Git and GitHub In-depth

Research Computing
UNIVERSITY OF COLORADO **BOULDER**

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Git and GitHub In-depth

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- Website: www.rc.colorado.edu
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- Slides: https://github.com/ResearchComputing/git_github_in_depth_short_course
- Survey: http://tinyurl.com/curc-survey18

Goals

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

Learning Goals

- Learn basic Git and GitHub fluency
  - Creating a repo, add, commit, pull, clone, push
- Collaboration in GitHub
  - Forks, Pull Requests, Issues

Outline

- Installing Git and linking GitHub to your Git
- Creating your own repository locally
- Pushing local changes to GitHub
- Collaboration

Disclaimer:

In this presentation, we will assume that you have a basic understanding of version control and have been introduced to Git and GitHub. There is no need to be fluent in Git or GitHub (we will cover the basics).

Getting Git on your local machine

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 on installing Git

Linking Git to GitHub

- Once downloaded, we can then configure Git with our GitHub username and email via the command line. This allows us to interact with our GitHub more easily.
  - First, set your username. For example, if my GitHub username is gh-user, then I would do the following:

    ```
    $ git config --global user.name “gh-user”
    ```

  - Now, set your email. For example, if my email for GitHub is gh-user@gmail.com, then I would do the following:

    ```
    $ git config --global user.email “gh-user@gmail.com”
    ```

- Confirm Git has been configured (should show your entered info)

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

Personal Access Token

- Allows you to verify your identity with GitHub
- For more information, see https://docs.github.com/en/authentication/keeping-your-account-and-data-secure/managing-your-personal-access-tokens
- Downside is that you need to enter your username and then the Personal Access Token as your password for events such as:
  - Any interaction with a private repo
  - Pushing to a public repo
- There are ways to store your username and token, but these require third-party software

SSH Keys

- Alternative way to verify your identity with GitHub
- For more information see: https://docs.github.com/en/authentication/connecting-to-github-with-ssh/generating-a-new-ssh-key-and-adding-it-to-the-ssh-agent
  - Be sure to select the proper Operating System when using the link
- Setup is more involved, but makes it so that you never have to enter your username and token when interacting with a private repo or pushing to a public repo

Getting Started with Git (local)

Hands on tutorial

Goal: Create a simple project that contains a markdown file

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

```
$ mkdir git_work
$ cd git_work
$ 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

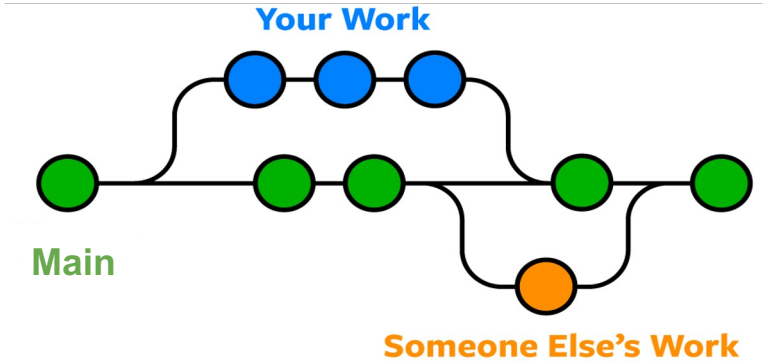
Now that we have a repo, we can create branches. Branches are a version of the repository.

- 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)

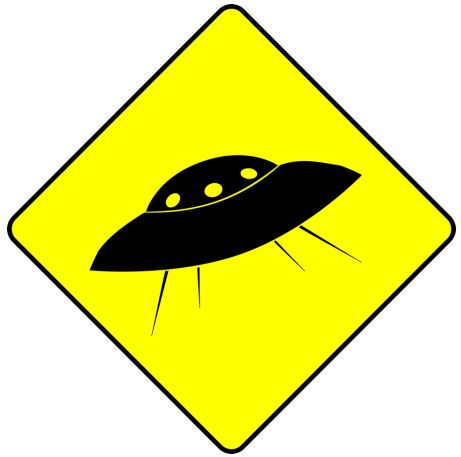
```
$ nano README.md
```

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

Best Practices: Documentation

- Include documentation with your project in GitHub so that others (and you) know what your project is and how it should be used.
- A README.md (markdown) file can be included in your GitHub project and will display on the front page
- What to include in a README:
  - What your project does
  - How people can use it
  - Who you are and how to contact you
  - License information
- Lots of examples and templates available

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 (files, directories, etc.) 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**

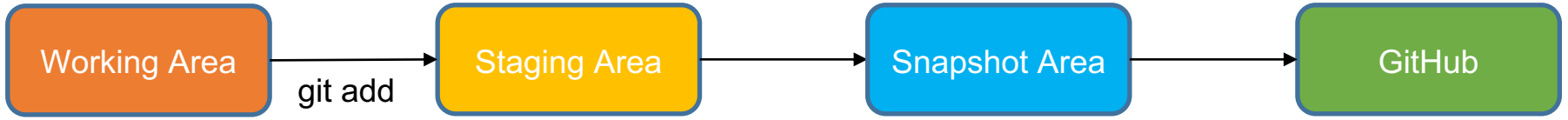
Let's add our README.md to the staging area

```
$ 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)



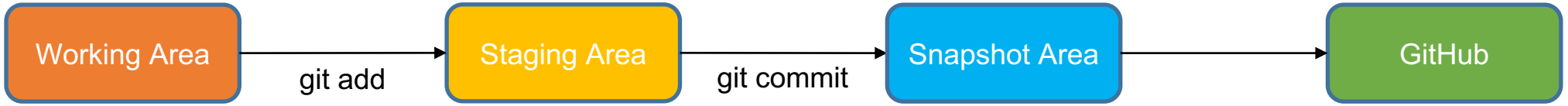
Git Commit

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

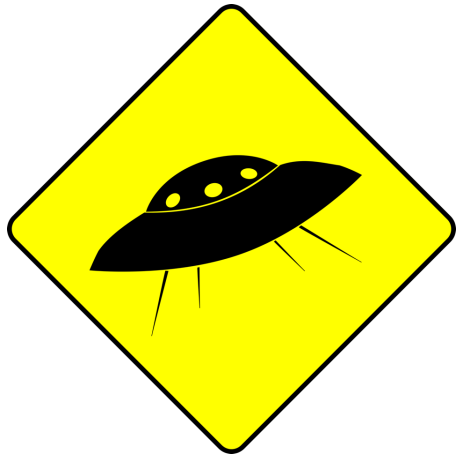
Git Log

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!

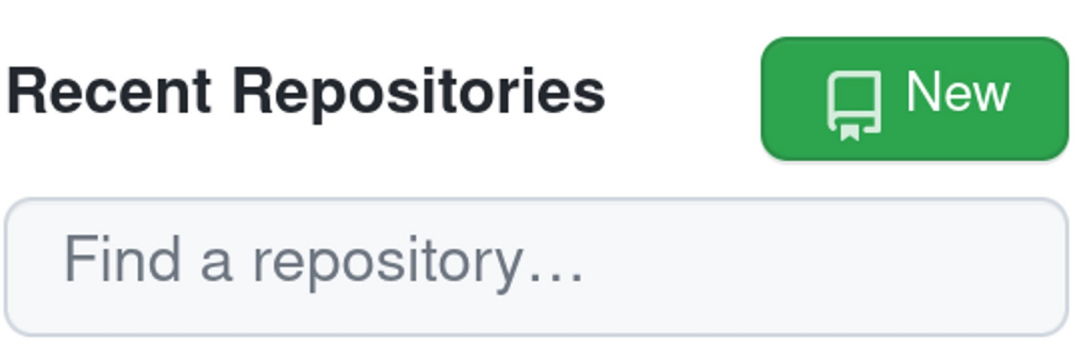


To GitHub we go!

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:

- When using an SSH key do:

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

- When using a Personal Access Token do:

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

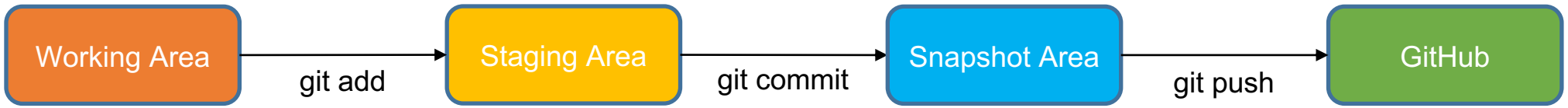
Sending local changes to GitHub

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

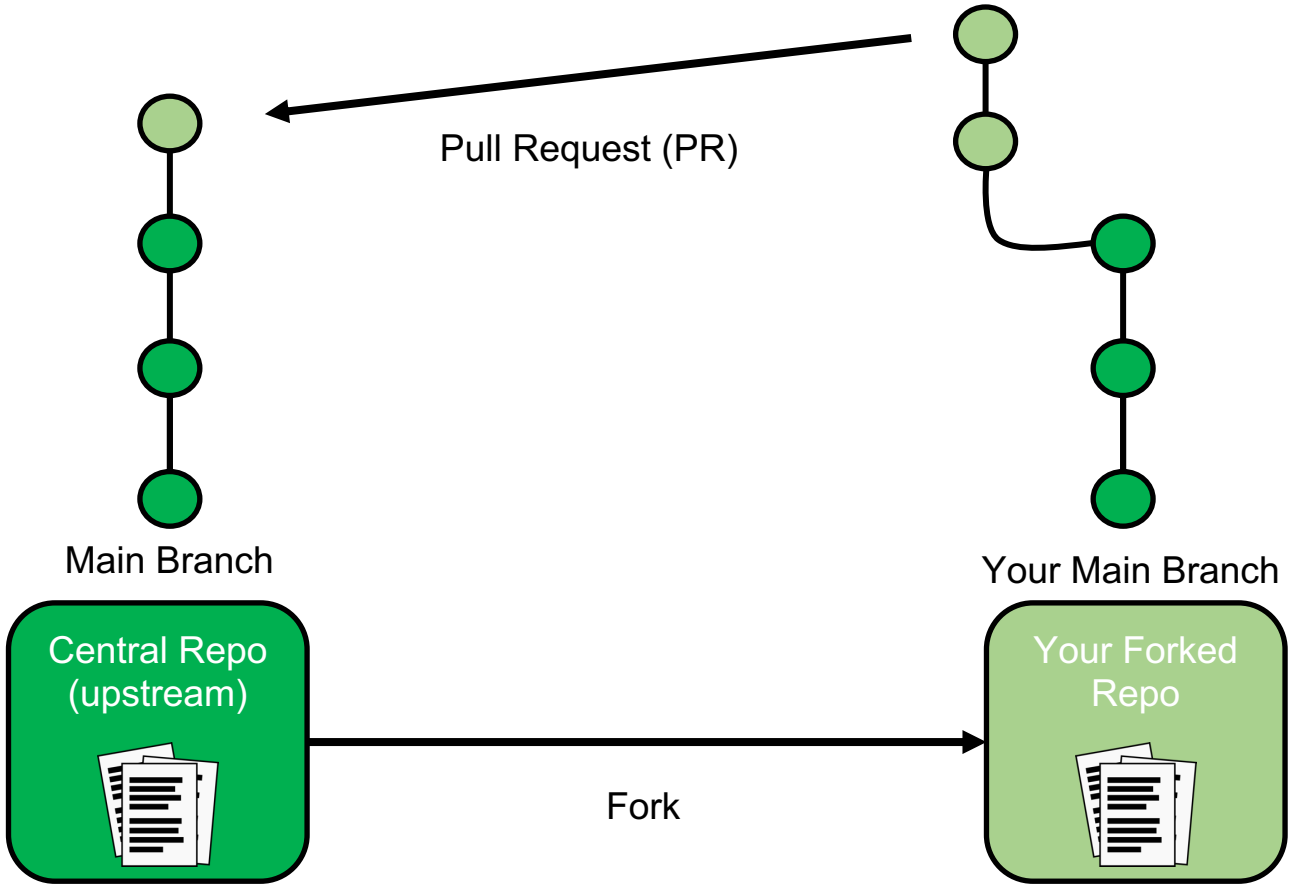
```
$ git pull <name of remote repo> <branch>
$ git pull origin main
```

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!

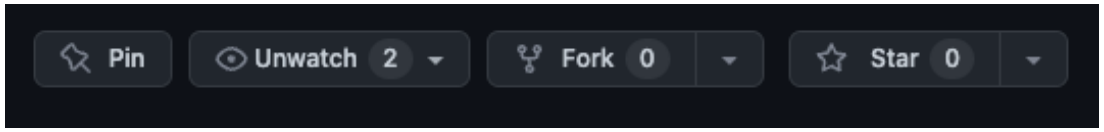
Advanced topic: Collaboration

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-rc/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
- Cloning when you have SSH keys:

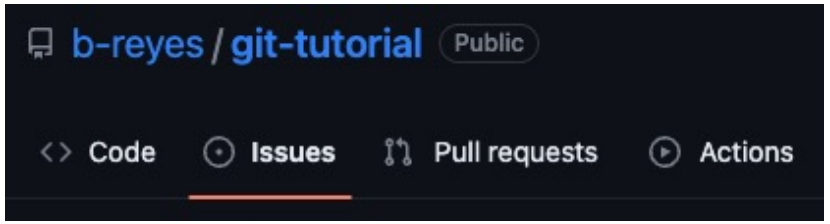
```
$ cd git_work
$ git clone git@github.com:<user>/git-tutorial.git
```

- Cloning when you are using Personal Access Tokens:

```
$ cd git_work
$ git clone https://github.com/user>/git-tutorial.git
```

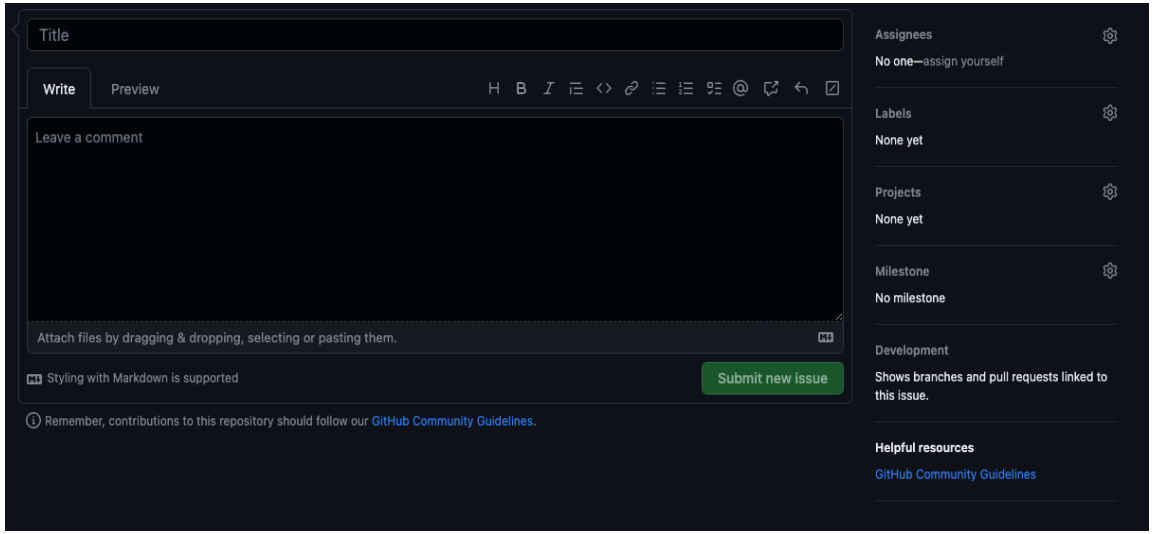
GitHub Issues

- 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. Ex. using SSH keys:

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

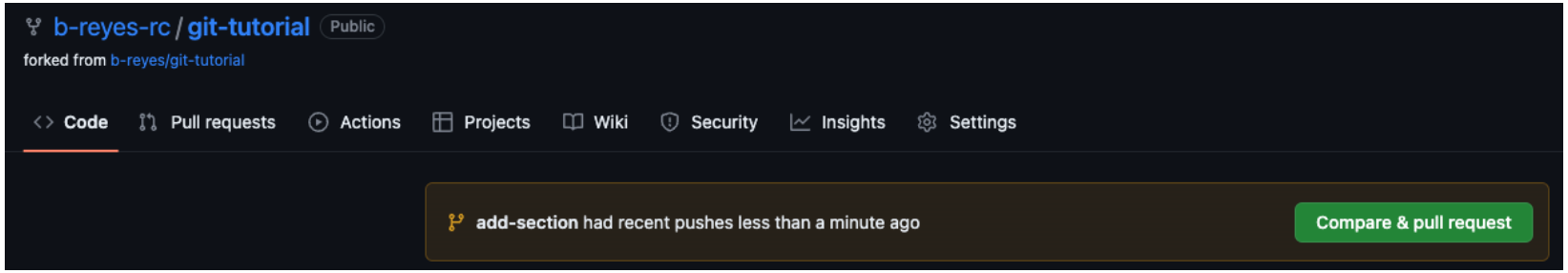
4. Create a new branch specific to your change

```
$ 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

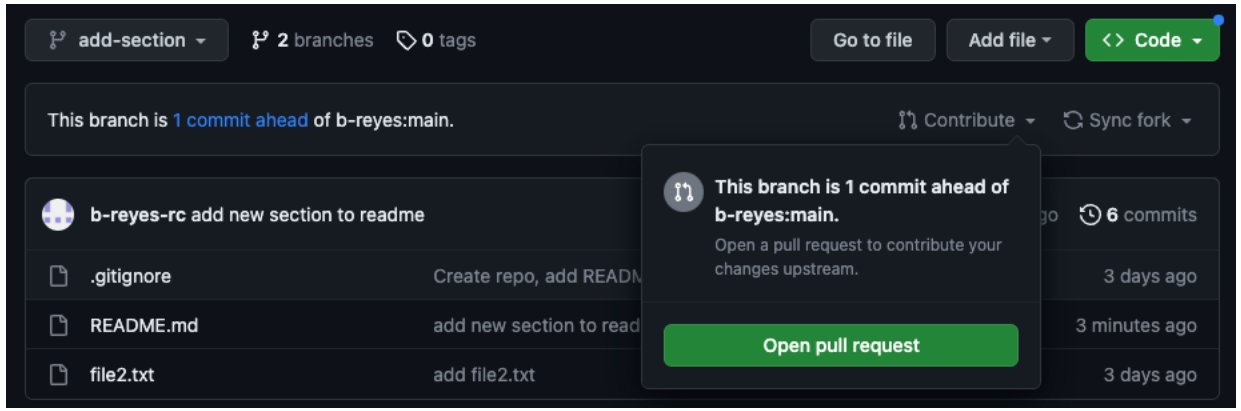
Creating a PR

- 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

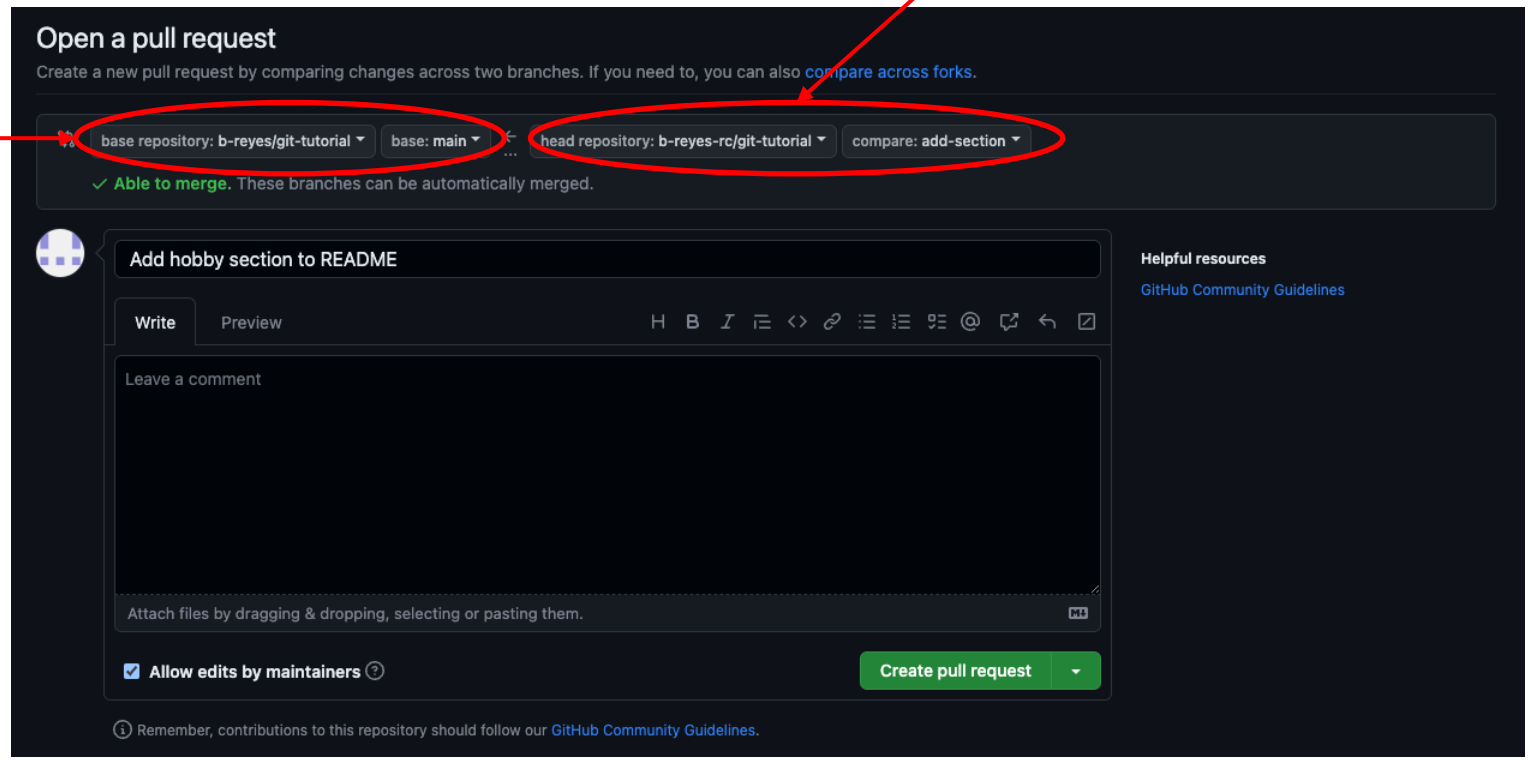
- After you push your changes to the forked repo
  1. Switch to your new branch
  2. Click the drop-down arrow next to “Contribute”
  3. Click “Open pull request”
- Will NOT disappear!



Creating a PR

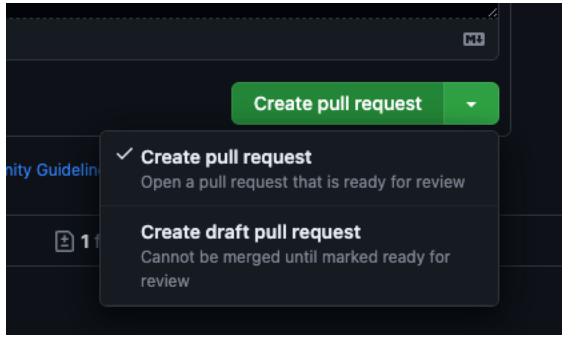
Our forked repo and branch with our changes

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?

- **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
- **GitHub Student Developer Pack:** https://education.github.com/pack
- **Helpdesk**: rc-help@colorado.edu

Survey and feedback

Survey: http://tinyurl.com/curc-survey18

Slides: https://github.com/ResearchComputing/git_github_in_depth_short_course