

Using Git: An Overview for Comp 20

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February 4, 2013

What is git?

- Git: Version Control System (VCS)
- Distributed: Lives on more than one computer
- Keeps track of snapshots of a directory: [VCS] repository = files + history
- [Free software](#)
- Really complex (300,000 lines of code, written in C, Bash, and Perl)
- Really useful (helps keep track of what you do, so you make fewer mistakes)
- Started by the Linus Torvals, who also started the Linux kernel
- Git \neq GitHub, though [Git's code](#) is available there.

Using Git

- Read the manual
- `git help <command>`
 - Warning: the documentation is pretty gross
- The following are the most useful bits of git knowledge I've picked up over the years.

Git: Local Repository Only

Basic Usage (local repository)

- `git init` – Create a repository

repo files

```
[ ] *  
[ ]
```

- `git add` – I want you to record the state of the following files

```

[ * ]
[ ]

```

- `git commit` – Actually do it. (And attach a message describing changes)

```

[ * (HEAD) message ]
[ ]

```

- **HEAD**: the current commit

Basic Usage (local repository)

- *rinse, repeat*

```

[ * (HEAD) message3 ]
[ * message2        ]
[ * message          ]
[ ]

```

Other Useful Basic Commands

- `git rm <filename>`
 - Remove a file from the repo
- `git mv <from-filename> <to-filename>`
 - Rename a file in the repo

Git: Local and Remote Repositories

Basic Usage (local + remote repository)

- Git repositories can be synchronized between multiple local and multiple remote computers (e.g. your laptop, halligan, and GitHub).
 - A repository's `.git/config` file has details
 - Default remote name is `origin`
 - `git remote add origin https://github.com/Hnasar/test.git`

- GitHub offers public remote repositories
- Local and remote repositories has benefits:
 - Work on stuff without an Internet connection
 - Work on a project from different computers
- Added complexity:
 - Manually keep changes synchronized.
 - Combining some changes requires intervention (a conflict)

Remote: Initial State

- Empty remote, new repository

local (laptop)	remote (GitHub)
[*]	[]
[*]	[]
[*]	[]
[]	[]

Remote: Updating the remote

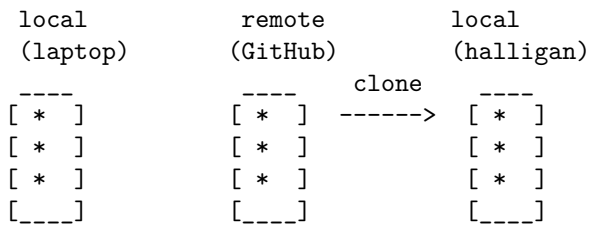
- Update the remote with local changes with `git push`

local (laptop)		remote (GitHub)
[*]	push	[*]
[*]	----->	[*]
[*]		[*]
[]		[]

- (DANGEROUS if the remote repo gets completely messed up, try `git push -f` It's usually better to resolve conflicts rather than do this. This can lead to lost data)

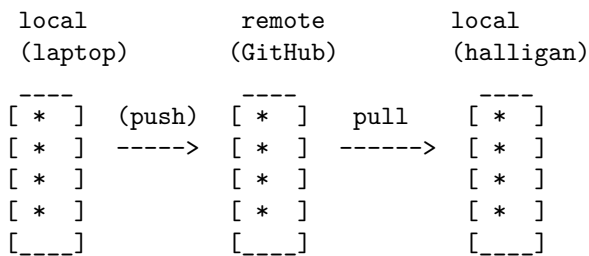
Remote: Creating a new local

- Download an entire remote repository to a new local copy with `git clone`



Remote: Updating the local

- Update local repositories with remote changes with `git pull`



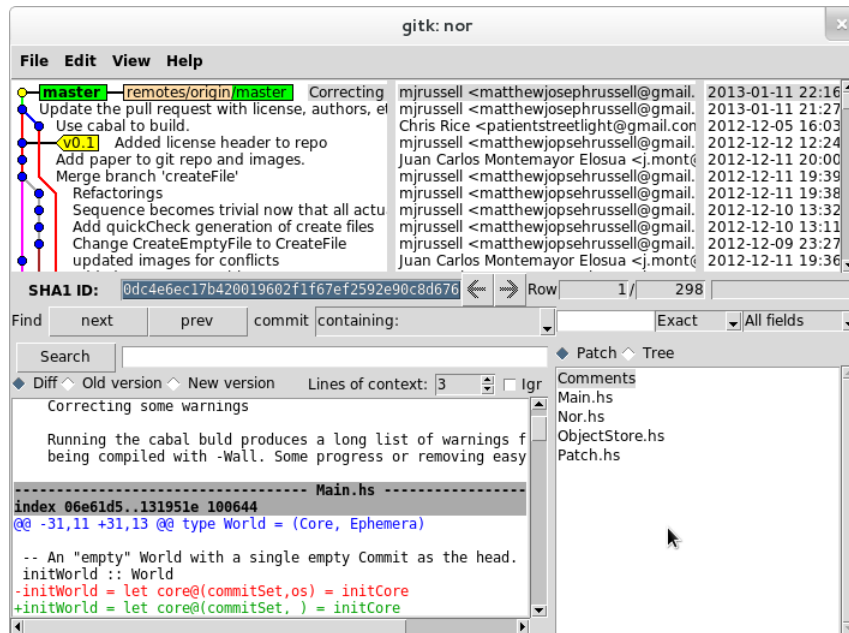
- *git pull is usually bad form. Use `git pull --rebase`*
- Read [this article](#) for more info.

Interlude: Setting up GitHub User Pages

- User pages: a GitHub feature that exposes a specific repository in your account as a website.
- Email account must be verified.
- Repository must be named: `username.github.com`
- 10 minutes needed before the page will load
- If you can't get it to work, delete the repo and recreate it.
- E.g. My GitHub username is *hnasar*. My “User Pages” repository is called `hnasar.github.com`, and it's accessible [here](#)

Viewing a Repository 1

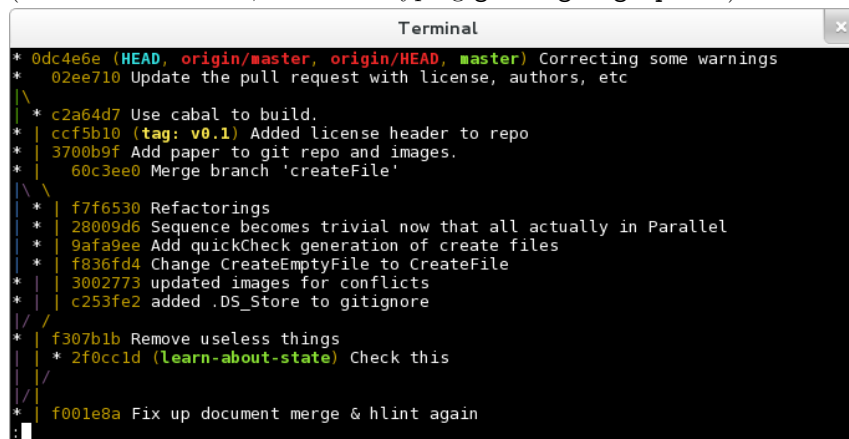
- `gitk --all`



- available on halligan, Ubuntu/Debian, [homebrew](#)

Viewing a Repository 2

- `git log --graph --oneline --all --decorate`
- mnemonic: (git log g.o.a.d.), goad, meaning it's annoying to type all that
- (Shortcut: Ctrl + r, then start typing `git log --graph ...`)



What next?

- Lots of potential topics. What are you interested in?

- Committing and good commit style
- Undoing commits and fixing things
- Working with branches
- GitHub forking and pull requests
- Time travel
- Questions from the audience

Committing and Good Commit Style

Adding and Committing

- Commits are the basic unit of a repository
- Mark a new state of files at a point in time
- Commit message indicates to viewers what the changes in the commit did.
- (Use `git diff` to see what was changed from the last commit)
- 2-part command
 1. `git add <path/s/>` – record these changes in the next commit
 2. `git commit` – make the commit, and add a message
- (try `git add -p` to select exactly which changes within files are added)
- Before a commit is made, `git reset` (without any arguments!) will undo `git add`
- `git commit` (with no arguments) will open *vim*. To save and quit, type `:wq`

Commit Style

- A good commit will contain only the changes necessary to some new feature of a repository.
- E.g. If the feature is: “ensure all `img` tags have an `alt` attribute”, a good commit will add `alt` tags for every `img` in one go, and NOT create a new commit for every changed `img` tag, or every file that I change things in.
- Good commit message form:
 - Feature in present tense
 - One blank line
 - Explanation/reasoning of changes

Add alt attribute to every `img`

As per Section 508 Amendment to the Rehabilitation Act of 1973 and the HTML 5 specification, every img should have an alt attribute which "provides equivalent content for those who cannot process images or who have image loading disabled".

Undoing Commits and Fixing Things

Git reset

- `git reset --hard <commit>`
 - DANGEROUS – you will lose any **uncommitted** changes
 - used to undo commits
 - Moves branch label, and HEAD to commit specified

Git reset example

- * 31a3f57 (HEAD, master) Third commit
 - * 20ea82d Second commit
 - * 9ef5cfb First commit
- `git reset --hard 20ea82d`

Git reset example

- * 20ea82d (HEAD, master) Second commit
- * 9ef5cfb First commit

Un-undoing Commits

- Commits are only truly deleted after a given time passes (several days)
 - `git reflog`
 - displays most recent commits which have been HEAD
- ```
20ea82d HEAD@{0}: reset: moving to HEAD~1
31a3f57 HEAD@{1}: checkout: moving from 20ea82d to master
20ea82d HEAD@{2}: checkout: moving from master to HEAD~1
31a3f57 HEAD@{3}: commit: Third commit
20ea82d HEAD@{4}: commit: Second commit
9ef5cfb HEAD@{5}: commit (initial): First commit
```
- `git reset --hard 31a3f57`

## Un-undoing Commits

- *Back to the start!*

```
* 31a3f57 (HEAD, master) Third commit
* 20ea82d Second commit
* 9ef5cfb First commit
```

## Working with Branches

### Branches

- Branches allow multiple lines of commits, which may be dealing with differing features, to not overlap (which might cause confusion).
- A branch is a label attached to a commit.
- Default branch name is `master`
- View branches (including the current one) with `git branch -a`

```
* 7a0fc15 Patch.hs: Fix incorrect editsToChangeHunks offsets
* e564f63 Make the type of Edit more general.
* | 0bbe999 Implements applyPatch
* | b6d7003 Implements sequencePatches
|/
* 6f2a864 Paralell patch changes
```

### Using Branches

- Create a branch with `git branch <branch-name>`
- Delete a branch with `git branch -d <branch-name>`
- Switch branches with `git checkout <branch-name>`
- When you commit, the new commit's parent is the tip of the current branch, and the branch will now point to the new commit.
- [A successful Git branching model](#)

### Combining Branches

1. `git merge <branch to merge in>`
  - Produces a commit with multiple parents



```

* ca5ac46 Merge branch 'master' of github.com:jmont/nor
|\
| * 7a0fc15 Patch.hs: Fix incorrect editsToChangeHunks offsets
| * e564f63 Make the type of Edit more general.
* | 0bbe999 Implements applyPatch
* | b6d7003 Implements sequencePatches
|/
* 6f2a864 Paralell patch changes

```

## 2. `git rebase <branch to rebase onto>`

- Removes the branch by making the branch's commits stem from the end of the other.

```

* 7a0fc15 Patch.hs: Fix incorrect editsToChangeHunks offsets
* e564f63 Make the type of Edit more general.
* 0bbe999 Implements applyPatch
* b6d7003 Implements sequencePatches
* 6f2a864 Paralell patch changes

```

## Conflicts

- Git is smart about what lines changed in which files in a commit
- Some commits indicate contradicting changes.
- If git can't figure it out, it writes both version the file, complains of a conflict and tells you to fix it.
- Make the file look how you want, then do `git add .` and `git commit`

```

these lines
are not
in conflict
<<<<<<
THESE ARE IN CONFLICT!
=====
These are in conflict.
>>>>>> version 2
these lines
are good too

```

## GitHub Forking and Pull Requests

### GitHub: Forking

- GitHub “Forking” is something GitHub invented (not a part of git)
- GitHub “Forking” is a way to copy a remote git repo from one GitHub user to another.
- “fork” typically means taking an existing project, and developing it in a new direction. This is what happened when Ubuntu forked from Debian. We say Debian is the upstream.

```
remote remote
tuftsdev/ hnasar/
running-dogs running-dogs

[*] fork [*]
[*] -----> [*]
[*] [*]
[____] [____]
```

### GitHub: Pull Request

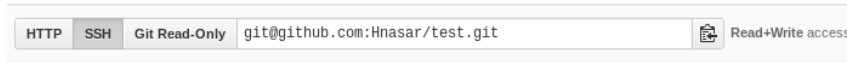
- Typically, free software developers share patches (modifications to code, try `git format-patch <commit>`) via email or posting on websites.
- GitHub created a notion of a “Pull Request” to easily allow GitHub “Forked” projects to collaborate in a similar fashion as sharing patches.
- [Good explanation](#)
- Pull Requests must be accepted by the recipient.

```
remote remote
tuftsdev/ hnasar/
running-dogs running-dogs

[_*_] <----- [*]
[*] pull [*]
[*] request [*]
[*] [*]
[____] [____]
```

## GitHub: No passwords

- Possible to use GitHub without typing in username & password each time
- [Set up SSH keys](#)
- Make sure that your remote URIs are set to `git@github.com/...`



- 
- Check a repository's `.git/config` file

## Time Travel

### Checkout & Blame

- checkout moves HEAD (the current commit, and the corresponding state of the files)
- (remember `git log --graph --oneline --all --decorate`)
- `git checkout <commit-hash>` (e.g. `git checkout 0dc4e6e`)
  - ‘detached HEAD’ state, which means HEAD isn’t on a branch
  - `git checkout` a branch to “reattach” the HEAD
- `git blame <file>` to see when and who last made changes to a part of a file.
- `git show <commit>` displays the contents of a given commit.

## End

### Questions/Comments

- More reference available [here](#)
- Still unclear?
- Did I miss something?