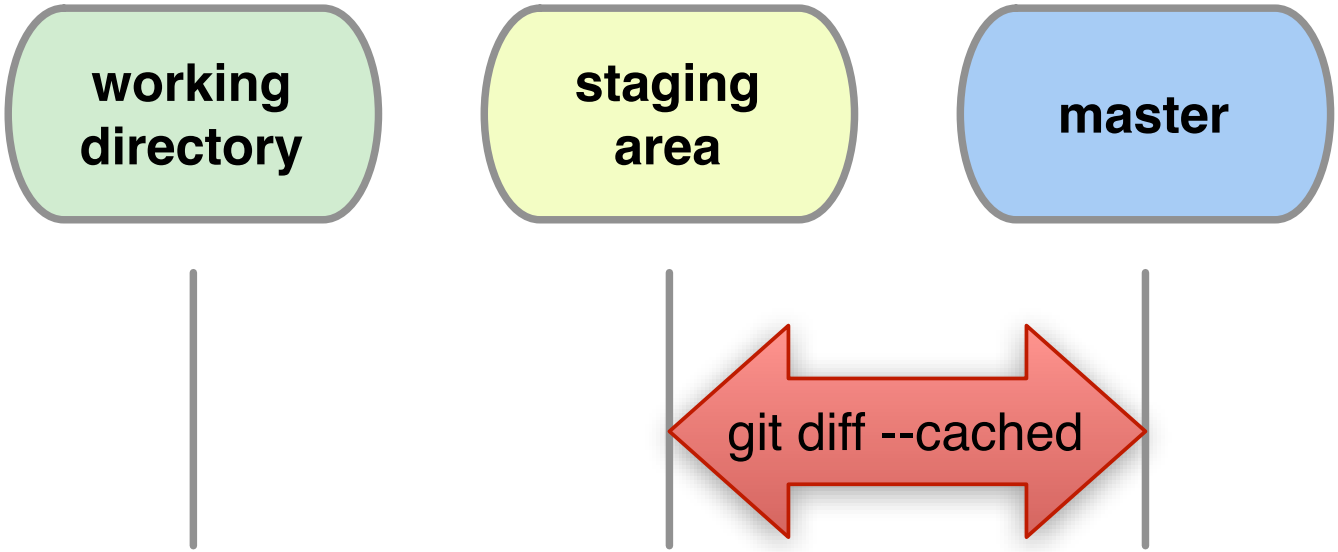
Shows what changes between *working directory* and *staging area* (*index*).



Single+Local `git`. Diff. OPTIONAL

Q: "`git add`" then "`git diff`". What output?

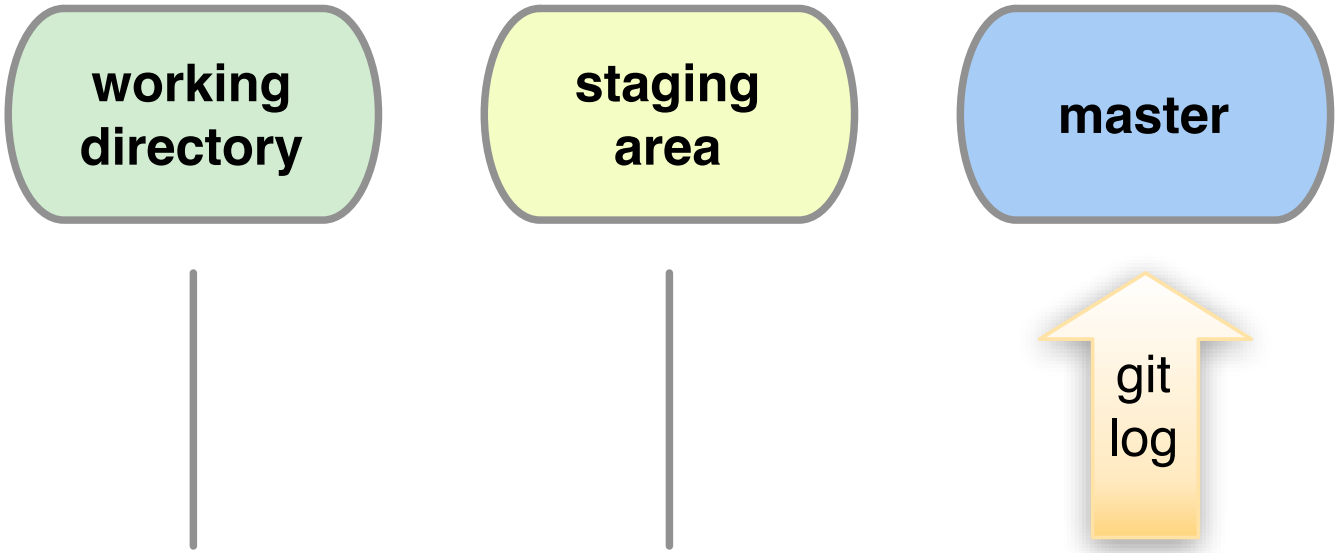
`git diff --cached` shows differences between index and last commit (HEAD).



Single+Local `git`. Logs.

```
git log
```

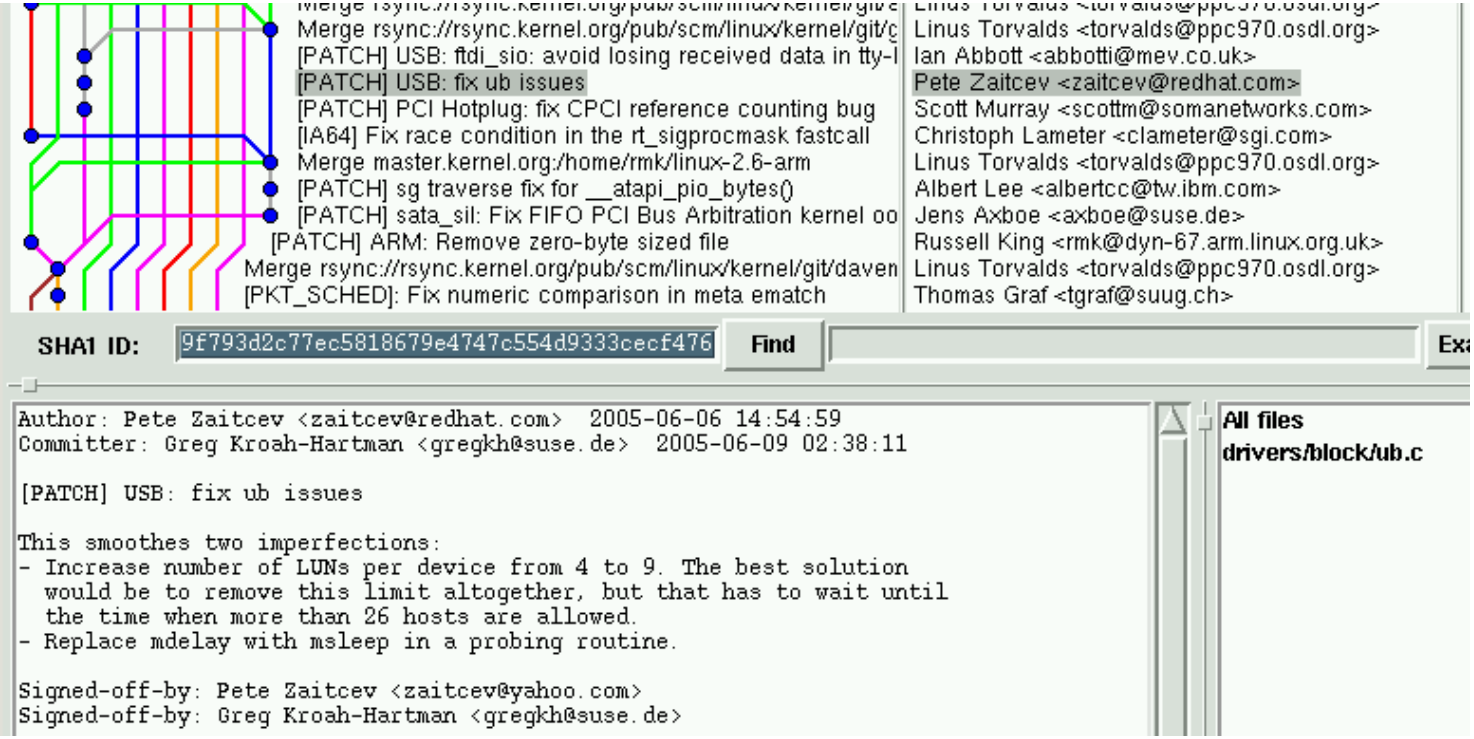
Shows details of the commits.



Single+Local `git`. Logs.

`gitk`

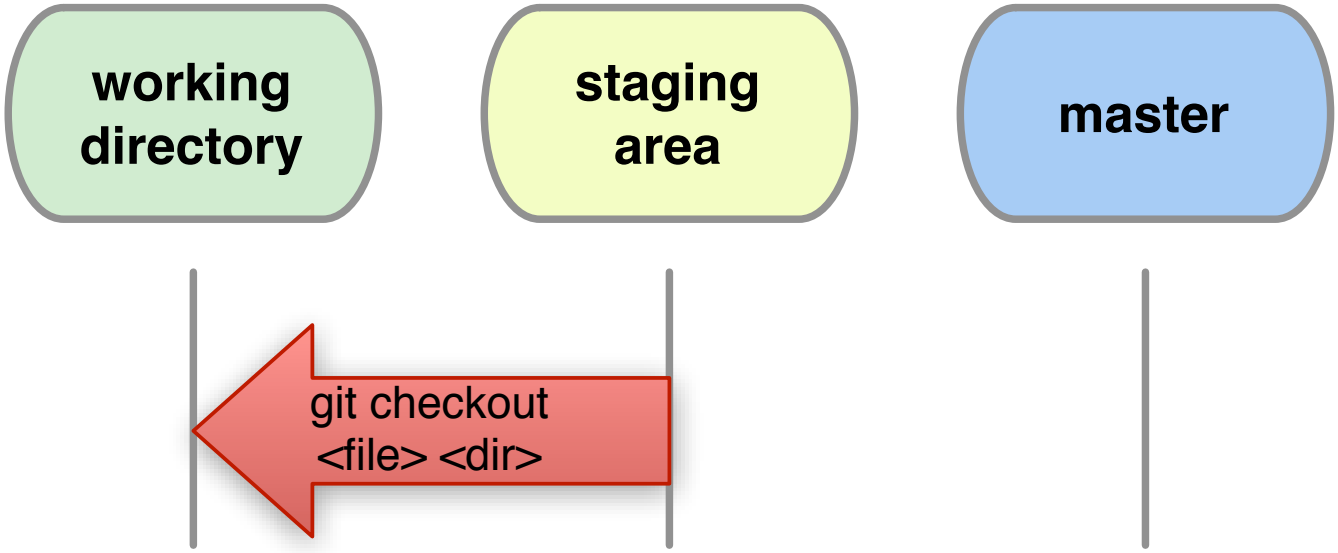
GUI to browse the **`git`** repository.



Single+Local `git`. “How to clean this mess??” OPT.

```
git checkout <filename>
```

Get rid of what changed in `<filename>` (between working dir and staging area).



Single+Local `git`. Time travelling. OPTIONAL

Back to the past when you did commit `dbb49293790b84...`

```
git checkout dbb4929
```

...and now, *back to the present!*

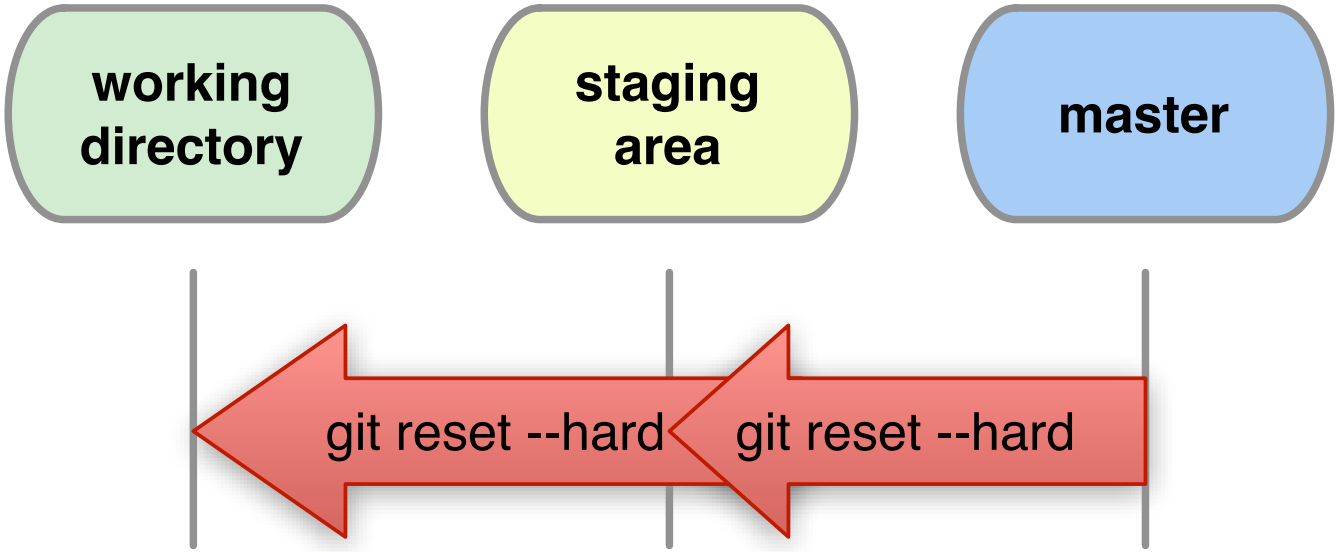
```
git checkout master
```

Single+Local `git`. “How to clean this mess??”. OPT.

First read *carefully* **`git status`**. If you panic:

```
git reset --hard HEAD
```

Restore all files as in the last commit.



Warning: `reset` can destroy history!

Single+Local `git`. (Re)move. OPTIONAL

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."
```

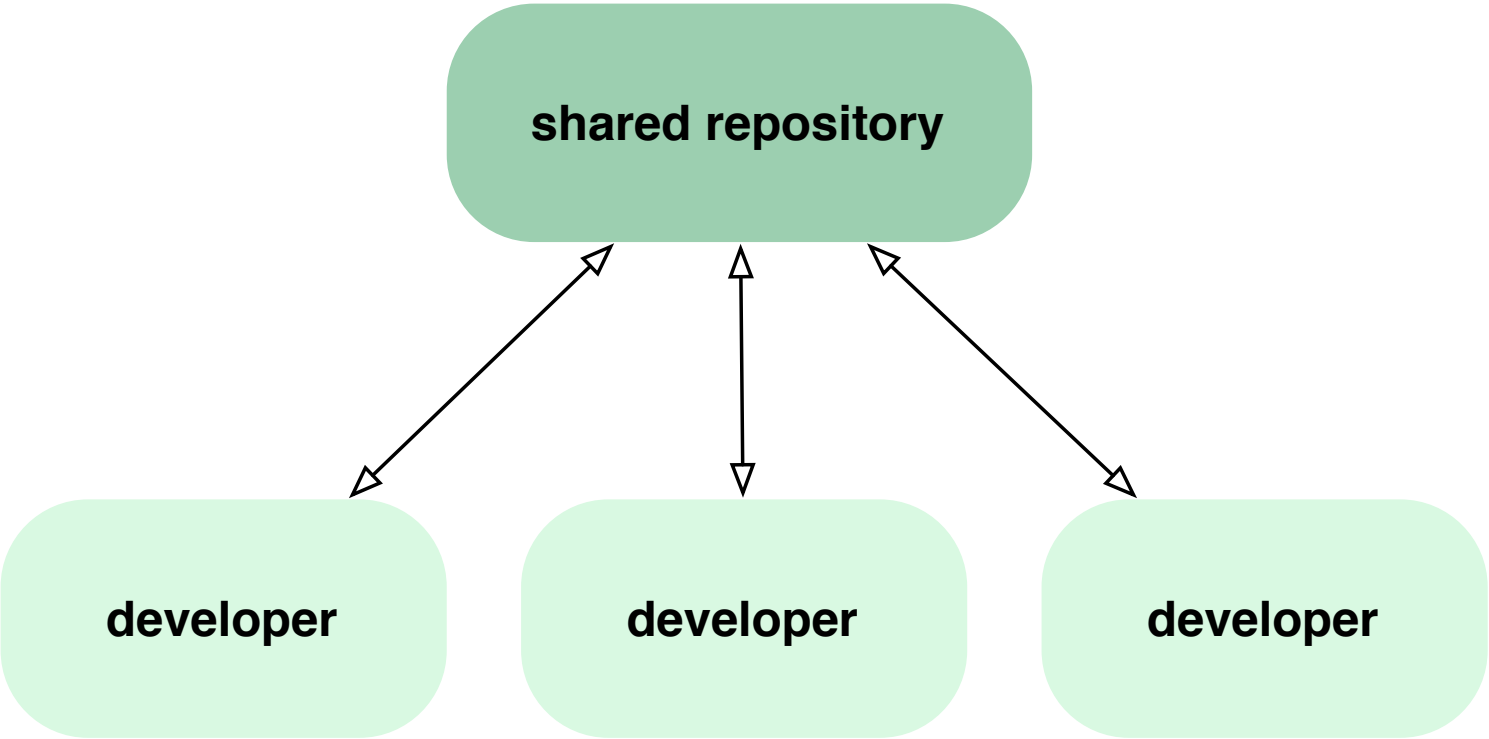
Single+Local `git`. Demo.

Demo: **`demo_git_single_local.txt`**

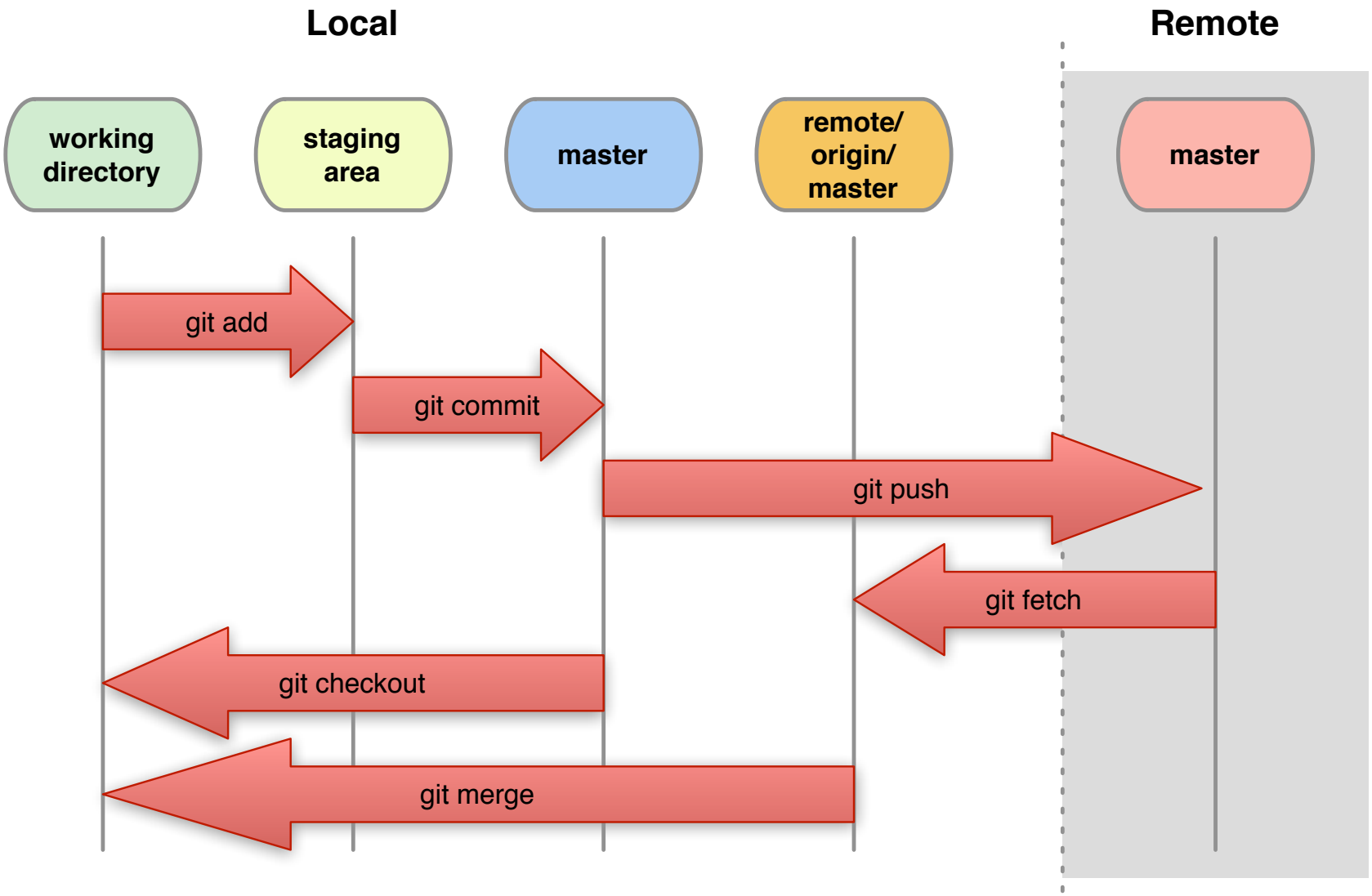
multi+remote/shared `git`.

Scenario 2: multiple developers + remote central repository.

multi+remote/shared `git`.



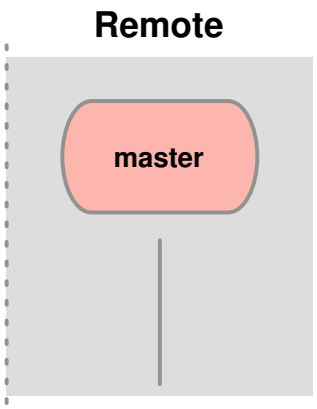
multi+remote/shared `git`.



multi+remote/shared `git`.

```
git clone <URL>
```

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



Available transport protocols:

- `ssh://`, `git://`, `http://`, `https://`, `file://`

Ex.: `git clone https://github.com/ASPP/pelita.git`

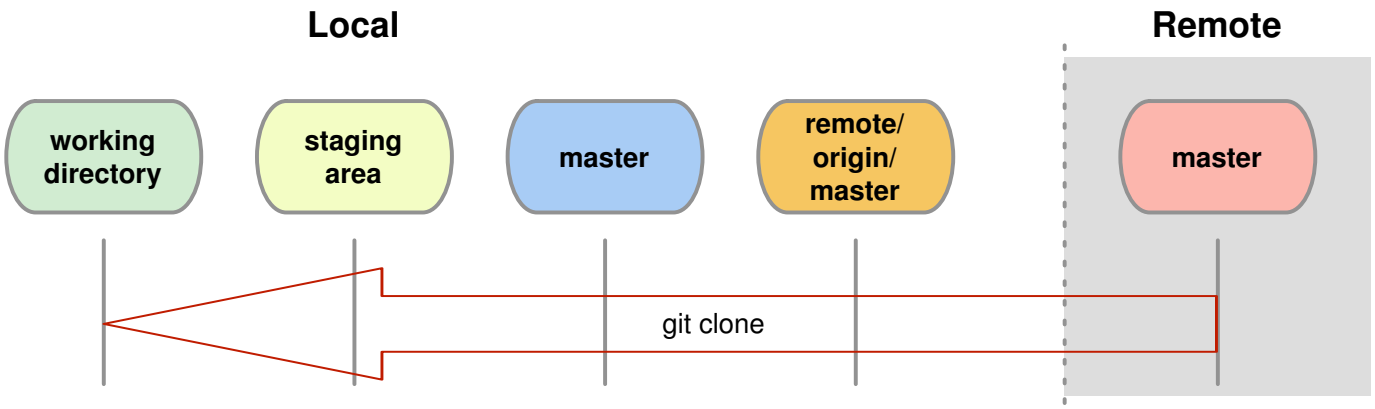
```
git remote -v
```

shows **name** and `URL` of the remote repository.

multi+remote/shared `git`.

```
git clone <URL>
```

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



Available transport protocols:

- `ssh://`, `git://`, `http://`, `https://`, `file://`

Ex.: `git clone https://github.com/ASPP/pelita.git`

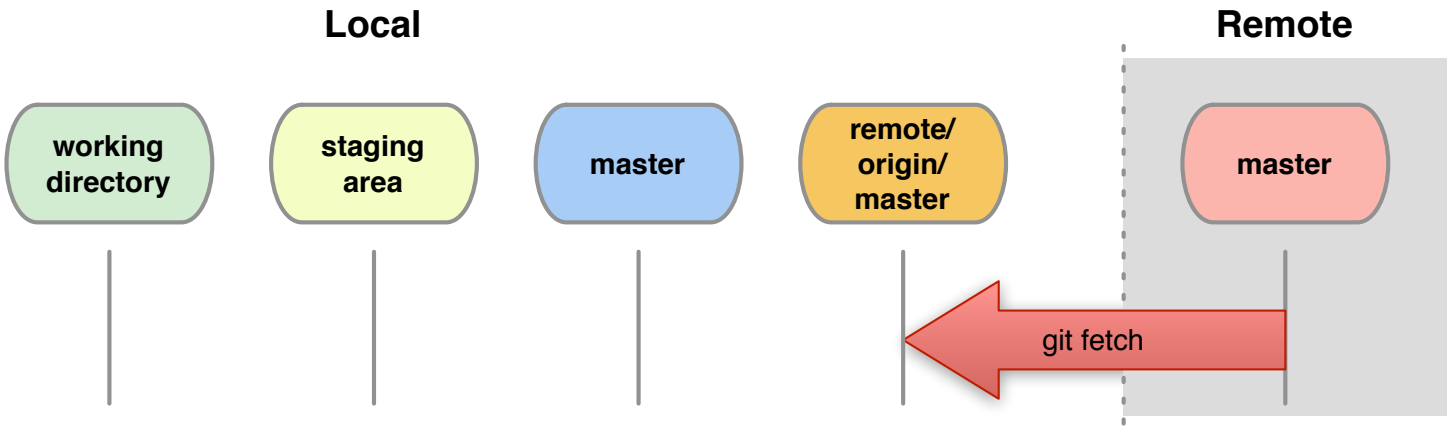
```
git remote -v
```

shows **name** and `URL` of the remote repository.

multi+remote/shared `git`. Fetch.

`git fetch`

- Downloads updates from remote master to local remote master.
- The local master, staging area and working directory do not change.



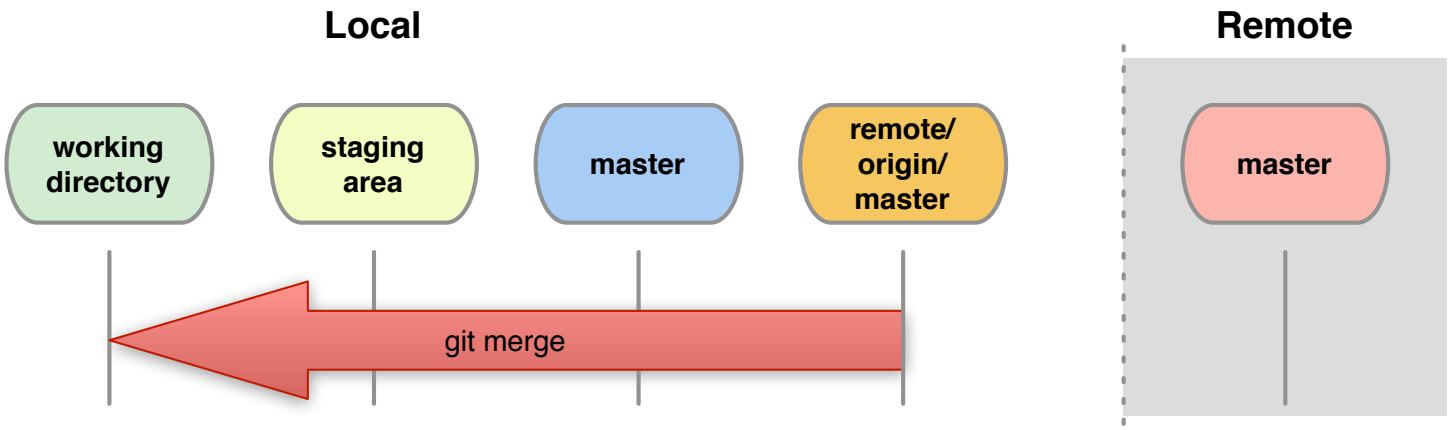
Q: Why **origin**?

A: Just a label for **Remote**. Choose the one you like.

multi+remote/shared `git`. Merge.

`git merge`

- Joins development histories together.
- Warning: can generate *conflicts*!
- **Note**: it merges only when all changes are committed.



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

multi+remote/shared `git`. Conflicts.

Conflict!

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

multi+remote/shared `git`. Conflicts.

How to resolve conflicts.

1. See where conflicts are:

```
git diff
```

2. Edit conflicting lines.
3. Add changes to the staging area:

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

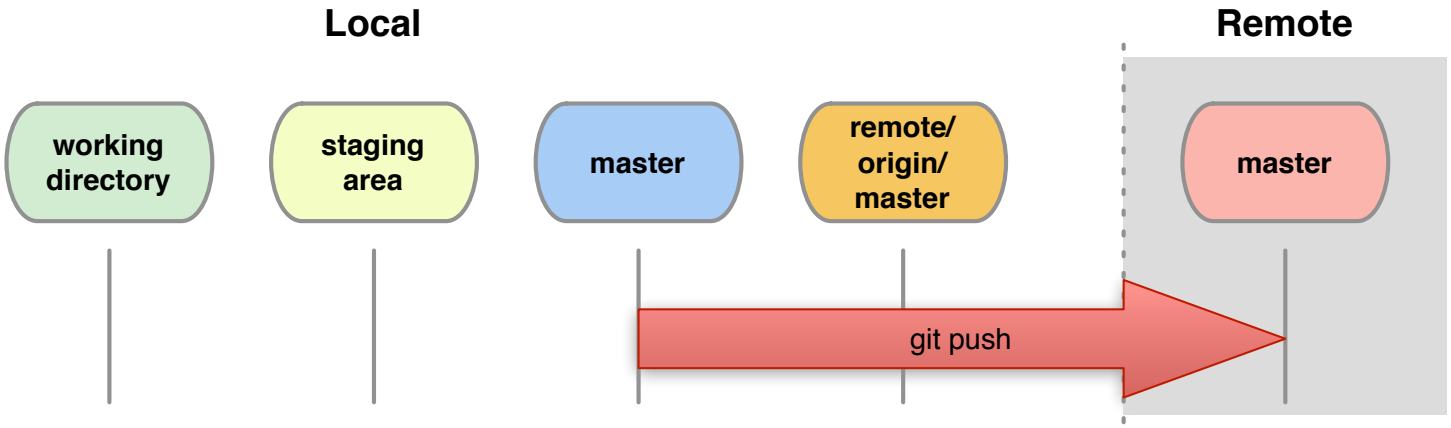
4. Commit changes:

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

multi+remote/shared `git`.

`git push`

- Updates *remote masters* (both Local and Remote).
- Requires **`fetch+merge`** first.



multi+remote/shared `git`.

Demo: **`demo_git_multi_remote.txt`**.

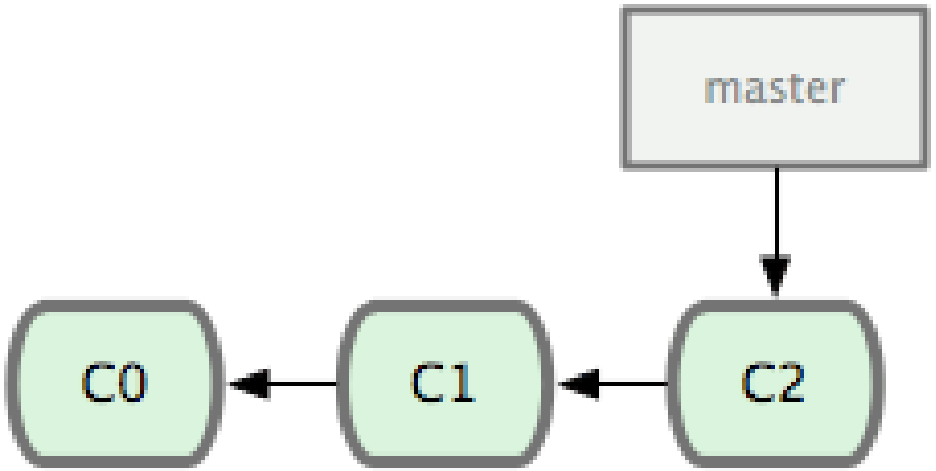
Other related files:

- **`create_remote_repo_sn.sh`**
- **`collaborator1.sh`**
- **`collaborator2.sh`**
- **`collaborator2.sh`**

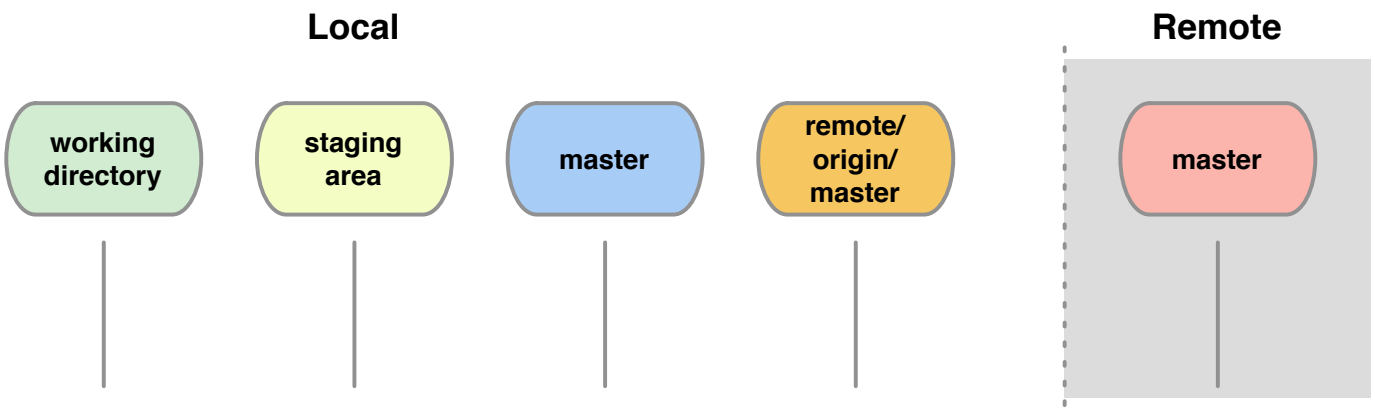
Branching.

basic branching

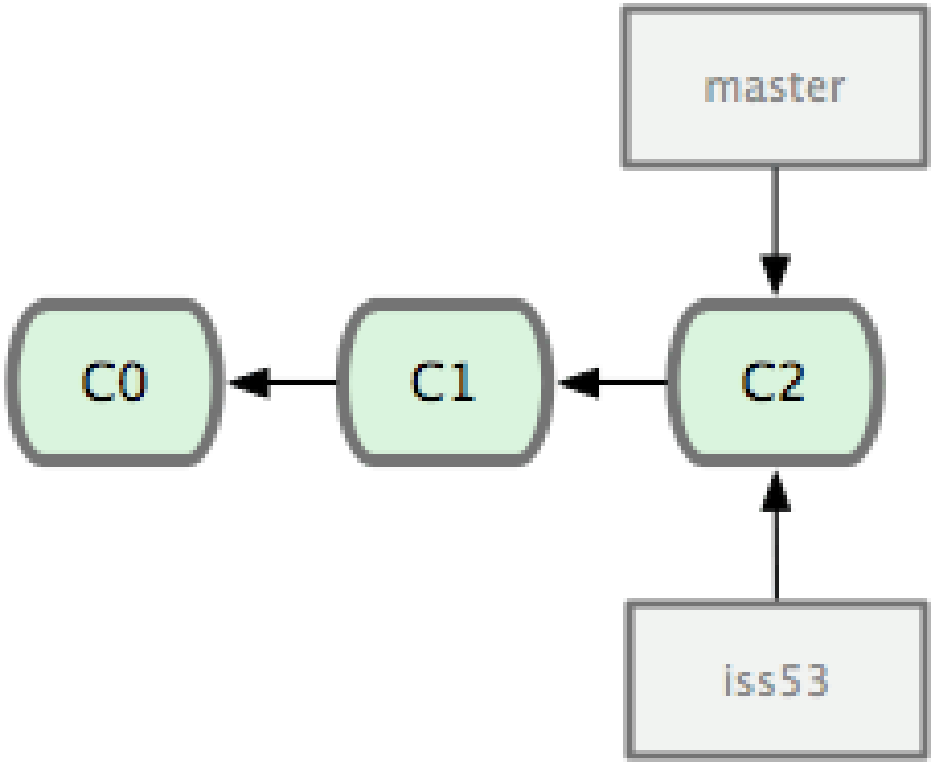
Branching.



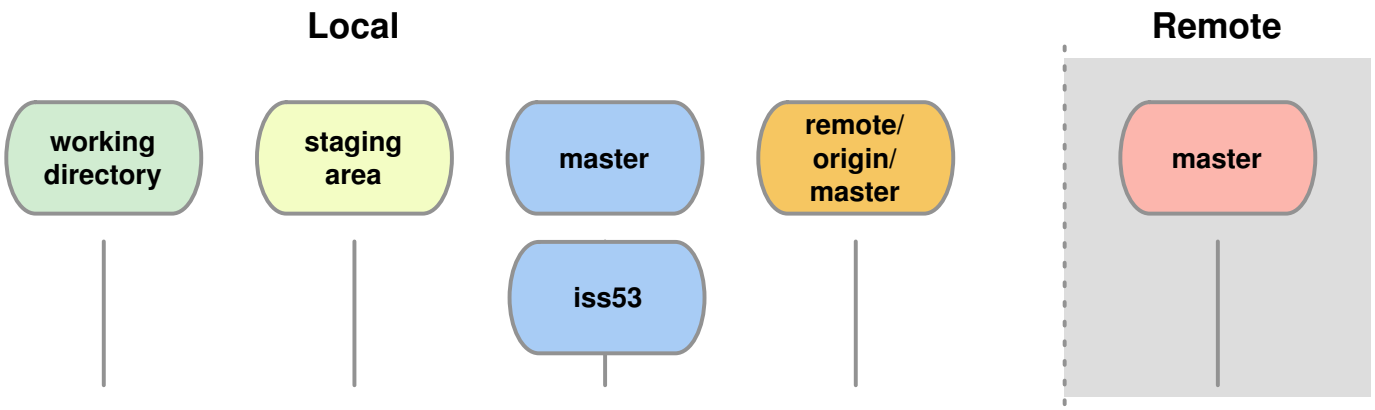

```
git commit (C0)
git commit (C1)
git commit (C2)
```



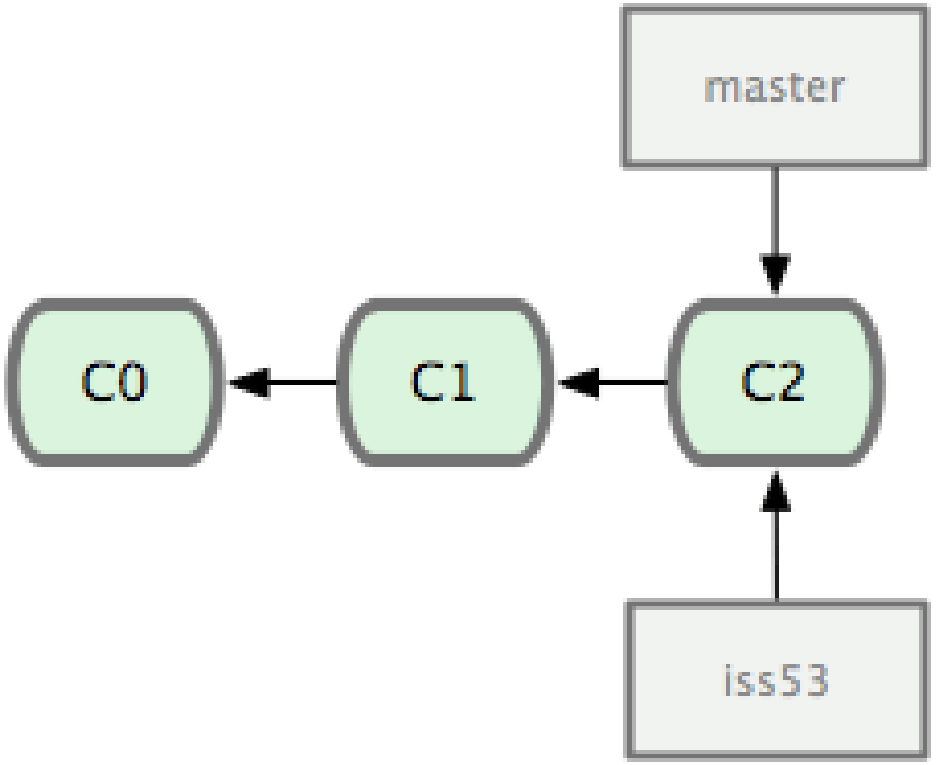
Branching.



git branch iss53
git checkout iss53
git checkout master



Branching.



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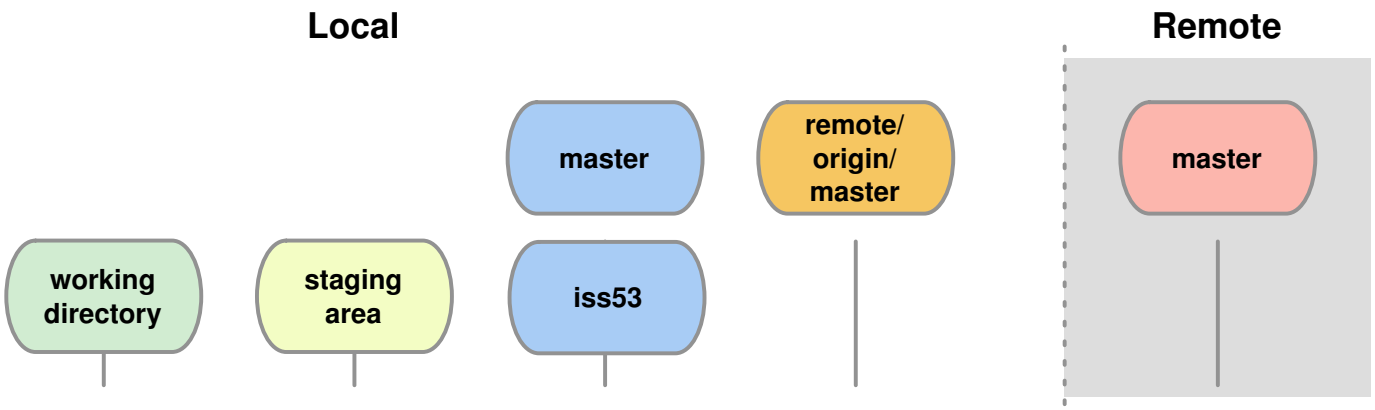
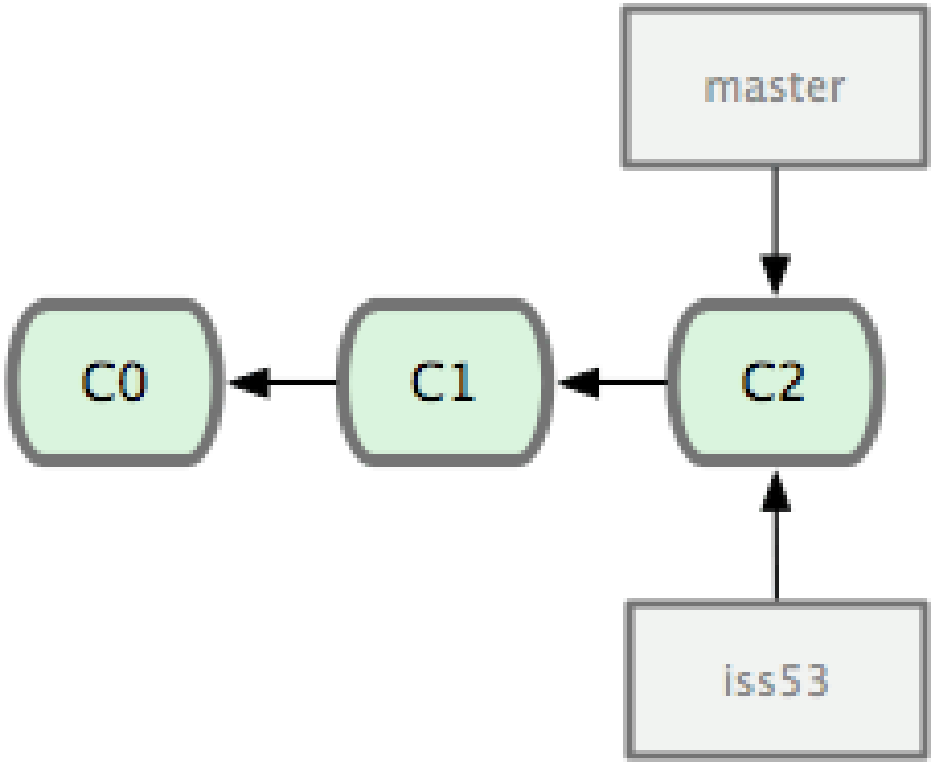
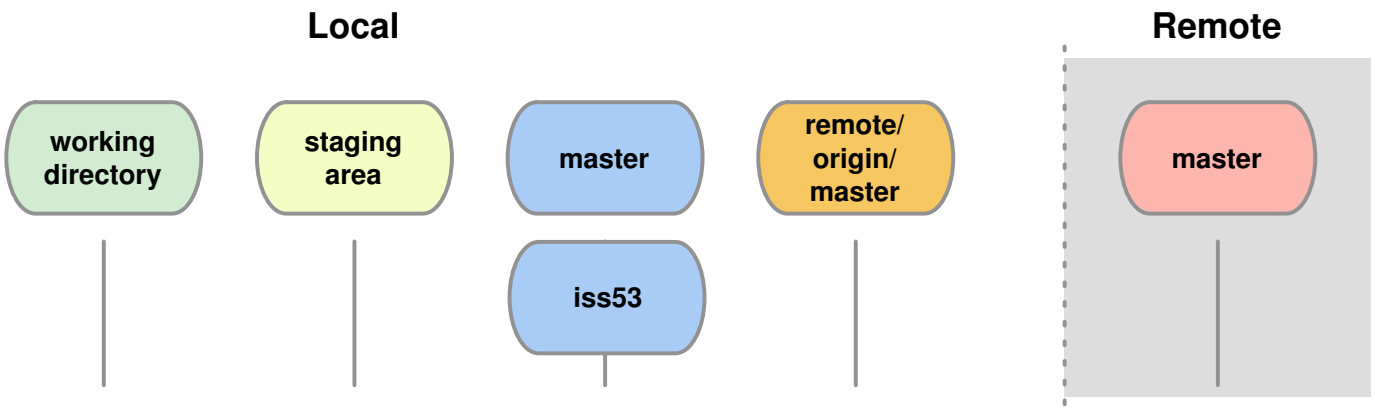


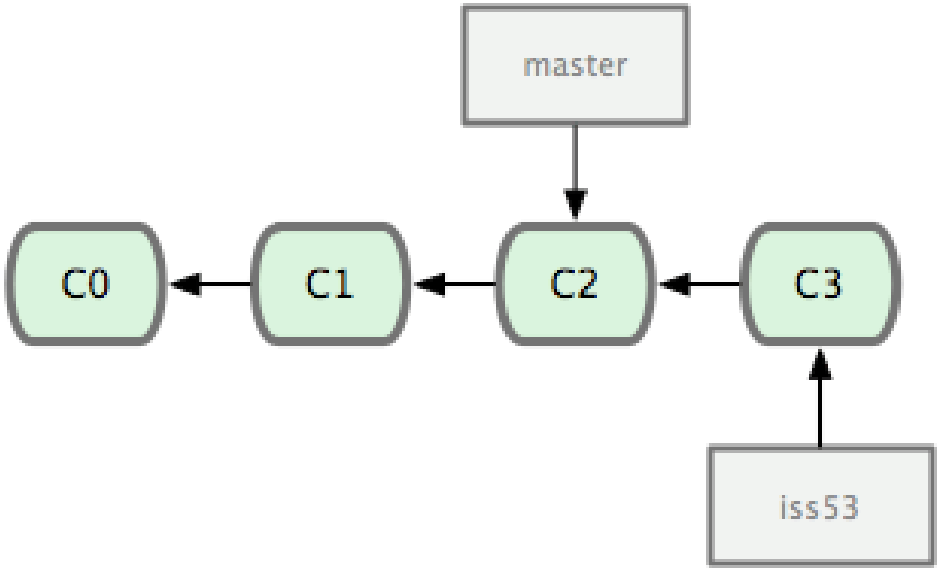
Branching.



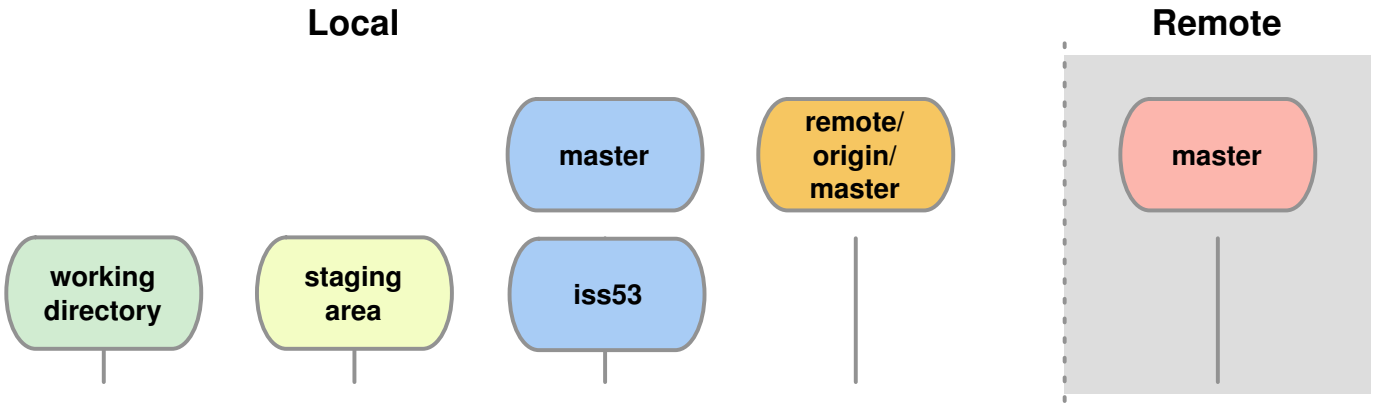
git branch iss53
git checkout iss53
git checkout master



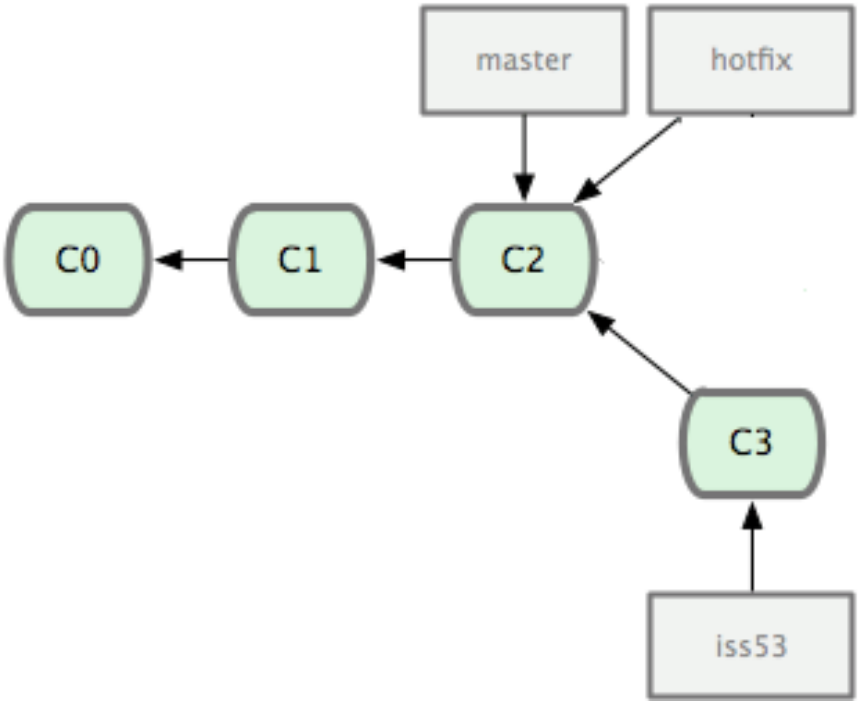
Branching.



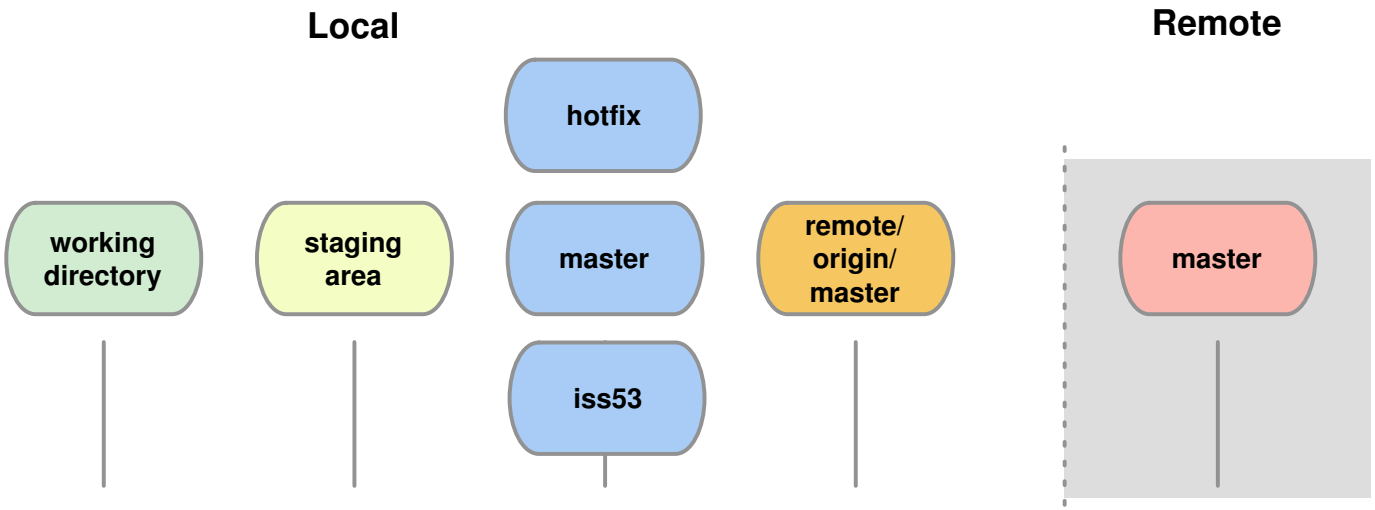

```
git checkout iss53
git commit (C3)
```



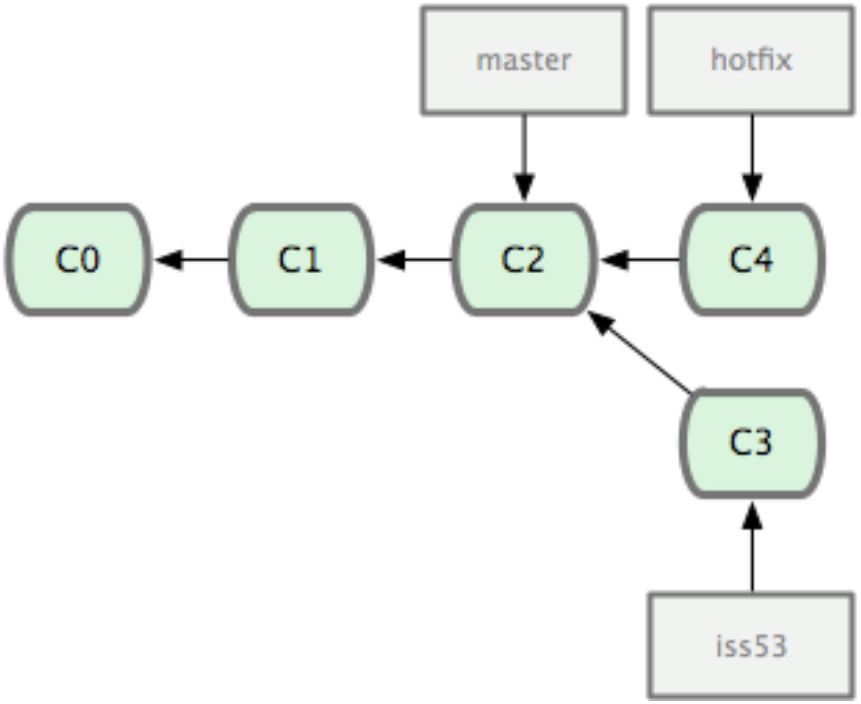
Branching.



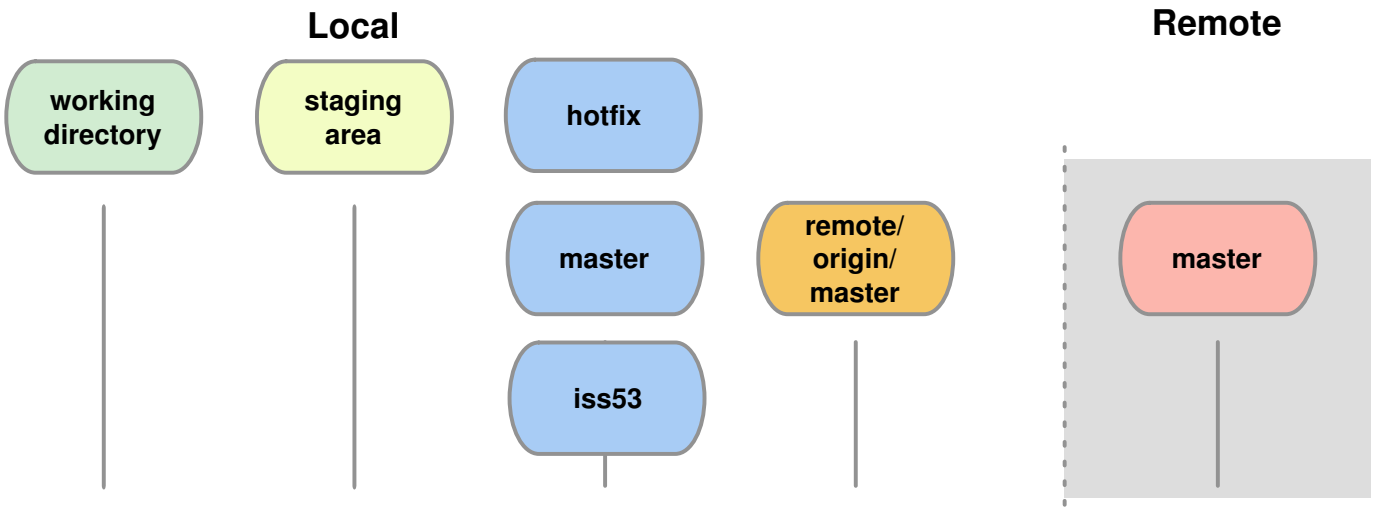
git branch hotfix
git checkout hotfix
git commit (C4)



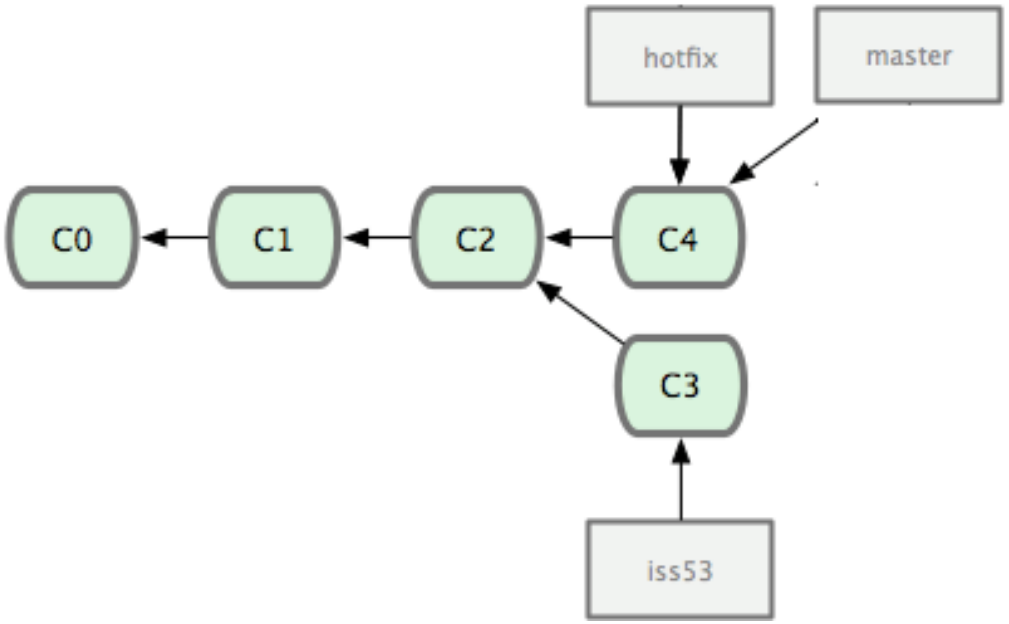
Branching.



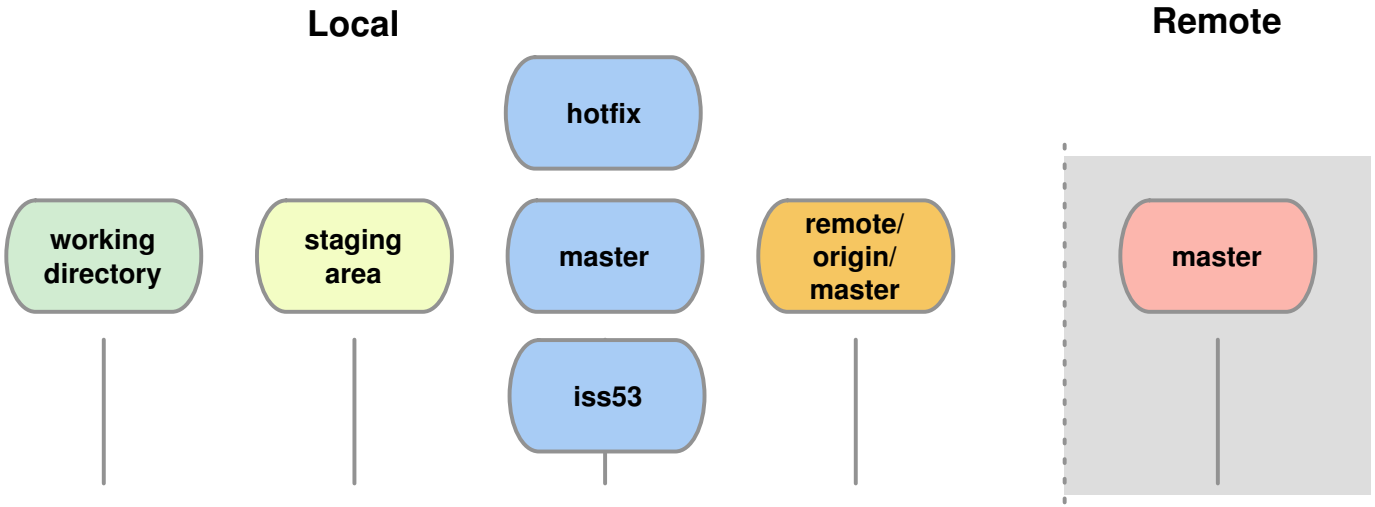
git branch hotfix
git checkout hotfix
git commit (C4)



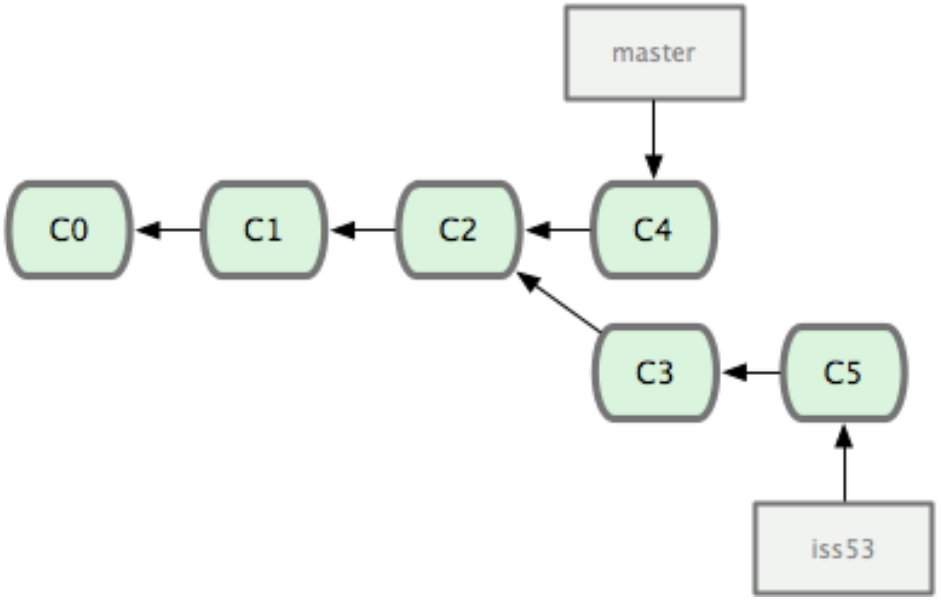
Branching.



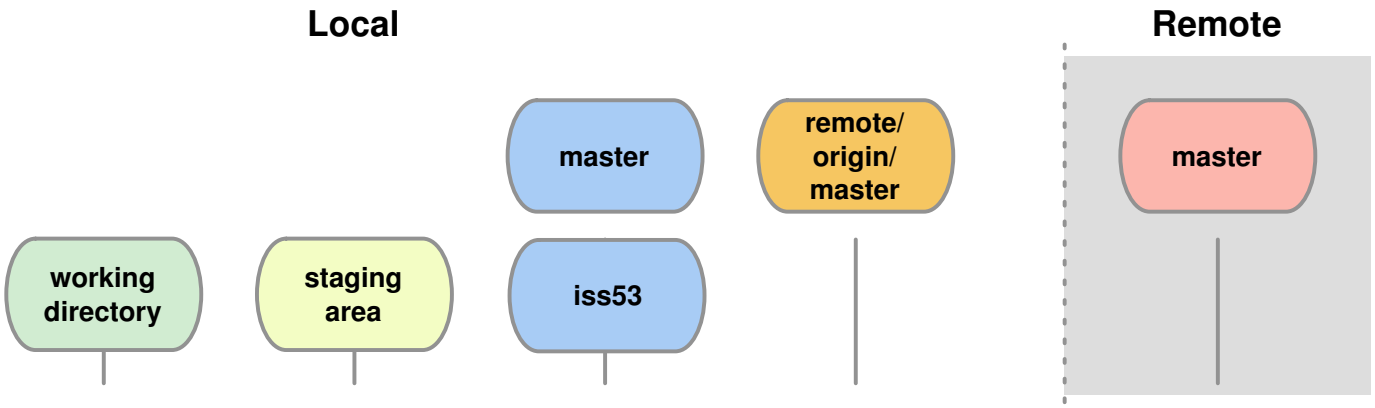

```
git checkout master
git merge hotfix
```



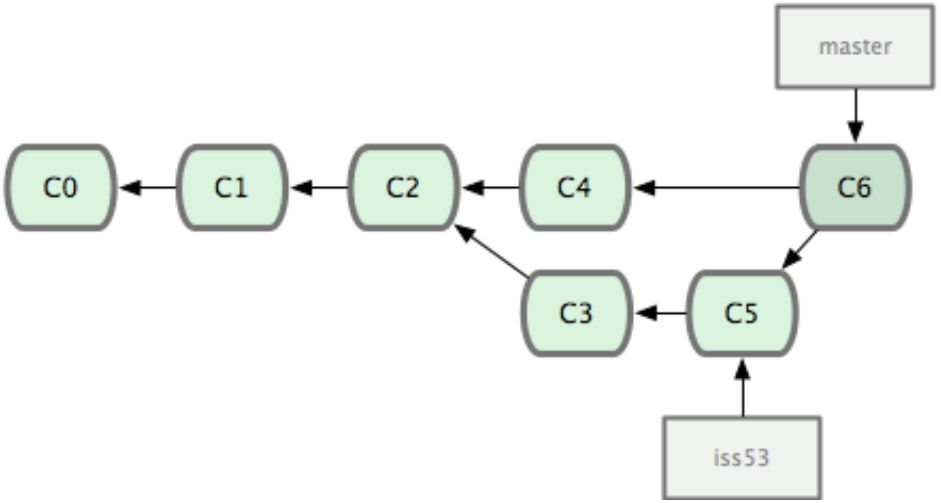
Branching.



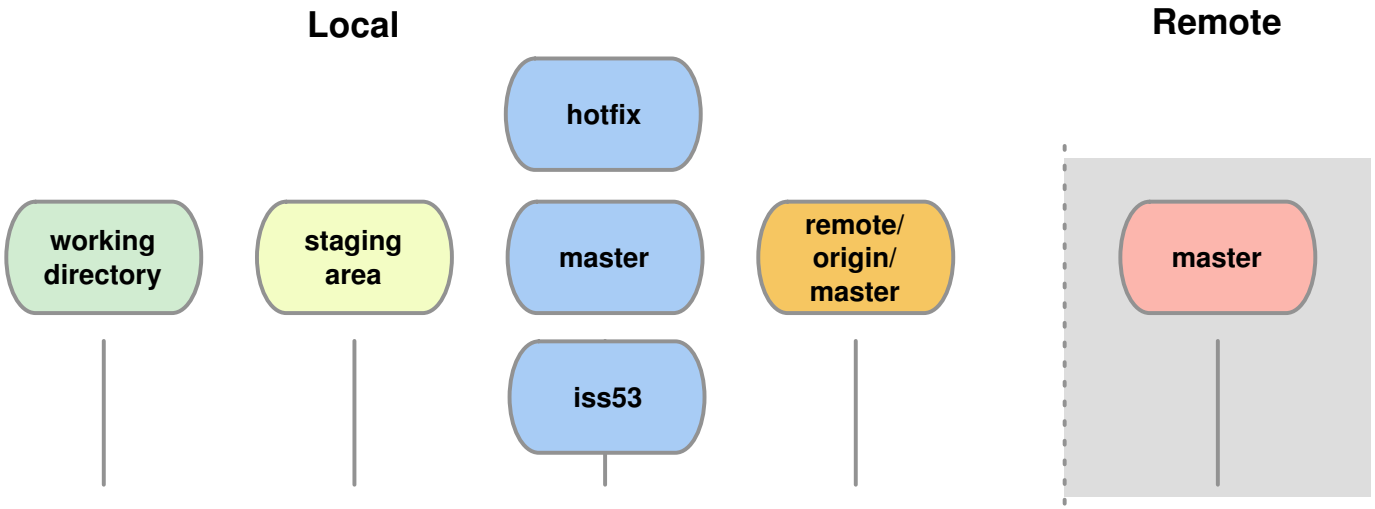

```
git checkout iss53
git commit (C5)
```



Branching.




```
git checkout master
git merge iss53
```

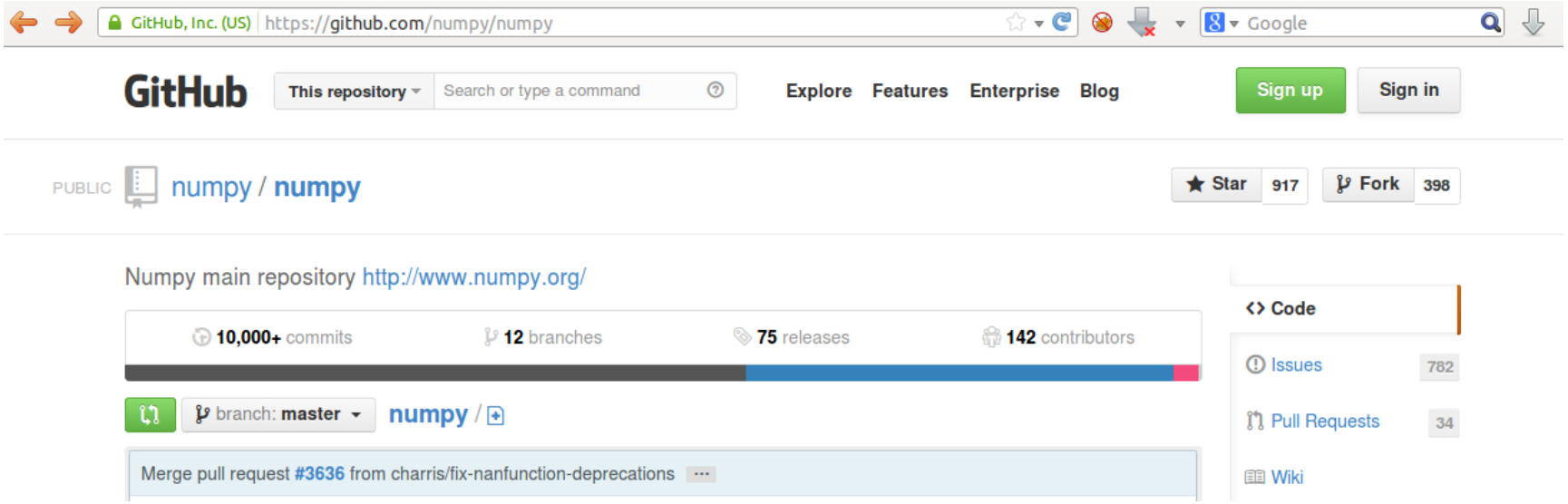


Contributing through GitHub

Scenario 3: contributing to a software project hosted on GitHub.

Contributing through GitHub

Q: Have you ever heard of GitHub?



What is GitHub?

- Wikipedia: *"GitHub is a web-based hosting service for software development projects that use* ***`git`****"*.
- 5 millions repositories (Jan 2013).
- Commercial...
- ...but friendly to Free / Open Source software projects.

Contributing through GitHub

Assumptions

- You use a software and feel ready to contribute to it.
- The software project is hosted on `http://github.com`

Intuitive Idea

- You **do not push** your changes to the main repository.
- Instead you create a public copy (**fork**) of the main repository...
- ...and then push your changes to that.
- Then you ask the owners of the main repository if they like your changes and want to merge them (**pull request**).

Contributing through GitHub. Not for everyone ;-)

torvalds commented

I don't do github pull requests.

github throws away all the relevant information, like having even a valid email address for the person asking me to pull. The diffstat is also deficient and useless.

Git comes with a nice pull-request generation module, but github instead decided to replace it with their own totally inferior version. As a result, I consider github useless for these kinds of things. It's fine for *hosting*, but the pull requests and the online commit editing, are just pure garbage.

I've told github people about my concerns, they didn't think they mattered, so I gave up. Feel free to make a bugreport to github.

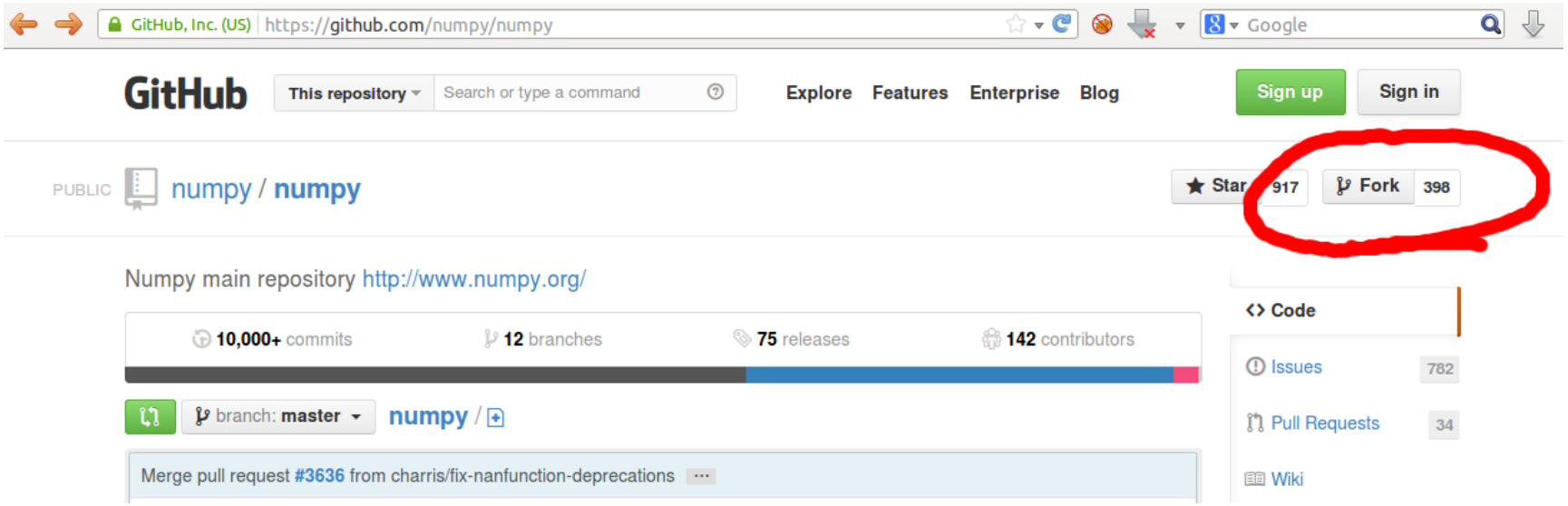
Linus

...

https://github.com/torvalds/linux/pull/17

Contributing through GitHub: Recipe I

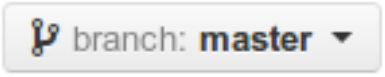
1. **Register** on `http://github.com`
2. **Visit** the GitHub page of the software project and **Fork** it:



3. **Clone your copy** of the project on your computer.

```
git clone git@github.com:<login>/<project>.git
```

4. Create a **branch** to host your improvements.



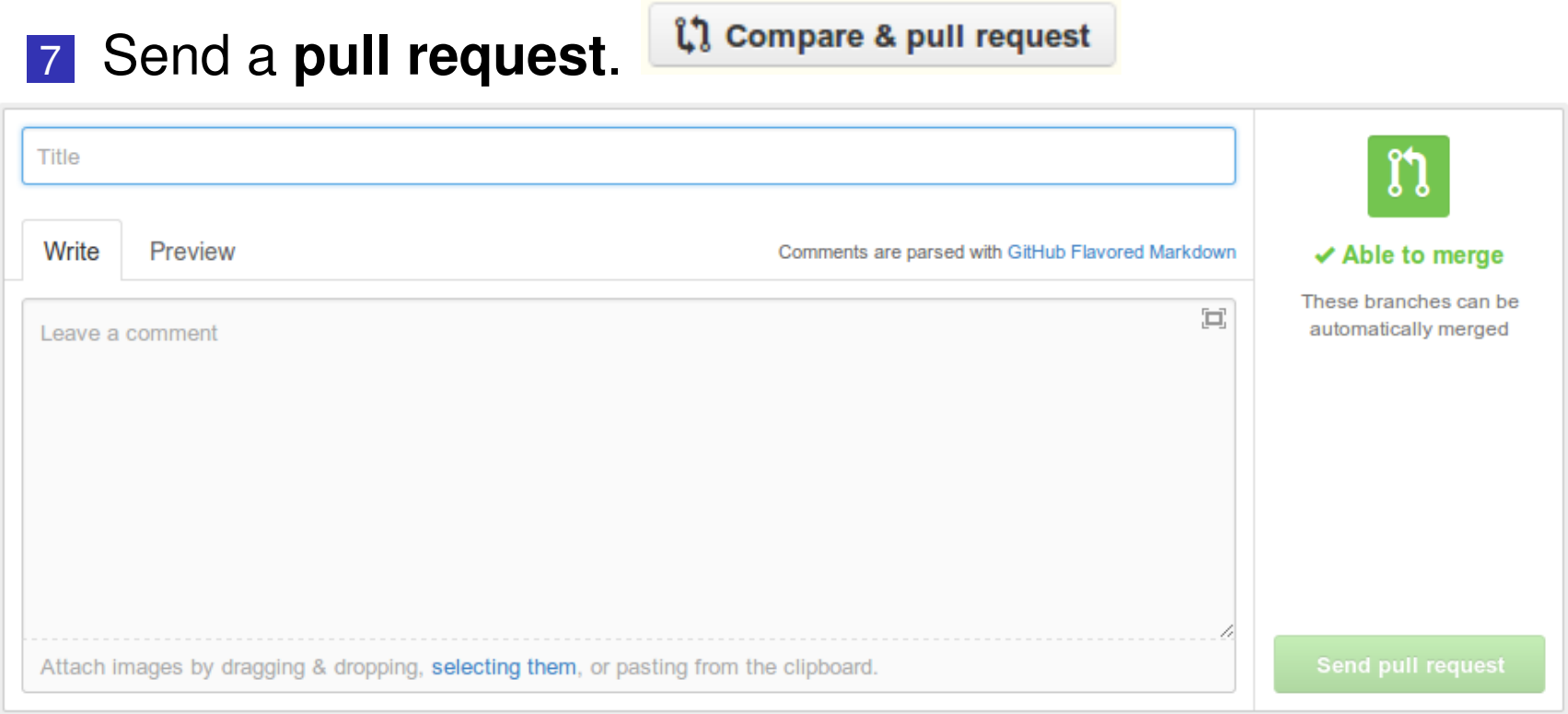
- `git branch <new-feature>`
- `git checkout <new-feature>`

Contributing through GitHub: Recipe II

5. Add your improvements.
   - `git add <new-file>`
   - `git commit -m ...`
6. **Push** your improvements.

```
git push origin <new-feature>
```

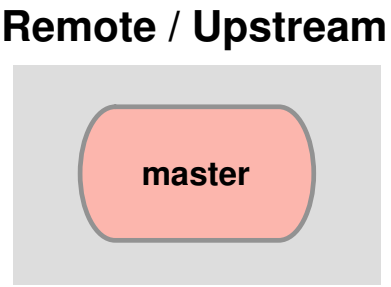
7. Send a **pull request**.



Contributing through GitHub

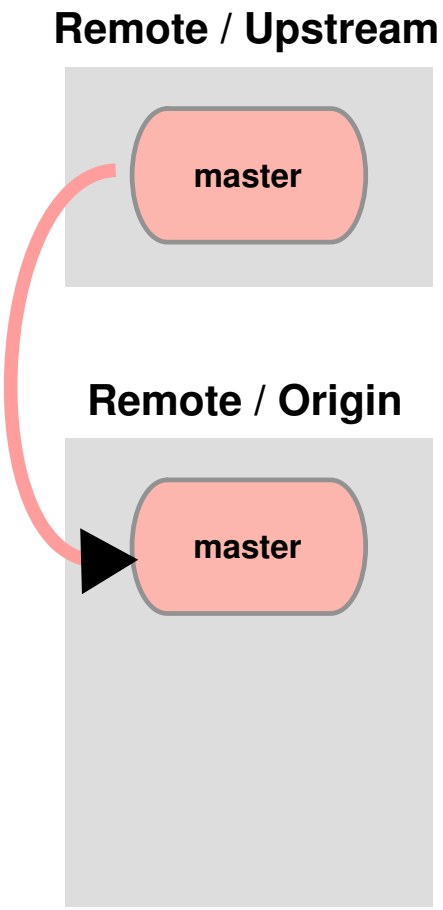
Detailed Explanation

Contributing through GitHub: Detailed Explanation



There is a software project hosted on remote GitHub repository (**upstream**). You want to improve it.

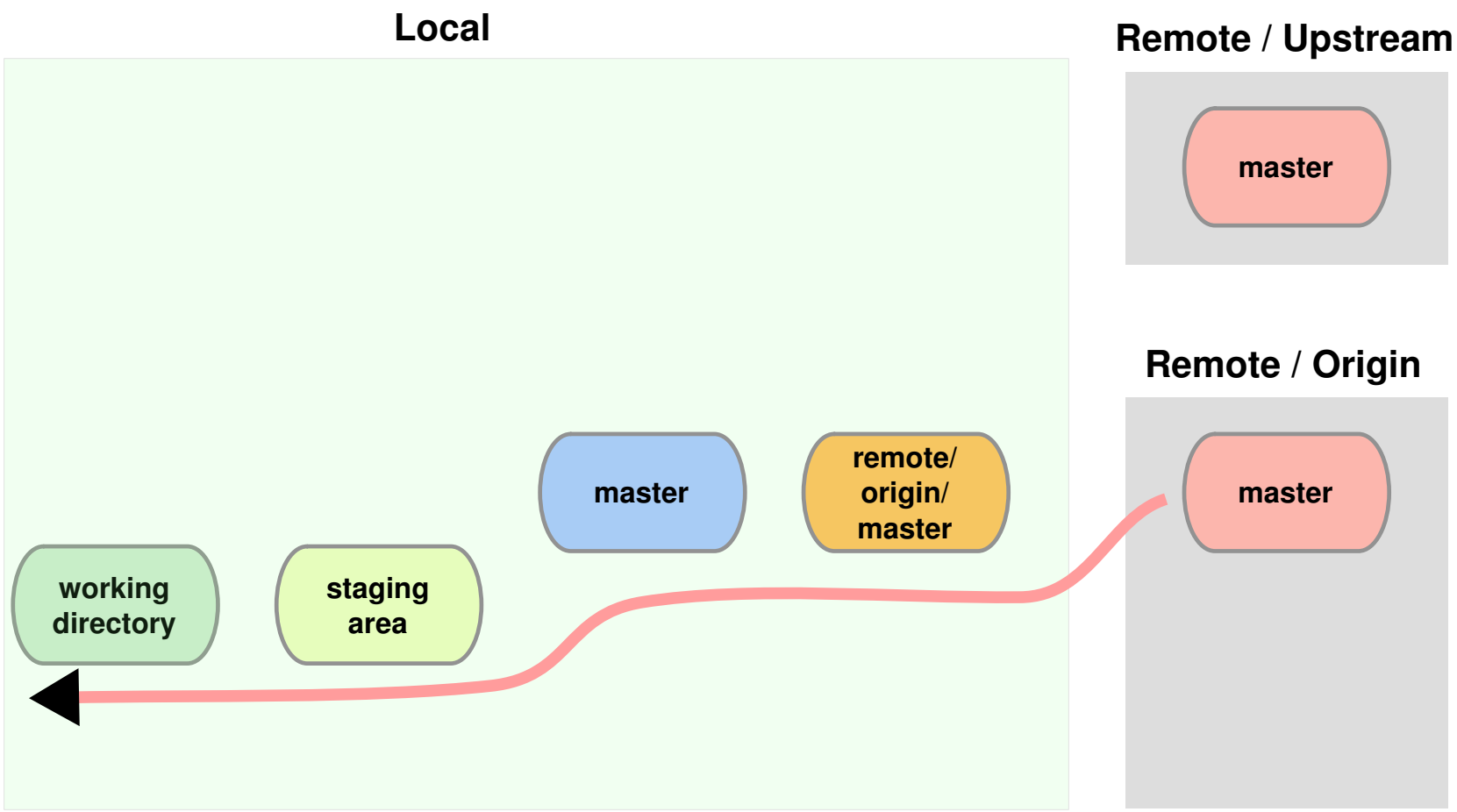
Contributing through GitHub: Detailed Explanation



So you **fork** it by creating a (remote) copy of it:

```
git clone --bare <UPSTREAM_URL>
```

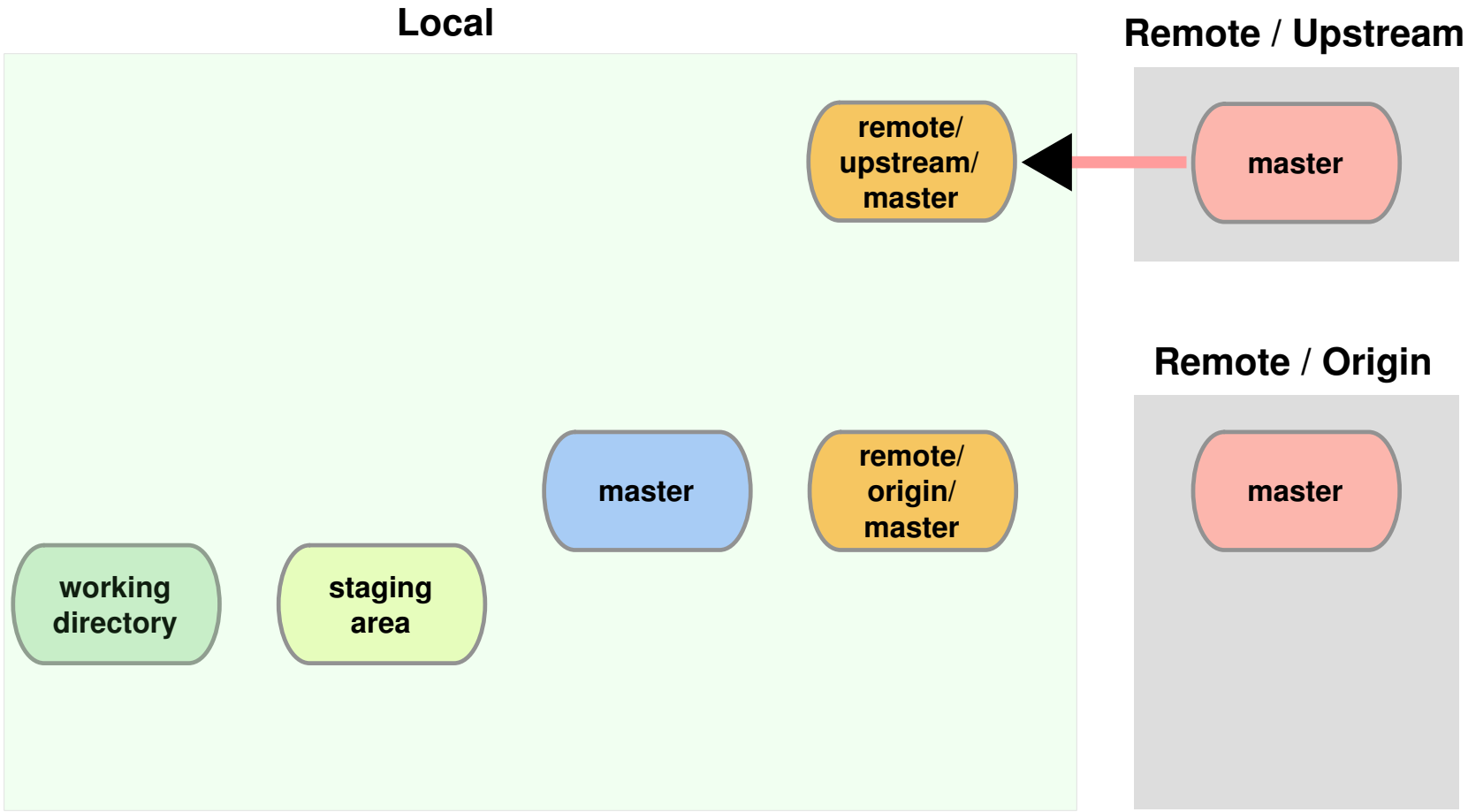
Contributing through GitHub: Detailed Explanation



Now you clone your copy on your local computer:

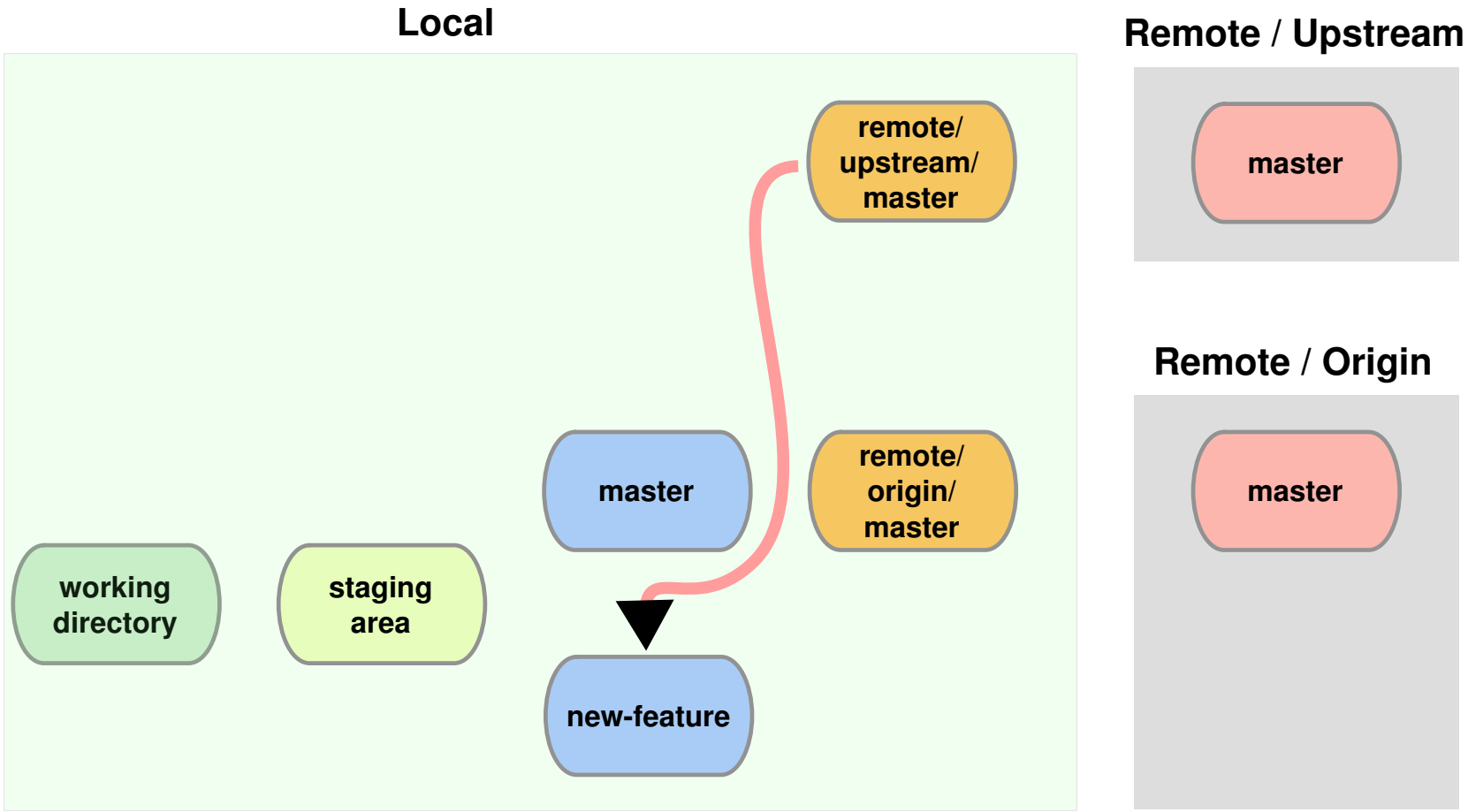
```
git clone <ORIGIN_URL>
```

Contributing through GitHub: Detailed Explanation



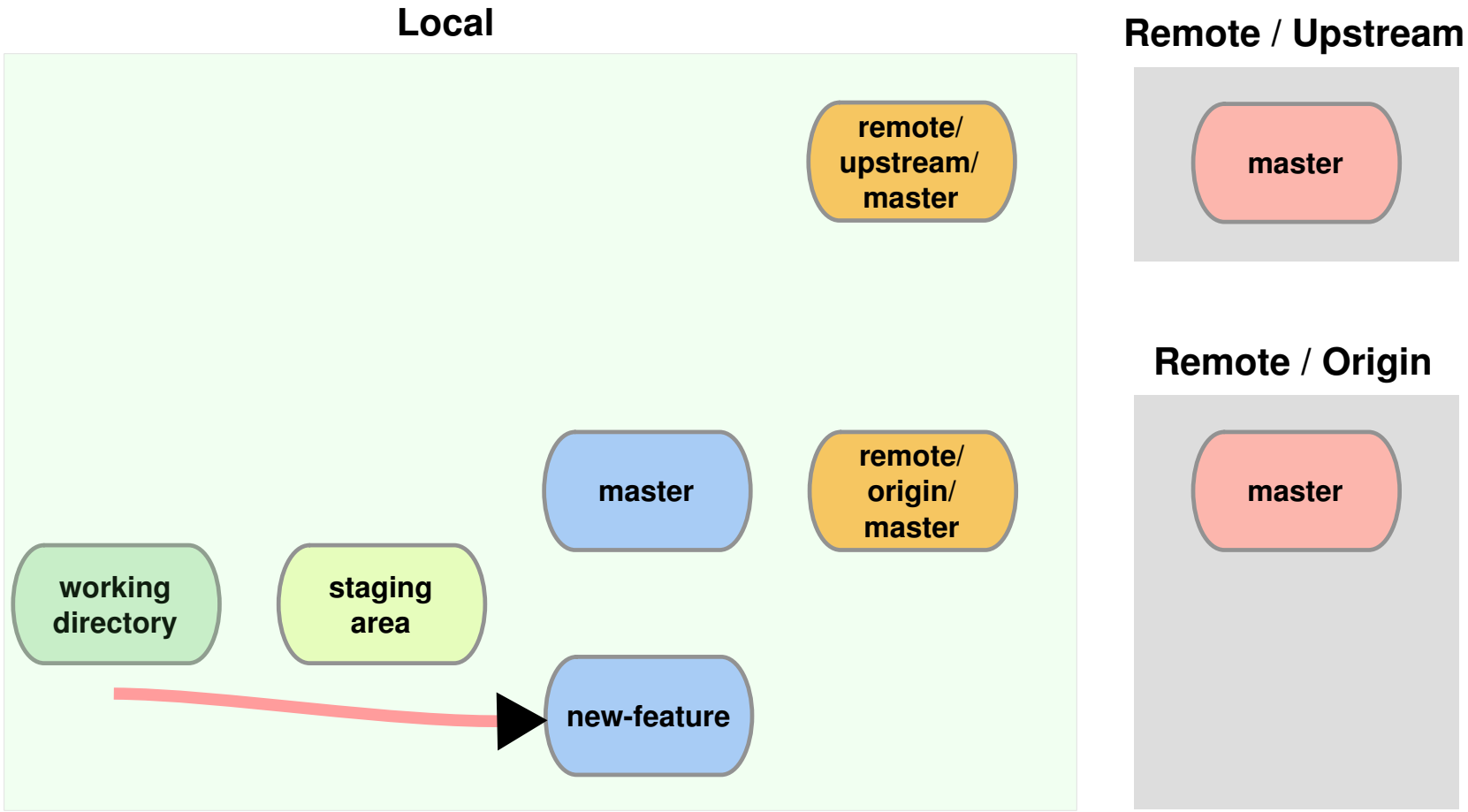

```
git remote add upstream <UPSTREAM_URL>
git fetch upstream
```

Contributing through GitHub: Detailed Explanation



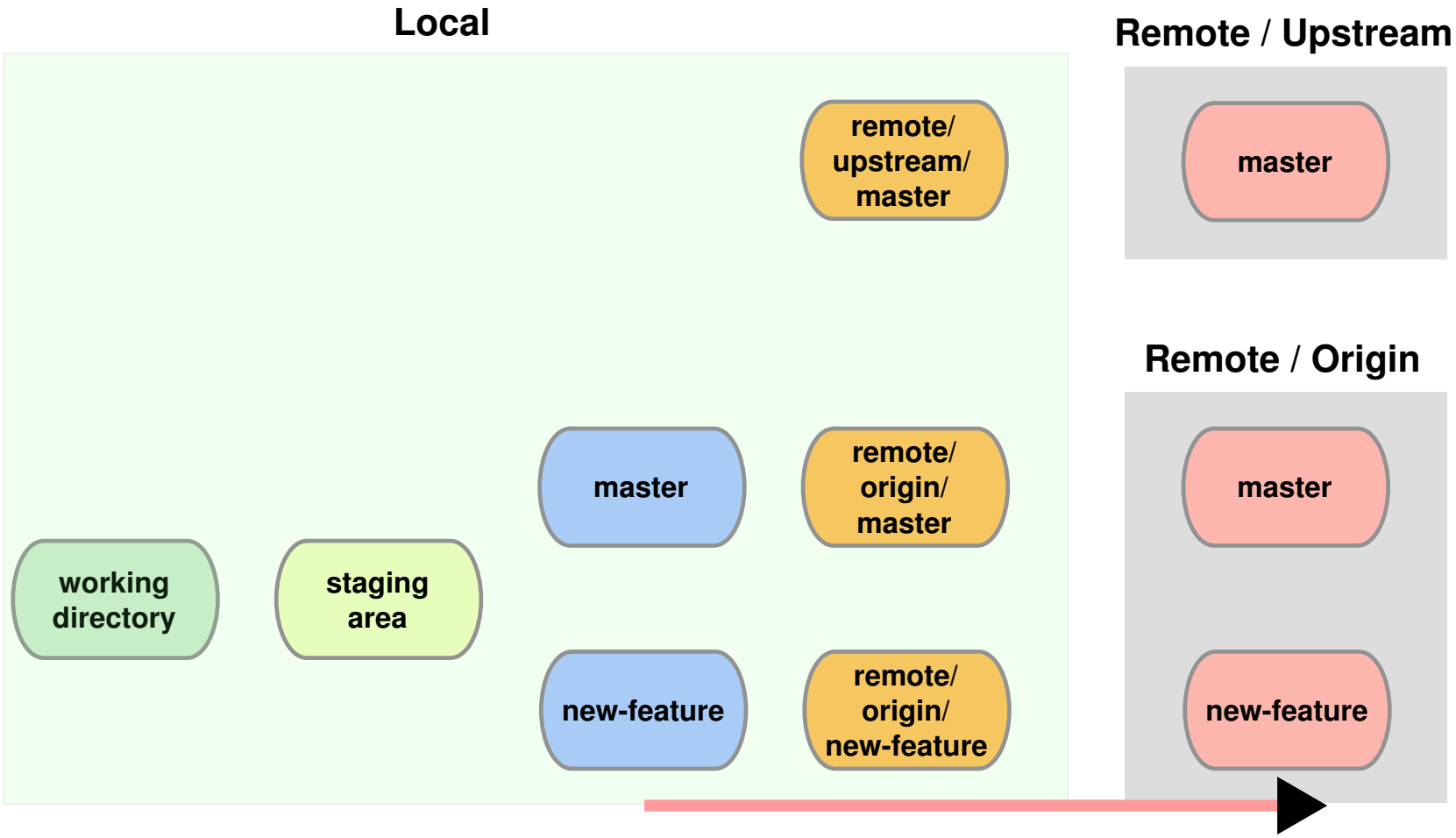

```
git branch new-feature upstream/master
git checkout new-feature
```

Contributing through GitHub: Detailed Explanation




```
git add ...
git commit ...
```

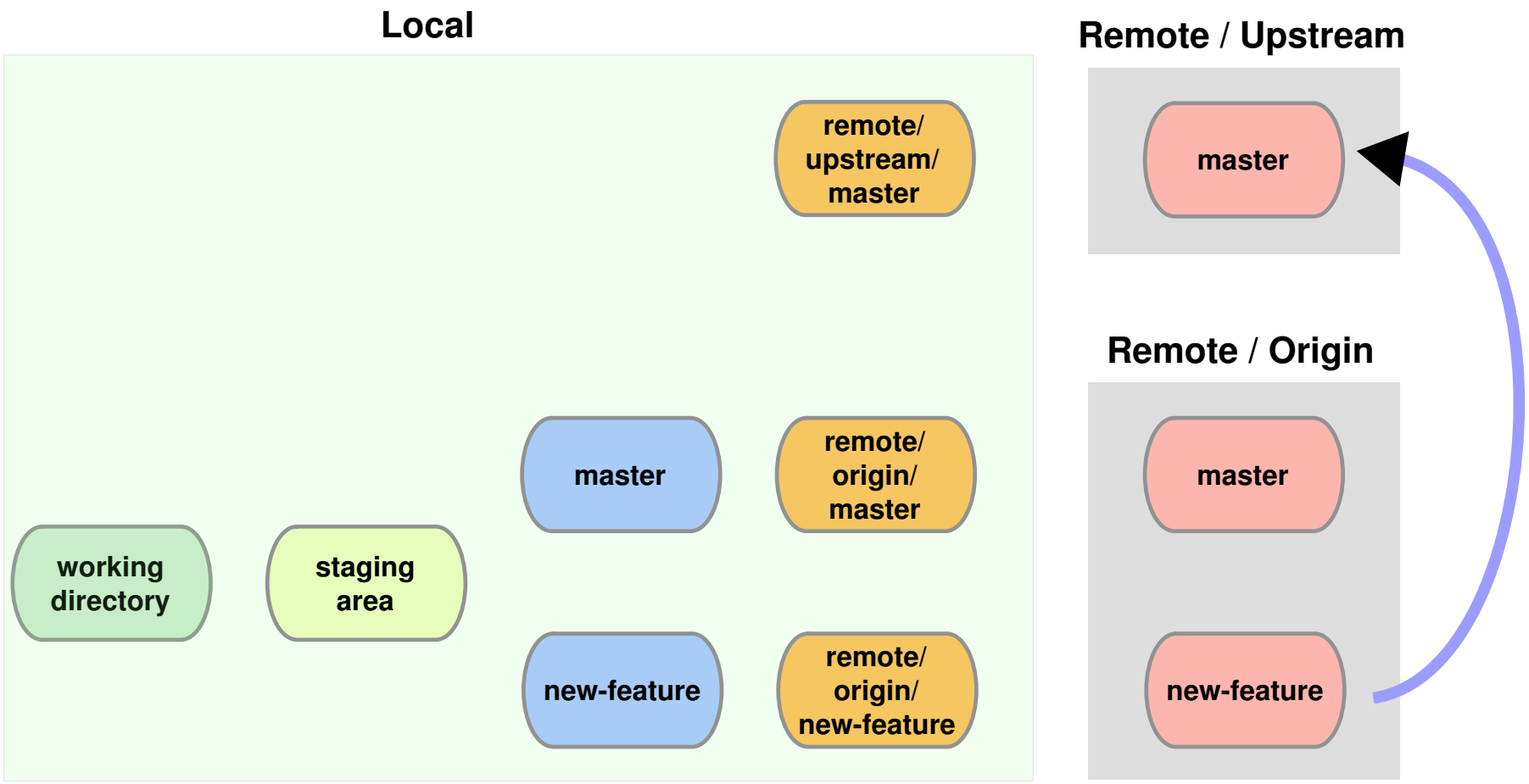
Contributing through GitHub: Detailed Explanation



publish your new feature:

`git push origin new-feature`

Contributing through GitHub: Detailed Explanation



Notify the owners of the main repository about **`new-feature`**
they: **`git fetch`** + (eventually) **`git merge`**

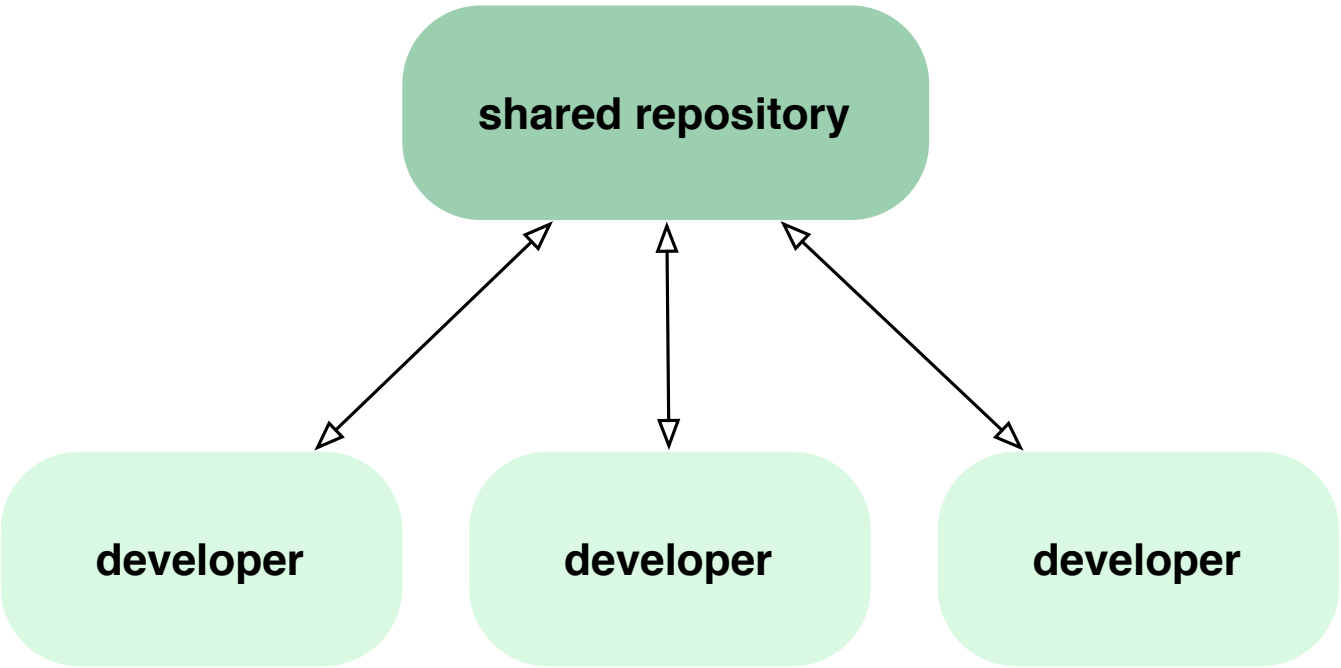
Setting up a remote+shared repository. OPTIONAL

GOAL: I want to share my local repository so others can **`push`**.

"Why can't I just *extend permissions* in my **local** repo?"

- Yes you can...
- ...but your colleagues will not push (read-only).

To have it read-write: set up a **remote** *shared* repository.



Setting up a remote+shared repository. OPTIONAL

You have a local repository and want to share it (**ssh**) from a remote server on which your colleagues already have access.

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`

On *local* machine push your repository to remote:

- `git remote add origin ssh://remote.com/path/newproject`
- `git push -u origin master`

Setting up a remote+shared repository. OPTIONAL

Demo: **`demo_git_setup_remote.txt`**.

Credits

- **Rike-Benjamin Schuppner**
- Zbigniew Jędrzejewski-Szmek
- Tiziano Zito
- Bastian Venthur
- `http://progit.com`
- `apcmag.com`
- `lwn.net`
- `http://www.markus-gattol.name/ws/scm.html`
- `http://matthew-brett.github.io/pydagogue/gitwash/git_development.html`

I want to know more about **`git`**!

Understanding how **`git`** works:

- **`git`** foundations, by Matthew Brett: `http://matthew-brett.github.com/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/`

Contributing to a project hosted on GitHub:

- "Gitwash", by Matthew Brett: `http://matthew-brett.github.io/pydagogue/gitwash/git_development.html`

Cool Stuff

Gource:

`http://code.google.com/p/gource/`

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