Working with Git and GitHub

Research Computing
UNIVERSITY OF COLORADO **BOULDER**

Be Boulder.

Working with Git and GitHub

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My Goal

- Convince you that basic Git/GitHub fluency is:
  - Easy
  - Practical
  - An extremely important tool in your tool belt!

Learning Goals

- Understand the basics of version control
- Differences between Git, GitHub
- Basic Git fluency
- How to collaborate with Git

Outline

- Brief overview of Git and GitHub
  - What is version control?
- Creating your own repository locally
- Pushing local changes to GitHub
- Collaboration

Have you set up Git/GitHub?

This is meant to be a mostly hands on tutorial. If you haven't yet, you may still be able to get everything set up in time using the link:

https://github.com/ResearchComputing/Summer_Camp_2023/blob/main/Day_Three/Using_git/README.md

Git vs GitHub

- Git: version control system
  - the actual software

- GitHub: Cloud-based storage website
  - Hosts repositories (“repos”)
  - Provides a GUI for many Git features
  - Allows for easy collaboration
    - Issues, pull requests

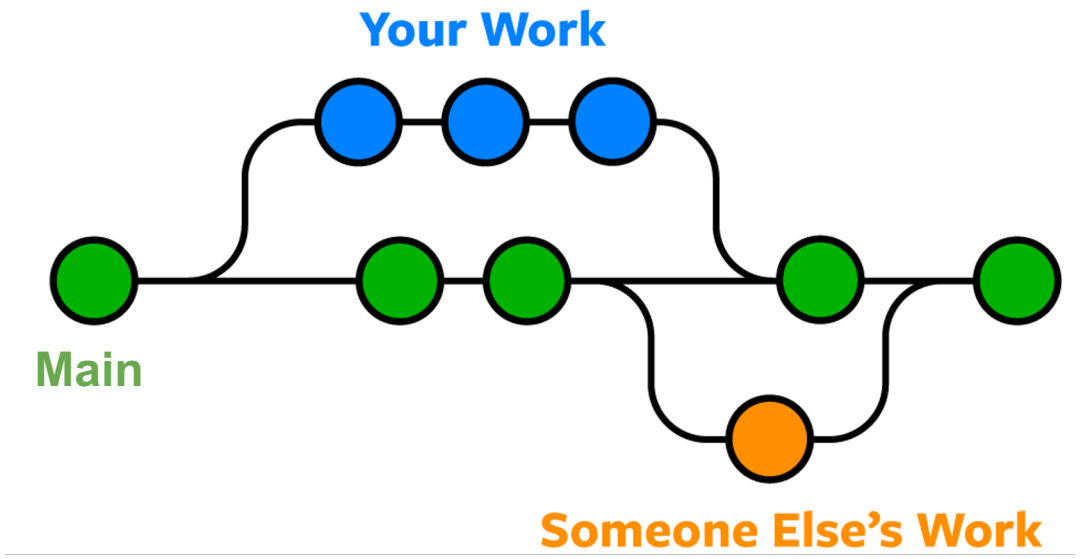
What is version control?

Version control is the practice of tracking and managing changes to files.

- Why do I need it?
  - Revert to various states of files
    - You can think of this as a backup
  - Allows you to modify items without harming the original copy
  - Not limited to code
    - documents, images, etc…

Additional benefits of version control

- Using version control provides
  - Clear tracking of the repo's history
  - Management and view of different branches (work)
  - Collaboration through merging of branches



Images: nobledesktop.com

Different Version Control Systems

- Subversion (svn)
- Mercurial
- CVS
- etx

- We’re going to stick to Git
  - industry standard
  - widely known
  - most resources

Images from Wikipedia

Getting Started with Git (local)

Setting Git up locally

Many systems have Git installed; however, you may need to download it on your local machine

- See https://git-scm.com/book/en/v2/Getting-Started-Installing-Git for more information

Today we are going to stick with using Git on a login node

Logging into RC via a Terminal

To login to an RC login node:

```
$ ssh <username>@login.rc.colorado.edu
```

- Supply your IdentiKey password and your Duo app will alert you to confirm the login
- Confirm Git has been configured (by you using the README)

```
$ git config --list
```

Hands on tutorial

Goal: Create a simple project that contains a markdown file

First let's create a new directory for our project:

```
$ cd /projects/$USER
$ mkdir git-tutorial
$ cd git-tutotial
```

Git Repository (Repo)

A Git repository tracks and saves the history of all changes made.

- All of this information is stored in ".git", which is the repository folder

We can make a directory (folder) a Git repo using "git init"

Git Init

In your “git-tutorial” directory run

```
$ git init
```

- Git creates the "hidden" directory called “.git”

```
$ ls -a
```

- Your directory is now a repo!
  - Git is now ready to to be used
  - Allows us to tell Git what items to watch

Create the main branch

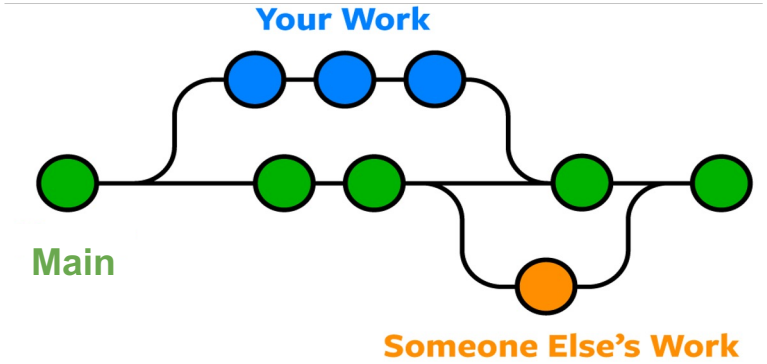
Now that we have a repo, we can create branches. Branches are a version of the repository.

- It is customary to name the primary branch “main”
- This can be done as follows (after an init)

```
$ git checkout –b main
```

- You can switch between branches

```
$ git checkout <branch-name>
```



Let's add a file!

It is customary to add a README.md

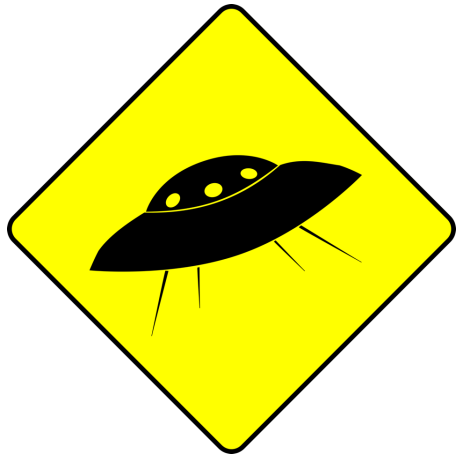
- Description of repo and any helpful information

To add a README.md, in "git-tutorial" create and edit the file using nano (or an editor of your choice)

```
$ nano README.md
```

- Add anything you would like!
- Be sure to save the file when you exit.

Git does not know about README.md yet!!



Areas of Git Workflow

Working Area

- Items that you are currently working on
- Are not tracked by Git!
- Exists locally

Staging Area

- When Git starts tracking and saving your work
- Exists locally
- Items are added to this area by using “git add”

Snapshot Area

- All staged items are captured
- Version of the repo
- Exists locally
- Items are added to this area by using “git commit”

GitHub

- Exists locally and on GitHub!
- Items are added to this area using “git push”

Git Status

The git status command **displays the state of the working and staging area**.

Let's see what area README.md is in

```
$ git status
```

- We see it is an untracked file, so it is in the working area

What if you don’t want Git to track something?

.gitignore

We can add a file named “.gitignore” to our repo

- Specifies what items should never be tracked

Let’s create a file to ignore!

```
$ echo "Super secret stuff" > confidential_data.txt
```

Add “.gitignore” to “git-tutorial” and put “confidential_data.txt” in it

```
$ echo confidential_data.txt > .gitignore
```

Let’s add our files to the staging area now!

Git Add

The git add command **adds a change in the working area to the staging area**

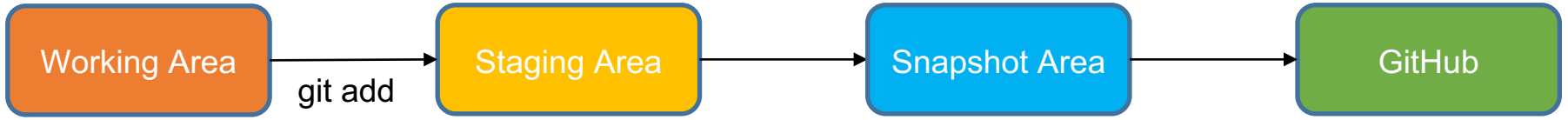
Let's add our README.md to the staging area

```
$ git add README.md
```

or add everything in the current directory

```
$ git add .
```

- Anytime a change is made, you need to do a git add (to track them)



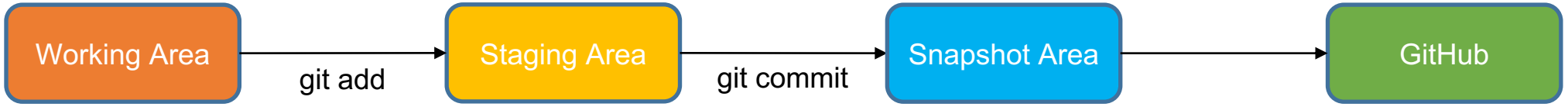
Git Commit

The git commit command **captures a snapshot of all staged items**

- Commits can be thought of as a version of the repo
- Commits should be accompanied with a brief message

Let's commit our staged item!

```
$ git commit -m 'Create repo, add README.md, add .gitignore'
$ git status
```



Common practice – add, commit

- git add
  - Can be performed as much as you want
  - Doesn’t need to be done after every change
- git commit
  - Always include a comment!!
  - Bundle common staged items together
  - Try not to put too many things in a commit

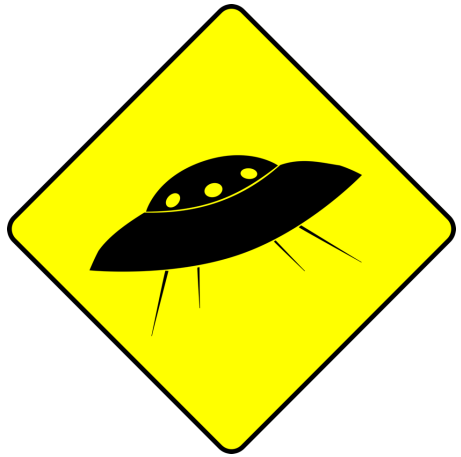
Git Log

The command git log **lists the commits made in that repository**

- Lists the most recent commits first

```
$ git log
```

All changes and files are only locally stored right now!

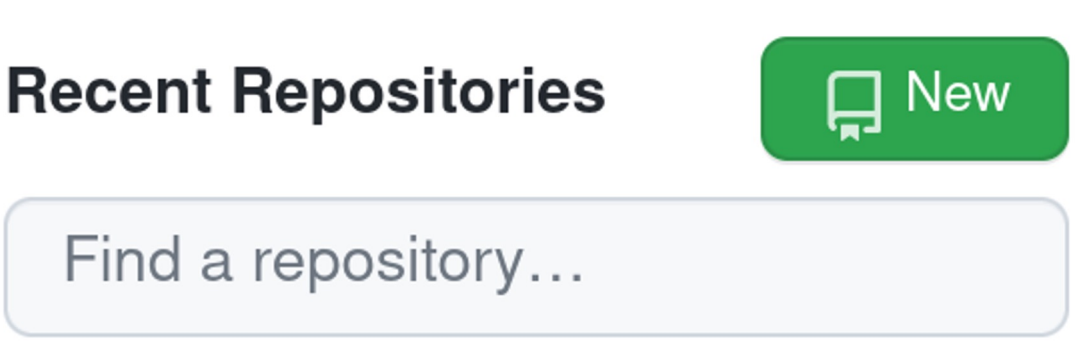


To GitHub we go!

GitHub

When you first create a repo locally, you will need to setup a new repository on GitHub too

- Go to https://github.com
- Sign in
- Click on “Create New Repository” or just “New”



Create Repo in GitHub

- Name your repo, I chose “git-tutorial”
- Don’t add a README or a .gitignore
- Click “Create repository”
- We have set everything up in the previous slides, we only need to copy the ssh link!

Linking local repo to GitHub repo

Git Remote

- Used to identify the remote (e.g. GitHub) repos are linked to your local repo
- Used to link remote repos to your local repo

To view currently linked remote repos:

```
$ git remote -v
```

To link our remote repository:

```
$ git remote add origin git@github.com:<user>/test-tutorial.git
```

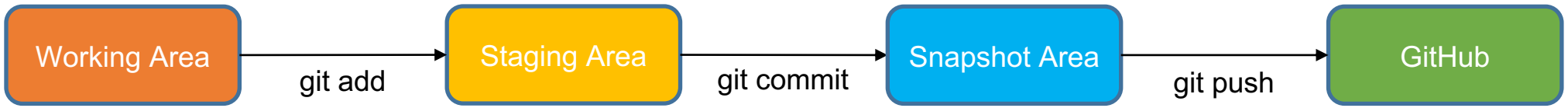
Sending local changes to GitHub

Git Push

Uploads local repository content to a remote repository

- Pushing is how you transfer commits from your local repo to a remote repo

```
$ git push <name of remote repo> <branch>
$ git push origin main
```



GitHub

- Go back to GitHub and refresh your page
  - should see the files we have added (and not the ones we've ignored)

- Some cool features!
  - look at our commits
  - directly edit/commit in the browser

- Let's do that! Let's something and commit it on GitHub
  - But now our remote repo is one commit ahead of our local one…

Git Fetch & Merge

- Git fetch retrieves the changes from the remote repo

```
$ git fetch
```

- Git merge combines two branches

```
$ git merge origin/main
```

There's an easier way!

Git Pull

Git pull combines the fetch and merge commands

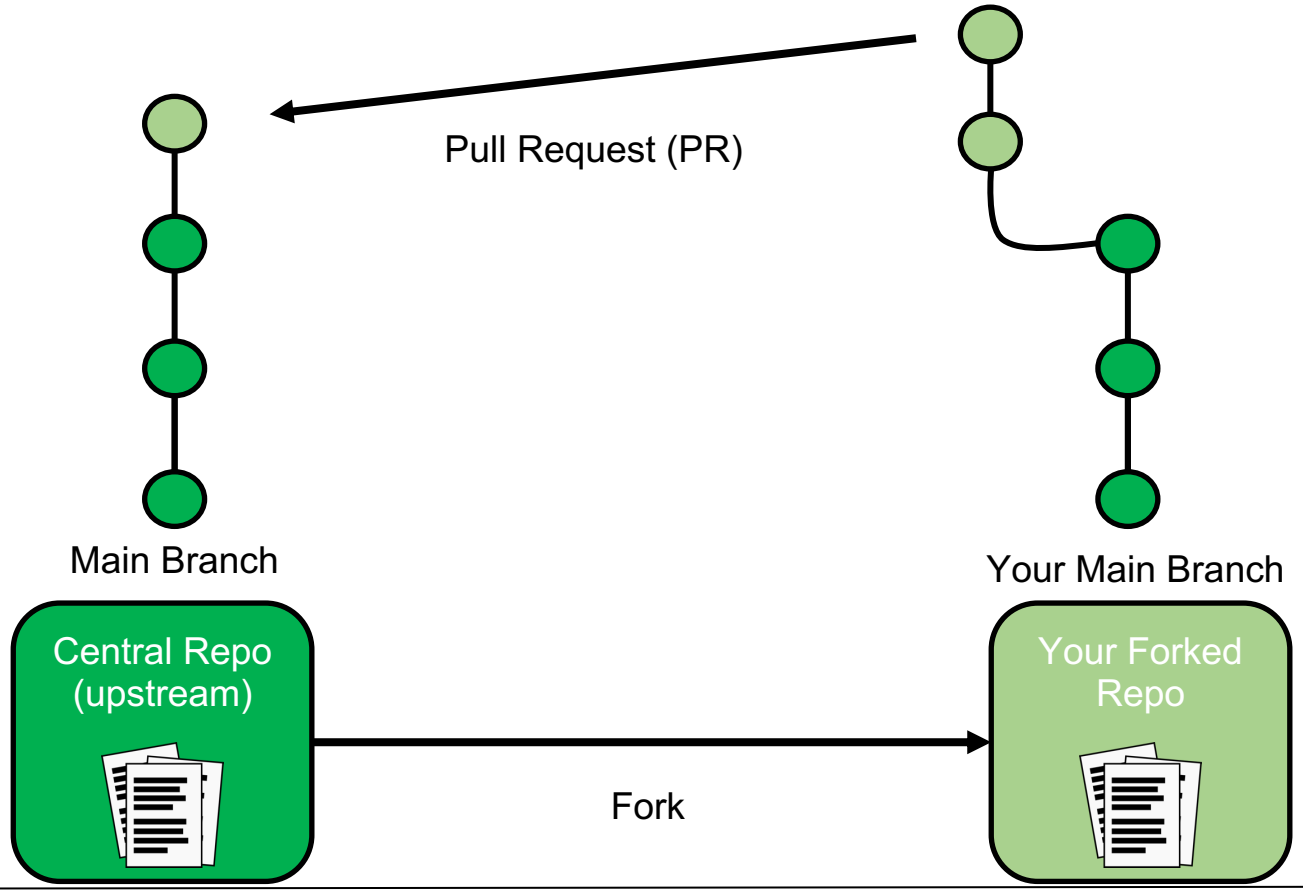
```
$ git pull <name of remote repo> <branch>
$ git pull origin main
```

IMPORTANT!

- Make sure no commits have been done on local branch
- It is fine to have staged items (git add)
- ALWAYS do git pull before any commits!

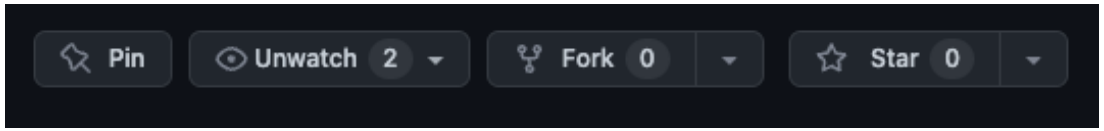
Collaboration

GitHub Forks



GitHub Forks

- Improves collaboration
  - Don’t have to worry about disturbing the upstream repo
  - Improves transparency through pull requests
- Go ahead and Fork my repo:
  - Go to https://github.com/b-reyes/git-tutorial
  - Click “Fork” button
  - Click “Create fork”
- Creates your own version of my repo under your GitHub



Git Clone

- Git clone **makes a clone (or copy) of a remote repo in a new directory, at another location**.

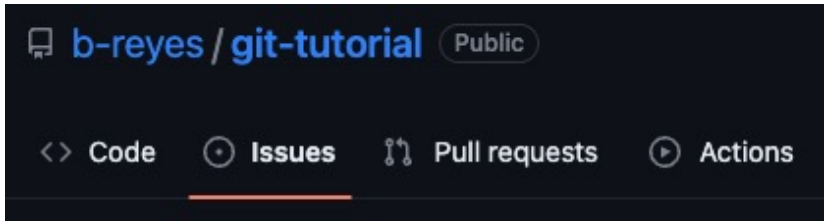
```
$ git clone <url> <optional new name>
```

- Easy way to grab third-party code, or pre-existing code you might need to work on

```
$ cd /projects/$USER
$ git clone git@github.com:<user>/git-tutorial.git
```

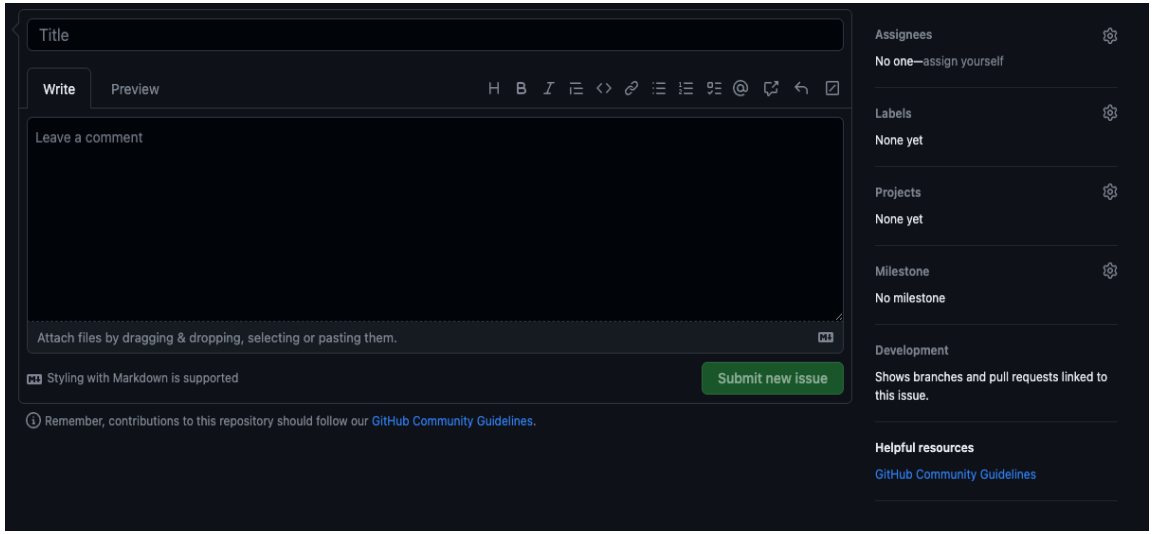
GitHub Issues

- Allows you to discuss the project
- Point out issues, request features, ask for help
- Useful place to see past user discussion



GitHub Issues

- Include as much detail as possible
  - Version of software
  - Operating system
- Provide a simple minimal example, if possible
- If a feature request
  - Outline possible implementation
  - Highlight its value



Pull Requests (PRs)

- A request that an upstream repo pull your branch into their branch
- Starting a PR does not automatically merge changes
  - Notifies maintainers of upstream repo
  - Allows maintainers to review your changes
    - Discussion of changes
    - Requested additional changes
- Maintainers of upstream repo merge in the changes

PR steps

1. Fork upstream repo
2. Clone the forked repo
3. Connect forked and cloned repo to upstream repo

```
$ git remote add upstream git@github.com:b-reyes/git-tutorial.git
```

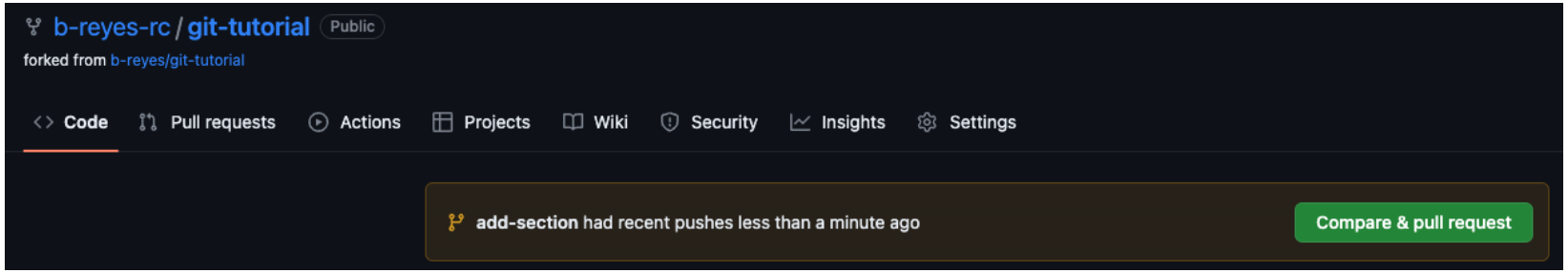
4. Create a new branch specific to your change

```
$ git checkout –b <new-branch> <branch-to-copy>
```

5. Make your changes on this branch
6. Perform a git add, commit, and push to origin
7. Create a PR from GitHub

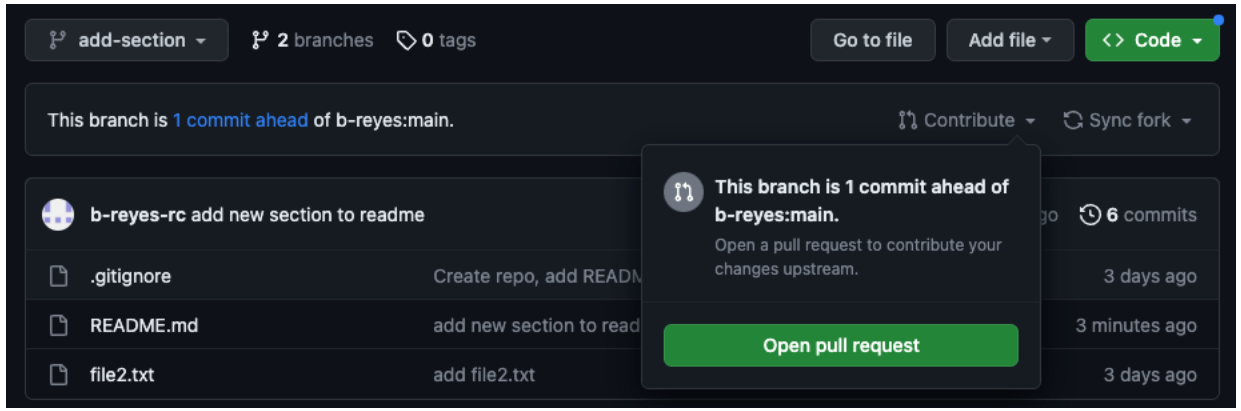
Creating a PR

- After you push your changes to the forked repo, you can click the pop-up “Compare & pull request” on GitHub
  - Will disappear after some time



Creating a PR

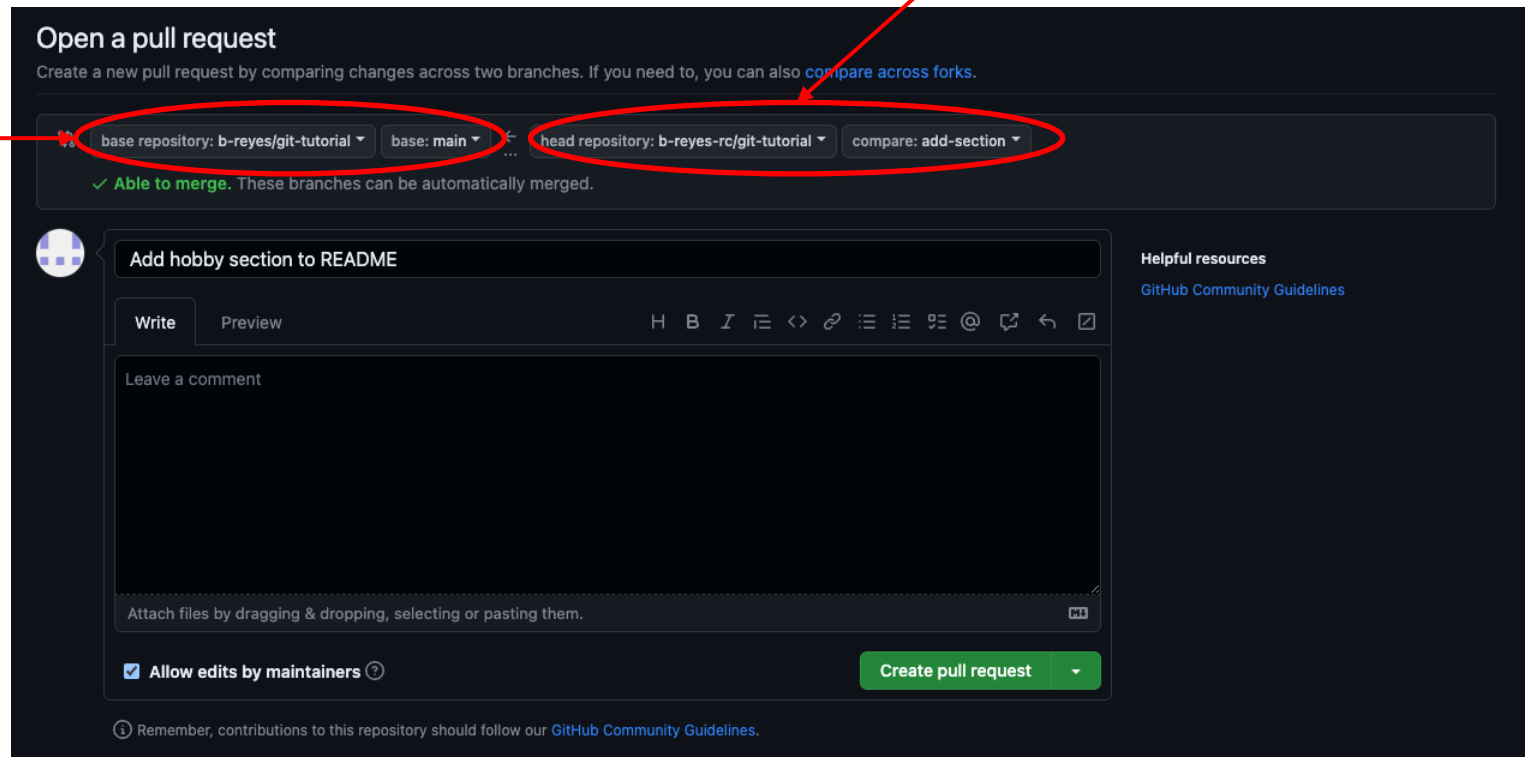
- After you push your changes to the forked repo
  1. Switch to your new branch
  2. Click the drop-down arrow next to “Contribute”
  3. Click “Open pull request”
- Will NOT disappear!



Creating a PR

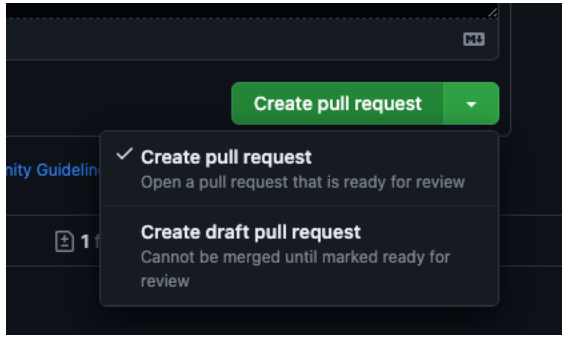
Our forked repo and branch with our changes

Upstream repo and branch we want to merge into



Pull Requests – Best Practice

- Create a new feature branch of forked repo
- When submitting a PR
  - Provide a short descriptive title
  - In comment section
    - Link to any current issue
    - Describe what the PR does and reasons for it
- Draft pull requests
  - PR is a work in progress
  - Can be used for discussion



Merging

- When doing a “git pull” you are merging in changes
- This process can be done manually
- When collaborating, multiple individuals can be working on the same item
  - Conflicts can happen!
- One needs to manually resolve conflicts
- Fantastic tutorial on merging:

https://www.atlassian.com/git/tutorials/using-branches/git-merge

Help! I'm stuck, where do I go?

- **Documentation**: curc.readthedocs.io/
- **Trainings with Center for Research Data and Digital Scholarship (CRDDS)**: https://www.colorado.edu/crdds/
- **Software Carpentries tutorial:** https://swcarpentry.github.io/git-novice/index.html
- **Helpdesk**: rc-help@colorado.edu