# GITing Started

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...

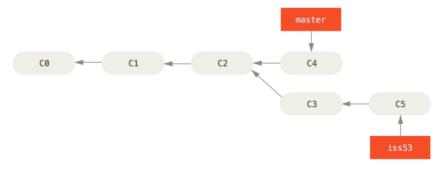
### Enter...Git!

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



#### 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
  - o man giteveryday
- Pro Gitbook
  - Free and comprehensive
  - Besides being on the web, has .pdf, .epub, and .mobi formats!
  - o 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

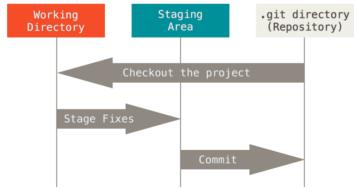
## Files have multiple states

- 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 added 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 Untracked Unmodified Modified Staged
    Add the file
    Remove the file
    Commit

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

# Putting it together, locally (2)

- 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
  - o git add
  - Accidentally added a file? git reset <filename> to take it out of the Index
- 3. Commit those files to the **Repository** 
  - o 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

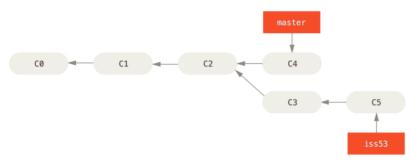
- Limit to 72 characters per line
- Explain what changed and why, not how
  - Your code (ideally) is the "how"
- Depending on your team/workplace: references to bug/issue number e.g. "Issue #22772", "Bug #1337"

## Commit message style

- No, I'm not making this up, it's <u>straight from the horse's mouth</u>
- 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
  - o git switch also switches to a branch; added in Git 2.23.0
  - git checkout -b <br/>
    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** 
  - o 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:eecs201/content/website.git
  - In another repo, origin can point to git@gitlab.umich.edu:brng/eecs201-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 mergeing the locally cached version of remote branch into the local branch
  - e.g. it's mergeing 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)

- <u>GitHub</u>
- BitBucket
- GitLab
  - GitLab is also a Git host server software that you can use to host your own repos
  - o gitlab.umich.edu is the GitLab server that the University of Michigan runs
  - o 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
  - o (git switch)
  - o (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