

Lecture 1 recap

Let's break out that terminal

Recap

What is a terminal?

- A device that receives and displays text and handles keyboard input (like a monitor+keyboard)
- We don't have real ones anymore: we have "terminal emulators" (e.g. Command Prompt, Windows Terminal, mac OS Terminal, Gnome Terminal)
 - The terminal emulator itself is just the software that draws text in a window and handles keystrokes from the user
- Shells emit text for the terminal to display (e.g. Bash, Zsh, csh) as well as deals with keystrokes passed in by the terminal
 - These are the software you're *really* interacting with to get things done
 - When they run other programs, they handle hooking up the new program to the terminal
- When a terminal is opened it then launches an instance of your chosen shell and hooks it up to the text display and keyboard.

Recap

- Basic commands: `man`, `pwd`, `ls`, `cd`, `mv`, `rm`, `touch`
- Script files
- Running scripts

Some more stuff

- Basic text editor: **nano**
- ^C (ctrl-C): SIGINT
 - "Signal, interrupt"
 - Interrupts running program: can be helpful if the program isn't receiving input or taking too long
 - More on signals next week...
- Variables
 - Things like **PATH, HOME, EDITOR**
 - Some programs will look at certain variables
- Argument documentation syntax
 - **command <mandatory arg> [optional arg]**
 - Don't include the **<> []**
- SSH keys: use the defaults unless you know what you're doing

Announcements

- Basic 1 is out
- Lecture 1 survey closing next week (Jan 21)
 - Normally surveys are due within the week
 - This week's survey will be normal and due on January 21
- Course server open for use

GITing Started

Lecture 2

```
git init; git status; git log; git add; git commit;
```

Overview

1. What is version control?
2. Basic Git flow
3. Git branches
4. A taste of Git remotes

Version control

- Keep track of changes of files over time, allowing you to roll back to previous versions
- Software to handle this are known as "version control systems" (VCS)

Two paradigms

Centralized (CVCS)

- Central server keeps track of all the changes and history
- Each developer has local copies of files they need, but need to check in with the server to do any versioning
- Server down? Good luck.
- Examples: CVS, SVN, Perforce

Decentralized (DVCS)

- Each developer has a local copy of the entire codebase and its history
- Developers can perform versioning locally without needing to contact a server
- Server optional
- Examples: Git, Mercurial

Why version control?

- Checkpointing your work
 - Have you ever made `main.c.backup1`, `main.c.backup2`,...?
- Keeping multiple parallel versions of your work
 - Have you implemented something one way, made another implementation but wanted to keep both around?
 - Have you ever emailed code or sent code in some messaging app?
 - Have you tried to coordinate people working on the same file?

Enter...

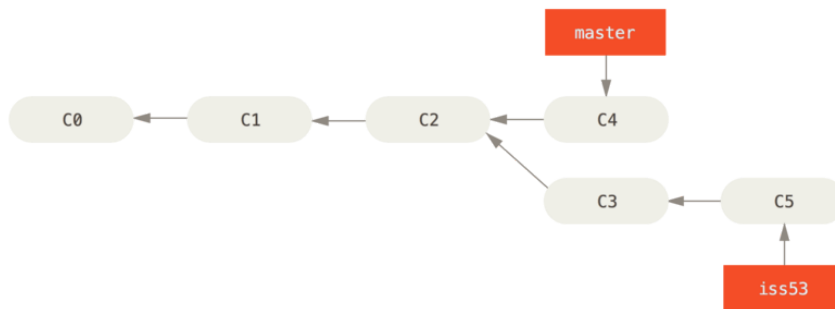
Enter...Git!

- Distributed version control system (DVCS)
- Designed by Linus Torvalds to manage the Linux kernel
- No server needed, super easy to get started with
 - `git init`
 - `git add`
 - `git commit`

That's it, lecture's over!

Git Overview

- Repository: a directory of stuff that Git is versioning
 - `.git` is the directory that holds all this metadata
- Commit: a checkpoint for the files in the repository
 - Given a hash for identification
 - (Unlike other VCS, has actual snapshots of files rather than diffs)
- History is a linked list of commits pointing to their parent
 - Directed acyclic graph (DAG) may be a more accurate term



From [Pro Git](#)

Basic commands

- `git init`
- `git status`
- `git log`
- `git add`
- `git reset`
- `git checkout`
- `git commit`

Some neat resources

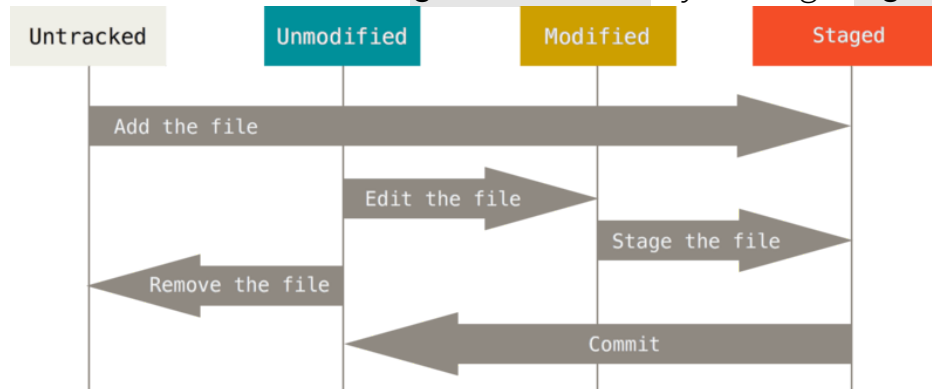
- `man git`
- `man git-<command>` or `git help <command>`
- [Official Git documentation](#)
- [Official Git tutorial](#)
 - `man gittutorial`
- [Official Git minimal set of useful commands](#)
 - `man giteveryday`
- [Pro Git book](#)
 - Free and comprehensive
 - Besides being on the web, has `.pdf`, `.epub`, and `.mobi` formats!
 - A really great read

Initializing a Git repository

- `git init`
 - That's pretty much it
- Initializes a Git repository inside the current directory
 - Creates the `.git` directory that contains all this Git data
- There will be an initial "branch" that you will be on with a default name
 - Currently it is `master`, subject to change
 - There is no special meaning ascribed to this by Git, it's just a default
 - (In newer versions of Git) You can specify the `-b` and `--initial-branch` arguments to change what the initial branch is
- FYI, initializing Git repos inside of Git repos might not work the way you expect them to
 - These sub-repos, or "sub-modules" follow their own versioning
 - The "parent" repo just keeps track of what version the sub-module is at, doesn't keep track of the files inside of it

Files have multiple states

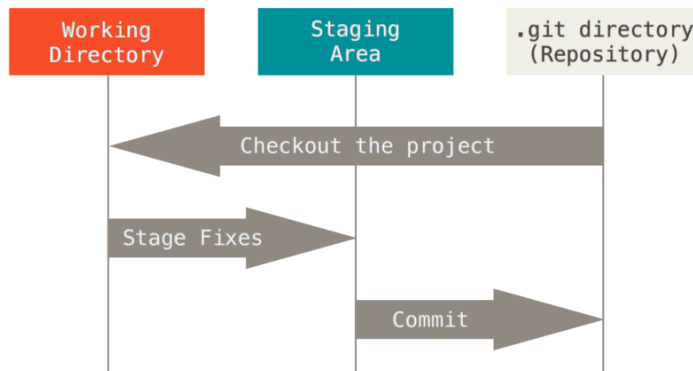
- **Unmodified:** Nothing has happened to this file; no changes as of the current commit
- **Modified:** This file differs from the version as of the current commit. Can be `git add` to be **Staged**
- **Staged:** This file differs, and is set to be in the next commit
- **Untracked:** This file does not exist as of the current commit
 - It's pretty similar to **Modified**; it "differs" by existing when it shouldn't
 - You can hide these from `git status` by adding a `.gitignore` file



From [Pro Git](#)

Ties into the "areas"

- **Working Directory:** the directory as your filesystem sees it, a mess of files which may or may not be changed, or may be even untracked
- **Staging Area/Index:** list of files whose snapshots will be part of the next commit
 - You'll see it referred to as either: I'm going to say "**Index**" for brevity and to distinguish it from the file state of **Staged**
- **Repository:** What commits Git now has saved
- Files and their snapshots will work their way through these three areas



From [Pro Git](#)

Scenario 1: Untracked file

1. An untracked file chills in the **Working Directory**
2. You decide to start versioning it, so you `git add` it, making it **Staged** and putting it into the **Index**
3. You commit the file in the **Index**, landing it in **Repository**

Scenario 2: Modified file

1. The file is now **Unchanged** as of the current commit, and is still chilling in the **Working Directory**
2. You make some changes, so now the file is **Modified**
 - Oops, maybe I don't like what I did and want to change it back to the old committed version, let's `git checkout` it
3. You `git add` it, making it **Staged** and putting it into the **Index**
 - Oops, maybe I added an extra file I didn't want to stage, let's `git reset` it back to **Modified**
4. You commit the file's snapshot, getting that snapshot into the **Repository**

Putting it together, locally (1)

Initialization

1. Initialize the repository
 - `git init`
2. Add the initial files you want to track to the **Index**
 - `git add`
3. Commit those initial files to the **Repository**
 - `git commit`

Putting it together, locally (2)

Loop

1. Modify some files

- Don't like a modification and want to make the file **Unmodified** again?
`git checkout <filename>`
- `git restore` is a new command that performs this behavior

2. Add **Modified/Untracked** files to the **Index**

- `git add`
- Accidentally added a file? `git reset <filename>` to take it out of the **Index**

3. Commit those files to the **Repository**

- `git commit`
- Didn't like your commit message or forgot to include some files? Add them to the **Index**, and `git commit --amend`

4. Goto 1, rinse and repeat

Commits

- `git commit -m <message>` is a quick and dirty way to make a commit
 - You see it a lot in tutorials because it's a one-liner, not because it's "good"
- Not super ideal when it's a project that you're going to collaborate with others on
- `git commit` will open the configured editor and allow you to more easily fully fill out a commit message

Commit message style

Title

- Limit to 50 characters
- Capitalize the first letter
- Imperative ("Fix xyz", "Remove abc")
- Summarize the commit

Body

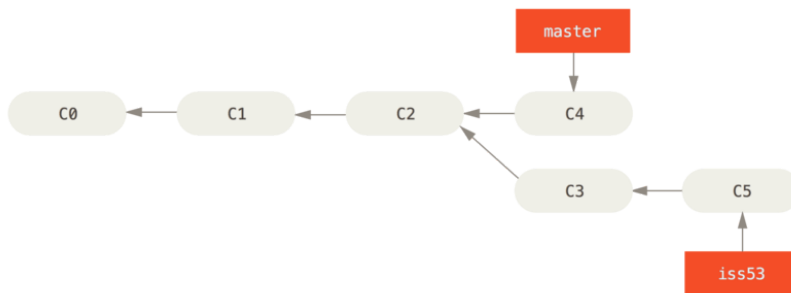
- Limit to 72 characters per line
- Explain what changed and why, not how
 - Your code (ideally) is the "how"
- Depending on your team/workplace: references to bug/issue number e.g. "Issue #22772", "Bug #1337"

Commit message style

- No, I'm not making this up, it's [straight from the horse's mouth](#)
- Ultimately these are just guidelines, not rules
 - Do what your team does, but try to keep good habits when you start something yourself

Branching

- Making a linked list of commits is cool, but what can we do with it? Can we go back? Can we split off?
- **HEAD** is a pointer pointing to the current commit that's being looked at
- A **branch** in Git is a pointer to a commit
 - Super lightweight compared to other VCS, go wild
 - **HEAD** will follow along with the branch you are on



From [Pro Git](#)

Branching

- Lots of applications:
 - Make a "backup" of branch: easy to refer to a particular commit
 - Manage a feature ("topic"/"feature" branches)
 - Have a separate line of development (e.g. taking two different approaches)
 - Represent release schedules (e.g. a development branch and a release branch)

Branching

- The default branch is **master**
 - Typically used for production/release
- **git branch** lists your local branches
- **git branch <branch-name>** creates a new branch
 - **<branch-name>** will point to wherever **HEAD** is pointing to
- **git checkout <branch-name>** checks out the branch, making your **HEAD** point to where **<branch-name>** is pointing to
 - **git switch** also switches to a branch; added in Git 2.23.0
 - **git checkout -b <branch-name>** creates **and checks out** the branch
- **git merge <branch-name>** will try to move the current branch to where **<branch-name>** is; this is called **fast-forwarding**
 - If the branches diverged (**<branch-name>** and the current branch both got new commits before merging), a special "merge commit" will be produced linking the two branches (we'll look at this later)

Remotes

- So far everything we've been looking at has been local
- What if you want to share it?
- A **remote** is a repository is hosted by some server on the Internet or internal network
- `git clone <URL> [directory]` will copy the repository from the server to your local machine
 - **origin** is the default name of the **remote** whose URL you cloned from
- `git remote -v` will list your **remotes**
- Confusingly, "remote" can refer to a particular server as well as the local repository's name for it
 - In one local repo, **remote origin** can point to `git@gitlab.umich.edu:eeecs201/content/website.git`
 - In another repo, **origin** can point to `git@gitlab.umich.edu:brng/eeecs201-basic-git.git`
 - These remote names are on a per-local repo basis

Remotes

- The **remote** has its own branches
 - Your local **Repository**'s branches might be *"tracking"* this a corresponding remote branch (more on this in the future)
 - e.g. local **dev** tracks **origin/dev**
- **git fetch** will get the latest commits from the **remote** into the **Repository**
 - These commits are more for the **Repository** to go "Oh hey, the remote branch has new commits on it!"
 - Effectively, the **Repository** has a local cached version of **origin/dev**
- **git pull** will do a **git fetch** and additionally **git merge**, potentially modifying your **Working Directory**
 - Under the hood, it's **merge**ing the locally cached version of remote branch into the local branch
 - e.g. it's **merge**ing **origin/dev** into **dev**
- As you work on your locally, you can make commits to your local **Repository**
- **git push** will send commits to the **remote**

Remote hosting services

(a.k.a. Git != GitHub)

- [GitHub](#)
- [BitBucket](#)
- [GitLab](#)
 - GitLab is also a Git host server software that you can use to host your own repos
 - gitlab.umich.edu is the GitLab server that the University of Michigan runs
 - gitlab.eecs.umich.edu is the GitLab server that the EECS runs

Communicating with remotes

- HTTP will use a username and password to authenticate
 - URL format: `https://somedomain.tld/path/to/repo.git`
 - Gets annoying having to type login info all the time
- SSH requires key setup
 - URL format: `git@somedomain.tld:path/to/repo.git`
 - No need to enter username and password though!
- These are the two most common for day to day use

Questions?

Addenda

Core commands

- `git init`
- `git status`
- `git log`
- `git add`
- `git reset`
- `git commit`
- `git branch`
- `git checkout`
 - `(git switch)`
 - `(git restore)`
- `git merge`

Remote and Collaboration commands

- `git clone`
- `git fetch`
- `git pull`
- `git push`
- `git remote`

Additional Commands

- `git help`
- `git stash`
- `git show`
- `git diff`
- `git rebase`
- `git blame`