Git
Revision Control

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Revision 144 (November 19, 2015)

Abstract

Git is a free and open source distributed version control system designed to handle everything from small to very large projects with speed and efficiency.

Git is easy to learn and has a tiny footprint with lightning fast performance. It outclasses SCM tools like Subversion, CVS, Perforce, and ClearCase with features like cheap local branching, convenient staging areas, and multiple workflows.[1]

[1] Git - https://git-scm.com/

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List of Definitions and Abbreviations

- **Branch** - [FIXME: Need data]
- **Git** - Quoting Linus: I'm an egotistical bastard, and I name all my projects after myself. First 'Linux', now 'Git'. ('git' is British slang for "pig headed, think they are always correct, argumentative").[2]
- **Repo** - "The multiple repository tool. Repo is a tool that we built on top of Git. Repo helps us manage the many Git repositories, does the uploads to our revision control system, and automates parts of the Android development workflow. Repo is not meant to replace Git, only to make it easier to work with Git in the context of Android. The repo command is an executable Python script that you can put anywhere in your path."
  https://code.google.com/p/git-repo/
- **Tag** - [FIXME: Need data]

[2] Git FAQ
https://git.wiki.kernel.org/index.php/GitFaq#Why_the_.27Git.27_name.3F

Introduction

Git is a distributed revision control system with an emphasis on speed,[3] data integrity,[4] and support for distributed, non-linear workflows.[5] Git was initially designed and developed by Linus Torvalds for Linux kernel development in 2005, and has since become one of the most widely adopted version control systems for software development.[6]

As with most other distributed revision control systems, and unlike most clientserver systems, every Git working directory is a full-fledged repository with complete history and full version-tracking capabilities, independent of network access or a central server.[7] Like the Linux kernel, Git is free software distributed under the terms of the GNU General Public License version 2.[8]

[3] Torvalds, Linus (2005-04-07). "Re: Kernel SCM saga..." linux-kernel (Mailing list). "So I'm writing some scripts to try to track things a whole lot faster."

[4] Torvalds, Linus (2007-06-10). "Re: fatal: serious inflate inconsistency". git (Mailing list). A brief description of Git's data integrity design goals.

[5] Linus Torvalds (2007-05-03). Google tech talk: Linus Torvalds on git. Event occurs at 02:30. Retrieved 2007-05-16.

[6] "Eclipse Community Survey 2014 results — Ian Skerrett". Ianskerrett.wordpress.com. 2014-06-23. Retrieved 2014-06-23.

[7] Chacon, Scott (24 December 2014). Pro Git (2nd ed.). New York, NY: Apress. pp. 2930. ISBN 978-1484200773.

[8] Git (software), From Wikipedia, the free encyclopedia, https://en.wikipedia.org/wiki/Git_(software)

Command Reference

Command	Description
`add`	Add file contents to the index
`apply`	Apply a patch to files and/or to the index
`clone`	Get a complete copy of a repository
`commit`	Record changes to the repository
`pull`	Fetch from and integrate with another repository or a local branch
`push`	Update remote refs along with associated objects
`rebase`	Forward-port local commits to the updated upstream head
`status`	Show the working tree status

Table 1: Commands

Add

Add file contents to the index

This command updates the index using the current content found in the working tree, to prepare the content staged for the next commit. It typically adds the current content of existing paths as a whole, but with some options it can also be used to add content with only part of the changes made to the working tree files applied, or remove paths that do not exist in the working tree anymore.[9]

Examples

Create and add `.repo/manifests/default.xml` file and `.repo/manifests/manifest.xml`

```
covellite:~/git/.repo/manifests$ git add default.xml
covellite:~/git/.repo/manifests$ git commit default.xml
covellite:~/git/.repo/manifests$ cd ..
covellite:~/git/.repo/$ ln -s manifests/default.xml manifest.xml
covellite:~/git/.repo/$ git add manifest.xml
covellite:~/git/.repo/$ git commit
```

[9] git-add - Add file contents to the index
https://git-scm.com/docs/git-add

Clone

To grab a complete copy of another user's repository, use git clone like this:

```
$ git clone https://github.com/USERNAME/REPOSITORY.git
# Clones a repository to your computer
```

When you run `git clone`, the following actions occur:
> A new folder called repo is made
> It is initialized as a Git repository
> A remote named origin is created, pointing to the URL you cloned from
> All of the repository's files and commits are downloaded there
> The default branch (usually called master) is checked out

For every branch `foo` in the remote repository, a corresponding remote-tracking branch `refs/remotes/origin/foo` is created in your local repository. You can usually abbreviate such remote-tracking branch names to `origin/foo`.[10]

Examples

To clone repository named `git` from GitHub to local `covellite` workstation:

```
covellite:~$ git clone https://github.com/marcilr/git.git
Cloning into 'git'...
warning: You appear to have cloned an empty repository.
Checking connectivity... done.
covellite:~$
```

Clone `.repo` repository into `git/` directory:

```
covellite:~/git$ git clone https://github.com/marcilr/.repo
Cloning into '.repo'...
warning: You appear to have cloned an empty repository.
Checking connectivity... done.
covellite:~/git$
```

[10] Fetching a remote, `git clone`, `git fetch`, `git merge`, `git pull`, https://help.github.com/articles/fetching-a-remote/

To clone a Git repository over SSH, you can specify ssh:// URL like this:

```
$ git clone ssh://user@server/project.git
```

Or you can use the shorter scp-like syntax for the SSH protocol:

```
$ git clone user@server:project.git
```

You can also not specify a user, and Git assumes the user you're currently logged in as.[11]

[FIXME: Need more commands here.]

[11] Git on the Server - The Protocols, The SSH Protocol,
https://git-scm.com/book/en/v2/Git-on-the-Server-The-Protocols

The SSH Protocol

A common transport protocol for Git when self-hosting is over SSH. This is because SSH access to servers is already set up in most places and if it isnt, it's easy to do. SSH is also an authenticated network protocol; and because its ubiquitous, it's generally easy to set up and use.

If you have two-factor authentication[12] enabled, you must create a personal access token[13] to use instead of your GitHub password.[14]

To clone a Git repository over SSH, you can specify ssh:// URL like this:

```
$ git clone ssh://user@server/project.git
```

Or you can use the shorter scp-like syntax for the SSH protocol:

```
$ git clone user@server:project.git
```

You can also not specify a user, and Git assumes the user youre currently logged in as.

The Pros

The pros of using SSH are many. First, SSH is relatively easy to set up SSH daemons are commonplace, many network admins have experience with them, and many OS distributions are set up with them or have tools to manage them. Next, access over SSH is secure all data transfer is encrypted and authenticated. Last, like the HTTP/S, Git and Local protocols, SSH is efficient, making the data as compact as possible before transferring it.

The Cons

The negative aspect of SSH is that you cant serve anonymous access of your repository over it. People must have access to your machine over SSH to access it, even in a read-only capacity, which doesnt make SSH access conducive to open source projects. If youre using it only within your corporate network, SSH may be the only protocol you need to deal with. If you want to allow anonymous read-only access to your projects and also want to use SSH, youll have to set up SSH for you to push over but something else for others to fetch over.[15]

[12] About Two-Factor Authentication, https://help.github.com/articles/about-two-factor-authentication/

[13] Creating an access token for command-line use to use instead of your GitHub password., https://help.github.com/articles/creating-an-access-token-for-command-line-use/

[14] Changing a remote's URL, https://help.github.com/articles/changing-a-remote-s-url/

[15] Ibid.

Branching & Tagging

In short: Best practice is branch out, merge often and keep always in sync.

There are pretty clear conventions about keeping your code in a separate branches from master branch:

1. You are about to make an implementation of major or disruptive change
2. You are about to make some changes that might not be used
3. You want to experiment on something that you are not sure it will work
4. When you are told to branch out, others might have something they need to do in master

Rule of thumb is after branching out, you should keep in sync with the master branch. Because eventually you need to merge it back to master. In order to avoid a huge complicated mess of conflicts when merging back, you should commit often, merge often.[16]

[16] Git branching and tagging best practices
http://programmers.stackexchange.com/questions/165725/git-branching-and-tagging-best-practices

Cloud Repository

A cloud repository provides easy access from distributed locations and alleviates backup issues. Candidates for a cloud repository include Bitbucket,[17] GitHub,[18] or Google Code.[19]

GitHub

[FIXME: Still need cli list, rename, and delete functionality.]

[17] Bitbucket - Code, Manage, Collaborate, Bitbucket is the Git solution for professional teams
https://bitbucket.org/

[18] GitHub - Where software is built
https://github.com/

[19] Google Code - Provides a free collaborative development environment for open source projects.
https://code.google.com/

Pushing from local repository to GitHub hosted remote

You push your local repository to the remote repository using the git push command after first establishing a relationship between the two with the `git remote add [alias] [url]` command. If you visit your Github repository, it will show you the URL to use for pushing. You'll first enter something like:

```
git remote add origin git@github.com:username/reponame.git
```

Unless you started by running git clone against the remote repository, in which case this step has been done for you already.

And after that, you'll type:

```
git push origin master
```

After your first push, you can simply type:

```
git push
```

when you want to update the remote repository in the future.

edited Jul 10 '14 at 14:17 by thomio

answered May 13 '12 at 18:01 by larsks

...

Subversion implicitly has the remote repository associated with it at all times. Git, on the other hand, allows many "remotes", each of which represents a single remote place you can push to or pull from.

You need to add a remote for the GitHub repository to your local repository, then use `git push <REMOTE>` or `git pull <REMOTE>` to push and pull respectively - or the GUI equivalents.

...

Once you have associated the two you will be able to push or pull branches.

answered May 13 '12 at 18:01

by Daniel Pittman

Caching your GitHub password in Git

If you're cloning GitHub repositories using HTTPS, you can use a credential helper to tell Git to remember your GitHub username and password every time it talks to GitHub.

If you clone GitHub repositories using SSH, then you authenticate using SSH keys instead of a username and password. For help setting up an SSH connection, see Generating SSH Keys.[20]

[19] Pushing from local repository to GitHub hosted remote, http://stackoverflow.com/questions/10573957/pushing-from-local-repository-to-github-hosted-remote

[20] Generating SSH keys, https://help.github.com/articles/generating-ssh-keys/

Turn on the credential helper so that Git will save your password in memory for some time. By default, Git will cache your password for 15 minutes.[21]

1. In Terminal, enter the following:

```
$ git config --global credential.helper cache
# Set git to use the credential memory cache
```

2. To change the default password cache timeout, enter the following:

```
$ git config --global credential.helper 'cache --timeout=3600'
# Set the cache to timeout after 1 hour (setting is in seconds)
```

[FIXME: The GitHub user and pass got saved by alternate means. How was that done?]

Create a Github Repo from the Command Line

Creating a GitHub repository from the command line is incredibly convenient.

Googled up some simple shell script to create GitHub repo via command line:

```
"curl -u $username:$token" https://api.github.com/user/repos \
-d '{"name":"'$repo_name'"}'}
```

To use, you could simply replace `$username` with your GitHub username, `$token` with a Personal Access Token[22] for the same user (available for generation in your GitHub Settings > Applications), and `$repo_name` with your desired new Repository name.[23]

Creating a repo from the command line is definitely faster than going to Github and using the web app to get the job done, but in order to truly make this task speedy, we need some Bash programming.

[21] Caching your GitHub password in Git, https://help.github.com/articles/caching-your-github-password-in-git/

[22] GitHub supports Personal access tokens, under Settings, click Personal access tokens. Personal access tokens function like ordinary OAuth access tokens. They can be used instead of a password for Git over HTTPS, or can be used to authenticate to the API over Basic Authentication. I set mine to the usual:) https://github.com/settings/tokens

[23] Create a Github Repo from the Command Line, by Eli Fatsi - Jan 29, 2014, https://viget.com/extend/create-a-github-repo-from-the-command-line

```
github-create() {
  repo_name=$1

  dir_name=‘basename $(pwd)‘

  if [ "$repo_name" = "" ]; then
    echo "Repo name (hit enter to use ’$dir_name’)?"
    read repo_name
  fi

  if [ "$repo_name" = "" ]; then
    repo_name=$dir_name
  fi

  username=‘git config github.user‘
  if [ "$username" = "" ]; then
    echo "Could not find username, run ’git config \
    --global github.user <username>’"
    invalid_credentials=1
  fi

  token=‘git config github.token‘
  if [ "$token" = "" ]; then
    echo "Could not find token, run ’git config \
    --global github.token <token>’"
    invalid_credentials=1
  fi

  if [ "$invalid_credentials" == "1" ]; then
    return 1
  fi

  echo -n "Creating Github repository ’$repo_name’ ..."
  curl -u "$username:$token" https://api.github.com/user/repos \
  -d ’{"name":"’$repo_name’"}’ > /dev/null 2>&1
  echo " done."

  echo -n "Pushing local code to remote ..."
  git remote add origin git@github.com:$username/$repo_name.git \
  > /dev/null 2>&1
  git push -u origin master > /dev/null 2>&1
  echo " done."
}
```

Plop this function into your `~/.bash_profile`, open a new Terminal window or source `~/.bash_profile`, and the function will be loaded up and ready for use.

Then while in an existing git project, running `github-create` will create the repo and push your master branch up in one shot. You will need to set some github config variables (instructions will be spit out if you don't have them). Heres an example:

```
BASH:projects $ rails new my_new_project
  ..... (a whole lot of generated things)
BASH:projects $ cd my_new_project/
BASH:my_new_project $ git init && git add . && git commit \
-m 'Initial commit'
 ..... (a whole lot of git additions)
BASH:my_new_project $ github-create
  Repo name (hit enter to use 'my_new_project')?

  Creating Github repository 'my_new_project' ... done.
  Pushing local code to remote ... done.
```

Had I called the function with an argument `github-create my_project` then it would have used the argument and skipped the Repo name question.[24]

On GCI Network Services, OSS `covellite` Debian jessie 8.2 workstation the `gtihub-create` did not execute. Put github-create() into a standalone `~/gtihub-create` script with call to `gtihub-create()` under main.

Tested with:

```
$ mkdir ~/quux
$ cd ~/quux
$ git init
Initialized empty Git repository in /home/marcilr/quux/.git/
$ github-create
Repo name (hit enter to use 'quux')?

Could not find username, run 'git config --global github.user <username>'
Could not find token, run 'git config --global github.token <token>'
$
```

[24] Create a Github Repo from the Command Line, by Eli Fatsi - Jan 29, 2014, https://viget.com/extend/create-a-github-repo-from-the-command-line

Configured the GetHub username and token to alleviate GutHub credential errors:

```
$ git config --global github.user marcilr
$ git config --global github.token <token>
```

Was then able to run `~/github-create` successfully:

```
$ cd ~/quux/
$ github-create
Repo name (hit enter to use 'quux')? <enter>

Creating Github repository 'quux' ... done.
Pushing local code to remote ... done.
$
```

Checking GitHub via online access I found the new `quux` repo.

[FIXME: Need Bitbucket vs. GitHub section]

Repo

"Repo is a repository management tool that we built on top of Git. Repo unifies the many Git repositories when necessary, does the uploads to a revision control system, and automates parts of the development workflow. Repo is not meant to replace Git, only to make it easier to work with Git in the context of Android. The `repo` command is an executable Python script that you can put anywhere in your path. In working with source files, you will use Repo for across-network operations. For example, with a single Repo command you can download files from multiple repositories into your local working directory."[25]

[FIXME: The above `repo` quote has been heavily modified. Need to rewrite with original verbage.]

`.repo/` subdirectory

The `.repo/` subdirectory, located in the repository base, holds repo configuration. The configuration includes a manifest with information about all the projects and where their associated git repositories are located.

Files within the `.repo/` subdirectory includes:

```
manifests/
manifests.git
manifest.xml -> manifests/default.xml
project-objects
projects/
repo/
```

To create the `.repo/` subdirectory:

```
$ cd <my_repo>
$ mkdir .repo/
$
```

Manifest

The repo keeps a manifest, "within the hidden directory named '.repo'," in "a git project named '`manifests`' which usually contains a file named '`default.xml`'. This file contains information about all the projects and where their associated git repositories are located. This file is also versioned thus when you use the '`repo init -b XYZ`' command it will be reverted and you can back to older branches that may have added/removed git projects compared to the head."[26]

[25] Developing – http://source.android.com/source/developing.html

[26] How does the Android repo manifest repository work?
http://stackoverflow.com/questions/6149725/how-does-the-android-repo-manifest-repository-work

The `default.xml` file is symlinked to `.repo/manifest.xml` and is created when the repo was initialized using:

```
repo init -u <manifest path>
```

Examples

Following is a manifest, in `.repo/manifests/default.xml` file, showing use of GitHub with username, ssh:// URL syntax, and 3 project repos with different usernames:[27]

```
<?xml version="1.0" encoding="UTF-8"?>
<manifest>
  <remote name="origin" fetch="ssh://git@github.com/" />
  <default revision="master" remote="origin" />

  <project path="lib/plist-lib"
           name="keiji/AndroidPListLib.git" remote="origin" />

  <project path="lib/json-pull-parser"
           name="vvakame/JsonPullParser.git" remote="origin" />

  <project path="apps/twicca_megane_plugin"
           name="zaki50/TwiccaMeganePlugin.git" remote="origin" />
</manifest>
```

[27] Keiji Ariyama, https://github.com/keiji/repo-sample/blob/master/default.xml

Commands

Repo usage takes the following form:[28]

```
repo <COMMAND> <OPTIONS>
```

Optional elements are shown in brackets [ ]. For example, many commands take a project list as an argument. You can specify project-list as a list of names or a list of paths to local source directories for the projects:

```
repo sync [<PROJECT0> <PROJECT1> <PROJECTN>]
repo sync [</PATH/TO/PROJECT0> ...  </PATH/TO/PROJECTN>]
```

Once Repo is installed, you can find the latest documentation starting with a summary of all commands by running:

```
repo help
```

You can get information about any command by running this within a Repo tree:

```
repo help <COMMAND>
```

NOTE: For `repo` commands without syntax here see the Repo command reference.[29]

[28] Repo command reference
https://source.android.com/source/using-repo.html#help

[29] Ibid.

Command	Description
abandon	Permanently abandon a development branch
branch	View current topic branches
branches	View current topic branches
checkout	Checkout a branch for development
cherry-pick	Cherry-pick a change
diff	Show changes between commit and working tree
diffmanifests	Manifest diff utility
download	Download and checkout a change
grep	Print lines matching a pattern
forall	Executes the given shell command in each project.[30]
help	Display detailed help on a command
info	Get info on the manifest branch, current branch or unmerged branches
init	Install repo in the current working directory
list	List projects and their associated directories
overview	Display overview of unmerged project branches
prune	Prune (delete) already merged topics
rebase	Rebase local branches on upstream branch
start	Start a new branch for development
status	Show the working tree status
sync	Update working tree to the latest revision
upload	Upload changes for code review

Table 2: Repo Commands

init

`$ repo init -u <URL> [<OPTIONS>]`
Installs Repo in the current directory. This creates a `.repo/` directory that contains Git repositories for the Repo source code and the standard Android manifest files. The `.repo/` directory also contains `manifest.xml`, which is a symlink to the selected manifest in the `.repo/manifests/` directory.[31]

Command	Description
-u	Specify a URL from which to retrieve a manifest repository. The common manifest can be found at: `https://android.googlesource.com/platform/manifest`
-m	Select a manifest file within the repository. If no manifest name is selected, the default is default.xml.
-b	Specify a revision, i.e., a particular manifest-branch.

Table 3: init Options

Examples

This will create a new place to hold your local copy of the source tree. "url" should point to a Manifest repository that describes the whole sources. It is a special project with a file (default.xml) that lists all the projects that Android is made of. In the Manifest file, each projects has attributes about: where to place it in the tree, where to download it from (git server), revision that will be used (usually a branch name, tag or commit sha-id).[32]

```
repo init -u <url> -b <branch>
```

Note: For all remaining Repo commands, the current working directory must either be the parent directory of `.repo/` or a subdirectory of the parent directory.[33]

[FIXME: Need example of GitHub checkout]

[31] Repo command reference – https://source.android.com/source/using-repo.html
[32] Repo: Tips & Tricks, http://xda-university.com/as-a-developer/repo-tips-tricks
[33] Repo command reference – https://source.android.com/source/using-repo.html

Appendix

A successful Git branching model
by Vincent Driessen on Tuesday, January 05, 2010
Fine branching diagram here.
http://nvie.com/posts/a-successful-git-branching-model/

Bitbucket vs. GitHub: Which project host has the most?
The right choice boils down to a number of factors – you might even consider using both
http://www.infoworld.com/article/2611771/application-development/application-development-bitbucket-v

Developing
Has Repo and Gerrit details with syntax and examples.
http://source.android.com/source/developing.html

Fetching a remote
> `git clone`
> `git fetch`
> `git merge`
> `git pull`
https://help.github.com/articles/fetching-a-remote/

Git
https://git-scm.com/

Git (software)
From Wikipedia, the free encyclopedia
https://en.wikipedia.org/wiki/Git_(software)

Git About
https://git-scm.com/about

Git branching and tagging best practices
Excellent details and semantics.
http://programmers.stackexchange.com/questions/165725/git-branching-and-tagging-best-practices

Git FAQ
https://git.wiki.kernel.org/index.php/GitFaq

Git on the Server - The Protocols, The SSH Protocol
The Git Book
https://git-scm.com/book/en/v2/Git-on-the-Server-The-Protocols

Git (software)
From Wikipedia, the free encyclopedia
https://en.wikipedia.org/wiki/Git_(software)

Git repositories on gerrit
https://gerrit.googlesource.com/

GitHub
Project host
https://github.com/

How does the Android repo manifest repository work?
http://stackoverflow.com/questions/6149725/how-does-the-android-repo-manifest-repository-work

Installing Repo
http://source.android.com/source/downloading.html#installing-repo

Managing Remotes
https://help.github.com/categories/managing-remotes/

Manifest Format for repo
https://gerrit.googlesource.com/git-repo/+/master/docs/manifest-format.txt

Pro Git (the git book)
Available as pdf, epub, mobi, and html.
http://git-scm.com/book/en/v2/

Re: repo + private repositories in github
Details on manifest for google repo use.
https://groups.google.com/forum/embed/#!topic/repo-discuss/kCXO-NdFvj4

Repo Command Reference
Using Repo and Git - very useful details here.
http://source.android.com/source/using-repo.html

Repo: Tips & Tricks
http://xda-university.com/as-a-developer/repo-tips-tricks

repo - The multiple repository tool
https://code.google.com/p/git-repo/

Set Up Git
>Creating a repository
>Forking a repository

>Being social
https://help.github.com/articles/set-up-git/