

# Using Git: An Overview for Comp 20

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## 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        ]
[ ]

```

## 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)

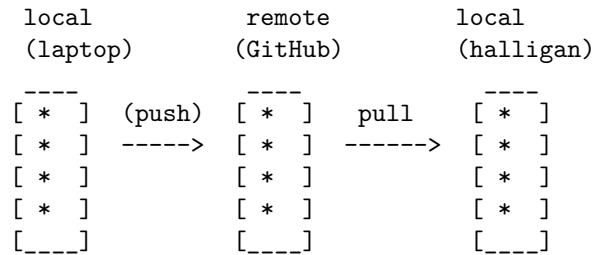
## Remote: Creating a new local

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

local (laptop)	remote (GitHub)		local (halligan)
----	----	clone	----
[ * ]	[ * ]	----->	[ * ]
[ * ]	[ * ]		[ * ]
[ * ]	[ * ]		[ * ]
[____]	[____]		[____]

## Remote: Updating the local

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



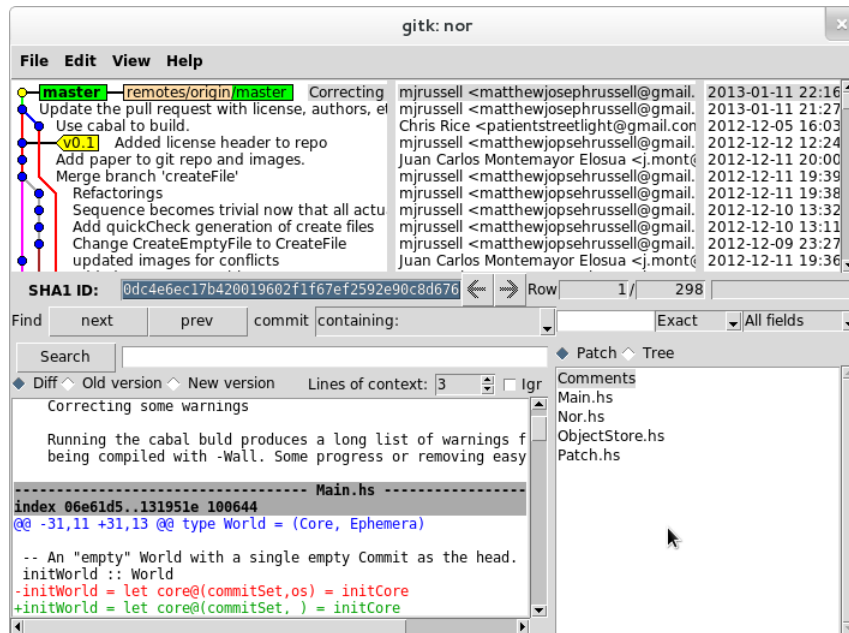
- *git pull is usually bad form. Use `git pull --rebase`*
- Read [this article](#) for more info.

## 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

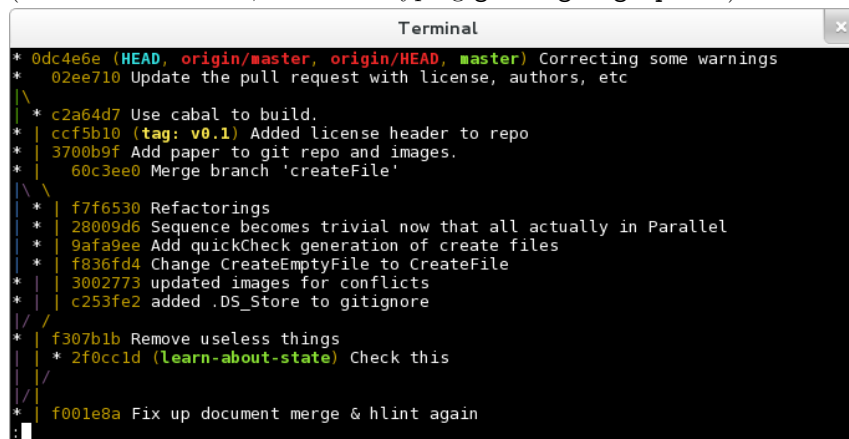
- `gitk --all`



- 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`

## 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 LibreOffice forked from OpenOffice and Ubuntu from Debian.

|           |         |
|-----------|---------|
| 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.

```

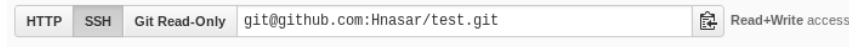
remote           remote
tuftsdev/         hnasar/
running-dogs      running-dogs

[ * ] <----- [ * ]
[ * ]      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?