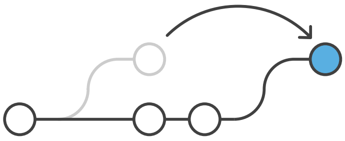
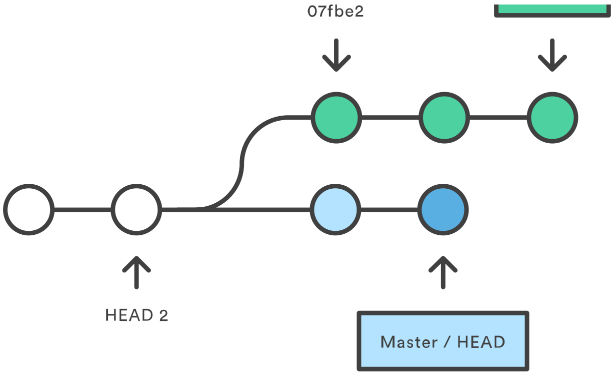


Refs and the Reflog

Git is all about commits: you stage commits, create commits, view old commits, and transfer commits between repositories using many different Git commands. The majority of these commands operate on a commit in some form or another, and many of them accept a commit reference as a parameter. For example, you can use `git checkout` to view an old commit by passing in a commit hash, or you can use it to switch branches by passing in a branch name.



By understanding the many ways to refer to a commit, you make all of these commands that much more powerful. In this chapter, we'll shed some light on the internal workings of common commands like `git checkout`, `git branch`, and `git push` by exploring the many methods of referring to a commit.

We'll also learn how to revive seemingly "lost" commits by accessing them through Git's reflog mechanism.

Hashes

The most direct way to reference a commit is via its SHA-1 hash. This acts as the unique ID for each commit. You can find the hash of all your commits in the `git log` output.

```
commit 0c708fdec272bc4446c6cabea4f0022c2b616eba
Author: Mary Johnson <mary@example.com>
Date:   Wed Jul 9 16:37:42 2014 -0500

    Some commit message
```

When passing the commit to other Git commands, you command:

```
git show 0c708f
```

It’s sometimes necessary to resolve a branch, tag, or another indirect reference into the corresponding commit hash. For this, you can use the `git rev-parse` command. The following returns the hash of the commit pointed to by the `master` branch:

```
git rev-parse master
```

This is particularly useful when writing custom scripts that accept a commit reference. Instead of parsing the commit reference manually, you can let `git rev-parse` normalize the input for you.

Refs

A **ref** is an indirect way of referring to a commit. You can think of it as a user-friendly alias for a commit hash. This is Git’s internal mechanism of representing branches and tags.

Refs are stored as normal text files in the `.git/refs` directory, where `.git` is usually called `.git`. To explore the refs in one of your repositories, navigate to `.git/refs`. You should see the following structure, but it will contain different files depending on what branches, tags, and remotes you have in your repo:

```
    remotes/
        origin/
            master
    tags/
        v0.9
```

The heads directory defines all of the local branches in you repository. Each filename matches the name of the corresponding branch, and inside the file you'll find a commit hash. This commit hash is the location of the tip of the branch. To verify this, try running the following two commands from the root of the Git repository:

```
# Output the contents of `refs/heads/master` file:
cat .git/refs/heads/master

# Inspect the commit at the tip of the `master` b
git log -1 master
```

The commit hash return by the `cat` command should match the commit ID displayed by `git log`.

To change the location of the `master` branch, all Git has to do is change the contents of the `refs/heads/master` file. Similarly, creating a new branch is simply a matter of writing a commit hash to a new file. This is part of the reason why Git branches are so lightweight compared to SVN.

The `tags` directory works the exact same way, but it contains tags instead of branches. The `remotes` directory lists all remote repositories that you created with `git remote` as separate subdirectories. Inside each one, you'll find all the remote branches that have been fetched into your repository.

Getting Started

Collaborating

Migrating to Git

Advanced Tips

Advanced Git Tutorials

Merging vs. Rebasing

Reset, Checkout, and Revert

Advanced Git log

Git Hooks

Refs and the Reflog

Hashes

Refs

Packed Refs

Special Refs

Refspecs

Relative Refs

define the full name of the ref, or use a short name and let Git search for a matching ref. You should already be familiar with short names for refs, as this is what you're using each time you refer to a branch by name.

```
git show some-feature
```

The `some-feature` argument in the above command is actually a short name for the branch. Git resolves this to `refs/heads/some-feature` before using it. You can also specify the full ref on the command line, like so:

```
git show refs/heads/some-feature
```

This avoids any ambiguity regarding the location of the ref. This is necessary, for instance, if you had both a tag and a branch called `some-feature`. However, if you're using proper naming conventions, ambiguity between tags and branches shouldn't generally be a problem.

We'll see more full ref names in the Refspecs section.

Packed Refs

For large repositories, Git will periodically perform a garbage collection to remove unnecessary objects and compress refs into a single file for more efficient performance. You can force this compression with the garbage collection command:

the `refs` folder into a single file called `packed-refs` located in the top of the `.git` directory. If you open up this file, you'll find a mapping of commit hashes to refs:

```
00f54250cf4e549fdfcafe2cf9a2c90bc3800285 refs/hea
0e25143693cfe9d5c2e83944bbaf6d3c4505eb17 refs/hea
bb883e4c91c870b5fed88fd36696e752fb6cf8e6 refs/tag
```

On the outside, normal Git functionality won't be affected in any way. But, if you're wondering why your `.git/refs` folder is empty, this is where the refs went.

Special Refs

In addition to the `refs` directory, there are a few special refs that reside in the top-level `.git` directory. They are listed below:

- HEAD – The currently checked-out commit/branch.
- FETCH_HEAD – The most recently fetched branch from a remote repo.
- ORIG_HEAD – A backup reference to HEAD before drastic changes to it.
- MERGE_HEAD – The commit(s) that you're merging into the current branch with `git merge`.
- CHERRY_PICK_HEAD – The commit that you're cherry-picking.

These refs are all created and updated by Git when

Getting Started

Collaborating

Migrating to Git

Advanced Tips

Advanced Git Tutorials

Merging vs. Rebasing

Reset, Checkout, and Revert

Advanced Git log

Git Hooks

Refs and the Reflog

Hashes

Refs

Packed Refs

Special Refs

Refspecs

Relative Refs

pulling the fetched branches into the repository. Of course, you can use all of these like any other ref, as I'm sure you've done with `HEAD`.

These files contain different content depending on their type and the state of your repository. The `HEAD` ref can contain either a **symbolic ref**, which is simply a reference to another ref instead of a commit hash, or a commit hash. For example, take a look at the contents of `HEAD` when you're on the `master` branch:

```
git checkout master
cat .git/HEAD
```

This will output `ref: refs/heads/master`, which means that `HEAD` points to the `refs/heads/master` ref. This is how Git knows that the `master` branch is currently checked out. If you were to switch to another branch, the contents of `HEAD` would be updated to reflect the new branch. But, if you were to check out a commit instead of a branch, `HEAD` would contain a commit hash instead of a symbolic ref. This is how Git knows that it's in a detached HEAD state.

For the most part, `HEAD` is the only reference that you'll be using directly. The others are generally only useful when writing lower-level scripts that need to hook into Git's internal workings.

Refspecs

and to configure some advanced `git push` and `git fetch` behavior.

A refspec is specified as `[+]<src>:<dst>`. The `<src>` parameter is the source branch in the local repository, and the `<dst>` parameter is the destination branch in the remote repository. The optional `+` sign is for forcing the remote repository to perform a non-fast-forward update.

Refspecs can be used with the `git push` command to give a different name to the remote branch. For example, the following command pushes the `master` branch to the `origin` remote repo like an ordinary `git push`, but it uses `qa-master` as the name for the branch in the `origin` repo. This is useful for QA teams that need to push their own branches to a remote repo.

```
git push origin master:refs/heads/qa-master
```

You can also use refspecs for deleting remote branches. This is a common situation for feature-branch workflows that push the feature branches to a remote repo (e.g., for backup purposes). The remote feature branches still reside in the remote repo after they are deleted from the local repo, so you get a build-up of dead feature branches as your project progresses. You can delete them by pushing a refspec that has an empty `<src>` parameter, like so:

```
git push origin :some-feature
```

This is very convenient, since you don't need to log in to

Tutorials

following will have the same effect as the above command:

```
git push origin --delete some-feature
```

By adding a few lines to the Git configuration file, you can use refspecs to alter the behavior of `git fetch`. By default, `git fetch` fetches *all* of the branches in the remote repository. The reason for this is the following section of the `.git/config` file:

```
[remote "origin"]
    url = https://git@github.com:mary/example-repo
    fetch = +refs/heads/*:refs/remotes/origin/*
```

The `fetch` line tells `git fetch` to download all of the branches from the `origin` repo. But, some workflows don't need all of them. For example, many continuous integration workflows only care about the `master` branch. To fetch only the `master` branch, change the `fetch` line to match the following:

```
[remote "origin"]
    url = https://git@github.com:mary/example-repo
    fetch = +refs/heads/master:refs/remotes/origin
```

You can also configure `git push` in a similar manner. For instance, if you want to always push the `master` branch to `qa-master` in the `origin` remote (as we did above), you would change the config file to:

```
[remote "origin"]
    url = https://git@github.com:mary/example-repo
    fetch = +refs/heads/master:refs/remotes/origin
```

Tutorials

Getting Started

Collaborating

Migrating to Git

Advanced Tips

Advanced Git Tutorials
Merging vs. Rebasing
Reset, Checkout, and Revert
Advanced Git log
Git Hooks
Refs and the Reflog
Hashes
Refs
Packed Refs
Special Refs
Refspecs
Relative Refs

Git commands transfer branches between repositories. They let you rename and delete branches from your local repository, fetch/push to branches with different names, and configure `git push` and `git fetch` to work with only the branches that you want.

Relative Refs

You can also refer to commits relative to another commit. The `~` character lets you reach parent commits. For example, the following displays the grandparent of `HEAD`:

```
git show HEAD~2
```

But, when working with merge commits, things get a little more complicated. Since merge commits have more than one parent, there is more than one path that you can follow. For 3-way merges, the first parent is from the branch that you were on when you performed the merge, and the second parent is from the branch that you passed to the `git merge` command.

The `~` character will always follow the *first* parent of a merge commit. If you want to follow a different parent, you need to specify which one with the `^` character. For example, if `HEAD` is a merge commit, the following returns the second parent of `HEAD`.

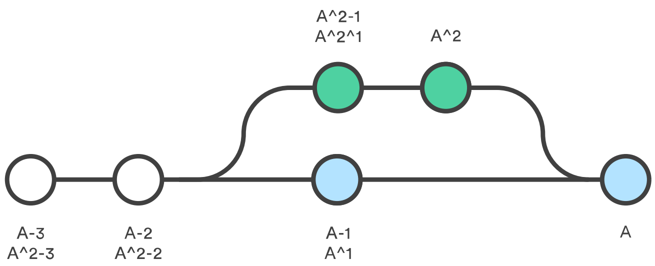
```
git show HEAD^2
```

that rests on the *second* parent.

```
git show HEAD^2^1
```

To clarify how `~` and `^` work, the following figure shows you how to reach any commit from `A` using relative references. In some cases, there are multiple ways to reach a commit.

Accessing commits using relative refs



Relative refs can be used with the same commands that a normal ref can be used. For example, all of the following commands use a relative reference:

```
# Only list commits that are parent of the second
git log HEAD^2

# Remove the last 3 commits from the current bran
git reset HEAD~3

# Interactively rebase the last 3 commits on the c
git rebase -i HEAD~3
```

The Reflog

The reflog is Git's safety net. It records almost every

Getting Started

Collaborating

Migrating to Git

Advanced Tips

Advanced Git Tutorials

Merging vs. Rebasing

Reset, Checkout, and Revert

Advanced Git log

Git Hooks

Refs and the Reflog

Hashes

Refs

Packed Refs

Special Refs

Refspecs

Relative Refs

in your local repo. To view the reflog, run the `git reflog` command. It should output something that looks like the following:

```
400e4b7 HEAD@{0}: checkout: moving from master to
0e25143 HEAD@{1}: commit (amend): Integrate some a
00f5425 HEAD@{2}: commit (merge): Merge branch ';f
ad8621a HEAD@{3}: commit: Finish the feature
```

This can be translated as follows:

- You just checked out `HEAD~2`
- Before that you amended a commit message
- Before that you merged the `feature` branch into `master`
- Before that you committed a snapshot

The `HEAD{<n>}` syntax lets you reference commits stored in the reflog. It works a lot like the `HEAD~<n>` references from the previous section, but the `<n>` refers to an entry in the reflog instead of the commit history.

You can use this to revert to a state that would otherwise be lost. For example, lets say you just scrapped a new feature with `git reset`. Your reflog might look something like this:

```
ad8621a HEAD@{0}: reset: moving to HEAD~3
298eb9f HEAD@{1}: commit: Some other commit messag
bbe9012 HEAD@{2}: commit: Continue the feature
9cb79fa HEAD@{3}: commit: Start a new feature
```

The three commits before the `git reset` are now dangling, which means that there is no way to reference commit to get back to the state of your repository before you ran `git reset`.

```
git checkout HEAD@{1}
```

This puts you in a detached `HEAD` state. From here, you can create a new branch and continue working on your feature.

Summary

You should now be quite comfortable referring to commits in a Git repository. We learned how branches and tags were stored as refs in the `.git` subdirectory, how to read a `packed-refs` file, how `HEAD` is represented, how to use refspecs for advanced pushing and fetching, and how to use the relative `~` and `^` operators to traverse a branch hierarchy.

We also took a look at the reflog, which is a way to reference commits that are not available through any other means. This is a great way to recover from those little “Oops, I shouldn’t have done that” situations.

The point of all this was to be able to pick out exactly the commit that you need in any given development scenario. It’s very easy to leverage the skills you learned in this article against your existing Git knowledge, as some of the most common commands accept refs as arguments, including `git log`, `git show`, `git checkout`, `git reset`, `git revert`, `git rebase`, and many others.

Tutorials

Recommend

Want future articles?

Enter Your Email For Git News

Site hosted by