Git for Version Control


http://www.cs.washington.edu/403/
About Git

• Created by Linus Torvalds, creator of Linux, in 2005
  – Came out of Linux development community
  – Designed to do version control on Linux kernel

• Goals of Git:
  – Speed
  – Support for non-linear development
    (thousands of parallel branches)
  – Fully distributed
  – Able to handle large projects efficiently

  – *(A "git" is a cranky old man. Linus meant himself.)*
Installing/learning Git

- Git website: http://git-scm.com/
  - Reference page for Git: http://gitref.org/index.html
  - Git tutorial: http://schacon.github.com/git/gittutorial.html
  - Git for Computer Scientists:
    - http://eagain.net/articles/git-for-computer-scientists/

- At command line: (where verb = config, add, commit, etc.)
  - git help verb
Centralized VCS

- In Subversion, CVS, Perforce, etc. A central server repository (repo) holds the "official copy" of the code
  - the server maintains the sole version history of the repo
- You make "checkouts" of it to your local copy
  - you make local modifications
  - your changes are not versioned
- When you're done, you "check in" back to the server
  - your checkin increments the repo's version
Distributed VCS (Git)

- In git, mercurial, etc., you don't "checkout" from a central repo
  - you "clone" it and "pull" changes from it

- Your local repo is a complete copy of everything on the remote server
  - yours is "just as good" as theirs

- Many operations are local:
  - check in/out from local repo
  - commit changes to local repo
  - local repo keeps version history

- When you're ready, you can "push" changes back to server
Git snapshots

- Centralized VCS like Subversion track version data on each individual file.
- Git keeps "snapshots" of the entire state of the project.
  - Each checkin version of the overall code has a copy of each file in it.
  - Some files change on a given checkin, some do not.
  - More redundancy, but faster.
Local git areas

- In your local copy on git, files can be:
  - In your local repo
    - (committed)
  - Checked out and modified, but not yet committed
    - (working copy)
  - Or, in-between, in a "staging" area
    - Staged files are ready to be committed.
    - A commit saves a snapshot of all staged state.
Basic Git workflow

- **Modify** files in your working directory.
- **Stage** files, adding snapshots of them to your staging area.
- **Commit**, which takes the files in the staging area and stores that snapshot permanently to your Git directory.
In Subversion each modification to the central repo increments the version # of the overall repo.
- In Git, each user has their own copy of the repo, and commits changes to their local copy of the repo before pushing to the central server.
- So Git generates a unique **SHA-1 hash** (40 character string of hex digits) for every commit.
- Refers to commits by this ID rather than a version number.

- Often we only see the first 7 characters:
  - 1677b2d Edited first line of readme
  - 258efa7 Added line to readme
  - 0e52da7 Initial commit
• Set the name and email for Git to use when you commit:
  - `git config --global user.name "Bugs Bunny"`
  - `git config --global user.email bugs@gmail.com`
  - You can call `git config --list` to verify these are set.

• Set the editor that is used for writing commit messages:
  - `git config --global core.editor nano`
    • (it is vim by default)
Creating a Git repo

Two common scenarios: (only do one of these)

• To create a new **local Git repo** in your current directory:
  - `git init`
    • This will create a `.git` directory in your current directory.
    • Then you can commit files in that directory into the repo.
  - `git add filename`
  - `git commit -m "commit message"`

• To **clone a remote repo** to your current directory:
  - `git clone url localDirectoryName`
    • This will create the given local directory, containing a working copy of the files from the repo, and a `.git` directory (used to hold the staging area and your actual local repo)
## Git commands

<table>
<thead>
<tr>
<th>command</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>git clone <code>url</code> <code>[dir]</code></td>
<td>copy a Git repository so you can add to it</td>
</tr>
<tr>
<td>git add <code>file</code></td>
<td>adds file contents to the staging area</td>
</tr>
<tr>
<td>git commit</td>
<td>records a snapshot of the staging area</td>
</tr>
<tr>
<td>git status</td>
<td>view the status of your files in the working directory and staging area</td>
</tr>
<tr>
<td>git diff</td>
<td>shows diff of what is staged and what is modified but unstaged</td>
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<tr>
<td>git help <code>[command]</code></td>
<td>get help info about a particular command</td>
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<tr>
<td>git pull</td>
<td>fetch from a remote repo and try to merge into the current branch</td>
</tr>
<tr>
<td>git push</td>
<td>push your new branches and data to a remote repository</td>
</tr>
</tbody>
</table>

Others: init, reset, branch, checkout, merge, log, tag
Add and commit a file

- The first time we ask a file to be tracked, _and every time before we commit a file_, we must add it to the staging area:
  - `git add Hello.java Goodbye.java`
    - Takes a snapshot of these files, adds them to the staging area.
    - In older VCS, "add" means "start tracking this file." In Git, "add" means "add to staging area" so it will be part of the next commit.

- To move staged changes into the repo, we commit:
  - `git commit -m "Fixing bug #22"

- To undo changes on a file before you have committed it:
  - `git reset HEAD -- filename` (unstages the file)
  - `git checkout -- filename` (undoes your changes)
  - All these commands are acting on your local version of repo.
Viewing/undoing changes

- To view status of files in working directory and staging area:
  - `git status` or `git status -s` (short version)

- To see what is modified but unstaged:
  - `git diff`

- To see a list of staged changes:
  - `git diff --cached`

- To see a log of all changes in your local repo:
  - `git log` or `git log --oneline` (shorter version)

  1677b2d Edited first line of readme
  258efa7 Added line to readme
  0e52da7 Initial commit

  • `git log -5` (to show only the 5 most recent updates), etc.
An example workflow

[rea@attu1 superstar]$ emacs rea.txt
[rea@attu1 superstar]$ git status
   no changes added to commit
   (use "git add" and/or "git commit -a")
[rea@attu1 superstar]$ git status -s
   M rea.txt
[rea@attu1 superstar]$ git diff
   diff --git a/rea.txt b/rea.txt
[rea@attu1 superstar]$ git add rea.txt
[rea@attu1 superstar]$ git status
   # modified:   rea.txt
[rea@attu1 superstar]$ git diff --cached
   diff --git a/rea.txt b/rea.txt
[rea@attu1 superstar]$ git commit -m "Created new text file"
Branching and merging

Git uses branching heavily to switch between multiple tasks.

• To create a new local branch:
  - `git branch name`

• To list all local branches: (* = current branch)
  - `git branch`

• To switch to a given local branch:
  - `git checkout branchname`

• To merge changes from a branch into the local master:
  - `git checkout master`
  - `git merge branchname`
Merge conflicts

- The conflicting file will contain `<<<<` and `>>>` sections to indicate where Git was unable to resolve a conflict:

```
<<<<<< HEAD:index.html
<div id="footer">todo: message here</div>
=======
<div id="footer">
  thanks for visiting our site
</div>
>>>>>> SpecialBranch:index.html
```

- Find all such sections, and edit them to the proper state (whichever of the two versions is newer / better / more correct).
Interaction w/ remote repo

- **Push** your local changes to the remote repo.
- **Pull** from remote repo to get most recent changes.
  - (fix conflicts if necessary, add/commit them to your local repo)

- To fetch the most recent updates from the remote repo into your local repo, and put them into your working directory:
  - `git pull origin master`

- To put your changes from your local repo in the remote repo:
  - `git push origin master`
• **GitHub.com** is a site for online storage of Git repositories.
  – You can create a **remote repo** there and push code to it.
  – Many open source projects use it, such as the Linux kernel.
  – You can get free space for open source projects, or you can pay for private projects.
  – Free private repos for educational use:  [github.com/edu](https://github.com/edu)

• **Question:** Do I always have to use GitHub to use Git?
  – **Answer:** No! You can use Git locally for your own purposes.
  – Or you or someone else could set up a server to share files.
  – Or you could share a repo with users on the same file system, as long everyone has the needed file permissions).