GIT - THERE BE DRAGONS!

from *(l)user* to *r00t* in 60 minutes

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January 28, 2019

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LICENSE

Agenda

Introduction

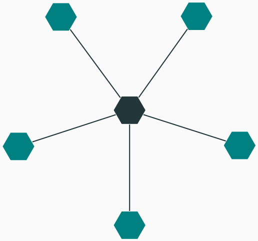
SCM/Revision control systems

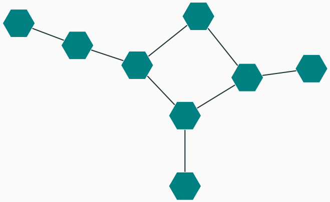
“Version control is a system that records changes to a file or set of files over time so that you can recall specific versions later (…) if you screw things up or lose files, you can easily recover.” [`https:///git-scm.org/`]

What you get:

- Compare changes over time or revert files.
- See who introduced an issue.
- Make experimental changes (and merge them).
- …

RCS models: centralized/distributed


Centralized: Subversion (SVN), CVS...


Distributed: git, Mercurial (hg)...

git - the stupid content tracker (1/3)

This is not GitHub, nor GitLab...

git - the stupid content tracker (2/3)

Git: a distributed RCS.

Started by Linus Torvalds; currently maintained by Junio C Hamano.

git - the stupid content tracker (3/3)

- 139 separate binaries, wrapped by `git(1)`; some of them accept lots of options! e.g. `git-log` parses 100+ options
- Divided into high level (porcelain) and low level (plumbing) commands
- Largely documented:

  ```
  $ basename --suffix=.1.gz
  /usr/share/man/man1/git* | xargs man | wc -l
  53260
  ```
  (=870 pages PDF)
- Target of this talk: *people using Git*

Minimum set of commands

Initialization	`git clone`
	`git init`

Interrogation	`git log`
	`git status`
	`git diff`

Manipulation	`git add`
	`git commit`

Interaction	`git push`
	`git pull`

Git essentials

Working tree and .git/ directory (1/2)

`.git/` directory: contains Git administrative and control files.

Working tree: the tree of checked out files.

```
repository/
├── .git/
│   ├── config
│   ├── HEAD
│   └── …
├── Makefile
├── main.cpp
└── …
```

Working tree and .git/ directory (2/2)

Bare repository: NO working tree + NO `.git/` directory sub-directory.
Git files directly present in the directory.

```
repository.git/
├── config
├── HEAD
└── …
```

Objects, references and symrefs (1/3)

Object: raw octets stored in Git; identified by its SHA-1.
Types: *commit*, *tree*, *blob*, *tag*.

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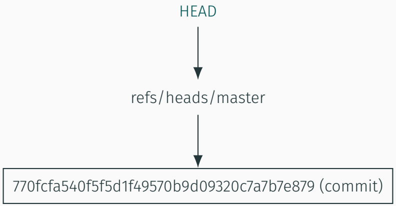
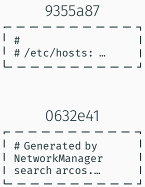
Symref: a ref that points to another ref, e.g. HEAD.



Objects, references and symrefs (2/3)

The contents of an object depend on its type:

Blob: raw data; stores file contents.



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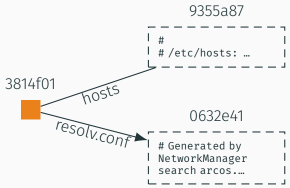

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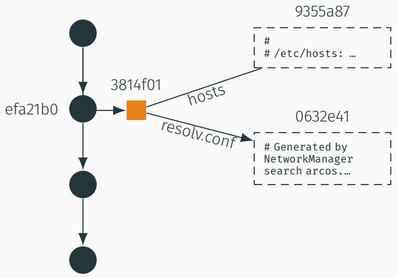

Objects, references and symrefs (2/3)

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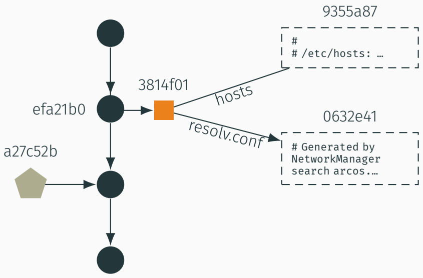
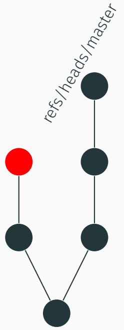
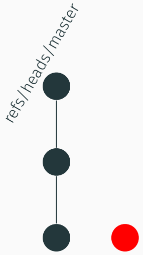
Tag: ref pointing to a commit + message + PGP signature (optional).



Objects, references and symrefs (3/3)

Typically, objects can be reached given a ref (but not always).





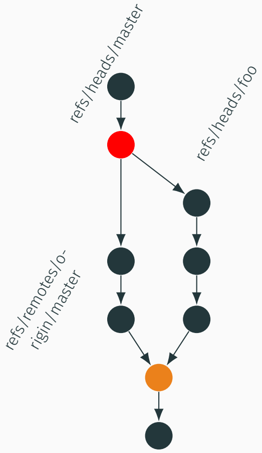
Unreachable object: an object which is not reachable from any reference.

Dangling object: not reachable even from other unrechable objects.

More at `gitglossary(7)`

Project history, branches and tags

Commit objects form a DAG (they point to their parents). This DAG is known as the history of a project.



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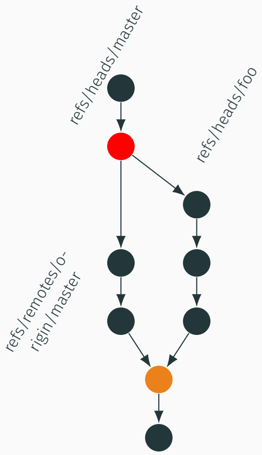

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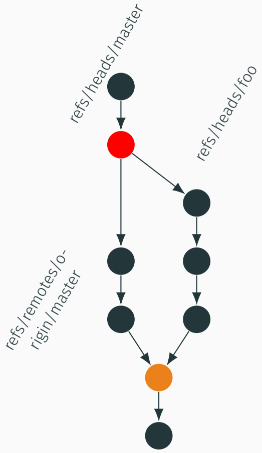

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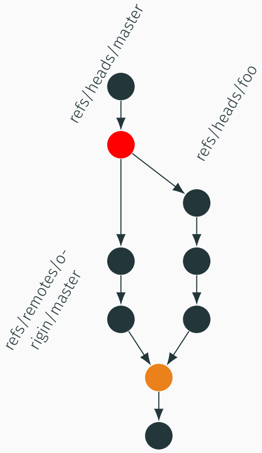
Local heads at: `refs/heads/`.

Remote-tracking branch: a ref to a remote head; follow changes from another repository.
At `refs/remotes/*/`.



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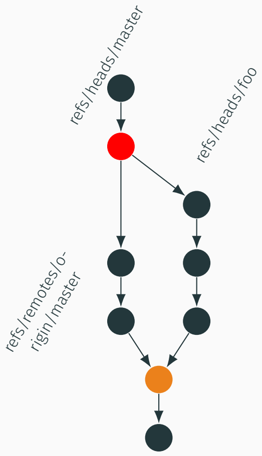
Merge commit: a commit object that has ≥ 2 parents.

Octopus: a merge that has > 2 parents.



The “index” (cache) file

Short story: basically, it is the staging area for the next commit.

- “A collection of files with stat information, whose contents are stored as objects.” [`gitglossary(7)`]

[1]Last modified time, size, etc.

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- For each file, it stores <object SHA-1> <attributes[1]>

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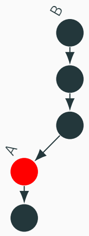
```

- Changes to the working tree found by comparing these attributes.
- Entries may be updated (`git add`) and new commits may be created from the index.

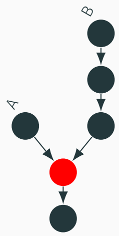
[1]Last modified time, size, etc.

Other definitions (1/3)

Fast-forward: a special type of merge; given two heads A and B, merging B into A is considered fast-forward if $merge\_base(A, B) == A$, i.e. A is ancestor of B.



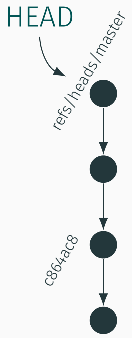
Fast-forward (update ref only!)



Non fast-forward (requires a merge)

Other definitions (2/3)

HEAD: symref that dereferences to the current checked-out head.



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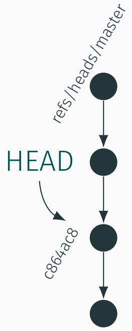

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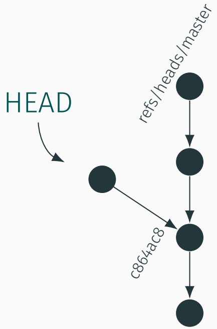

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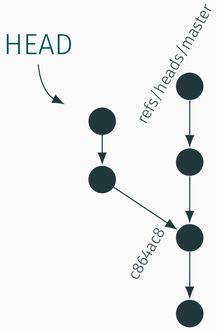

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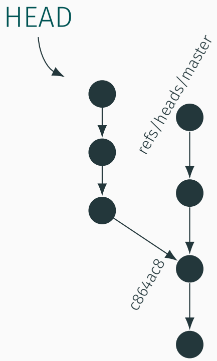

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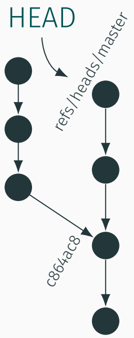


if HEAD is made to point somewhere else, they will become unreachable (and eventually deleted by the GC). Create a ref to avoid this!

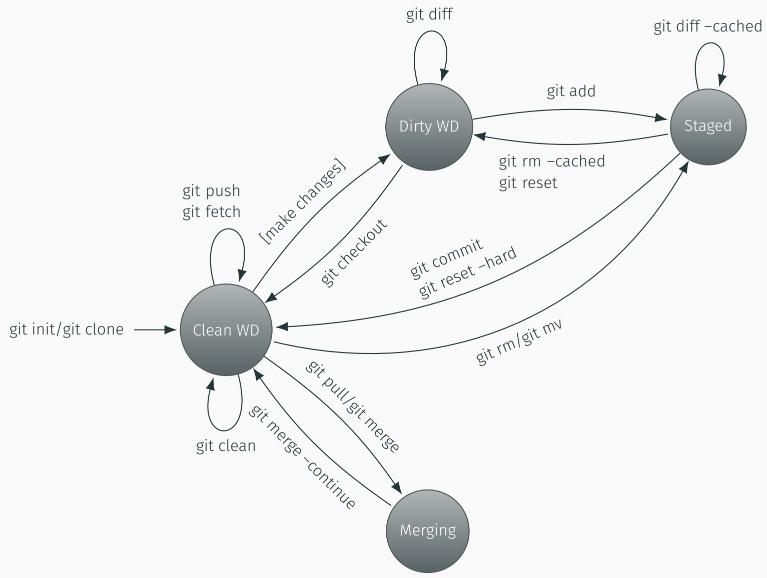
Other definitions (3/3)

Reflog: stores the local history of a ref.

- What was `HEAD` pointing at before the last change?
- What did `refs/heads/foo` pointed at two weeks ago?

[(l)user] Porcelain

Simple (and incomplete) FSM



Init/Clone a repository

To get started, you can either

- Create an empty repository, e.g.

```
$ git init [--bare] ~/foo/
```

- Obtain a copy of a remote repository[2], e.g.

```
$ git clone [--depth=1] https://earth/public/repo.git/
```

[2]The `--depth` option creates a shallow clone (history pruned). To unshallow run `git pull --unshallow`.

Overview of branches

```
# Create a branch started off from 'HEAD'
$ git branch foo HEAD
$ git checkout foo
Switched to branch 'foo'

$ git checkout -b foo HEAD # Shorthand for the above commands
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$ git branch -d foo      # Delete a branch
$ git branch -m foo bar  # Move/rename a branch

# List branches
$ git branch --verbose
* foo    d7832a7f Closes issue #17
  master 99446829 Closes issue #16
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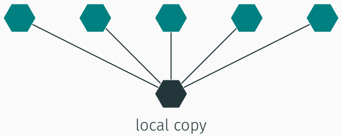
# Merge a branch
$ git merge foo
# Resolve conflicts + 'git add <pathspec> ' + 'git merge --continue'
# or 'git merge --abort'
```

Working with remotes (1/4)

Git can manage remote sites (remotes[3]) whose branches you track.

- Supports http[s]://, ssh://, git:// and file://.
- `git-clone` automatically adds the remote *origin* (the URL you cloned)
- May have different push/fetch URLs



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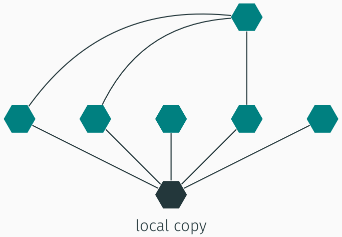

[3]See `git-remote(1)` for more information.

Working with remotes (2/4)

- Remotes may be added with `git-remote`, e.g.

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  Default is to track all branches[4].

[4] Otherwise, see `-t <branch>`

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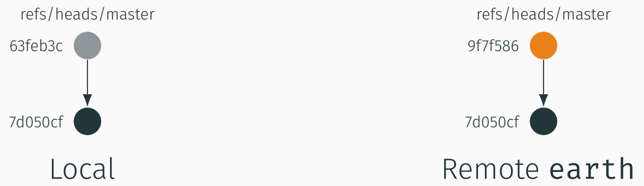
- `git-pull` is equivalent to `git fetch` + `git merge FETCH_HEAD`

[4]Otherwise, see `-t <branch>`

Working with remotes (3/4)

Trying a `$ git push earth master`

- On the remote end: receive object pack + update refs



[5] See the `-f` git-push(1) option and `receive.denyNonFastForwards`.

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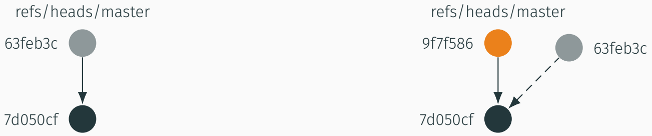

Local

Remote **`earth`**

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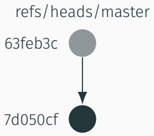
  Typically, remotes will deny non-fast-forward pushes[5]



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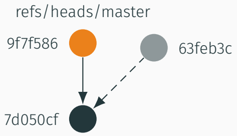

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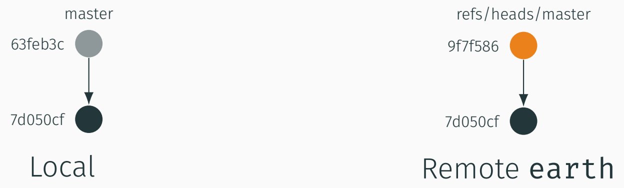
```
! [rejected]      master ->master (non-fast-forward)
error: failed to push some refs to '…'
```

[5]See the `-f` git-push(1) option and `receive.denyNonFastForwards`.

Working with remotes (4/4)

Trying a `$ git pull earth master`[6]



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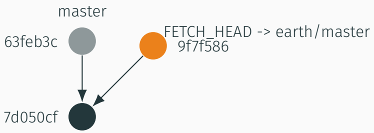

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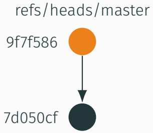

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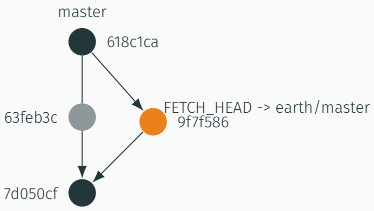

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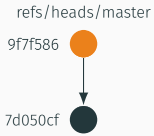

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Bug hunting

Git helps you to find bugs (and their authors)…

git-bisect(1) uses binary search to find a “bad” commit

```
$ git bisect start HEAD v1.2 # HEAD is bad, v1.2 is good
$ git bisect [good|bad] # Manually mark it as working/broken
…
$ git bisect run my_script arguments # Or automatically (good if $? = 0)
$ git bisect reset
```

git-blame(1) annotates each line of a file with revision information

```
$ git blame README.md
63feb3c8 (jalopezg 2019-01-18 19:36:40 +0100 1) >This file was created by …
ded8aa43 (jalopezg 2019-01-22 20:18:04 +0100 2) foo
```

Specifying revisions (1/2)

Some Git commands take symbolic revision parameters (names specific commit or all commits reachable from that commit)[7].

<sha1> SHA-1 object name, or a non-ambiguous leading substring.

<refname> A ref name, e.g. refs/heads/master. Search order: `$GIT_DIR/<refname>`, `refs/`, `refs/tags/`, `refs/heads/`, `refs/remotes/`, `refs/remotes/<refname>/HEAD`.

<refname>@{<n>} The n-th prior value of that ref.

<rev>^ The first parent.

<rev>~<n> The n-th generation ancestor.

<rev>:<path> Names the blob or tree of <rev>.

[7] This is an overview; see gitrevisions(7) for the complete list.

Specifying revisions (2/2)

Specifying ranges:

^<rev> Exclude commits reachable from <rev>.

<rev1>..<rev2> A shorthand for ^rev1 rev2, i.e. commits reachable from rev2, but not from rev1, or $(rev1, \ rev2]$

<rev1>...<rev2> Commits reachable either from rev1 or rev2, but not from both.

[sudoer] More porcelain

Save/Restore a dirty working directory

`git-stash(1)` saves the current state of the working directory + the index, and goes back to a clean WD.

Saved changes can be restored with `$ git stash pop`. Git-stash stack can be dumped by `$ git stash list`.

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```
$ echo foo > README.md
$ git status
On branch foo
Changes not staged for commit:
        modified: README.md
```

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```
$ echo foo > README.md
$ git status
On branch foo
Changes not staged for commit:
        modified: README.md

$ git stash
Saved working directory and index state WIP on foo: 9f7f586 README.md has been added
$ git status
On branch foo
nothing to commit, working tree clean
```

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On branch foo
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Saved working directory and index state WIP on foo: 9f7f586 README.md has been added
$ git status
On branch foo
nothing to commit, working tree clean

$ git stash pop
On branch foo
Changes not staged for commit:
        modified: README.md
Dropped refs/stash@{0} (35365e0c188e877ded1ecdd8190ec5bb1b6c2c1b)
```
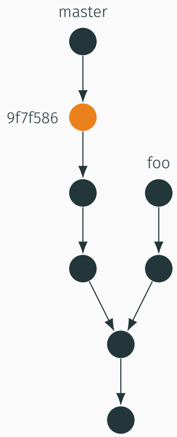

Applying changes from other branches

`git-cherry-pick(1)` apply the changes introduced by the given commits, e.g.

`$ git cherry-pick 9f7f586`.

The patch may not apply cleanly; if that is the case, you are required to resolve conflicts



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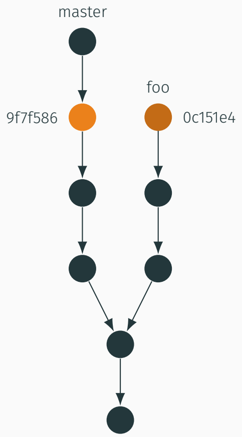
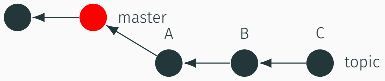


Rebase (+ interactive rebase!) (1/4)

Sometimes you fork a branch and it becomes outdated w.r.t. its parent. Quite probably, you would merge the parent branch.



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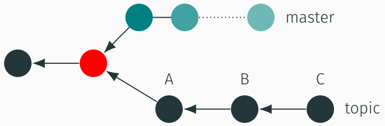

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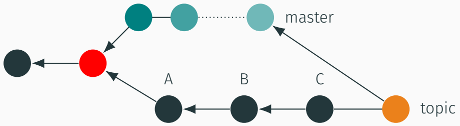

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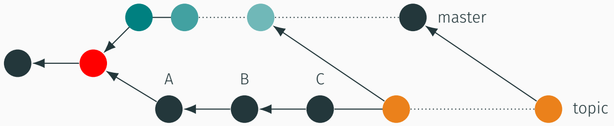

Rebase (+ interactive rebase!) (1/4)

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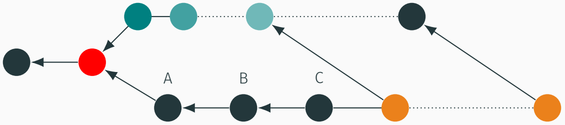
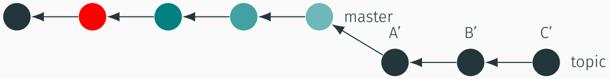


This clutters project history. Reapplying `topic` commits on top of `master` is better!



```
# Assuming that 'topic' is the current branch, this gives the result above
$ git rebase master
```

Rebase (+ interactive rebase!) (2/4)

It is one of the most powerful Git commands. In fact, it can be used to rewrite project history (next slide).

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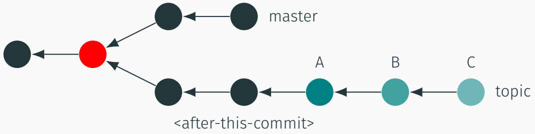
If there are conflicts, you will have to resolve them (as in merge).

⚠ `GIT-REBASE(1)` IMPLICATIONS:

- Requires rewriting commits and is PROBLEMATIC if you already pushed those objects
- You can break things: YOU HAVE BEEN WARNED!
- If you ever force-push a rebased branch, others will have to fix their history. See git-rebase(1), section "RECOVERING FROM UPSTREAM REBASE".

Rebase (+ interactive rebase!) (3/4)

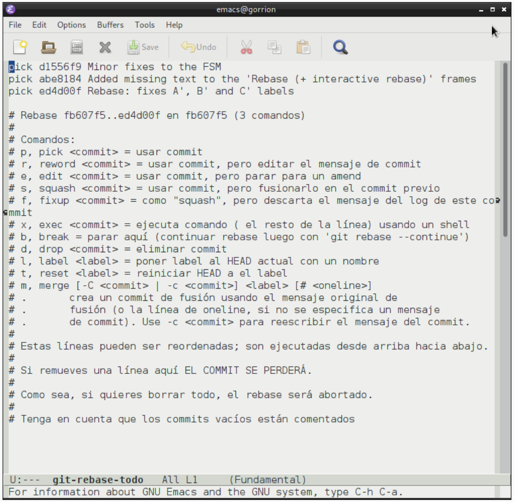
`git-rebase(1)` has an interactive mode in which you can edit/reorder/remove the commits which are rebased.
It is very common to rewrite part of a branch to have a more meaningful history, e.g.



```
# This fires up an editor and gives you the chance to edit the commit list before
     they are applied (commits A, B and C)
$ git rebase -i <after-this-commit>
```

⚠ USE WITH CARE. Read git-rebase implications!

Rebase (+ interactive rebase!) (4/4)



```
pick d1556f9 Minor fixes to the FSM
pick abe8184 Added missing text to the 'Rebase (+ interactive rebase)' frames
pick ed4d00f Rebase: fixes A', B' and C' labels

# Rebase fb607f5..ed4d00f en fb607f5 (3 comandos)
#
# Comandos:
# p, pick <commit> = usar commit
# r, reword <commit> = usar commit, pero editar el mensaje de commit
# e, edit <commit> = usar commit, pero parar para un amend
# s, squash <commit> = usar commit, pero fusionarlo en el commit previo
# f, fixup <commit> = como "squash", pero descarta el mensaje del log de este co
mmit
# x, exec <commit> = ejecuta comando ( el resto de la línea) usando un shell
# b, break = parar aquí (continuar rebase luego con 'git rebase --continue')
# d, drop <commit> = eliminar commit
# l, label <label> = poner label al HEAD actual con un nombre
# t, reset <label> = reiniciar HEAD a el label
# m, merge [-C <commit> | -c <commit>] <label> [# <oneline>]
# .       crea un commit de fusión usando el mensaje original de
# .       fusión (o la línea de oneline, si no se especifica un mensaje
# .       de commit). Use -c <commit> para reescribir el mensaje del commit.
#
# Estas líneas pueden ser reordenadas; son ejecutadas desde arriba hacia abajo.
#
# Si remueves una línea aquí EL COMMIT SE PERDERÁ.
#
# Como sea, si quieres borrar todo, el rebase será abortado.
#
# Tenga en cuenta que los commits vacíos están comentados

U:---  git-rebase-todo   All L1     (Fundamental)
For information about GNU Emacs and the GNU system, type C-h C-a.
```

More about fixing history (1/2)

So common that `git-commit(1)` has the `--squash` and `--fixup` options. They mark commits to be automatically squashed. Rewriting occurs after a `$ git rebase --autosquash`.

More about fixing history (1/2)

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```
$ git log --oneline
e7a2019 (HEAD -> master) Any other changes
9f7f586 Added README.md
02a7fb9 Added bar.txt
```

More about fixing history (1/2)

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```
$ git log --oneline
e7a2019 (HEAD -> master) Any other changes
9f7f586 Added README.md
02a7fb9 Added bar.txt

$ echo foo >> README.md && git commit -a --fixup 9f7f586
$ git log --oneline
24a54df (HEAD -> master) fixup! Added README.md
e7a2019 Any other changes
9f7f586 Added README.md
02a7fb9 Added bar.txt
```

More about fixing history (1/2)

So common that `git-commit(1)` has the `--squash` and `--fixup` options. They mark commits to be automatically squashed. Rewriting occurs after a `$ git rebase --autosquash`.

```
$ git log --oneline
e7a2019 (HEAD -> master) Any other changes
9f7f586 Added README.md
02a7fb9 Added bar.txt

$ echo foo >> README.md && git commit -a --fixup 9f7f586
$ git log --oneline
24a54df (HEAD -> master) fixup! Added README.md
e7a2019 Any other changes
9f7f586 Added README.md
02a7fb9 Added bar.txt

$ git rebase -i --autosquash 02a7fb9
Successfully rebased and updated refs/heads/master.
$ git log --oneline
528efb7 (HEAD -> master) Any other changes
a59735c Added README.md
02a7fb9 Added bar.txt
```

⚠ USE WITH CARE. Read git-rebase implications!

More about fixing history (2/2)

If you only need to rewrite the last commit use

```
$ git commit --amend
```

⚠ USE WITH CARE. Read git-rebase implications!

git filter-branch

Q: I know how to rewrite commits. Can I automate the process?

git filter-branch

Q: I know how to rewrite commits. Can I automate the process?
A: `git-filter-branch(1)` lets you rewrite branches, applying filters to modify each tree/information about each commit, e.g.

```
$ git log --oneline
92cb761 (HEAD -> foo) Added nsswitch.conf
9f7f586 Added README.md
02a7fb9 (bar) Added bar.txt

$ git filter-branch --msg-filter 'sed -e "s/Added \([[:graph:]]*\)$/\1 has
been added/"' foo

$ git log --oneline
6e9fbd6 (HEAD -> foo) nsswitch.conf has been added
63feb3c README.md has been added
2fe54f3 bar.txt has been addded
```

⚠ USE WITH CARE. Read git-rebase implications!

Comparing branches

Q: Can I see where each of the given branches is w.r.t. others?

Comparing branches

Q: Can I see where each of the given branches is w.r.t. others?

A: `git-show-branch` is your friend. Also, `git log --graph --oneline …`

```
$ git show-branch master foo
! [master] Added README.md
 * [foo] Added nsswitch.conf
  ! [bar] Added bar.txt
---
 *  [foo] Added nsswitch.conf
+*  [master] Added README.md
+*+ [bar] Added bar.txt

# To include all remote-tracking and local branches:
$ git show-branch --all
```

Share by other means

TAR or ZIP archives of a particular tree can be created by `git-archive(1)`, e.g.

```
$ git archive --format=tar --prefix=foo/ -o foo.tar.gz master
```

Git also can generate an archive of packed objects and references to be imported into a repository (useful if machines are not directly connected), e.g.

```
[alice@earth ~]$ git bundle create /tmp/foo-master.git master
# /tmp/foo-master.git is copied to moon by some means.

[bob@moon ~]$ git clone -b master ~/foo-master.git

# Or if the repository already exists…
[bob@moon ~]$ git remote add foo-bundle ~/foo-master.git
[bob@moon ~]$ git pull foo-bundle master
```

ReReRe

"git-rerere - Reuse recorded resolution of conflicted merges"

FYI, see the `git-rerere(1)` manual page.

[r00t] Plumbing

Repository layout

objects/: the object store.

objects/[0-9a-f][0-9a-f]/: loose objects.

objects/pack/: object packs (store many objects in compressed form).

refs/: references are stored in subdirectories of this directory.

packed-refs: the same as refs/ but in a more efficient way.

HEAD: the HEAD symref.

```
repository/
└── .git/
    ├── objects/
    │   ├── pack/
    │   └── [0-9a-f][0-9a-f]/
    ├── refs/
    │   ├── heads/
    │   ├── tags/
    │   └── remotes/
    ├── packed-refs
    ├── HEAD
    ├── config
    ├── hooks/
    ├── index
    ├── info/
    ├── logs/
    ├── shallow
    └── …
└── …
```

More at `gitrepository-layout(5)`.

Repository layout

config: repository specific configuration file.

hooks/: (described later).

index: the “index” file.

info/: additional information, e.g. `info/grafts`.

logs/: reflogs are stored here.

shallow: similar to `info/grafts` but internally used for shallow clones.

```
repository/
├── .git/
│   ├── objects/
│   │   ├── pack/
│   │   └── [0-9a-f][0-9a-f]/
│   ├── refs/
│   │   ├── heads/
│   │   ├── tags/
│   │   └── remotes/
│   ├── packed-refs
│   ├── HEAD
│   ├── config
│   ├── hooks/
│   ├── index
│   ├── info/
│   ├── logs/
│   ├── shallow
│   └── …
└── …
```

More at `gitrepository-layout(5)`.

HOWTO: create a commit using the “index”

```
$ echo foo > bar.txt

# Add 'bar.txt' to the index
$ git update-index --add bar.txt
```

HOWTO: create a commit using the “index”

```
$ echo foo > bar.txt

# Add 'bar.txt' to the index
$ git update-index --add bar.txt

# Create a tree object from the current index
$ git write-tree
6d21ed3d662ea6040da2fe0fd66fe80fefe689a5
```

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# Create a new commit object
$ git commit-tree -p HEAD -m 'Added␣bar.txt' 6d21ed3d662ea6040da2fe0fd66fe80fefe689a5
02a7fb9f9145086807cbe2ed45ea82149c3d1b34
```

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02a7fb9f9145086807cbe2ed45ea82149c3d1b34

# Update refs/heads/master
$ git update-ref refs/heads/master 02a7fb9f9145086807cbe2ed45ea82149c3d1b34
```

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02a7fb9f9145086807cbe2ed45ea82149c3d1b34

# Update refs/heads/master
$ git update-ref refs/heads/master 02a7fb9f9145086807cbe2ed45ea82149c3d1b34

$ git log -1
commit 02a7fb9f9145086807cbe2ed45ea82149c3d1b34 (HEAD -> master)
Author: Javier López Gómez <jalopezg@inf.uc3m.es>
Date:   Fri Jan 18 18:59:39 2019 +0100

    Added bar.txt
```

HOWTO: commit arbitrary content

```
# Create blob object for 'README.md'; use 'git cat-file blob 1f6c266' to see blob
     contents
$ git hash-object -t blob -w --path=README.md --stdin <<EOF
> This file was created by git-hash-object.
EOF
1f6c2663d33465dcd83f2151b15fb57369f29570
```

HOWTO: commit arbitrary content

```
# Create blob object for 'README.md'; use 'git cat-file blob 1f6c266' to see blob
     contents
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> This file was created by git-hash-object.
EOF
1f6c2663d33465dcd83f2151b15fb57369f29570

# Create tree object (add 'README.md' entry to the HEAD tree)
$ git ls-tree HEAD | awk '{␣print;␣}␣END␣{␣print␣"100644␣blob␣1
     f6c2663d33465dcd83f2151b15fb57369f29570\tREADME.md";␣}' | git mktree
0082679644a2b435b6cf09a65324292da28a41b4
```

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     f6c2663d33465dcd83f2151b15fb57369f29570\tREADME.md";␣}' | git mktree
0082679644a2b435b6cf09a65324292da28a41b4

# Create a new commit object
$ git commit-tree -p HEAD -m 'Added␣README.md' 0082679644
     a2b435b6cf09a65324292da28a41b4
9f7f586f952c515893dd6597936f6fea64dd17ce
```

HOWTO: commit arbitrary content

```
# Create blob object for 'README.md'; use 'git cat-file blob 1f6c266' to see blob
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$ git commit-tree -p HEAD -m 'Added␣README.md' 0082679644
     a2b435b6cf09a65324292da28a41b4
9f7f586f952c515893dd6597936f6fea64dd17ce

# Update refs/heads/master
$ git update-ref refs/heads/master 9f7f586f952c515893dd6597936f6fea64dd17ce
```

HOWTO: commit arbitrary content

```
# Create blob object for 'README.md'; use 'git cat-file blob 1f6c266' to see blob
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     a2b435b6cf09a65324292da28a41b4
9f7f586f952c515893dd6597936f6fea64dd17ce

# Update refs/heads/master
$ git update-ref refs/heads/master 9f7f586f952c515893dd6597936f6fea64dd17ce

# WTF?
$ git status
On branch master
Changes to be committed:
  (use "git␣reset␣HEAD␣<file>..." to unstage)

        deleted:    README.md
```

HOWTO: commit arbitrary content

```
# Create blob object for 'README.md'; use 'git cat-file blob 1f6c266' to see blob
     contents
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# Create tree object (add 'README.md' entry to the HEAD tree)
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$ git commit-tree -p HEAD -m 'Added␣README.md' 0082679644
     a2b435b6cf09a65324292da28a41b4
9f7f586f952c515893dd6597936f6fea64dd17ce

# Update refs/heads/master
$ git update-ref refs/heads/master 9f7f586f952c515893dd6597936f6fea64dd17ce

# WTF?
$ git status
On branch master
Changes to be committed:
  (use "git␣reset␣HEAD␣<file>..." to unstage)

        deleted:    README.md
$ git reset --hard HEAD
```

Additional stuff

Configuration (1/2)

- 480+ options. Git searches configuration at:
  - **/etc/gitconfig** System-wide configuration.
  - **~/.gitconfig** User-specific configuration.
  - **$GIT_DIR/config** Repository specific.
- Can be edited manually or using `git-config(1)`, e.g.

```
$ git config [--system|--global|--local] user.email 'John Doe'
```

```
[user]
email = jalopezg@inf.uc3m.es
name = Javier López-Gómez
…
```

Configuration (2/2)

`alias.*` options may be used to create command aliases, e.g.

```
$ git config --global alias.sb 'show-branch @ @{push}'
$ git sb
! [@] Updated README.md
 ! [@{push}] Closes issue #16
--
+  [@] …
```

FYI, see the `git-config(1)` manual page.

Fsck and garbage collection

git-fsck(1) Verifies the connectivity and validity of the objects.

```
$ git fsck [--unreachable] [--no-reflogs] [--lost-found] […]
```

git-gc(1) Runs housekeeping tasks, e.g. pack objects/refs, remove unreachable objects, prune reflog, etc.[8]

```
$ git gc [--aggressive] [--auto] […]
```

[8] `git gc --auto` may automatically run as part of some git commands.

Hooks (1/2)

Hooks are programs that are executed at certain points, e.g. after a merge *(post-merge)*, or before git-receive-pack updates refs *(pre-receive)*.

- Invoked locally/on the remote end[9]

[9] Stdout and stderr are forwarded.

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- Invoked locally/on the remote end[9]
- Must be executable (+x)
- IN: environment, command-line arguments, stdin
  OUT: stdout, stderr, exit status
- Can be used for commit validation, issue management or triggering a build (CI)

[9] Stdout and stderr are forwarded.

Hooks (2/2)

See templates installed into `.git/hooks/` and the `githooks(5)` manual page.

```
applypatch-msg         pre-rebase             post-update
pre-applypatch         post-checkout          push-to-checkout
post-applypatch        post-merge             pre-auto-gc
pre-commit             pre-push               post-rewrite
prepare-commit-msg     pre-receive            sendemail-validate
commit-msg             update                 fsmonitor-watchman
post-commit            post-receive           p4-pre-submit
```

git-daemon, git-instaweb

"git-daemon - A really simple server for Git repositories" [`git-daemon(1)`], e.g.[10]

```
[alice@earth ~]$ git daemon --verbose --base-path=$HOME/repos \ --reuseaddr
--export-all $HOME/repos/*/.git


[bob@mars ~]$ git clone git://earth/foo
```

git-instaweb allows browsing a repository[11], e.g.

```
$ git instaweb [--local] --httpd=lighttpd --port=8080
$ git instaweb --stop
```

[10] It normally listens on port TCP 9418.
[11] Requires perl-cgi and lighttpd.

Other projects

git-annex

libgit2

git-crypt

Conclusion

Closing words

- Git is powerful. REALLY!
- Although targetted to SCM, it may be used to store (large) binary data and replicate it to remote sites
- Sysadmins: start versioning `/etc` today
- Read more at: `http://git-scm.org/` or `git-*(1)` manual pages
- "I am now a git expert... Am I?"

Wait! There is more...

Porcelain

git-add
git-am
git-archive
git-bisect
git-branch
git-bundle
git-checkout
git-cherry-pick
git-citool
git-clean
git-clone
git-commit
git-describe
git-diff
git-fetch
git-format-patch
git-gc
git-grep
git-gui
git-init
git-log
git-merge
git-mv
git-notes
git-pull
git-push
git-range-diff
git-rebase
git-reset
git-revert
git-rm
git-shortlog
git-show
git-stash
git-status
git-submodule
git-tag
git-worktree
git-config
git-fast-export
git-fast-import
git-filter-branch
git-mergetool
git-pack-refs
git-prune
git-reflog
git-remote
git-repack
git-replace
git-annotate
git-blame
git-count-objects
git-difftool
git-fsck
git-help
git-instaweb
git-merge-tree
git-rerere
git-show-branch
git-verify-commit
git-verify-tag
git-whatchanged
git-archimport
git-cvsexportcommit
git-cvsimport
git-cvsserver
git-imap-send
git-p4
git-quiltimport
git-request-pull
git-send-email
git-svn

Plumbing

git-apply
git-checkout-index
git-commit-graph
git-commit-tree
git-hash-object
git-index-pack
git-merge-file
git-merge-index
git-mktag
git-mktree
git-multi-pack-index
git-pack-objects
git-prune-packed
git-read-tree
git-symbolic-ref
git-unpack-objects
git-update-index
git-update-ref
git-write-tree
git-cat-file
git-cherry
git-diff-files
git-diff-index
git-diff-tree
git-for-each-ref
git-get-tar-commit-id
git-ls-files
git-ls-remote
git-ls-tree
git-merge-base
git-name-rev
git-pack-redundant
git-rev-list
git-rev-parse
git-show-index
git-show-ref
git-unpack-file
git-var
git-verify-pack
git-daemon
git-fetch-pack
git-http-backend
git-send-pack
git-update-server-info
git-http-fetch
git-http-push
git-parse-remote
git-receive-pack
git-shell
git-upload-archive
git-upload-pack
git-check-attr
git-check-ignore
git-check-mailmap
git-check-ref-format
git-column
git-credential
git-credential-cache
git-credential-store
git-fmt-merge-msg
git-interpret-trailers
git-mailinfo
git-mailsplit
git-merge-one-file
git-patch-id
git-sh-i18n
git-sh-setup
git-stripspace

Thanks!

Thank you
for listening!

¿?