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           remote
(laptop)        (GitHub)
 ____            ____
[ *  ]          [    ]
[ *  ]          [    ]
[ *  ]          [    ]
[____]          [____]
```

Remote: Updating the remote

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

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

Remote: Updating the local

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

```
 local           remote          local
 (laptop)       (GitHub)         (halligan)
 ____            ____              ____
[ *  ]  (push)  [ *  ]   pull    [ *  ]
[ *  ]  ----->  [ *  ]  ------>  [ *  ]
[ *  ]          [ *  ]           [ *  ]
[ *  ]          [ *  ]           [ *  ]
[____]          [____]           [____]
```

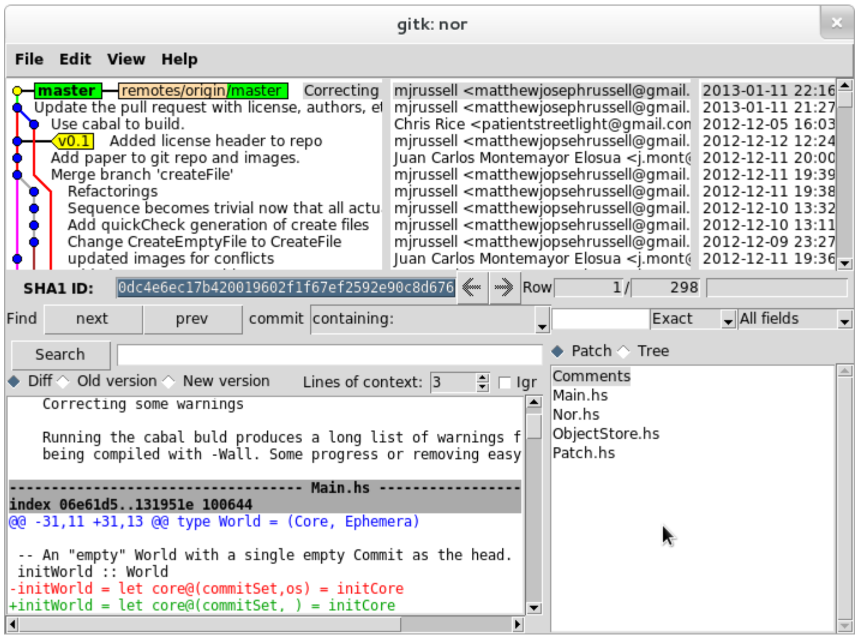
- *`git pull` is usually bad form. Use `git pull --rebase`*
- Read this article for more info.

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`

- 

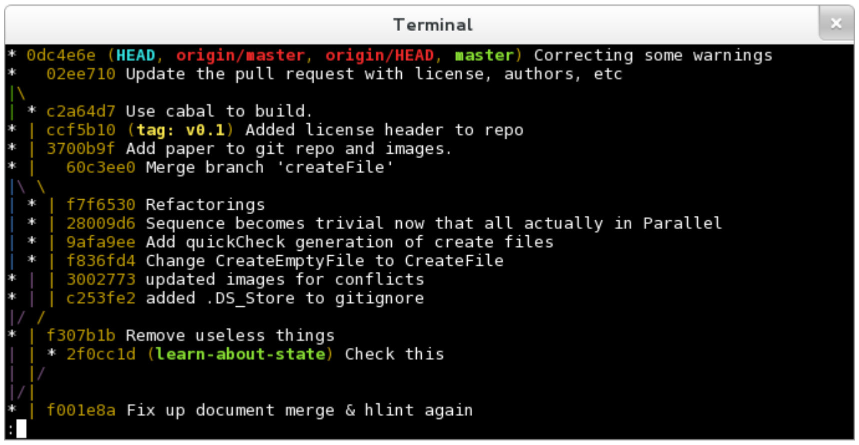
```
master  remotes/origin/master  Correcting           mjrussell <matthewjosephrussell@gmail.  2013-01-11 22:16
Update the pull request with license, authors, et   mjrussell <matthewjosephrussell@gmail.  2013-01-11 21:27
  Use cabal to build.                               Chris Rice <patientstreetlight@gmail.con 2012-12-05 16:03
v0.1  Added license header to repo                  mjrussell <matthewjopsehrussell@gmail.  2012-12-12 12:24
  Add paper to git repo and images.                 Juan Carlos Montemayor Elosua <j.mont(  2012-12-11 20:00
  Merge branch 'createFile'                         mjrussell <matthewjopsehrussell@gmail.  2012-12-11 19:39
    Refactorings                                    mjrussell <matthewjopsehrussell@gmail.  2012-12-11 19:38
    Sequence becomes trivial now that all actu      mjrussell <matthewjopsehrussell@gmail.  2012-12-10 13:32
    Add quickCheck generation of create files       mjrussell <matthewjopsehrussell@gmail.  2012-12-10 13:11
    Change CreateEmptyFile to CreateFile            mjrussell <matthewjopsehrussell@gmail.  2012-12-09 23:27
    updated images for conflicts                    Juan Carlos Montemayor Elosua <j.mont(  2012-12-11 19:36

SHA1 ID: 0dc4e6ec17b420019602f1f67ef2592e90c8d676   Row 1 / 298
```

```
    Correcting some warnings

    Running the cabal buld produces a long list of warnings f
    being compiled with -Wall. Some progress or removing easy

----------------------------------- Main.hs ----------------
index 06e61d5..131951e 100644
@@ -31,11 +31,13 @@ type World = (Core, Ephemera)

 -- An "empty" World with a single empty Commit as the head.
 initWorld :: World
-initWorld = let core@(commitSet,os) = initCore
+initWorld = let core@(commitSet, ) = initCore
```

```
Comments
Main.hs
Nor.hs
ObjectStore.hs
Patch.hs
```

- 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` ...)
- 

```
* 0dc4e6e (HEAD, origin/master, origin/HEAD, master) Correcting some warnings
*   02ee710 Update the pull request with license, authors, etc
|\
| * c2a64d7 Use cabal to build.
* | ccf5b10 (tag: v0.1) Added license header to repo
* | 3700b9f Add paper to git repo and images.
* |   60c3ee0 Merge branch 'createFile'
|\ \
| * | f7f6530 Refactorings
| * | 28009d6 Sequence becomes trivial now that all actually in Parallel
| * | 9afa9ee Add quickCheck generation of create files
| * | f836fd4 Change CreateEmptyFile to CreateFile
* | | 3002773 updated images for conflicts
* | | c253fe2 added .DS_Store to gitignore
|/ /
* | f307b1b Remove useless things
| | * 2f0cc1d (learn-about-state) Check this
| |/
|/|
* | f001e8a Fix up document merge & hlint again
:
```

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

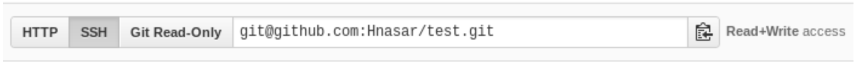
GitHub: Pull Request

- Typically, free software 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/`...
- 
  HTTP SSH Git Read-Only git@github.com:Hnasar/test.git Read+Write access
- 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

- Still unclear?
- Did I miss something?