Intro to git / github.com

Version control and code sharing

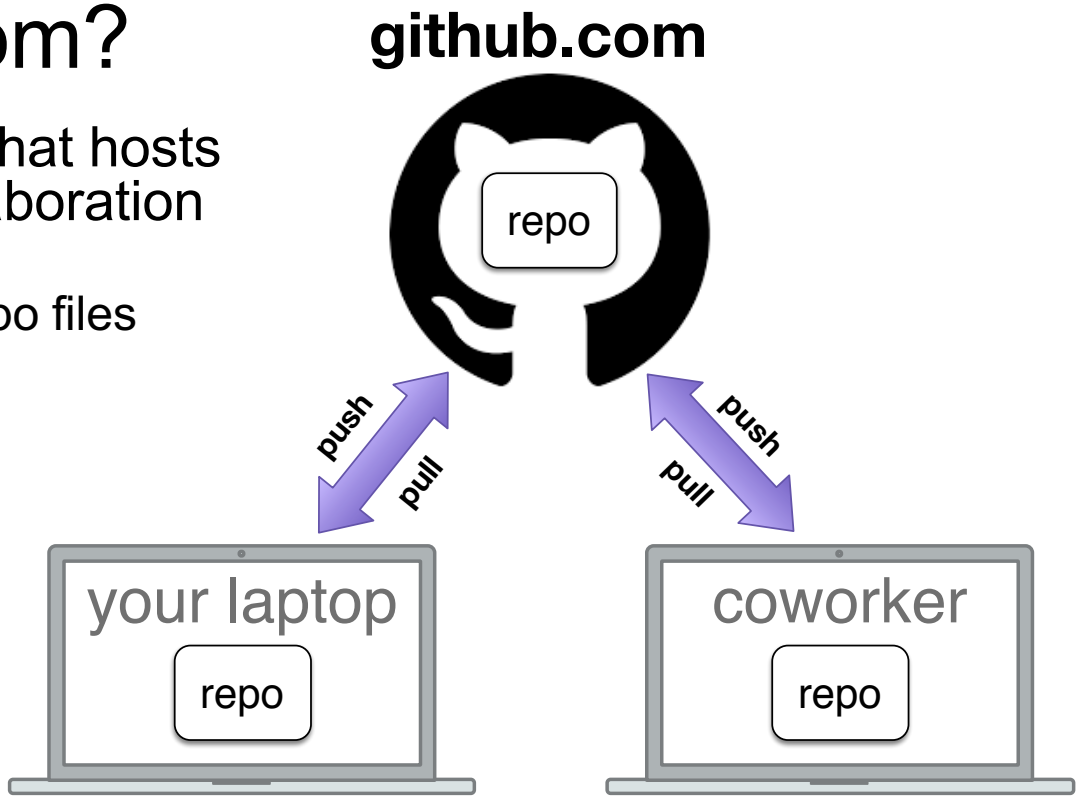
Terence Parr
MSDS program
University of San Francisco

What is git?

- Git is a version control system that tracks changes to files and directories within a repository
- A repository is just a directory subtree containing files and, optionally, directories that we tell git to treat as a repository
- Git allows multiple people to operate on two different copies of the repository without getting confused or losing changes
- Workers push/pull changes from a repo on one machine to a repo on a collaborator's machine
- Git is a program that runs on your laptop

What is github.com?

- Github.com is a website that hosts repositories, making collaboration much easier
  - A web interface to your repo files
  - A free backup!
- Note: git != github.com
  - git is program
  - github is a web site/server
- For our purposes, we'll ignore the advanced capabilities, such as branching and merging (master/main/...)



See github learning resources

Motivation

- Every commercial developer uses version control at work
- Every company you encounter uses it
- For that reason alone, you need to learn version control to be functional in a commercial setting, such as your practicum
- In this class and future classes, you will also use version control to submit your work

An analogy to backup systems

- If your laptop is stolen, we will be sympathetic but not excuse missing projects
  - github doubles as a backup
  - but I recommend you also get backblaze to keep off-site backups of your disk
- Personally, I also have a local Timemachine OS X backup drive sitting next to my computer that takes a snapshot every hour
- Using this multi-tiered backup strategy is a good way to think about how programmers use version control
  - git is kind of like Time Machine, a local backup (that tracks changes)
  - github.com is kind of like the off-site backblaze cloud-based backup
- A difference between git and a backup system is that we tell git **when** to take a snapshot
- Each snapshot should be a logical chunk of work done to your files

Repositories (Repos)

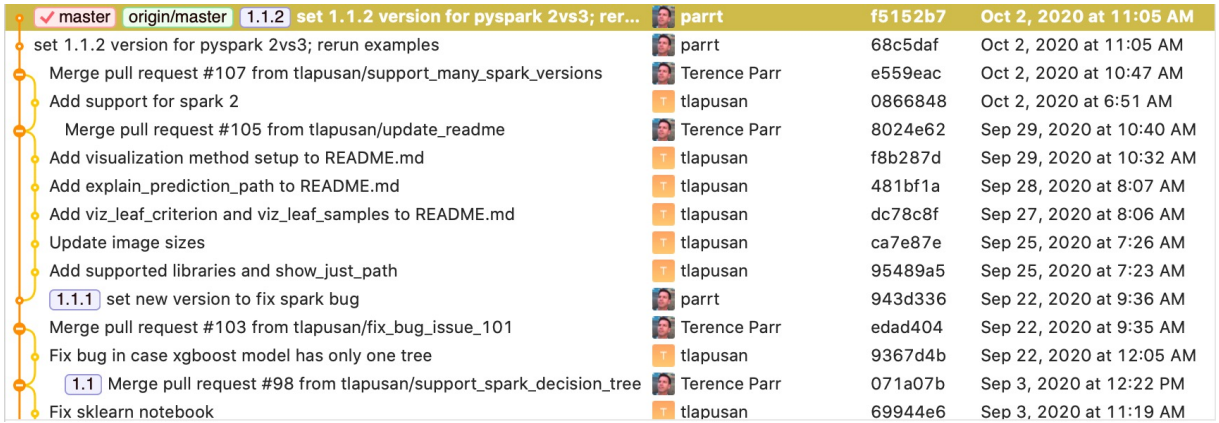
- Not only do we have to tell git **when** to take a snapshot, we also tell it **which** files to pay attention to (in the repo directory)
- The set of files to track is called a *repository* and at any given time, my computer has lots and lots of these repositories
- All files associated with a repo sit somewhere in or below a directory
- Each project you work on will be in a separate directory/repo
- A git repository instance is just a directory but it also has a **.git** (hidden) subdirectory, with a database of all changes
- To remove a repo, just **rm** the whole repo directory; there is no central server to notify (this would not delete repo from github.com)

Committing changes

- As with the Time Machine backup, git tracks snapshots as the difference from the last time you requested a snapshot
- Each snapshot is called a *commit* (and programmers think of these commits as *transactions*)
- Perform a commit to lock in a logical chunk of work, such as the addition of a feature or fixing of a bug
- **Warning**: always use the "-a" option on the git commit command

Commit log (history)

- Having a complete list of changes is extremely useful
- We can revert those change sets later
- We can discover who created or when a bug was introduced
- Can temporarily reset your repository to a moment in time

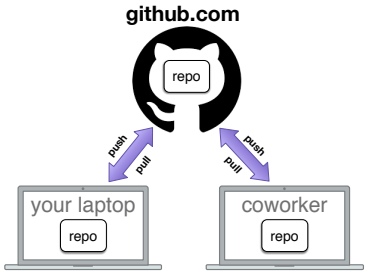


master origin/master 1.1.2 set 1.1.2 version for pyspark 2vs3; rer...	parrt	f5152b7	Oct 2, 2020 at 11:05 AM
set 1.1.2 version for pyspark 2vs3; rerun examples	parrt	68c5daf	Oct 2, 2020 at 11:05 AM
Merge pull request #107 from tlapusan/support_many_spark_versions	Terence Parr	e559eac	Oct 2, 2020 at 10:47 AM
Add support for spark 2	tlapusan	0866848	Oct 2, 2020 at 6:51 AM
Merge pull request #105 from tlapusan/update_readme	Terence Parr	8024e62	Sep 29, 2020 at 10:40 AM
Add visualization method setup to README.md	tlapusan	f8b287d	Sep 29, 2020 at 10:32 AM
Add explain_prediction_path to README.md	tlapusan	481bf1a	Sep 28, 2020 at 8:07 AM
Add viz_leaf_criterion and viz_leaf_samples to README.md	tlapusan	dc78c8f	Sep 27, 2020 at 8:06 AM
Update image sizes	tlapusan	ca7e87e	Sep 25, 2020 at 7:26 AM
Add supported libraries and show_just_path	tlapusan	95489a5	Sep 25, 2020 at 7:23 AM
1.1.1 set new version to fix spark bug	parrt	943d336	Sep 22, 2020 at 9:36 AM
Merge pull request #103 from tlapusan/fix_bug_issue_101	Terence Parr	edad404	Sep 22, 2020 at 9:35 AM
Fix bug in case xgboost model has only one tree	tlapusan	9367d4b	Sep 22, 2020 at 12:05 AM
1.1 Merge pull request #98 from tlapusan/support_spark_decision_tree	Terence Parr	071a07b	Sep 3, 2020 at 12:22 PM
Fix sklearn notebook	tlapusan	69944e6	Sep 3, 2020 at 11:19 AM

Cloning from, pushing to github

- Continuing with the analogy now, github.com is like the off-site cloud-based backup
- Each repo you mirror at github is like a free backup
- We'll likely create a repo using a web interface at github then **clone** that repo to an (initially empty) directory on our laptops
- As with committing changes, we also have to specifically **push** changes made to the local repository back to github
- Every push ensures that the complete file set and git change database (in **.git** subdirectory) is mirrored at github

Collaboration



- I can access your repos mirrored on github, whereas I have no access to your laptop drive
- To grade projects, I will **clone** your repository onto my disk
- If you make changes, I can **pull** those in after you **commit/push**
- I can make comments and then push back to your github repo, which you can then **pull** down to your laptop
- This is how multiple programmers communicate, and how I share work between my USF and home machines

Key commands summary

- I recommend using a git GUI like fork in practice, but we'll use the command line to learn the actual operations and sequence
- **git clone** *github_url*
- **git add** *file_or_dir*
- **git commit -a -m** '*commit message*'
- **git status**
- **git push origin main** (**main** could be called master)
- **git pull origin main**
- **git rm** *filename*
- **git mv** *from_filename to_filename*
- **git reset --hard HEAD**
- **git checkout –** *filename*

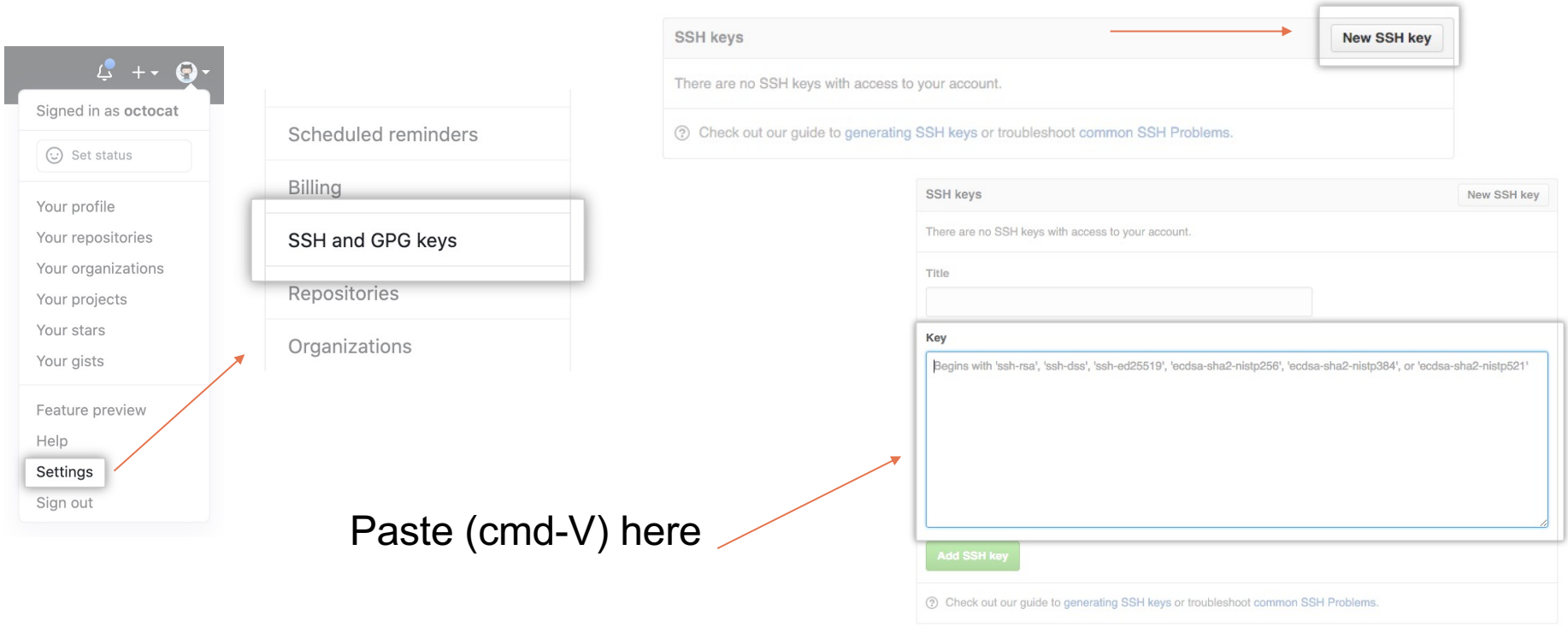
Connecting to github via SSH

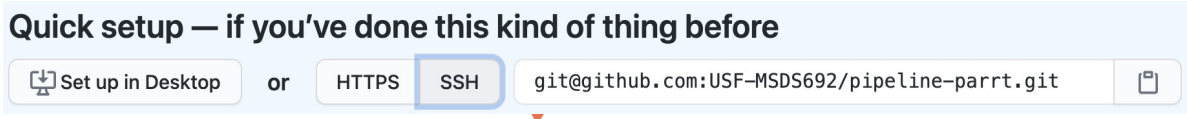
- Naturally you use the website with a username and password
- But to remotely access github repositories from the command line or tools such as fork, we need a secure mechanism to identify ourselves to github
- See the link below; most of you will not have SSH keys yet so follow "*Generating a new SSH key and adding it to the ssh-agent*"
  `ssh-keygen -t ed25519 -C your_email@example.com`
- Press "ENTER" to get all of the defaults; creates files like: **id_rsa** and **id_rsa.pub** (or **id_ed25519.pub**)

https://docs.github.com/en/github/authenticating-to-github/connecting-to-github-with-ssh

Adding your key to github

- Copy (cmd-C) contents of id_rsa.pub (or similar); at github:





Typical startup sequence

- Click on the invitation URL sent to you by instructor to create a repository, which creates repo at github:

  `https://github.com/USF-MSDS692/pipeline-parrt`

- Get the URL from github, which looks similar to repo's github web page URL:

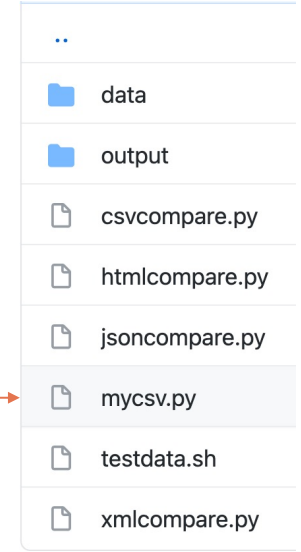
  `git@github.com:USF-MSDS692/pipeline-parrt.git`

- Clone that (empty) repo onto your laptop from command line:

```
critter:~/classes/msds692 $ git clone git@github.com:USF-MSDS692/pipeline-parrt.git
Cloning into 'pipeline-parrt'...
warning: You appear to have cloned an empty repository.
critter:~/classes/msds692 $ ls
pipeline-parrt/
critter:~/classes/msds692 $ cd pipeline-parrt/
critter:~/classes/msds692/pipeline-parrt $ ls
critter:~/classes/msds692/pipeline-parrt $
```

Getting an initial file

- In the directory created during cloning, you will create and edit files associated with the repository
- Let's download a starter kit file for this project; Click on **mycsv.py** and then right click Raw and “Save as…” into your repo directory **pipeline-parrt**



19 lines (17 sloc) | 457 Bytes — Raw | Blame

```
1  import sys
2
3  def getdata():
4      if len(sys.argv)==1: # if no file given, read from stdin
5          data = sys.stdin.read()
6      else:
```

Starter kit: https://github.com/parrt/msds692/tree/master/hw/code/pipeline

Adding files to the repo

- git ignores files unless we tell ask it to pay attention; it's not enough just to put files into the repository directory
- "**git add**" the files of interest so git knows to manage them
- Check status; git now sees files

```
critter:~/classes/msds692/pipeline-parrt $ ls
mycsv.py
critter:~/classes/msds692/pipeline-parrt $ git add mycsv.py
critter:~/classes/msds692/pipeline-parrt $ git status
On branch master

No commits yet

Changes to be committed:
  (use "git rm --cached <file>..." to unstage)
        new file:   mycsv.py
```

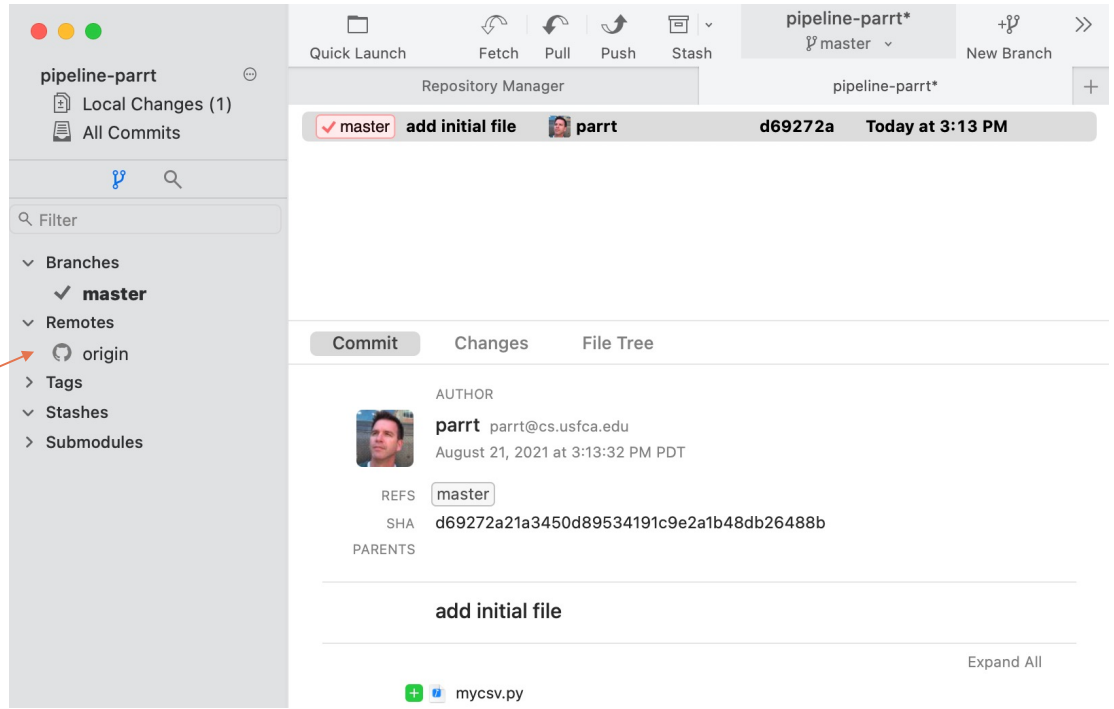
Commit a transaction

- Commit tells git to take a snapshot and record it in its log of changes
- Additions, deletions, renamings are all considered (reversible) changes
- Use a decent commit message and **don't forget** the "**-a**" argument which means "*do what this command should do by default*"

```
critter:~/classes/msds692/pipeline-parrt $ git commit -a -m 'add initial file'
[master (root-commit) d69272a] add initial file
 1 file changed, 19 insertions(+)
 create mode 100644 mycsv.py
critter:~/classes/msds692/pipeline-parrt $
```

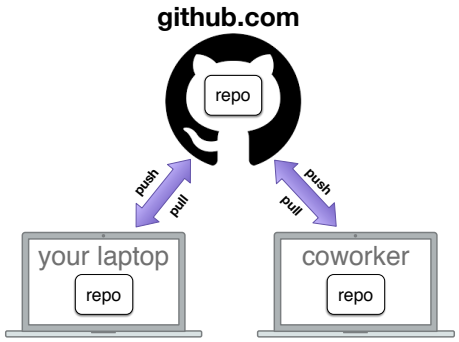
The fork GUI view

- There is only one commit but you can see the commit message and the files involved in the transaction
- You can also see the **origin** remote repository is connected because it's listed in the left gutter



Download fork here: https://git-fork.com/

Push to github to mirror repo

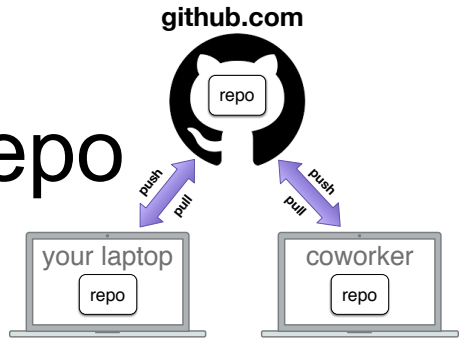


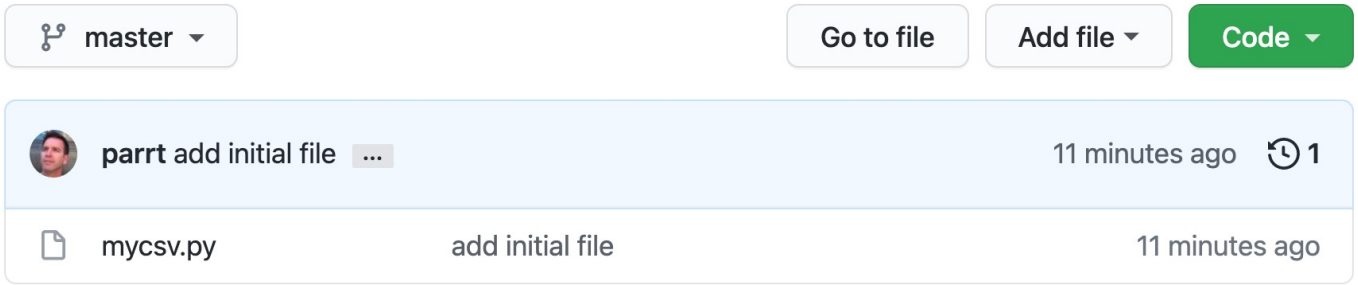
- Github does not know about your changes unless you explicitly push after committing
  - We're ignoring branches but we need to know what the main branch is called; it's either master or main (**master** is the legacy name)

```
critter:~/classes/msds692/pipeline-parrt $          git push
Enumerating objects: 3, done.
Counting objects: 100% (3/3), done.
Delta compression using up to 8 threads
Compressing objects: 100% (2/2), done.
Writing objects: 100% (3/3), 440 bytes | 440.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
To github.com:USF-MSDS692/pipeline-parrt.git
 * [new branch]      master -> master
```

Check github webpage for your repo

- Github repo page should show your new file



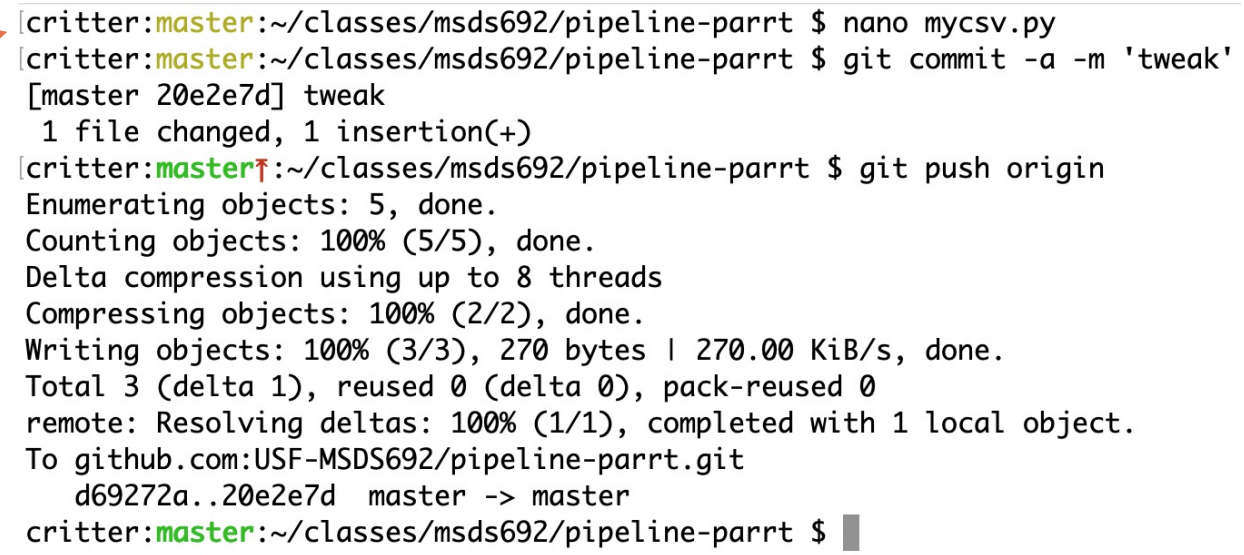


Initial add/commit sequence summary

- Clone repo from github to a directory with same name on laptop
- Copy or create files in repository directory
- Add those files
- Commit those changes (add/edit/delete are all changes)
- Push back to the origin (github.com)

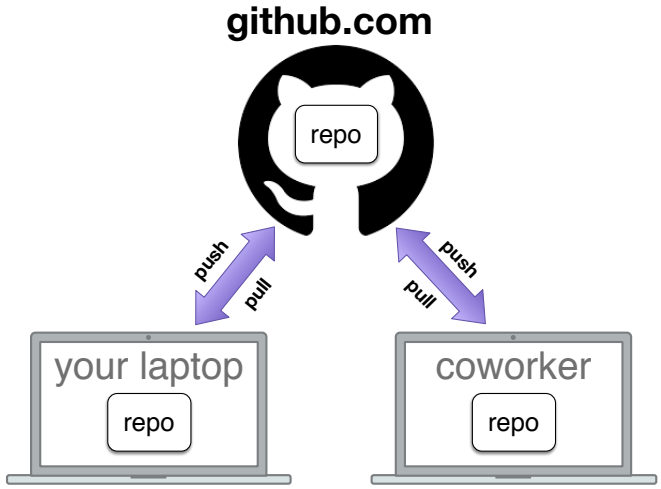
Making edits, mirroring on github

- During the normal course of software development, you will edit files and then commit these changes, pushing to github
- Here, I'm editing an Python file



Pull in changes from github

- If there are changes pushed to github that you do not have in your laptop copy, you must pull in those changes with: **git pull origin main** (or just **git pull**)
- This happens when I have cloned and added grading results to your repository and pushed them back, or you are working with a partner on a project; both of you push/pull via same github repo



Miscellaneous but useful commands

- **git rm** *filename*
  Remove a file from the directory and from git repo tracking
- **git mv** *from_filename to_filename*
  Rename a file or directory managed by git
- **git reset --hard HEAD**
  Wipe out any changes you've made to managed files, resetting the repository to the most recent commit
- **git checkout --** *filename*
  Undo changes made to a single file managed by git, resetting to the state of that file at the most recent commit

Configuring username/email the first time

- The first time you try to push something back to github, I think the use of **git** from the command line will ask you to configure your name and email address using the "**git config**" command with a bunch of options
- Or, it looks like you can do this from github's webpages; see https://docs.github.com/en/github/setting-up-and-managing-your-github-user-account/managing-email-preferences/setting-your-commit-email-address
- That might be easier because the command line will ask you to use **vi** or some other editor you are unfamiliar with

A warning

- **git** is ridiculously complicated and has a terrible interface in my opinion so proceed with caution, but it is the most commonly used!
- I recommend sticking with a few commands: clone/add/commit/push/pull/rm/mv
- Do NOT do branching/merging until you are much more comfortable with git and version control systems
- Anything beyond these simple commands, I avoid or use very carefully after reading the manual