CS104 Appendix A

Github

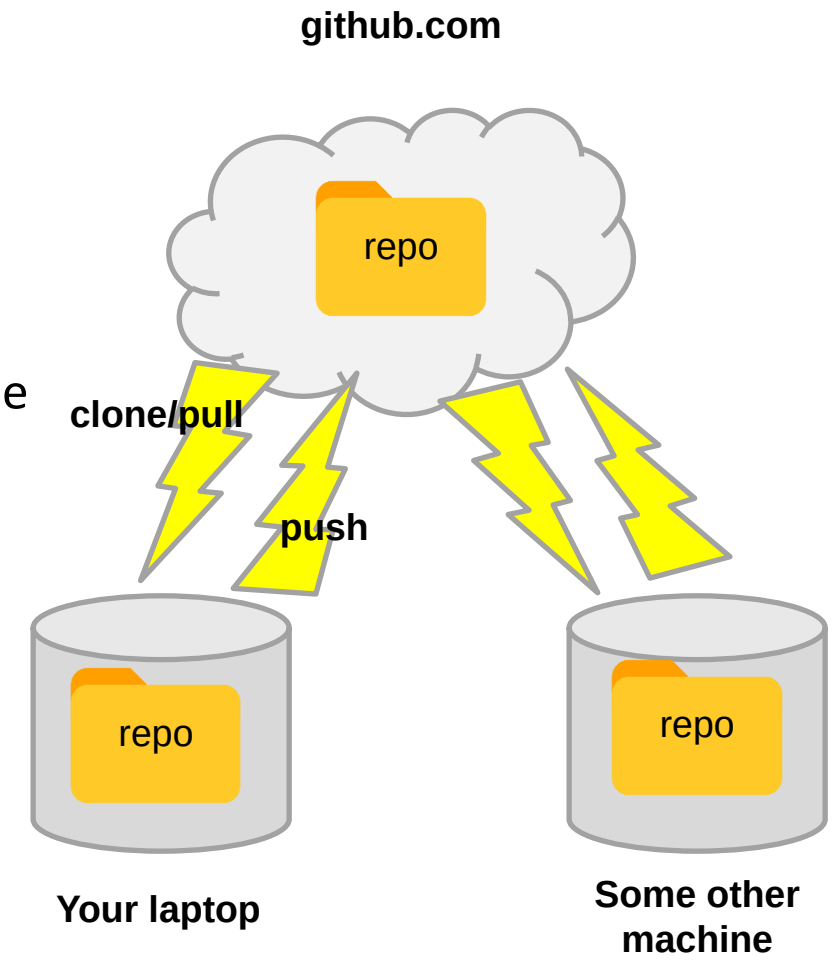
GIT AND GITHUB

Source/Version Control

- Have you ever made backups of backups of source files to save your code at various states of development (so you can recover to an earlier working version)?
- Have you ever worked on the same code with a partner and tried to integrate changes they made?
- These tasks can be painful without help
- Source/version control tools make this task easy
  - Allows one codebase (no separate folders or copies of files) that can be "checkpointed" (committed) at various times and then return back to a previous checkpoint/commit if desired
  - Can help merge differences between two versions of the same code
- Common source/version control tools are:
  - Git, Subversion, and a few older ones (cvs, rcs, clearcase, etc.)

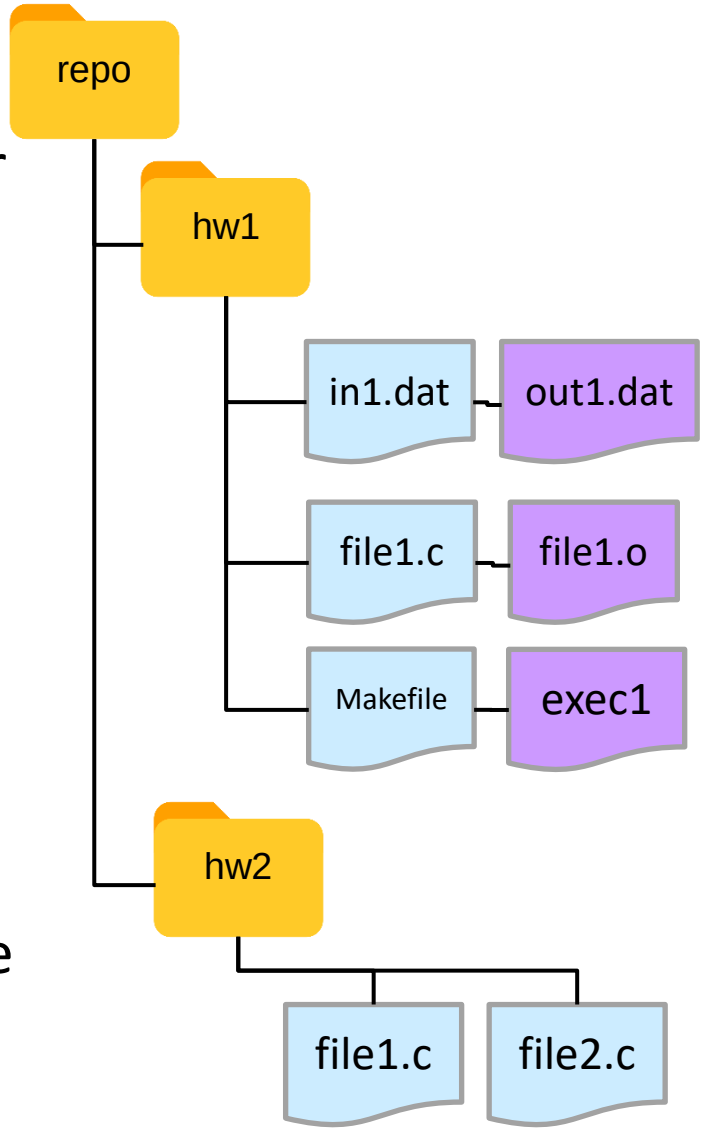
Git

- Git is a version control system
  - Stores "snapshots" of files (usually code) in a repository (think folder) at a explicit points in time that you choose
    - No more making backup copies
  - Allows easy updates to a view of the code at some historical point in time
- Git is "distributed" (often via Github)
  - Allows the repository to exist on various machines and each store new updates (aka "commits")
  - Github holds the central repository
  - Updates can be communicated to each "clone" of the repository by "push"-ing updates to and "pull" updates from the central repository on Github



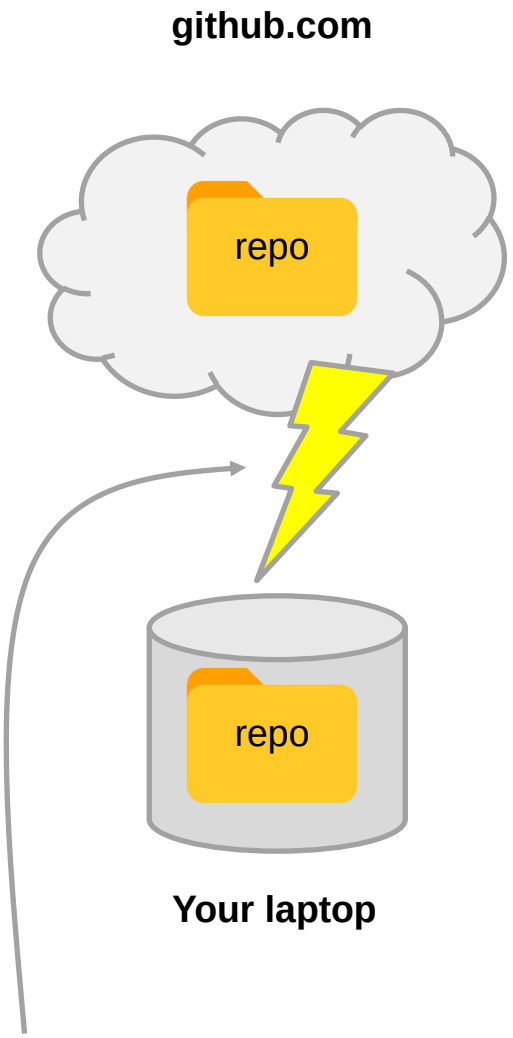
Repositories

- We generally organize our code and related files for a project in some folder
  - We will use the term "repository" for this ***top-level*** folder when it is under "version-control"
- Your repository can have some files that ARE version controlled…
  - Source code, Makefiles, input files
- …and some that ARE NOT
  - Object files, executables, output files
- Version controlled (aka 'tracked') files have their version history saved and are uploaded to Github



Cloning Repos

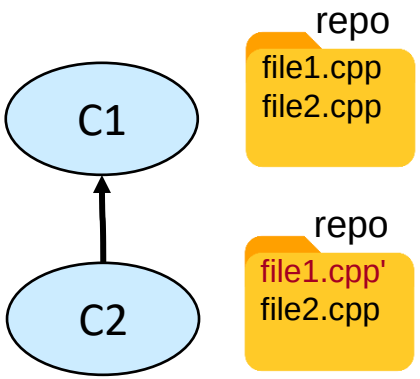
- Cloning a repo brings a copy of the specified repository onto your local machine
  - `git clone` *`url-of-repository`*
  - Only needs to be performed once per machine
- You can now perform additions, modifications, and removals locally (without being connected)
- Allows the two repositories to be synchronized in both directions via `git push` and `git pull`




```
git clone git@github.com:usc-csci104-summer2023/hw-ttrojan.git
```

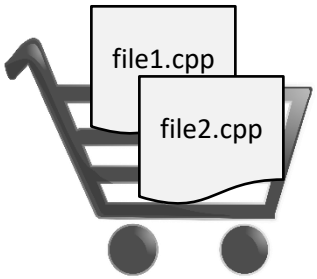
Adds and Commits

- Repositories are updated by performing commits
- We first indicate all the files we want to commit by performing one or more adds via `git add`
  - Like adding things to your cart
- Then we perform a `git commit` of the added files
  - Like checking out…this is when the snapshot is taken
- Note: Don't add folders, just files…folder structure will be added automatically

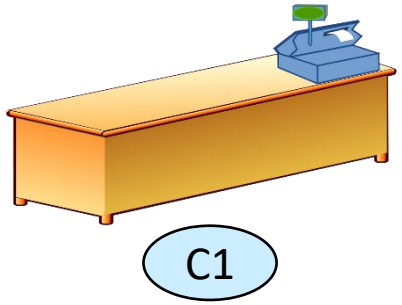


Sample Sequence:

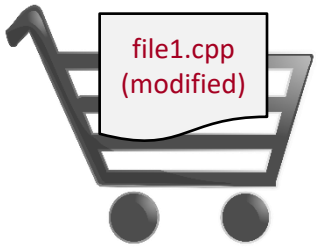
1 `git add file*.cpp`



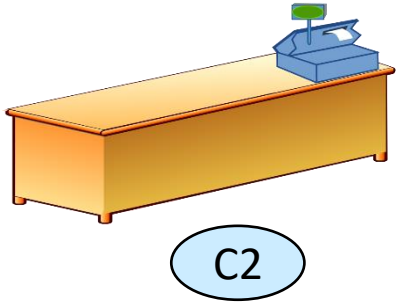
2 `git commit -m "Initial"`

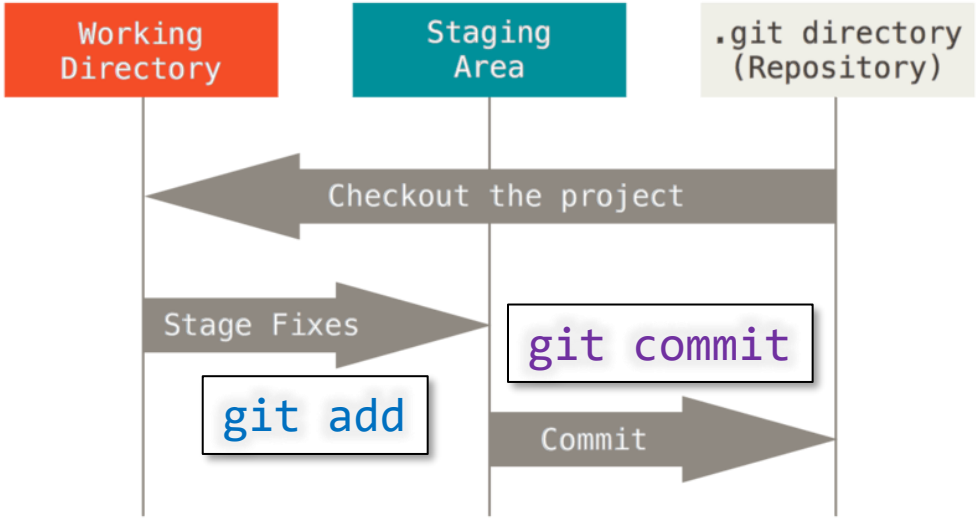


3 `git add file1.cpp`



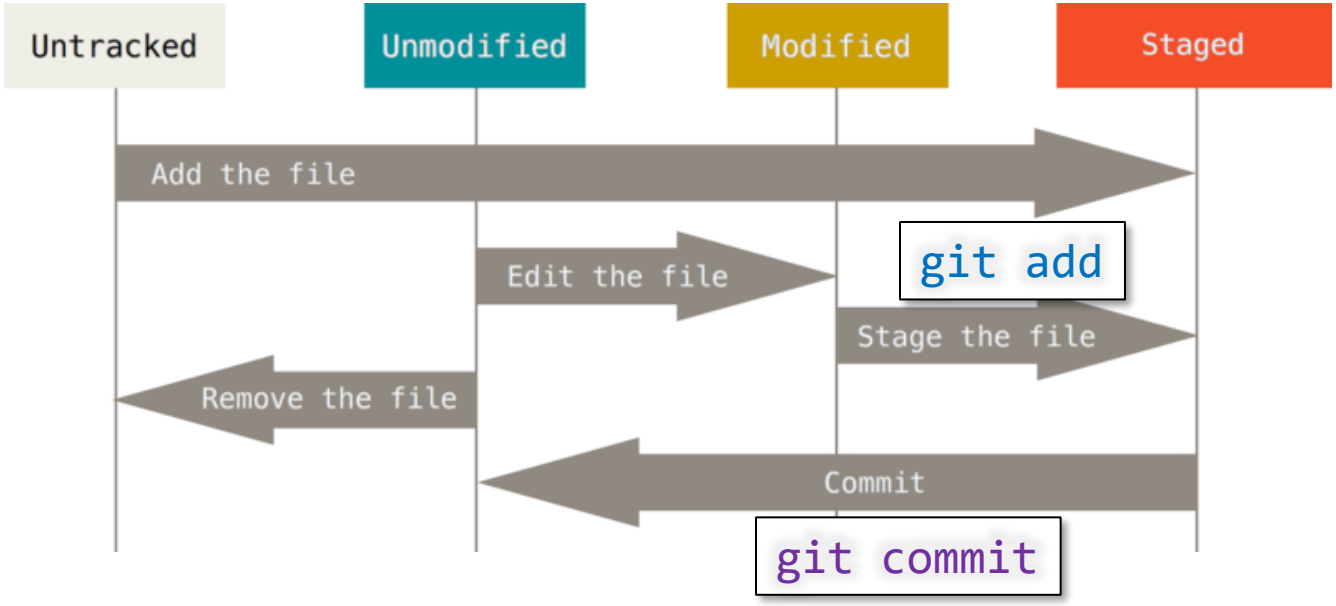
4 `git commit -m "Updated"`





Git "Locations"

https://git-scm.com/book/en/v2/Getting-Started-Git-Basics

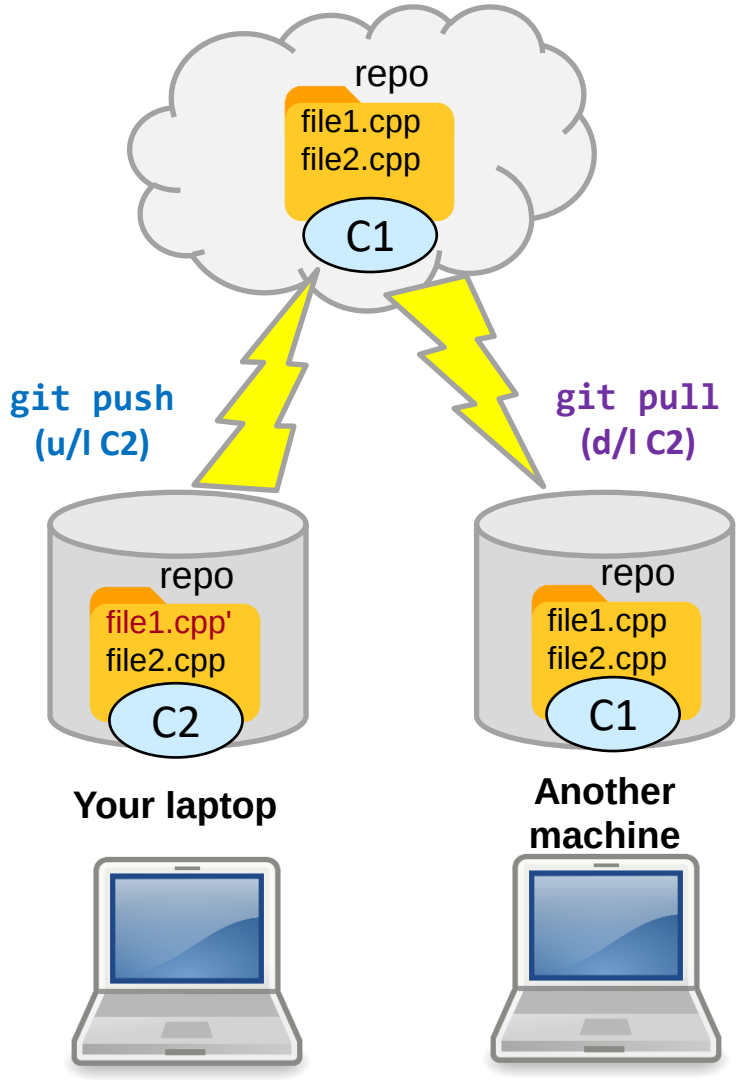


Git File Lifecycle

https://git-scm.com/book/en/v2/Git-Basics-Recording-Changes-to-the-Repository

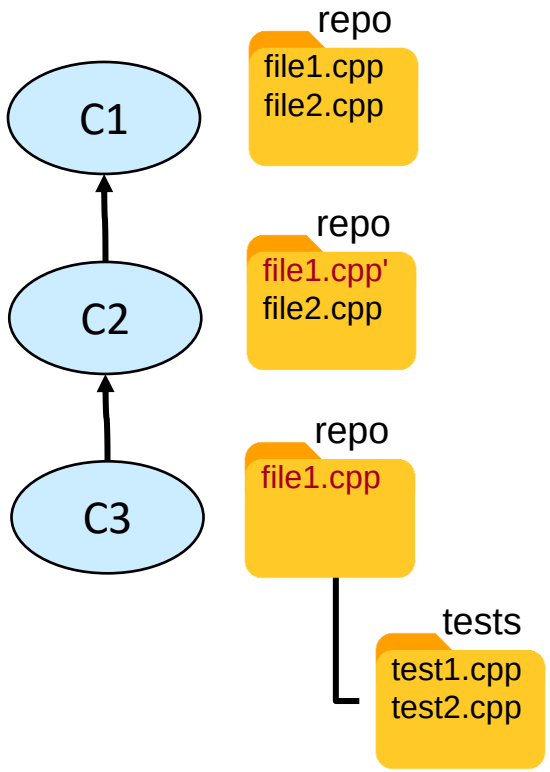
Push and Pull

- Suppose we make changes to our local repository
  - `git add file1.cpp`
  - `git commit -m "Added func2"`
- We upload the updates to the remote repository via a push operation
  - `git push`
- Another clone of the repository can download any updates from the remote repository via a pull operation
  - `git pull`



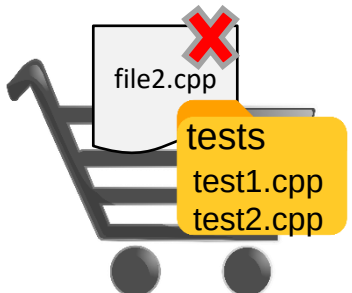
More Helpful git Command

- You cannot just delete a tracked file from your disk (git will still think it is part of your repo)
  - Use `` `git rm -rf <file/folder>` ``
- To add all files and subfolders underneath a particular folder:
  - Use `` `git add .` ``
- Use `git status` to see which files are untracked, modified, etc.
- Use `git log` to see your commit SHA

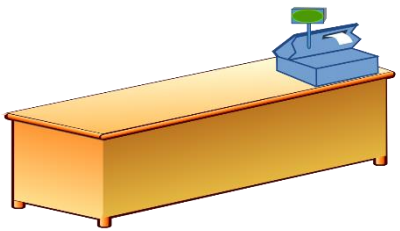


Sample Sequence:

1
```
git rm file2.cpp
cd test
git add .
```



2
```
git commit -m "Another"
```



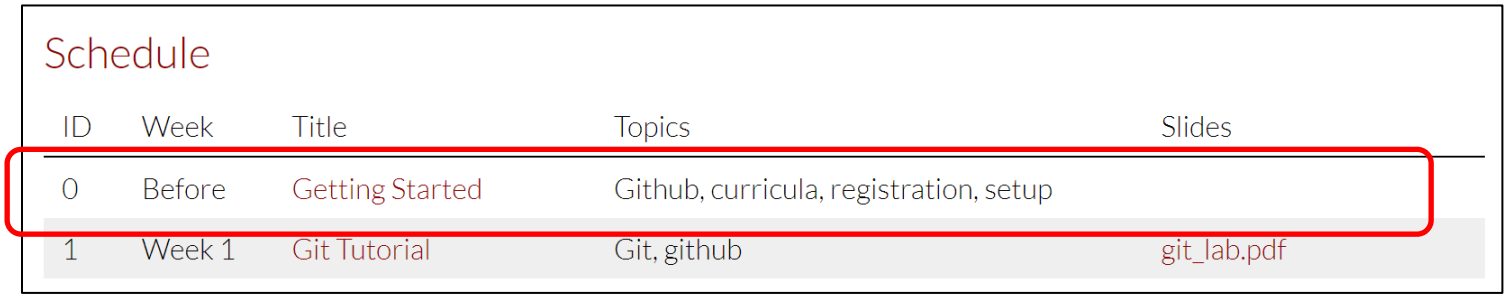
Summary

- `git add` *`file(s)`*
  - Stage a file to be committed
- `git commit -m "Change summary"`
  - Makes a snapshot of the code you added
- `git checkout -b` *`branch-name`*
  - Create a branch and switch to it
- git pull
  - Download commits from your remote repository
- git push
  - Upload your local commits to the remote repository
- `git checkout` *`branch-name`*
  - Switch to a new branch
- `git merge` *`other-branch-name`*
  - Merge the commits from other-branch-name into current branch
- HEAD is synonymous with the (current branch's) latest commit
- `origin` is usually the remote name for your repo on github
- `upstream` is usually the remote your repo was forked from (must be added)

LAB 1 PRE-REQUISITES

Lab 0 Setup

- Perform the necessary setup in Lab 0
  - See lab0 "Getting Started" link at https://bytes.usc.edu/cs104/labs



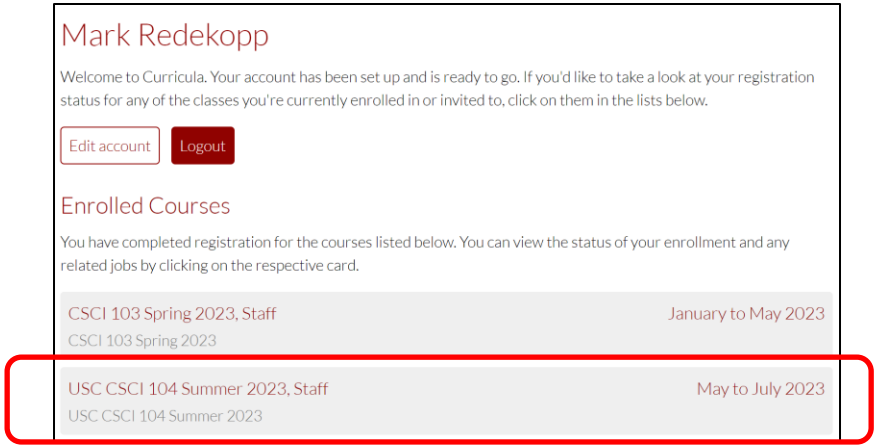
Schedule

ID	Week	Title	Topics	Slides
0	Before	Getting Started	Github, curricula, registration, setup	
1	Week 1	Git Tutorial	Git, github	git_lab.pdf

- Register and create an account with Github, if you have not
- Install git client on Mac or Windows
- Install Docker (PREFERABLE) or VM

Curricula System Registration

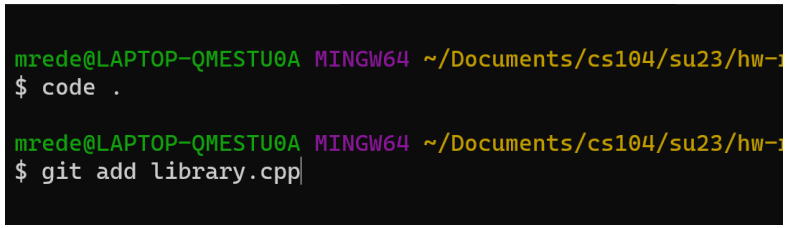
- Ensure you have registered with our "curricula" repo/submission management system
  - https://bytes.usc.edu/cs104/account/register/
- Ensure you accept the invitation to our course
  - https://bytes.usc.edu/cs104/account/
  - This will/should create a repository for you in our github organization where you will keep all your assignments



Native vs. Docker

Native (MacOS, Windows)

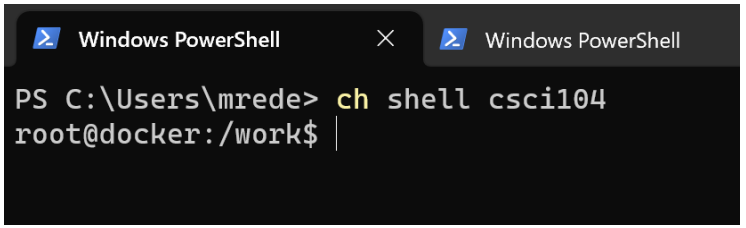
- Run git commands
  - clone, add, commit, push, etc.
- Edit
  - Run VSCode, etc.



- Do not try to compile/run/test!

Docker (connected terminal)

- Compile and run
  - g++, make
- Test and debug
  - cmake, gdb, valgrind



- Do not run git commands!

Editors and Command Line

- Unless you already have a favorite editor installed, we recommend you use VS Code.
  - It also has Github integration!

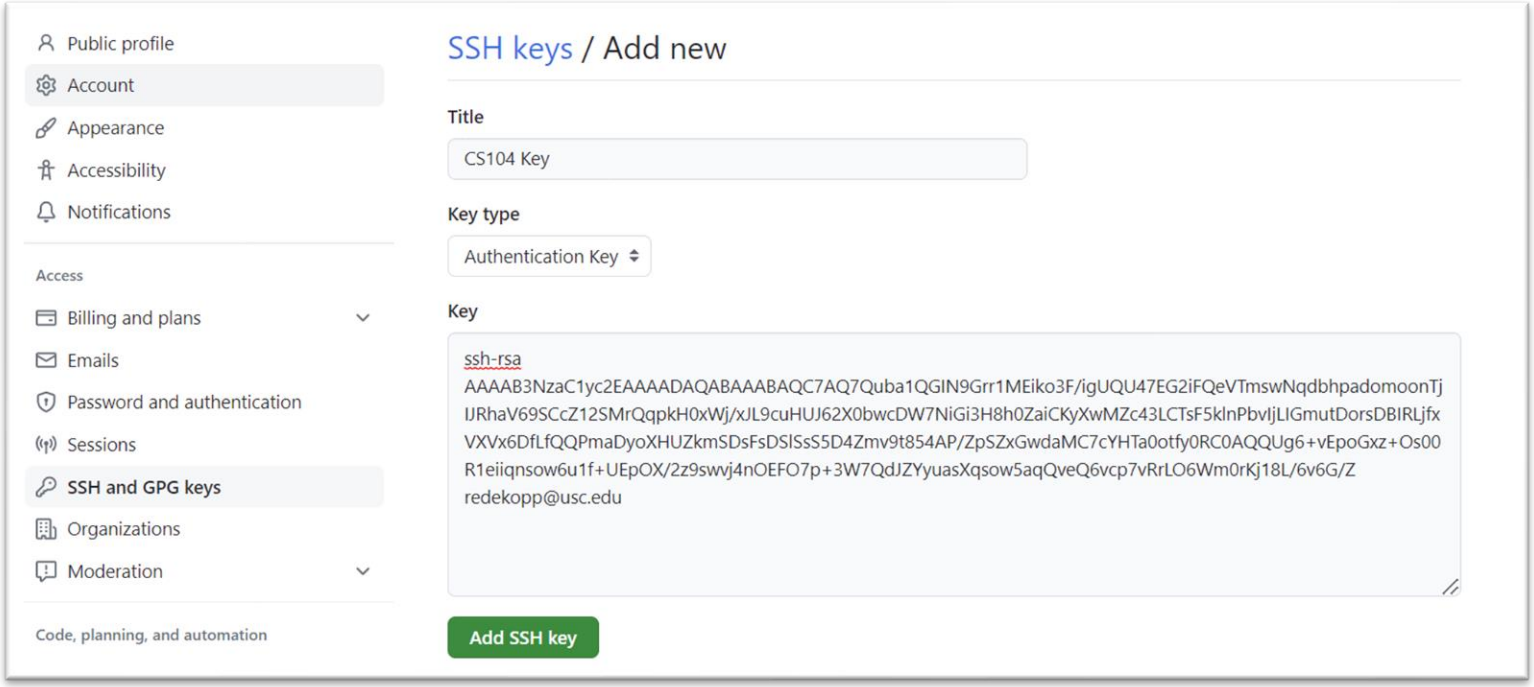
Keys 1 – Generate the key pair

- Each time you upload or download from Github to/from your repository you will need to authenticate
  - By default you can provide your username/password
  - But since you should be uploading often it's easier to setup an SSH key
- To setup a key on your laptop (or VM) at the terminal:
  - `$ ssh-keygen -t rsa -b 2048 -C ttrojan@usc.edu`
- Then open the contents of `~/.ssh/id_rsa.pub` in an editor OR at your terminal type:
  - $ more ~/.ssh/id_rsa.pub or $ cat ~/.ssh/id_rsa.pub
  - Select all the text printed on the terminal through the end of the last line and copy it to the clipboard

```
$ cat ~/.ssh/id_rsa.pub
ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAABAQC7AQ7Quba1QGIN9Grr1MEiko3F/igUQU47EG2iFQeVTmswNqdbhpadomoonTjIJRhaV69SCcZ12SMrQqpk
H0xWj/xJL9cuHUJ62X0bwcDW7NiGi3H8h0ZaiCKyXwMZc43LCTsF5klnPbvIjLIGmutDorsDBIRLjfxVXVx6DfLfQQPmaDyoXHUZkmSDsFsDSlSsS5D4Zmv9
t854AP/ZpSZxGwdaMC7cYHTa0otfy0RC0AQQUg6+vEpoGxz+Os00R1eiiqnsow6u1f+UEpOX/2z9swvj4nOEFO7p+3W7QdJZYyuasXqsow5aqQveQ6vcp7vR
rLO6Wm0rKj18L/6v6G/Z redekopp@usc.edu
```

Keys 2 – Give Github your Public Key

- Login to Github, go to your Settings (upper right) and find the "SSH Keys" tab
  - Click New SSH Key
  - Provide a name (your choice) for this key and then paste the contents of id_rsa.pub into the Key textbox
  - Click Add SSH Key



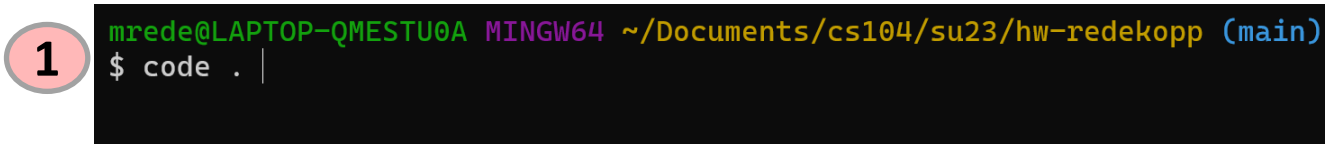
Clone Your Repos

- Perform Step 1 and Step 2 of Lab 1
  - In your NATIVE terminal, navigate (using `cd` to the folder you chose as your Docker work folder
  - Run `ch list` if you have forgotten
  - Then, clone the resources and your hw-username repos

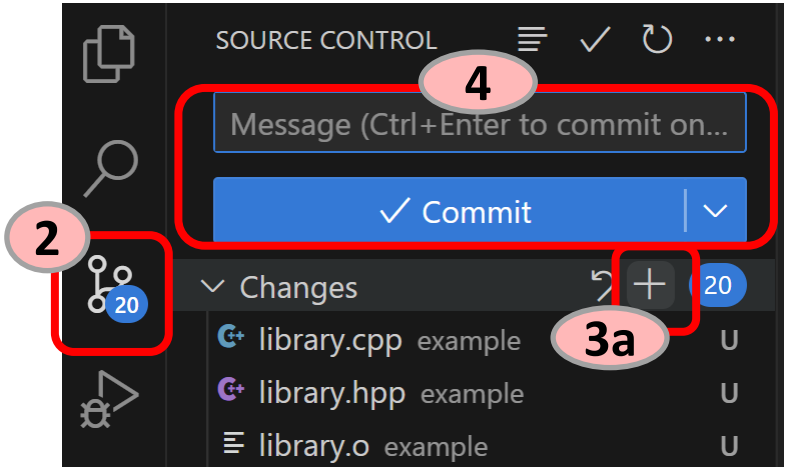
```
git clone git@github.com:usc-csci104-summer2023/hw-username.git
git clone git@github.com:usc-csci104-summer2023/resources.git
```

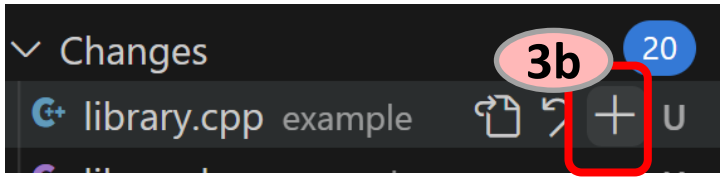
    - Say yes to any status/queries that appear when you run these commands
  - If they run, successfully you are in good shape and may continue through the rest of lab1.
  - If not, ask for help

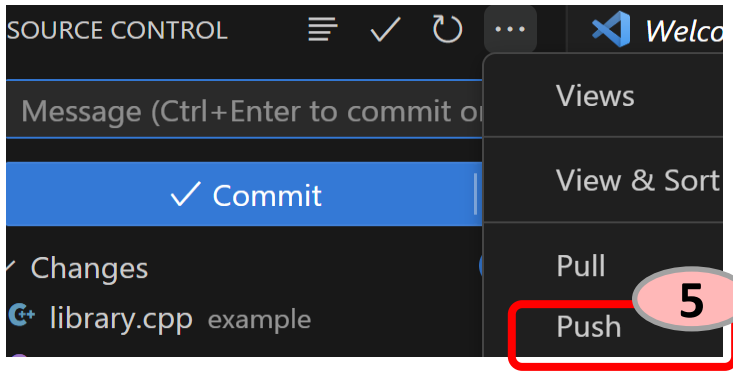
VSCode Github Integration



1. Start code from your hw-username folder and open the entire folder with the command: code .
2. Edit your code and when ready to use git, choose the git tool icon on the left
3. Add all the changed files (3a) or individual files (3b)
    1. Remember not to add executables, tests, etc.
4. Write a log message and then click commit
5. Click the … and then select push (or newer versions might have a blue Sync Changes button)







Helpful Links

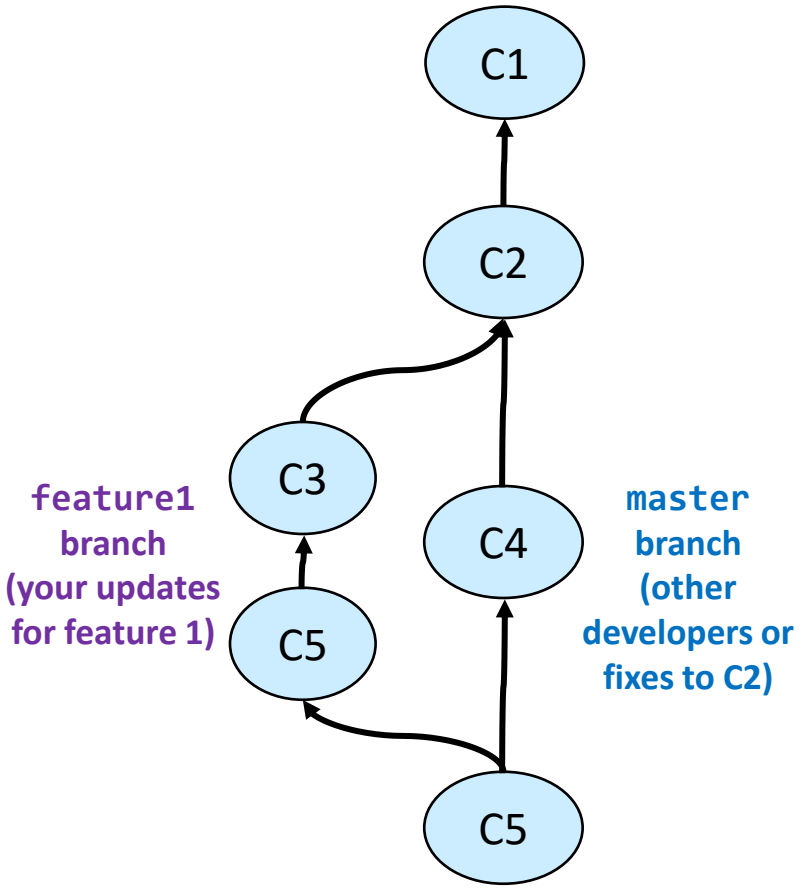
- https://help.github.com/
- Tutorial
  - https://learngitbranching.js.org/ (Do only the lessons below)
    - **Main Tab: Level 1 - Intro to Git Commits**
    - **Remotes Tab: Level 1: Push & Pull – Git Remotes**
- Cheat Sheets
  - https://services.github.com/on-demand/downloads/github-git-cheat-sheet/ (web version)
  - https://services.github.com/on-demand/downloads/github-git-cheat-sheet.pdf (print version)
- FAQ for common Github Issues (when you encounter a git issue doing your HW check this FAQ first)
  - http://bytes.usc.edu/cs104/cs-faq.html

(Probably not necessary for 104)

ADVANCED GIT (FOR REFERENCE)

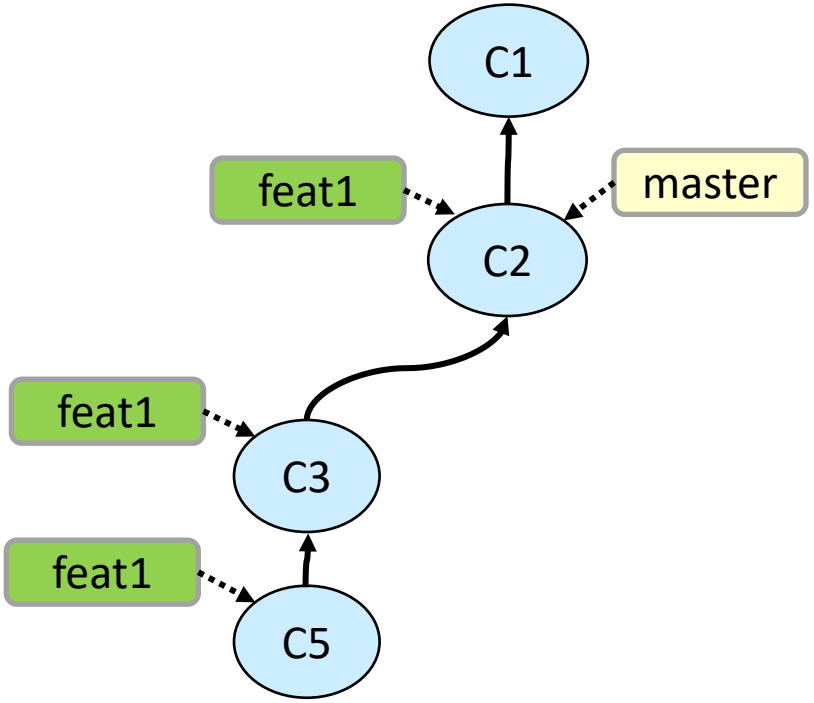
Branches Motivation

- Branches are useful when you are adding some new feature/fix, especially when others developers may also be doing the same by giving a separate sandbox to work in
- Branches allow you to
  - Grab the code from a particular starting point (i.e. commit)
  - Modify code, add, delete and commit
  - Merge the code back into the master branch



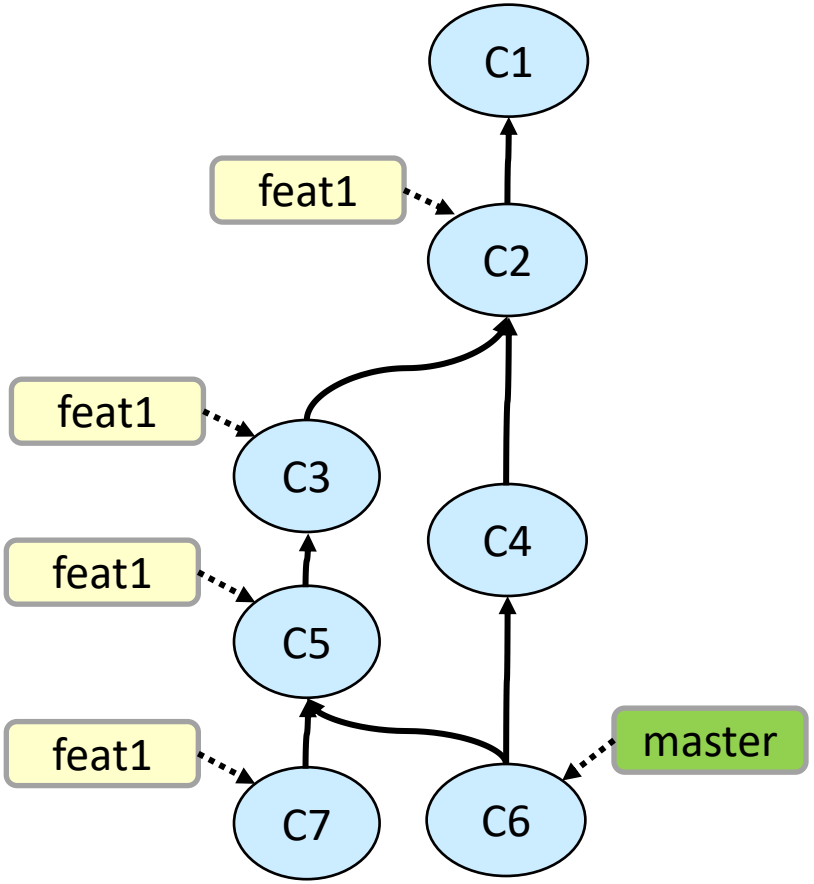
Branches (1)

- Each commit has one parent
- Branches are just names that can be associated with a commits
  - 'master' is the default branch
  - Created using:
    ```
    git checkout -b branch-name
    ```
- You can only be working on one particular branch at a time
- Any commits are applied to the current branch
- Example:
  - `git checkout -b feat1`
  - `git commit -m "Added part1"`
  - `git commit -m "Added part2"`



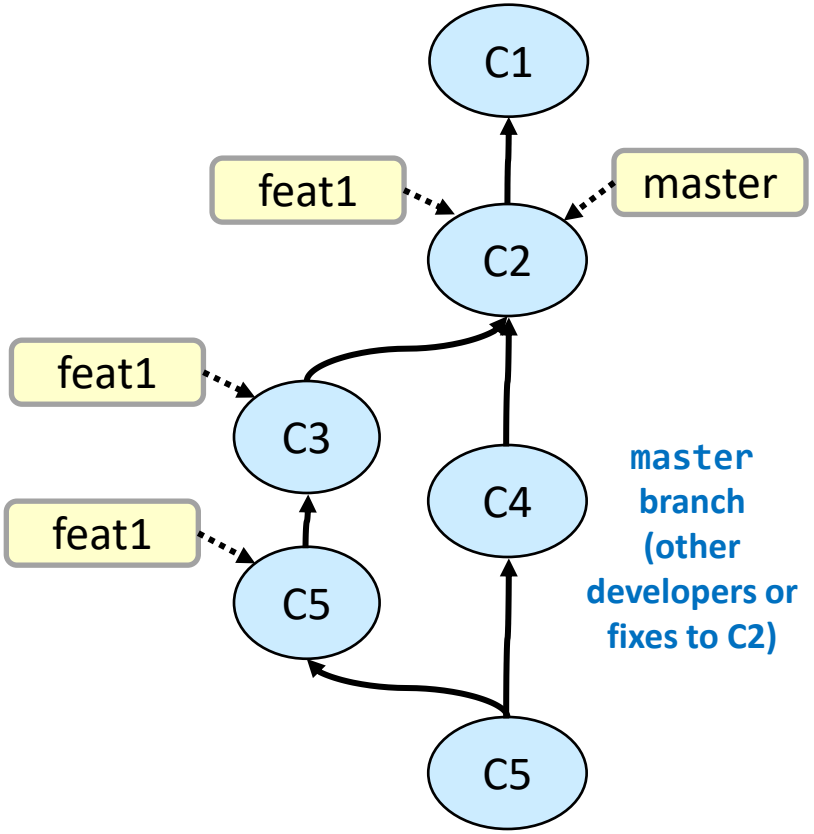
Branches and Merging

- We can switch between branches using `git checkout` *`branch-name`*
- Example:
  - `git checkout master`
  - `git commit -m "Fix bug 1"`
- Two branches can then be merged together via: `git merge` *`branch-to-merge-in`*
- A merge is a special commit with two "parents" and combines the code
- Example:
  - `git merge feat1`
- Note: You must be in the branch that will be updated with the code from the specified branch
  - The specified branch remains independent (you'd have to do another merge to sync both branches)
  - `git checkout feat1`
  - `git commit -m "Separate change"`



Conflicts

- If the merge encounters updates that it is not sure how to combine, it will leave the file in a conflicted state
- Can find conflicted files via:
  - `git status`
- Contents of conflicted files must be manually combined
  - Conflicted areas are highlight with `<<<<`, `====`, `>>>>` with the contents of each branch
  - Edit the file to your desired final contents
  - Then **add** and **commit**

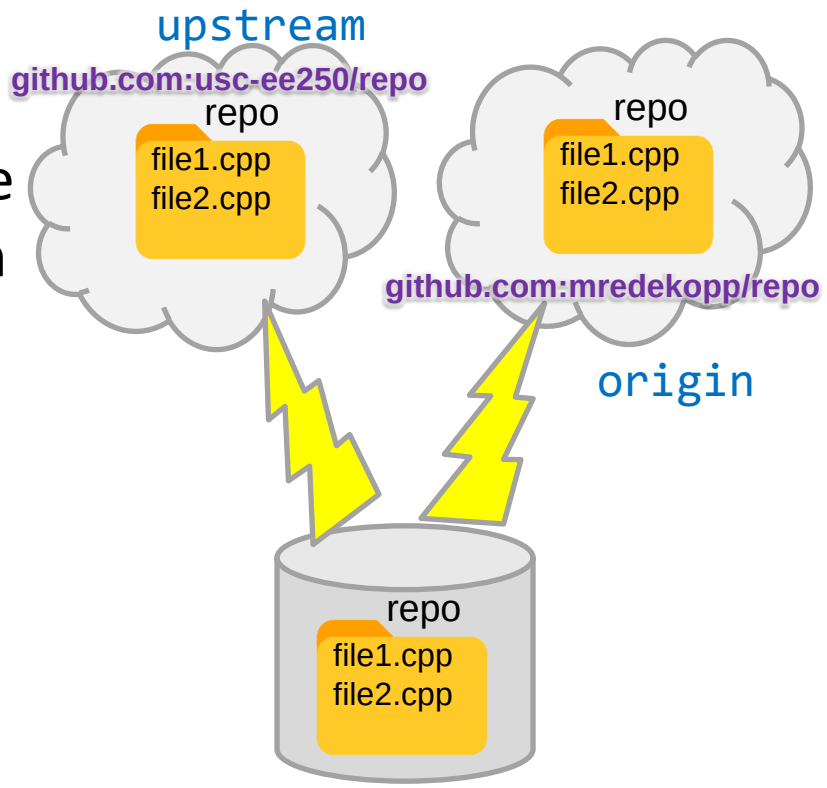


Sample Conflicted File

```
If you have questions, please
<<<<<<< HEAD
open an issue
=======
ask your question in IRC.
>>>>>>> feat1
```

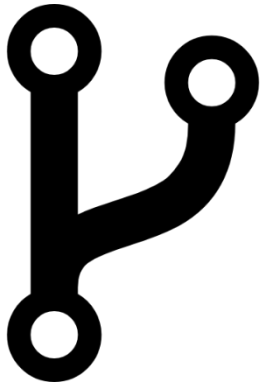
Remotes

- Remotes are just like their name indicates: remote locations where we can push and pull (or fetch) data from
- To list remotes
  - `git remote -v`
- To add a remote
  - `git remote add` *`name remote-url`*
  - `origin` is the common name for the remote repo from which you cloned
  - A remote is just an association of a name to a repo URL
- To choose & push a particular branch to a remote
  - `git push -u` *`remote local-branch`*



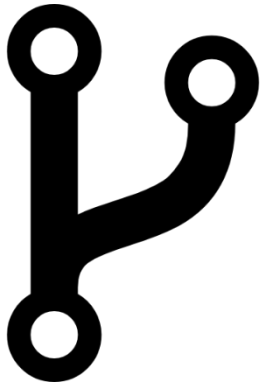
Forks

- A fork is a "copy" of a repository
  - Essentially a new repo whose starting point is the current state of the original, "forked" repo
  - Allows changes to be made (like a branch) or starting a new project based on some current codebase
    - If the original fork changes, there are means to pull those updates into your fork
  - It is possible to fork a fork ☺
- Example
  - The sensors we use have Python library support available on Github
  - We have forked that repo and made some changes for EE 250
  - You will then fork our repo (i.e. a fork of a fork) and modify it with your lab group
    - If we make changes in our repo, you can easily bring them into your fork



Upstreams

- Common definitions
  - upstream: The parent repository from which you forked
  - downstream: The forked ("child") repository (i.e. your repo)
- Common usage
  - The upstream fork can be thought of as just another remote
  - While the remote named origin usually refers to your fork on github, the remote named upstream usually refers to the parent of your fork
- Setting up access to the upstream fork
  - See https://help.github.com/articles/fork-a-repo/
  - `git remote -v`
  - `git remote add upstream` *`parent-fork-url`*
- Updating your code from the parent fork
  - `git fetch upstream`
  - `git checkout master` (can be skipped if you aren't using branches)
  - `git merge upstream/master`



An Example

- Suppose we create a repo for you: `p1-ttrojan`
  - It comes preloaded (because of actions we took) with some code that was from our own repo: `p1-skel`
  - `git clone git@github.com:usc-csci104-summer2021/hw-ttrojan`
  - `cd p1-ttrojan`
  - `# You make changes; add, commit, push`
- Now we make changes to `p1-skel`, how can you get and merge those changes in?
  - `git remote -v  # list the remotes`
  - `git remote add upstream git@github.com:usc-csci104-summer2021/p1-skel`
  - `git fetch upstream  # d/l changes to a temp area`
  - `git checkout master # make sure you're in your master branch`
  - `git merge upstream/master  # Update your code`