

Introduction to Git

18/11/2019

Stelios Vitalis

1. Version Control

1.1 Why do we need it?

1.2 What is it?

1.3 Architecture

1.4 Commits

1.5 Branches

2. Git

2.1 Definitions

2.2 Init or Clone

2.3 Add and Commit

2.4 Checkout

2.5 Branch and Merge

2.6 Remotes, Pull and Push

3. Github and Workflow

Versioning and Collaboration

The general concept

It's useful because:

- It tracks history of our work
- It allows us to work as a team
- It can be used to manage a project

Version Control System (VCS)

Definition

Definition

*Version Control is the **management** of changes to documents, computer programs, large web sites, and other collections of information.¹*

¹Wikipedia

Version Control System (VCS)

Benefits

A VCS:

- keeps **revisions**
- allows for **true collaboration**
- encapsulates **workflow** (e.g. track time, issues, project management)

VCS

Definitions

Repository

A storage location where all versions and information about them are stored.

Workspace

The actual working directory of the user.

Types of VCS

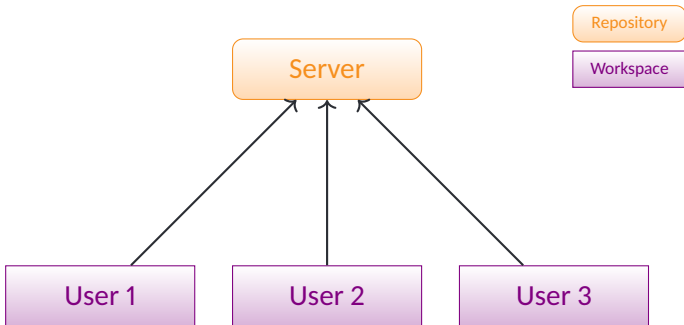
There are two types:

- Centralised
 - Subversion (SVN)
 - Microsoft Team Foundation Server (TFS)
 - Concurrent Versions System (CVS)
- Distributed
 - Git
 - Mercurial

Centralised

Architecture

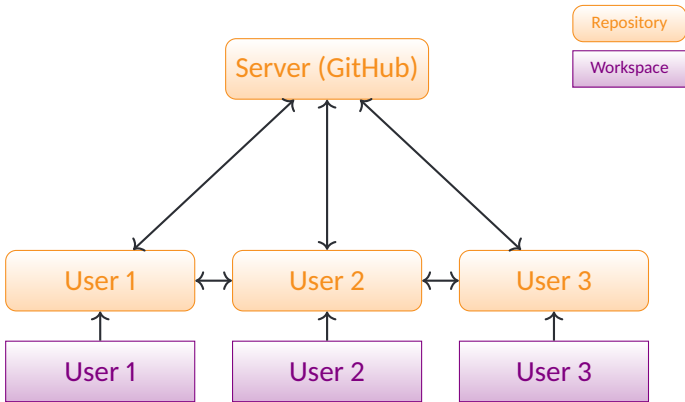
A server is the only repository and every user has a workspace.



Distributed

Architecture

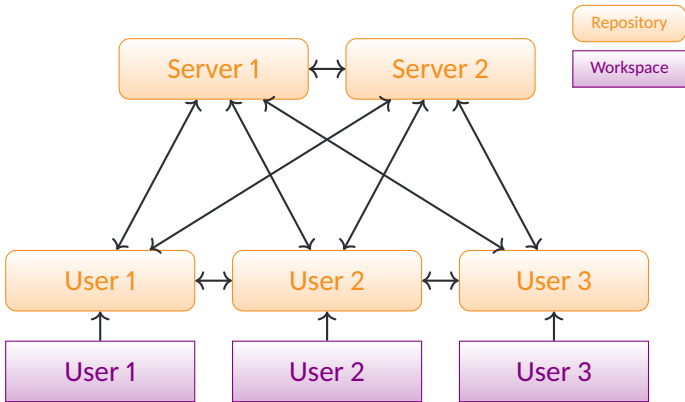
Every user has a copy of the repository and a workspace.



Distributed

Architecture

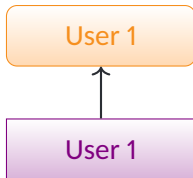
No “master” server. All repositories are, actually, equal.



Distributed

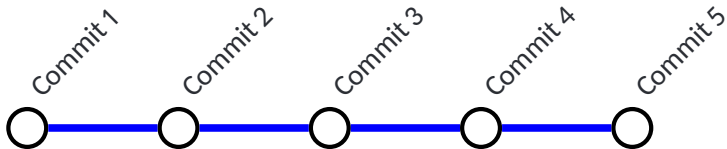
Architecture

In fact, no server is needed at all! It can be just a local folder.



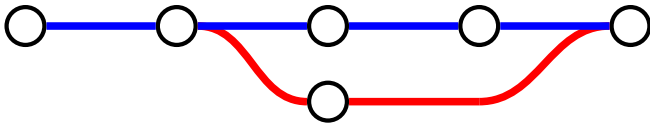
What is a repository?

Seems like a time line



What is a repository?

But it's more like a metro network



Repository “internals”

It's a graph



This nodes are called **commits** or **revisions**.

Commit or Revision

Information

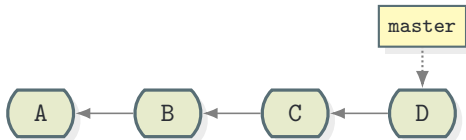
Every commit has:

- **ID:** some identifier
- **Author:** name and email of user who commits
- **Timestamp:** time of commit
- **Message:** what the commit contains

and, of course, the **changes** of the files that are submitted.

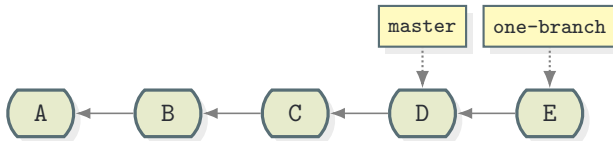
Repository “internals”

Branching



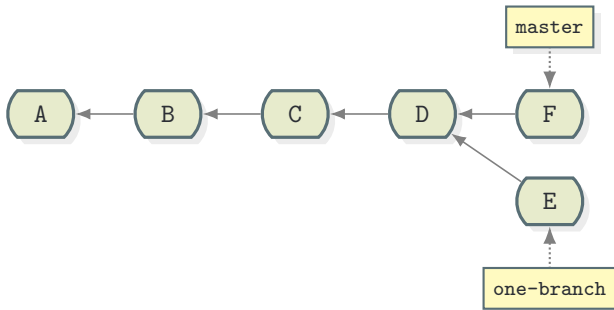
Repository “internals”

Branching



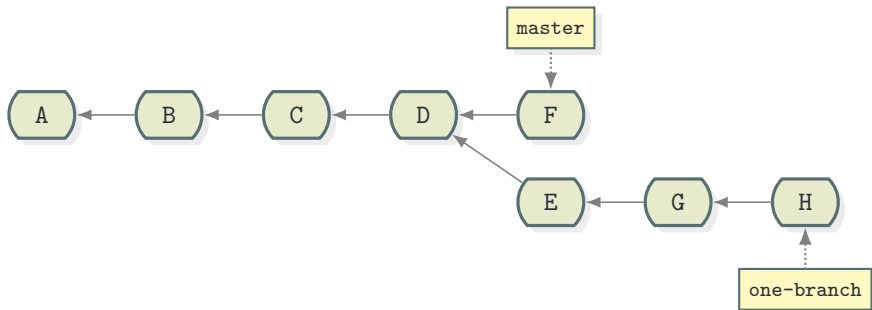
Repository “internals”

Branching



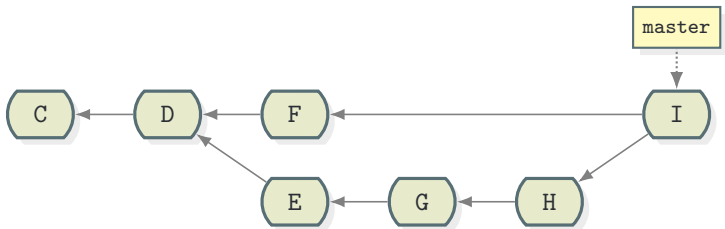
Repository “internals”

Branching



Repository “internals”

Merging



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Git

Some History

Git was created by Linus Torvalds in 2005 because there was no decent version control system to maintain the Linux kernel. He described the tool as "the stupid content tracker".

Git

Some History

He setup the following objectives:

- Performance
- Take CVS as an example of what not to do; if in doubt, make the exact opposite decision
- Support a distributed, BitKeeper-like workflow
- Include very strong safeguards against corruption, either accidental or malicious

Git

Definitions

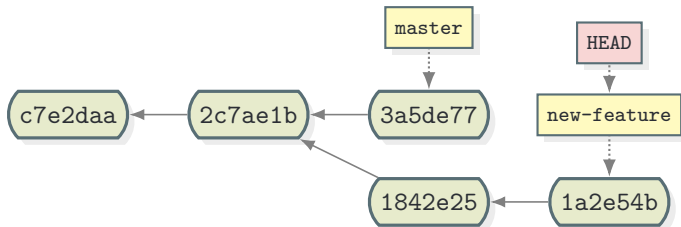
It's an open-source distributed VCS.

Specific definitions:

- Every commit has an ID which is its contents hash. E.g.:
2c7ae1b9865e58797ba326d2f7a115bebb034fd7
- We call the “current” commit as **HEAD**.

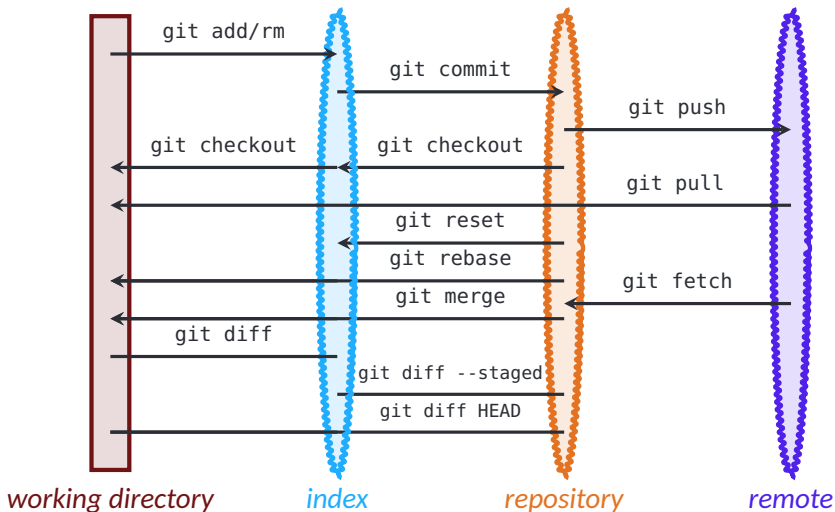
Git

Definitions



Git

Definitions



Create a repository

From scratch

```
git init
```

Creates a new empty repository.

The *working directory* is not affected, but an empty repository and index is created.

Create a repository

From a remote

```
git clone remote_address
```

Creates a copy of an existing online repository.

- A new folder is created.
- All commits/branches etc. are copied locally.
- The source repository is set as the *origin* remote.

Status

See where you stand

```
git status
```

Gives all information about the current state of repository and index.

- Shows current branch and difference with remote.
- Shows the staged files.
- Shows changed but not staged files.
- Shows untracked files.

Create a commit

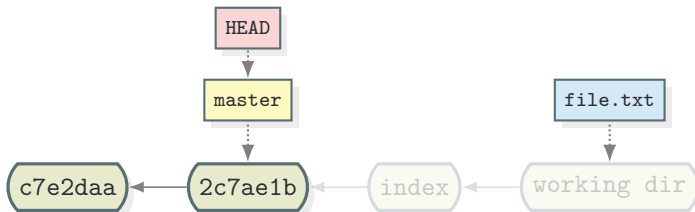
Add files to the index

```
git add filename
```

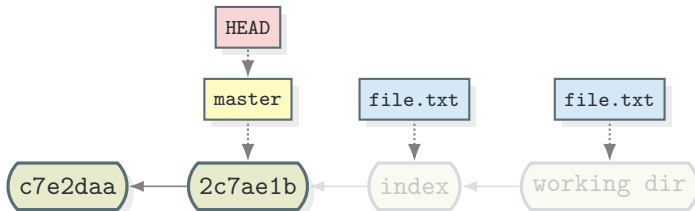
Adds the file to the index. We say it's **staged**.

- The current file from *working directory* is copied to the *index* only if it has changes compared to HEAD.
- The *filename* can be a pattern. Eg. "git add ." will add all files.
- Nothing has been committed yet.

git add file.txt



(a) Before...



(b) ... and after

Create a commit

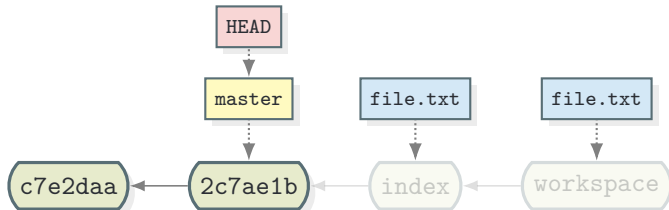
Commit staged files

```
git commit -m "message"
```

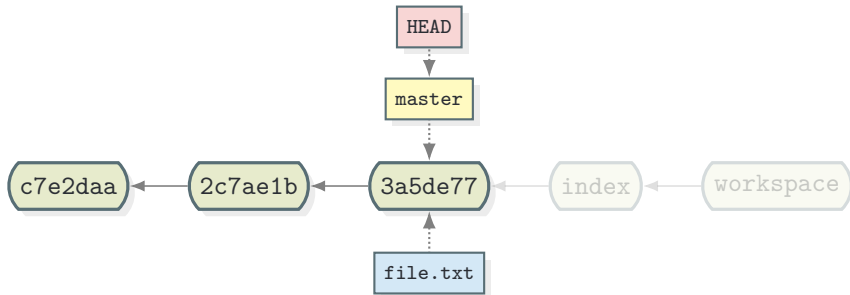
Creates a commit from a copy of the index.

- The new commit has the given message.
- After the commit, the index is cleared.
- The *HEAD* and the current *branch* tags are moved to the new commit.

`git commit -m "Changes to file.txt"`



(a) Before...



(b) ... and after

Move to a commit

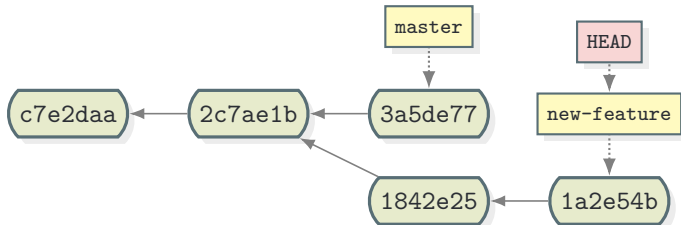
Change branch or version

```
git checkout ref
```

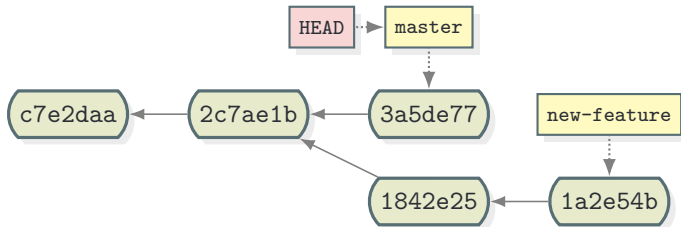
Moves to a branch/commit and changes the working directory accordingly.

- The *ref* can be a branch name, commit id or something else...
- The *HEAD* moves to the referred commit.
- The current branch changes (if a branch name is given).

git checkout master

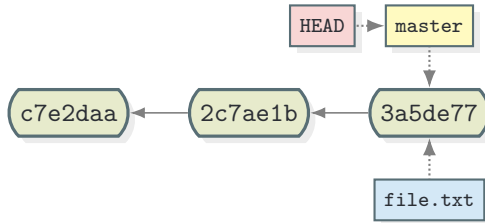


(a) Before...

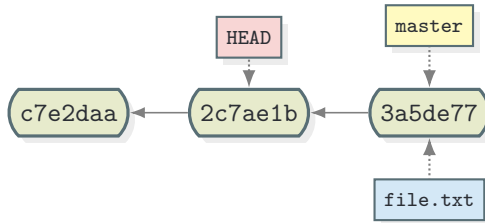


(b) ... and after. **The working directory will change as well!**

git checkout 2c7ae1b

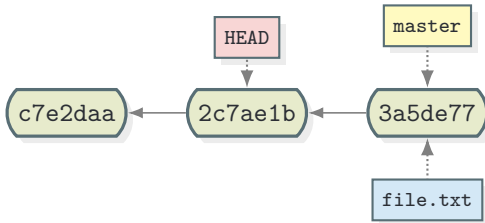


(a) Before...

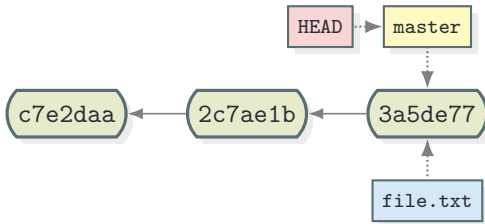


(b) ... and after. That's called a **detached HEAD** state!

git checkout master



(a) Before on a 'detached HEAD' state...



(b) ... and after. Back to normal.

Create a branch

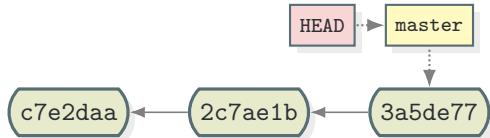
Use the branch command

```
git branch new-branch-name
```

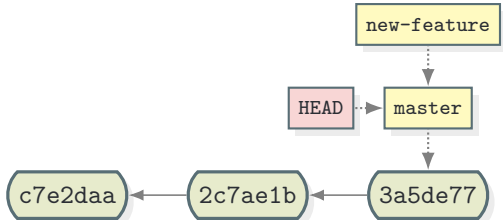
Create a new branch here.

- The new branch is created on the position of HEAD.
- The HEAD still points to the previous position.

git branch new-feature

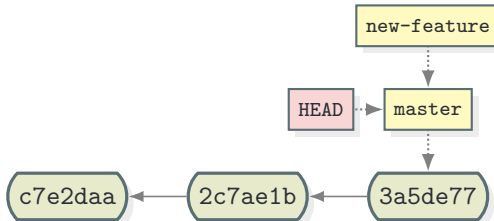


(a) Before...

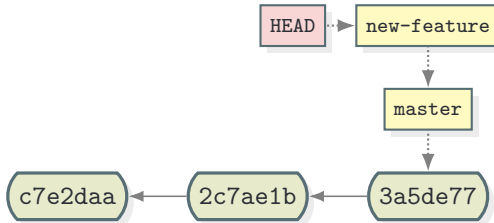


(b) ... and after.

git checkout new-feature



(a) Before...



(b) ... and after.

Create a branch

Use Checkout instead

```
git checkout -b new-branch-name
```

Create a new branch here and switch to it.

- The new branch is created on the position of HEAD.
- The HEAD now points to the new branch.

Merge branches

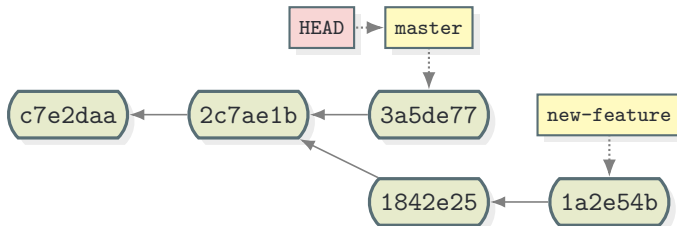
There is a command for that

```
git merge other-branch
```

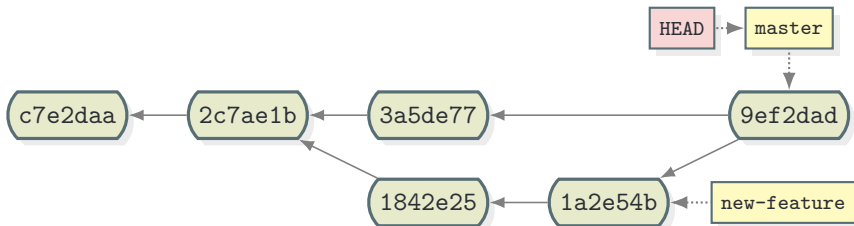
Merges the *other-branch* to this one.

- You call merge when you are on the branch that wants to “receive” the changes.
- Both branches remain after the merge, but changes have been incorporated to the current.

git merge new-feature



(a) Before...



(b) ... and after. **The working directory will change as well!**

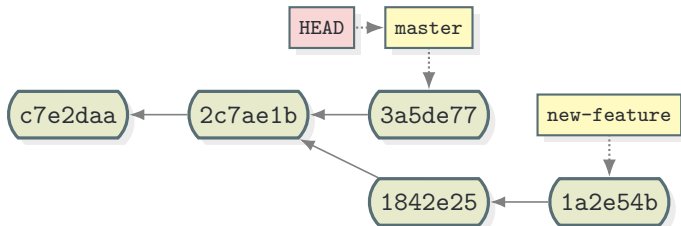
Conflict

A conflict happens when during a merge there are changes to the same lines of the same document or when there is contradictory changes.

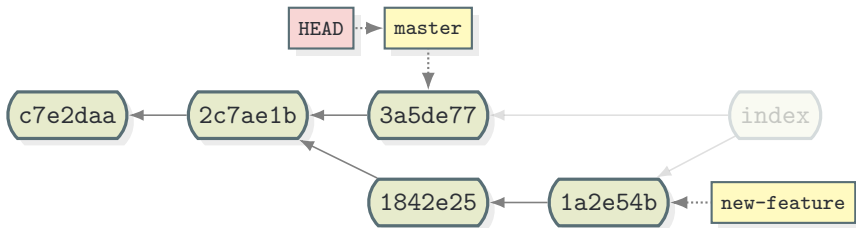
```
1 <<<<<< HEAD
2
3 Here is the original change.
4 =====
5 Here is the modified change.
6 >>>>>> 58326c301d09b58f3ac23d616e73f7b478424cc5
7
```

- Both versions are shown.
- You change your files as normally.
- You add them again to the index.
- You commit.

git merge new-feature



(a) Before...



(b) ... and after. **The conflicts are marked and you have to resolve!**

Remotes

The remote repositories

Remotes

A list of remote repositories that we can exchange commits.

- Every *remote* is reached through a url.
- It is given a *name* to be distinguished.
- Normally we call the “main” remote as **origin**.

Fetch

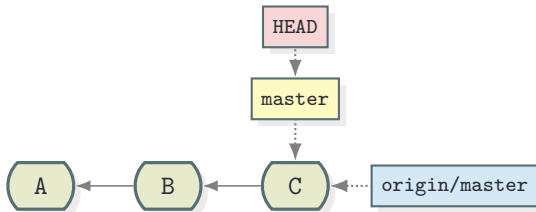
Get commits from remote

```
git pull
```

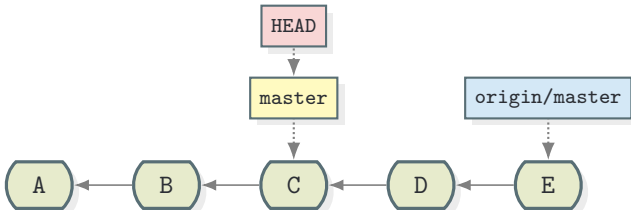
Fetches all commits from the remote and tries to merge the upstream to the current one.

- Remember, remote branches are also branches, so they can be merged.

git fetch origin

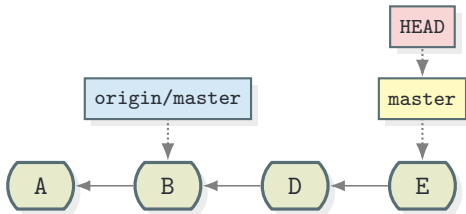


(a) Before...

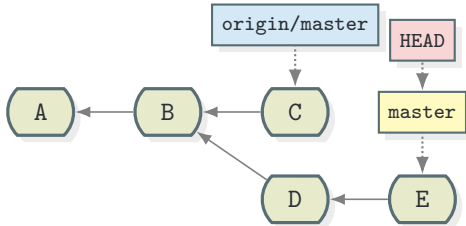


(b) ... and after.

git fetch origin



(a) Before...



(b) ... and after.

Pull

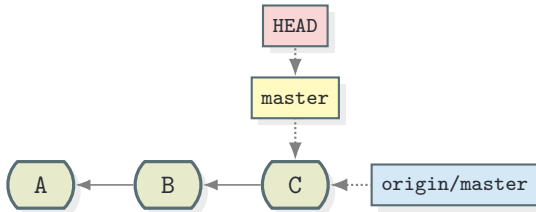
It's a fetch and merge

```
git pull [remote-name]
```

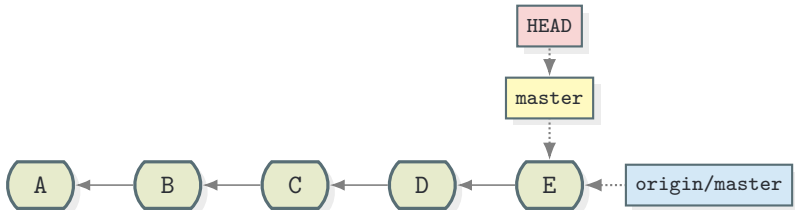
Fetches all commits from the remote and merges.

- It does `git fetch` and `git merge remote-name/branch`

git pull

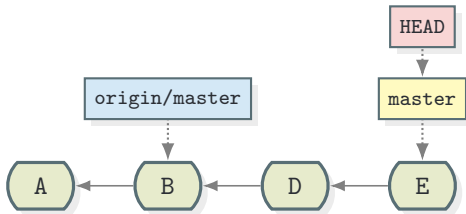


(a) Before...

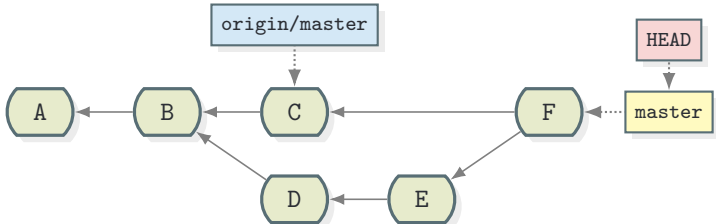


(b) ... and after.

git pull



(a) Before...



(b) ... and after.

Push

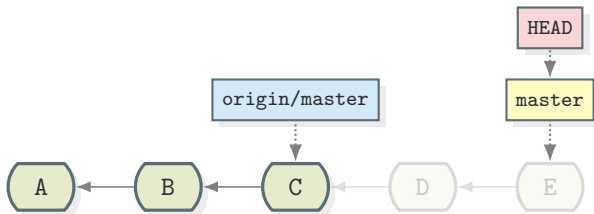
Share your changes to the world

```
git push
```

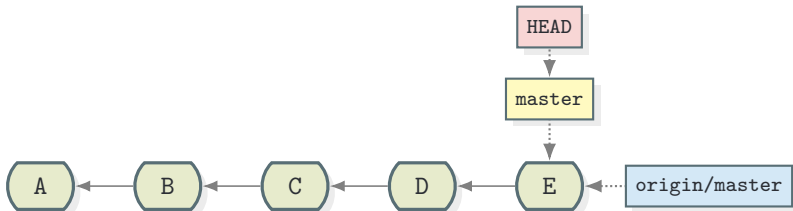
Push your local branch(es) to the remote.

- Normally it just pushes the current branch to the upstream.
- Will only work if the remote branch is updated and there is a fast-forward to the local branch.

git push

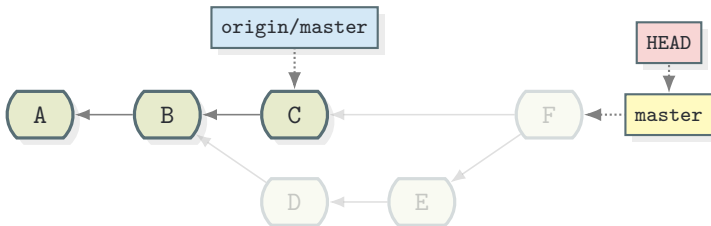


(a) Before...

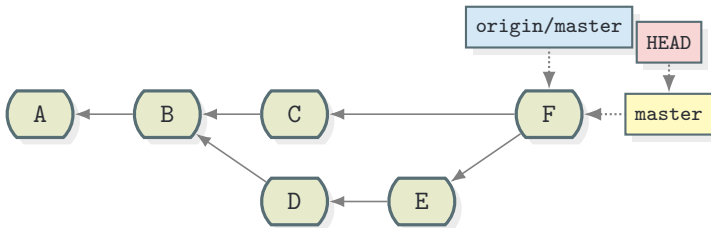


(b) ... and after.

git push



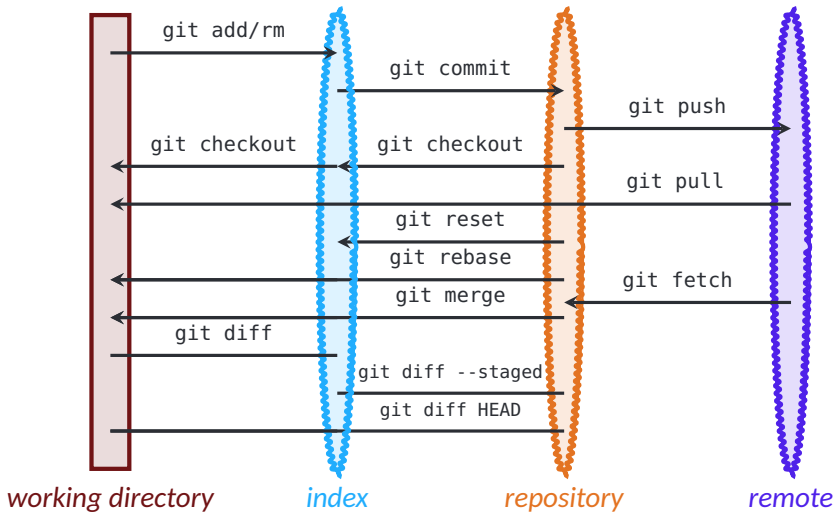
(a) Before...



(b) ... and after.

Git

Overview



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3. Github and Workflow

Github

It's just a web app

It's a repository hosting service, based on an closed-source web app that wraps git!

- You can create remote repositories there (free for public, paid for private use).
- It incorporates some management tools as well (issue-tracking, pull requests, continuous integration).

There are other platforms out there as well, like Gitlab.

Github

Host your own project

You can create repositories in GitHub and host your source code.

Same with GitLab.

You can do that before or after you create a local repository.

Github

Clone an existing repository

```
git clone https://github.com/qgis/QGIS.git
```

This repository Search Pull requests Issues Marketplace Explore

qgis / QGIS Watch 267 Star 1,725 Fork 1,158

<> Code Pull requests 95 Projects 0 Wiki Insights

QGIS is a free, open source, cross platform (lin/win/mac) geographical information system (GIS) <http://qgis.org>

44,491 commits 48 branches 97 releases 244 contributors GPL-2.0

Branch: master New pull request Create new file Upload files Find file Clone or download

ridhont Merge pull request #5561 from pvalsecc/wms_ogc_filters

.ci/travis	[docker] allow updating dependencies	
.docker	Remove dependency on QtScript	
.github	Rename CONTRIBUTE.md to CONTRIBUTING.md	
.tx	[18n] integrate esperanto translation	a year ago
cmake	Bump minimum spatialite version to 4.2	29 days ago
cmake_templates	Don't use thread_local on mingw or OpenBSD builds	a month ago
debian	Remove dependency on QtScript	5 days ago
doc	update HTML data provider metadata (#5700)	2 days ago
editors/QtCreator	Add header to Qt templates	8 months ago
external/astyle	ok is spelled OK	6 months ago

Clone with HTTPS ? Use SSH

Use Git or checkout with SVN using the web URL.

<https://github.com/qgis/QGIS.git>

Open in Desktop Download ZIP