Introduction to git and GitHub

Jennifer Lin

2022-09-06

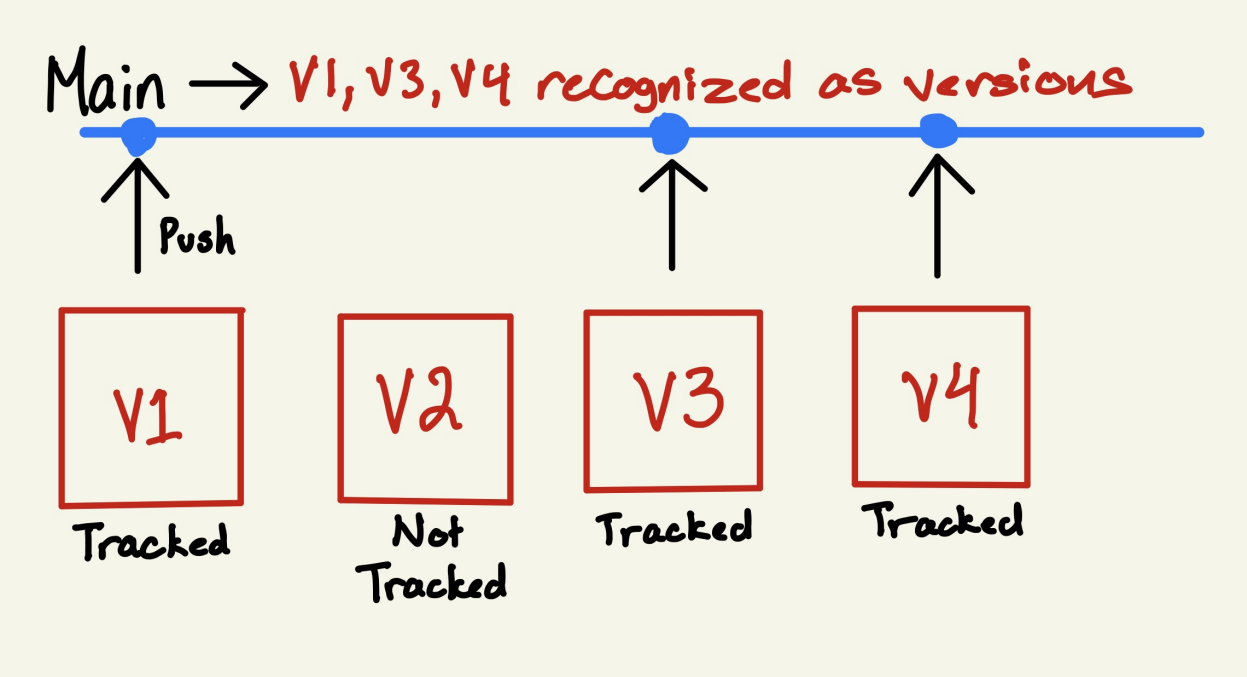
Contents

The Benefits of Version Tracking

Have you ever written a document on your computer where you have one version of the file that you swear is the final version so you name it "Paper FINAL.docx" and save? Then, have you realized that you made a mistake and needed to change something and then you

save this new version as "Paper FINAL FINAL.docx" and so on? Alternatively, have you saved a file called "Paper.docx" to realize that you had a wording in a previous version that you now liked but you deleted it because it did not look good back then? Have you wished that you could get a time machine to go back to find that wording?

I apply no judgment if any of the above scenarios ring true but you and I both agree that either scenario is not ideal. What if I told you that the time machine that you wish you had in the second scenario exists and it can help you find a smarter solution to both problems at the same time? Introducing **Version Control**, specifically `git` and GitHub.



For starters, `git` is the computer software and GitHub is the online app. Both cooperate to help you manage your documents and store various versions of your files so you can retrieve them if needed. This is the essence of version control. It creates a backlog of all the changes that you have made and saved to control cloud. Saving a document on your own computer does not help save the version. You **must** add it to the repository in order for it to be tracked. But much more on all of this later. First, let's get the programs set up.

Setting up `git` and GitHub

To set up `git`, locate the terminal application on your computer. All computers, regardless of the operating system, has a terminal. From there, check to make sure that it is installed by following the instructions here.

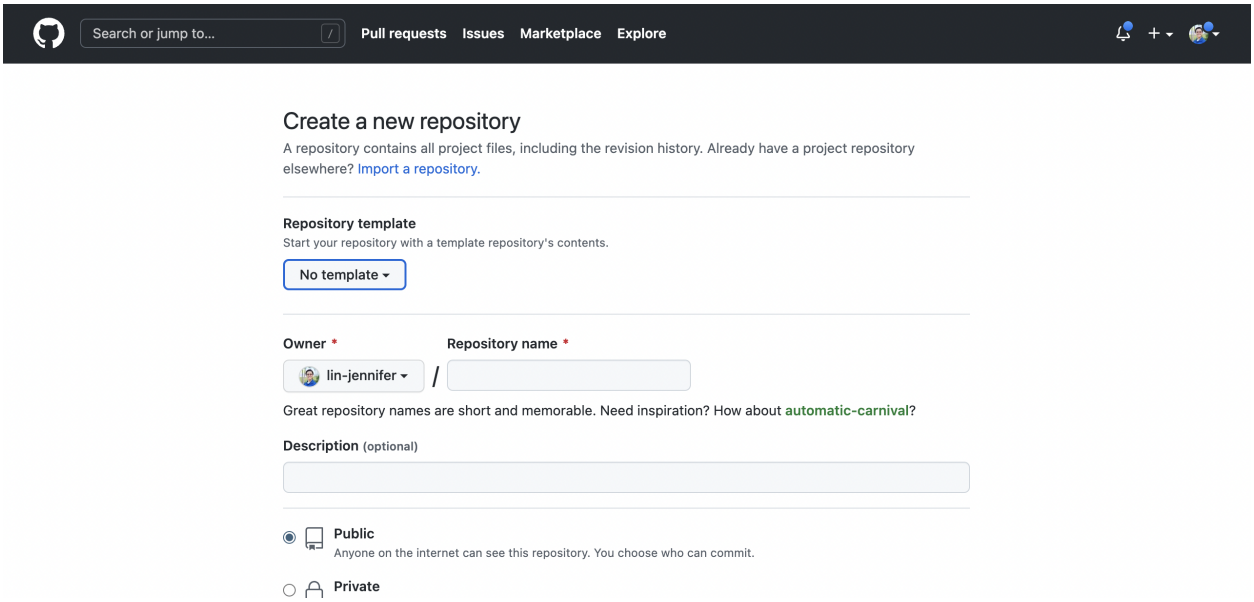
From here, you should set up a GitHub account on https://github.com/. Follow the instructions for signing up. When you are done, be sure to apply for the Education Developer Pack which gives you GitHub Pro so long as you are in academia as a teacher or as a student. GitHub Pro is usually $4 a month but the Developer Pack gives you its benefits for free. This

includes unlimited private and public repositories and access to use GitHub Pages, which is a neat way to create you own academic website.[1]

In addition, the Education Pack also provides neat perks for other programs. It provides you free access to things like DataCamp, NameCheap (for custom domain names, which can be useful when you are on the job market) and a bunch of other random computing tools that you may never need as a political scientist but are good to have in case you do need it. The main point is that the pack is easy to apply for, using your student ID and you should take advantage.

Creating a Repository

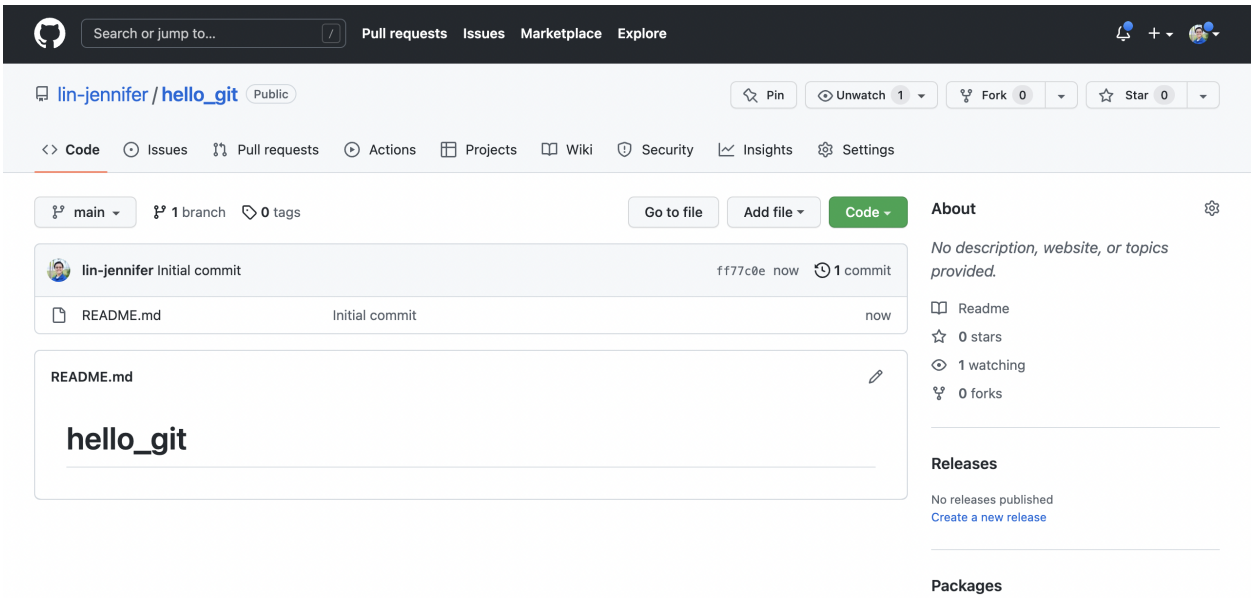
Now that you have your GitHub account set up, time to create a repository! A repository is a folder, usually for a project, that stores files. It is used similar to how you would use a folder on your own desktop. There is a command line method to create repositories, but why complicate our lives? Using your new GitHub account, locate the green `New` button on the upper left hand corner of your home scree. Click on it and you should see a form to create a new repository:



We are going to fill this out. I am going to create a learning GitHub repository and make it public so that it can be a companion repository for anyone to practice GitHub with this tutorial. Even though I am doing this, you should almost **always** make your repositories private as Google sometimes indexes GitHub repositories for anyone to find. This is how you can find R packages in their developer version or cool datasets. It is a useful tool but perhaps not ideal if you are using GitHub to track your working papers and code. This is the benefit of GitHub Pro. The free plan will limit your number of private repositories but this is unlimited for Pro.

[1] All GitHub accounts come with a custom domain for a website based in GitHub Pages. The domain is `username + github.io` so choose your username wisely!

Anyways, my learning repository will be `hello_git` and it will include the `README.md` file. This file is simply a default file that you should always include in your repositories. It is a good place to store important information about your project, especially once it is public. As you will soon see, the `README` is formatted nicely when you open the repository. It is the visitor's first look at your repository and it is also your first look at it too. So let's create this repository and see what we get.

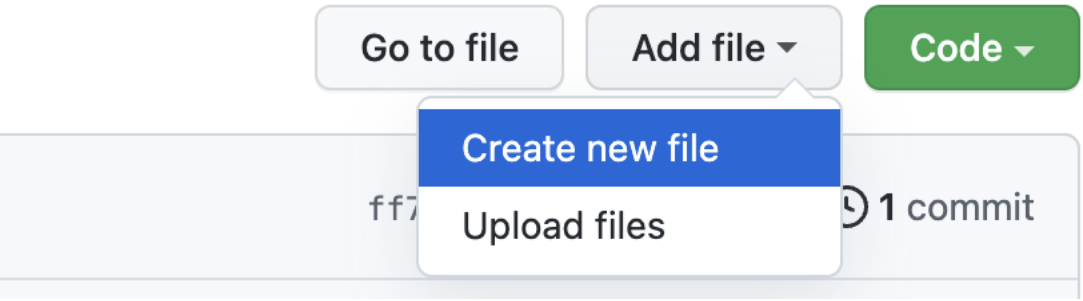


Notice that the `README` contains the title of the repository as a default. You can always edit the `README` using the little pencil icon on the upper right hand corner of the document window.

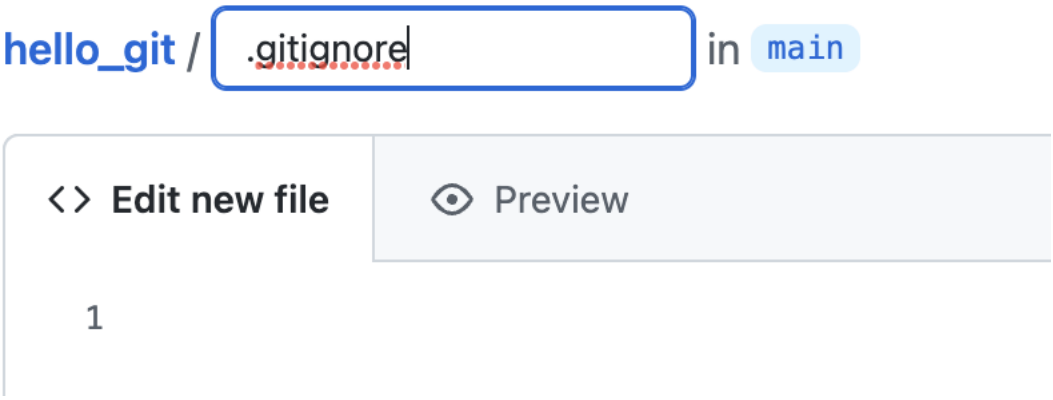
Adding the `.gitignore`

When you created the repository, there was an option to ask if you wanted a `.gitignore` file. A `.gitignore` file is one that tells `git` to ignore some files when you are pushing to the cloud. This might be especially useful if you have large data files on your computer that should not be pushed or if you have auxiliary files (like `.Rhistory` or `.DS_Store`) that are only useful to your computer and no one else. It can be difficult to create your own `.gitignore` as there are file extensions that are out there that apply to the software that you plan on using that you perhaps never learned about. Fortunately, there is an app for that.

Before we go there, though, let's create a new file on GitHub.

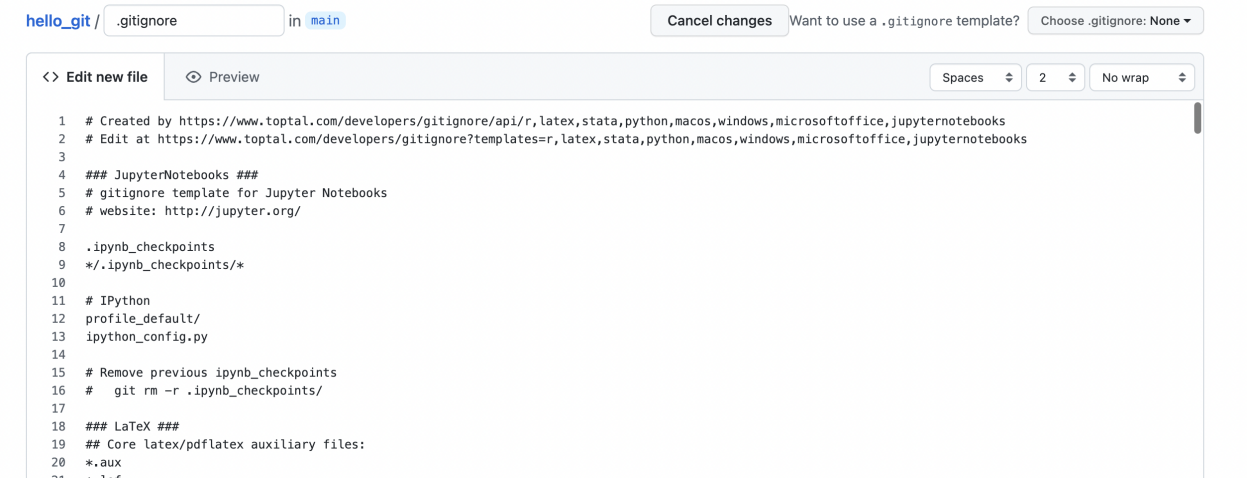


In the text box for a new file, write `.gitignore`. Immediately, you will see options on the right hand side for templates. Do not use those. The default only allows you to add one program, so you pick between R, LaTeX, Stata, Mac and so on, but you cannot have them all.

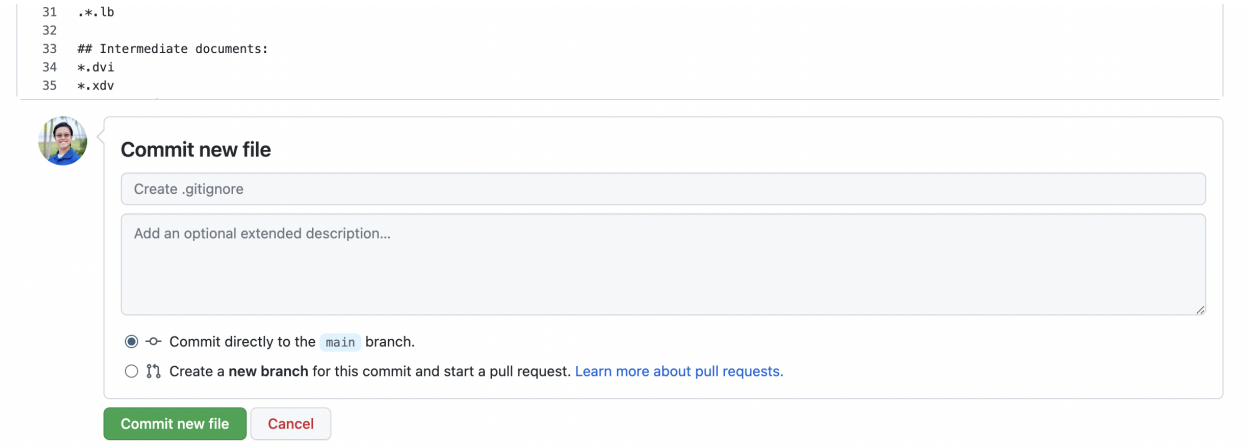


Enter gitignore.io. This is a web app that automatically creates `.gitignore` files for you, and can include all of the programs that you are planning to use. Here are all the software and programs that I like to include. ***Remember***, your computer is technically a program too and it has auxiliary files that you don't want to push either!

Once you click “Create”, you will get a whole list of file extensions. Select all on the screen and copy and paste it into the new file on your GitHub screen.



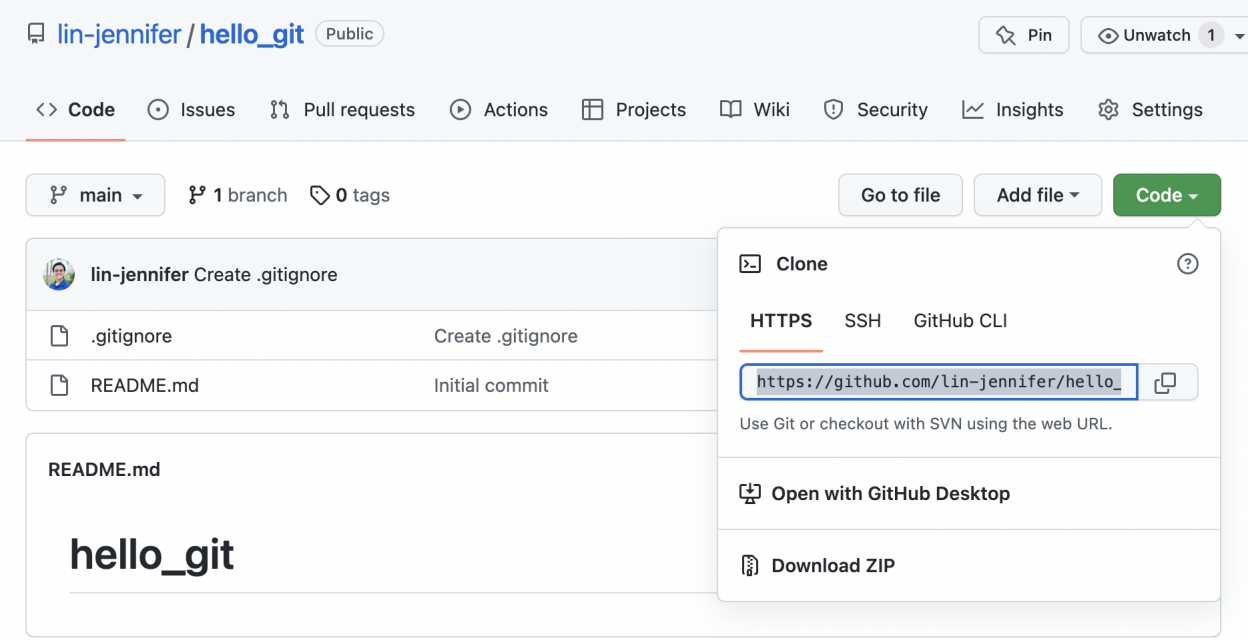
Now that this very long file of mostly extensions are copied into the editor on GitHub, you can scroll all the way to the bottom where it says “Commit New File”. Here, you can write a description of what you did, but the default text of “Create .gitignore” will do. We will talk more about commit messages later. Click “Create New File” and you are set!



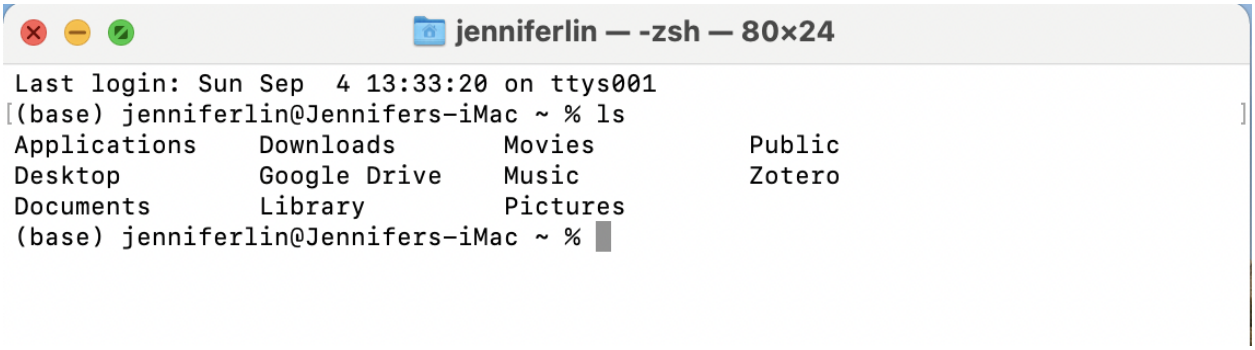
Clone Repository

Now, lets get the repository off the cloud and onto the computer. Here, we will use the terminal app that you located earlier. Going forward, I will make my demonstrations on a Mac, but Windows and Linux operates quite similarly.

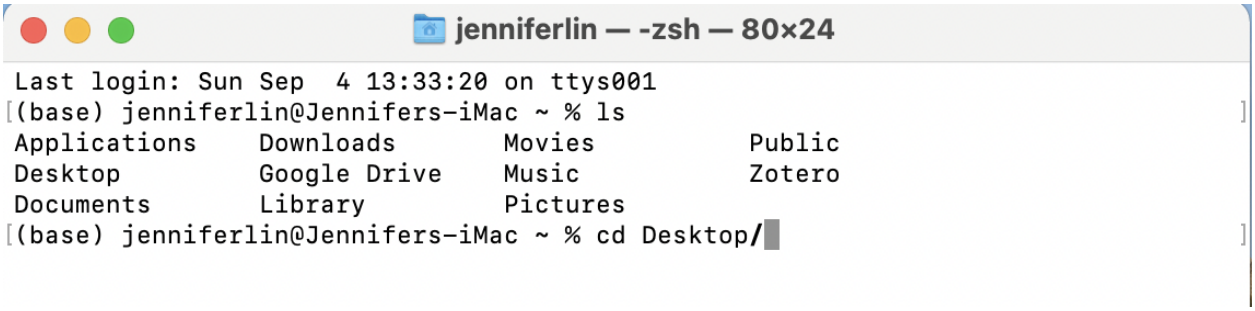
Looking on the homepage on the repository on GitHub, there is a green “Code” drop down menu. Click on it. You will see three options, one for a URL, one for opening on GitHub Desktop (more later) and one for downloading file as a Zip file. NEVER download it as a Zip file because this option does not come with the invisible `.git` file that `git` needs to track versions. Instead, we want the URL. Copy the entire URL.



Let's open up terminal and find out where we are. Use `ls` to see what folders are in the folder you are currently in. Usually, the default folder is your User folder.



We can then use the command `cd`, or Change Directory, to locate a folder on one of these sub-folders on the computer to place the repository. I am going to put it on my desktop.



Once I am on my Desktop, I can use the function `git clone + "URL"` to get the repository to my Desktop. This is where the URL that you copied earlier comes in handy.

```
(base) jenniferlin@Jennifers-iMac Desktop % git clone "https://github.com/lin-jennifer/hello_git.git"
Cloning into 'hello_git'...
remote: Enumerating objects: 6, done.
remote: Counting objects: 100% (6/6), done.
remote: Compressing objects: 100% (4/4), done.
remote: Total 6 (delta 0), reused 0 (delta 0), pack-reused 0
Receiving objects: 100% (6/6), 5.24 KiB | 5.24 MiB/s, done.
(base) jenniferlin@Jennifers-iMac Desktop %
```

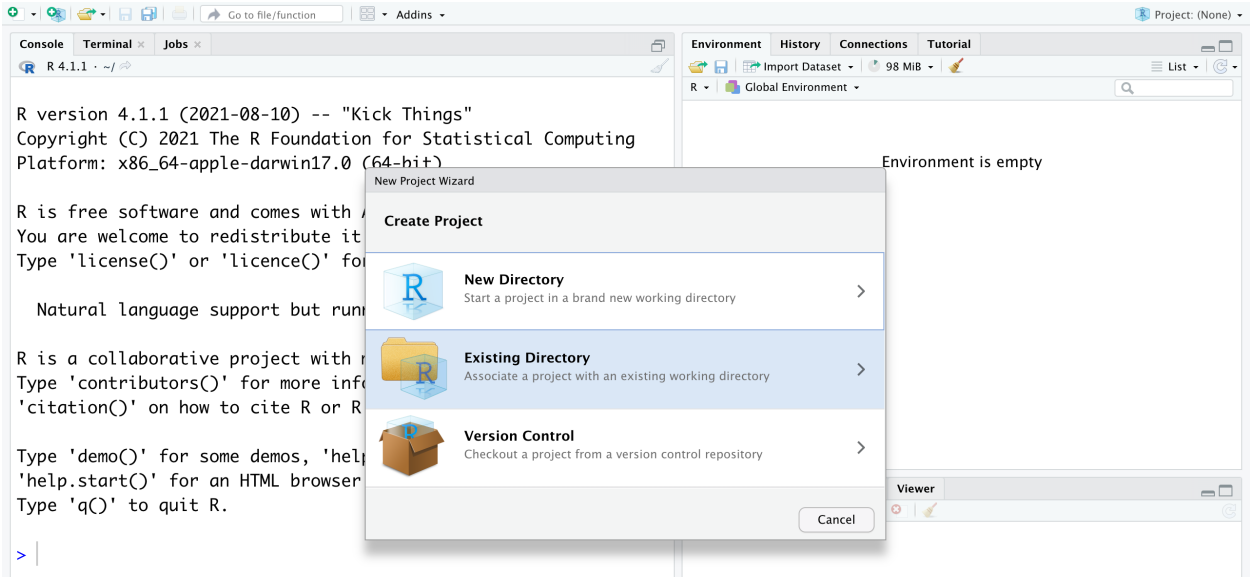
Notice that after we clone the repository, we are still on the Desktop in the terminal, but the folder is already in the destination. We need to navigate to the folder, using the handy `cd` command.

```
(base) jenniferlin@Jennifers-iMac Desktop % cd hello_git
(base) jenniferlin@Jennifers-iMac hello_git %
```

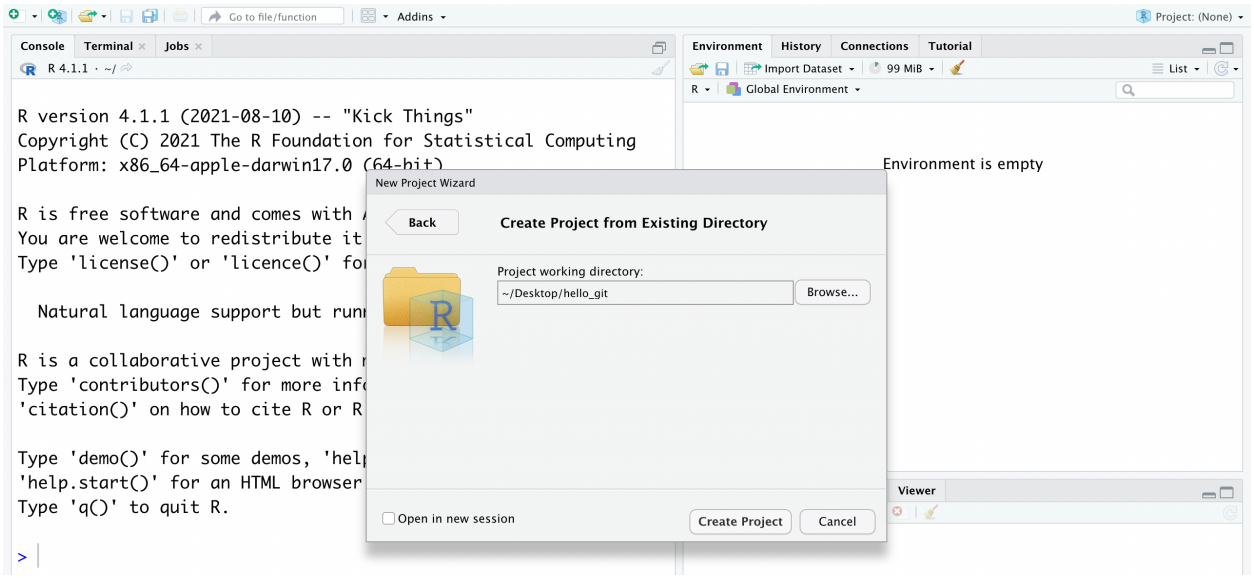
Now, open the repository folder on the Desktop, or wherever you cloned it. Notice how the only file here is the `README`. There was a `.gitignore` but it is not in the folder because it is one of those invisible `git` files. To prove that it is there, let's create a file that contains one of the ignore extensions and add it to the repository. We are going to use R as an example.

Adding Files to the Repository

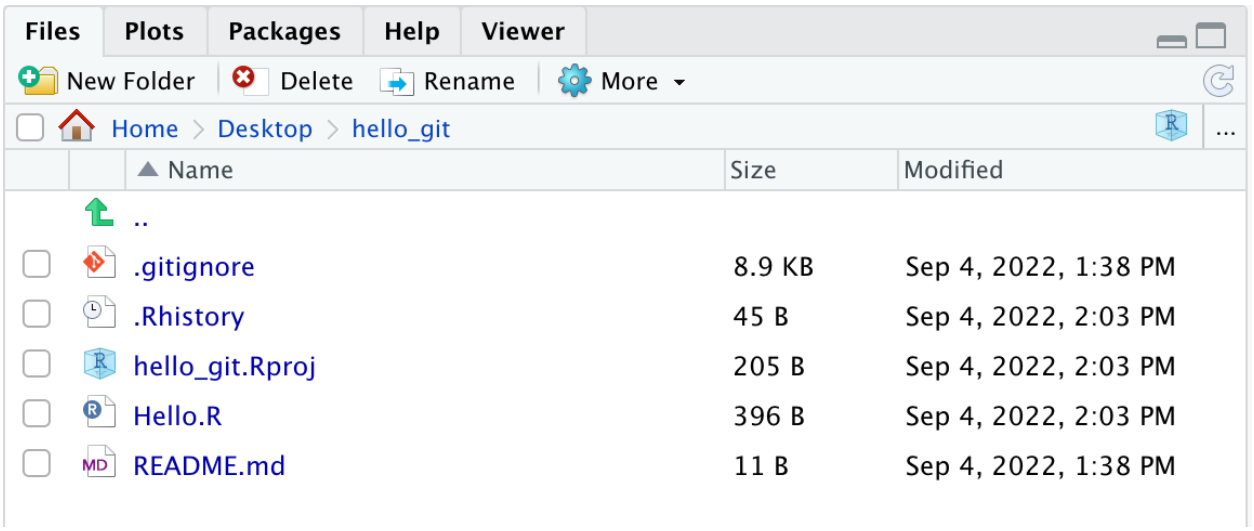
We can open a new R session and go to File > New Project. We then select the option that allows us to create a new project from an existing repository.



From there, add the file path, using the Browse button, for the repository. Then hit "Create Project".



Within this project, I am going to add an R script called `Hello.R`. The contents of this script are irrelevant. Save an R script, R markdown file, or really anything to your repository. In the Files section in the lower right hand corner of R Studio, you will see the contents of your repository.



Notice that the `.gitignore` is there and so is this things called `.Rhistory`. The `.Rhistory` file is something for R to track what commands you have ran. You do not need this when you share the repository to your co-authors or to the world. The `.gitignore` file is programmed to recognize this file and omit it when adding files to the repository.

`git add` and `git status`

And speaking of adding files, let's add the R project and the script to the repository. Go back out to the terminal and type `git status` into the command line. At some point, you will be prompted to add a username and password so that you can actually add the files. The system

should prompt you to do that. Since my system is already set up, I cannot demonstrate that here.

```
(base) jenniferlin@Jennifers-iMac Desktop % cd hello_git
(base) jenniferlin@Jennifers-iMac hello_git % ls
Hello.R         README.md       hello_git.Rproj
(base) jenniferlin@Jennifers-iMac hello_git % git status
On branch main
Your branch is up to date with 'origin/main'.

Untracked files:
  (use "git add <file>..." to include in what will be committed)
        Hello.R
        hello_git.Rproj

nothing added to commit but untracked files present (use "git add" to track)
(base) jenniferlin@Jennifers-iMac hello_git %
```

Notice that there are two untracked files, the R project and `Hello.R`. Let's get `git` to start tracking those.

Using `git add`, we can add all the files that we want to track. `git add + "Filename"` adds the particular file specified. Let's add the R project.

`git commit` and `git push`

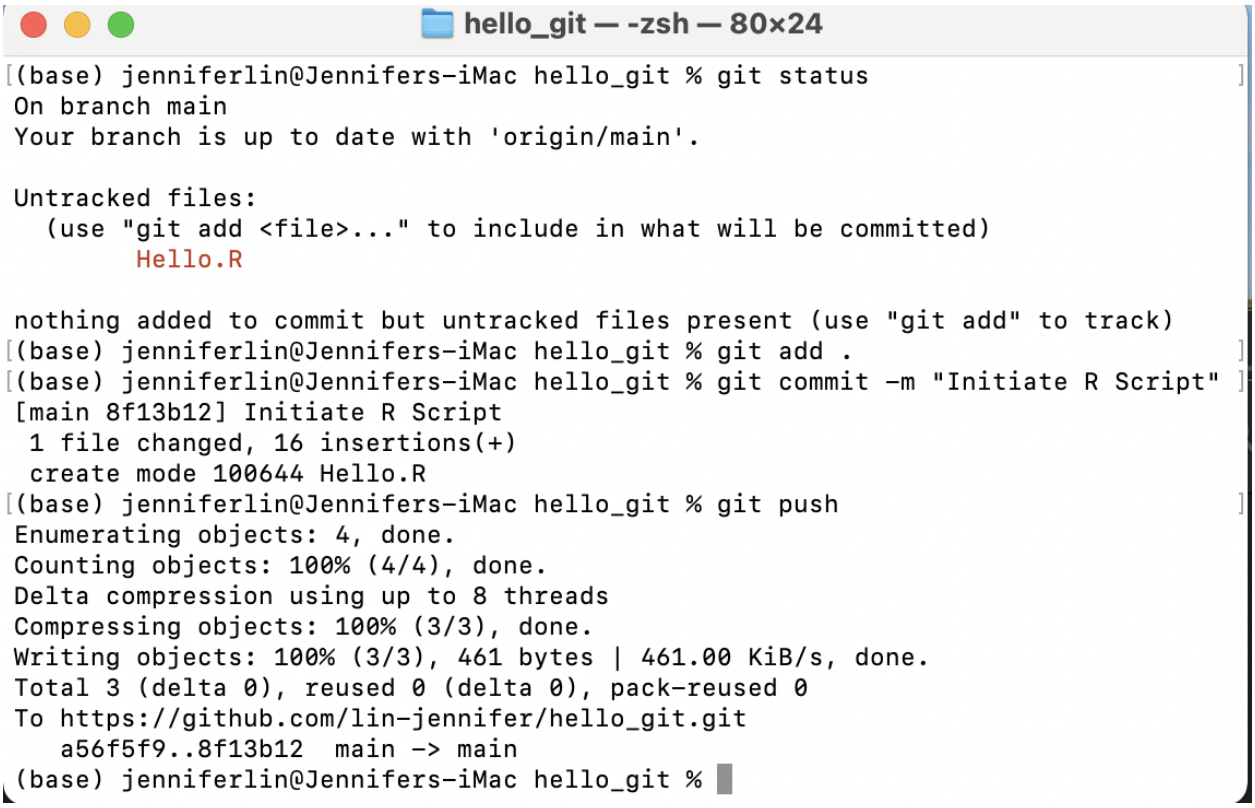
We can then use `git commit -m + "MESSAGE"` to insert a commit message about what we did. This captures an image of the file and `git` recognizes it as a new version. The message is a note to yourself about what you changed so you can go back and see the previous versions.

```
On branch main
Your branch is up to date with 'origin/main'.

Untracked files:
  (use "git add <file>..." to include in what will be committed)
        Hello.R
        hello_git.Rproj

nothing added to commit but untracked files present (use "git add" to track)
(base) jenniferlin@Jennifers-iMac hello_git % git add "hello_git.Rproj"
(base) jenniferlin@Jennifers-iMac hello_git % git commit -m "Initiate R Project
for Repo"
[main a56f5f9] Initiate R Project for Repo
 1 file changed, 13 insertions(+)
 create mode 100644 hello_git.Rproj
(base) jenniferlin@Jennifers-iMac hello_git %
```

To add it to the cloud, we can use `git push`.

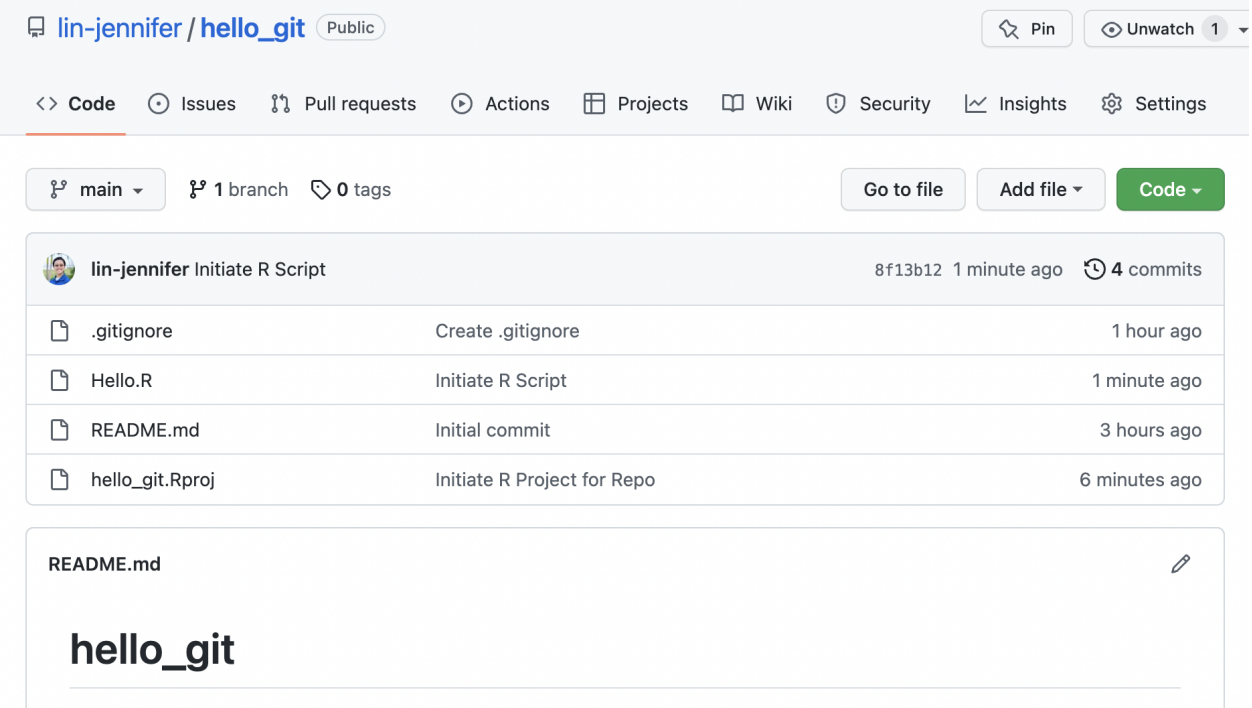
```
(base) jenniferlin@Jennifers-iMac hello_git % git commit -m "Initiate R Project
for Repo"
[main a56f5f9] Initiate R Project for Repo
 1 file changed, 13 insertions(+)
 create mode 100644 hello_git.Rproj
(base) jenniferlin@Jennifers-iMac hello_git % git push
Enumerating objects: 4, done.
Counting objects: 100% (4/4), done.
Delta compression using up to 8 threads
Compressing objects: 100% (3/3), done.
Writing objects: 100% (3/3), 475 bytes | 475.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
To https://github.com/lin-jennifer/hello_git.git
   9c05b11..a56f5f9  main -> main
(base) jenniferlin@Jennifers-iMac hello_git %
```

Are we done? Let's use `git status` to find out. It appears that we still have the `Hello.R` file to push. Let's add that with `git add`. But this time, instead of using `git add + "Filename"`, let's do `git add .`. This is a shorthand to add all the files that need a commit message. This is assigning one commit message to all of the files added, so be careful when using this shorthand!



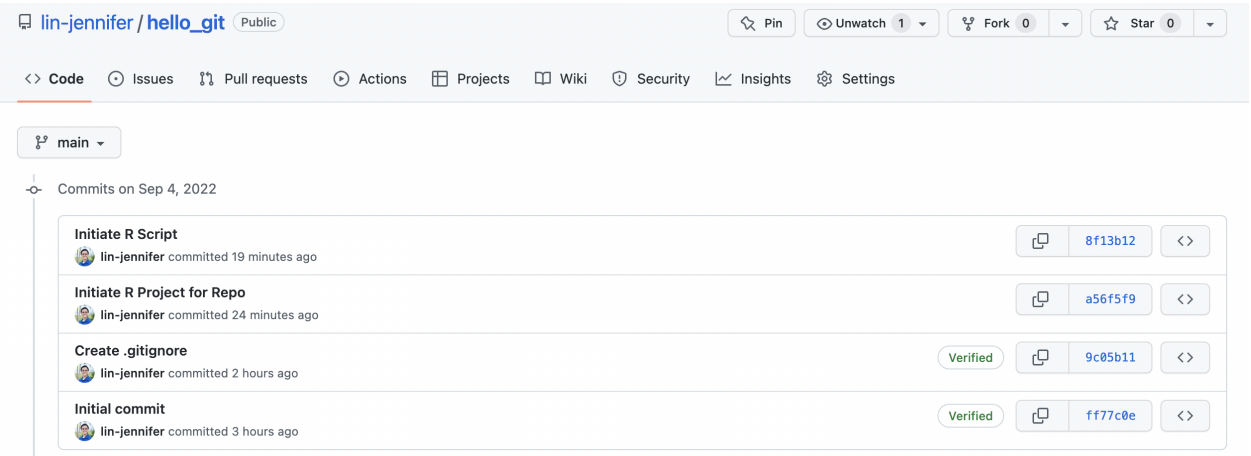
Checking Commits

Now, let's go back to the GitHub web app and see our repository. Notice how all of the files that we added, along with our commit messages, are in the repository.

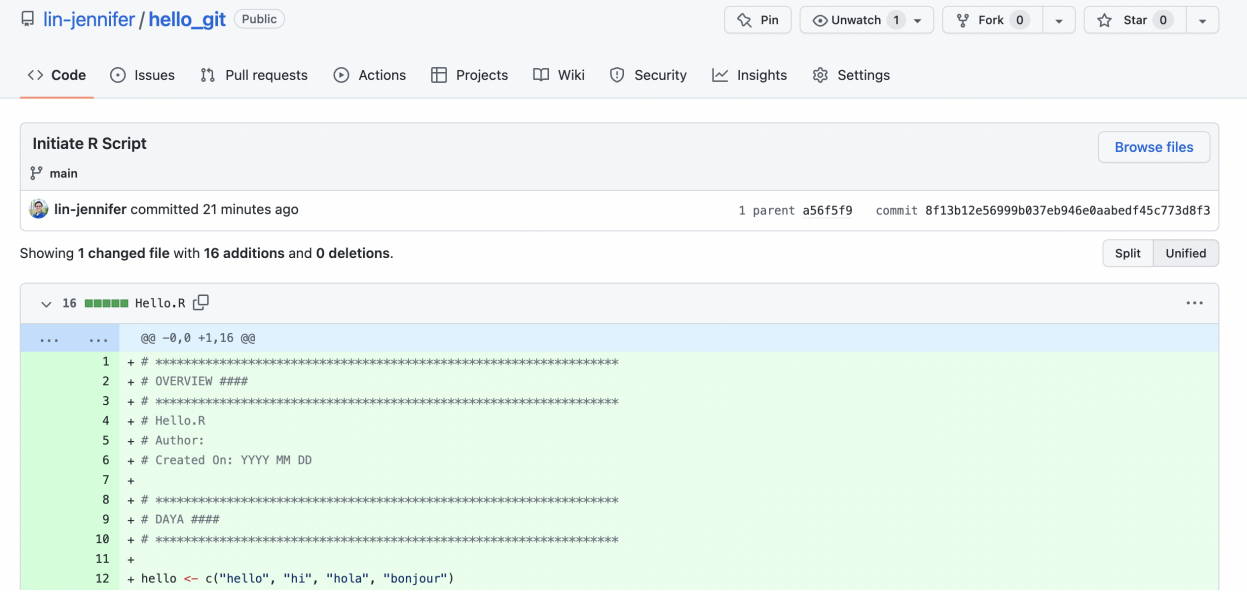


The one file that is missing is `.Rhistory` and that because it was ignored in the push process thanks to the `.gitignore`.

I can also click on the text that says "N Commits" under the green "Code" drop down to see my commits.



This does not look too bad! Let's click into the first one and see what happens.

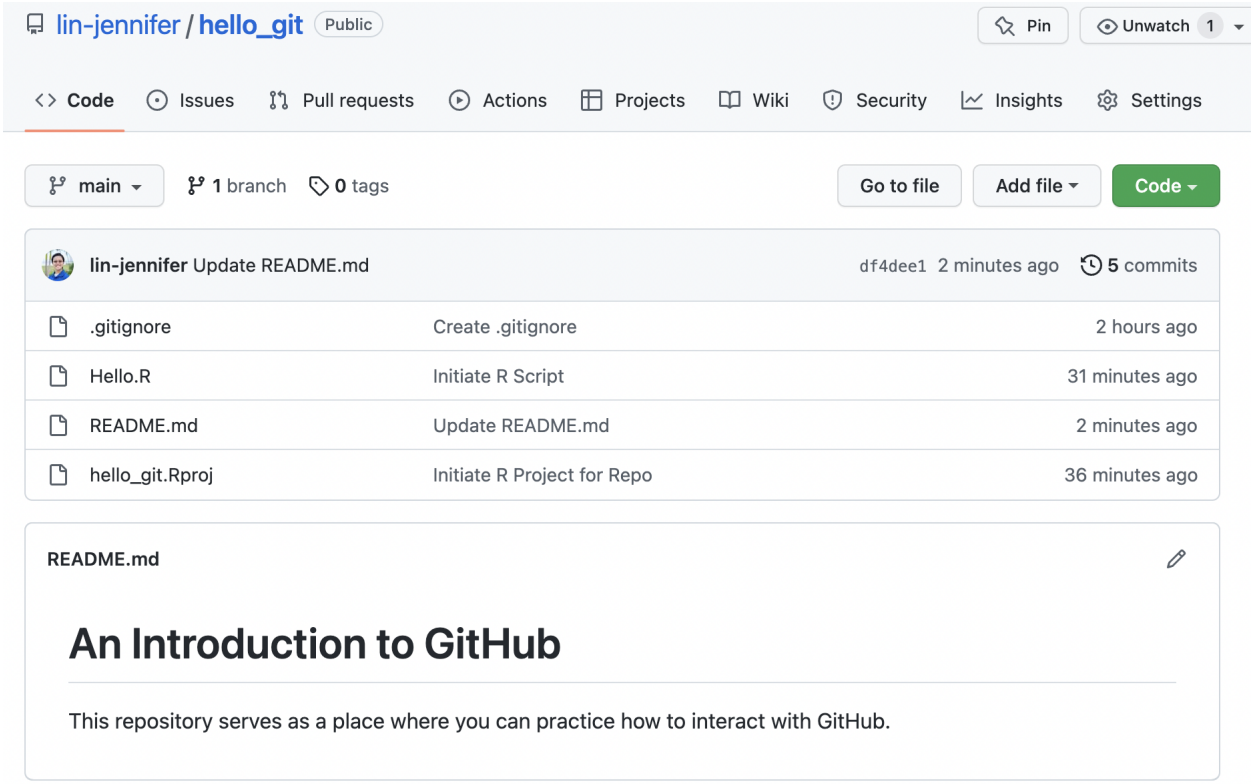


We see that GitHub is telling us what was added in green, and if applicable, what is deleted is in red.

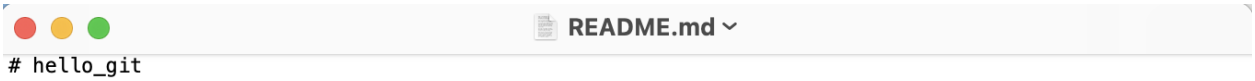
`git pull`

`git` is a push and pull process, especially when collaborating. Let me pretend to be a different user and make edits to the `README` using the tiny pencil on the upper right on the home screen. I will add some notes about what I did and overall, make it look nicer. Before I do, notice the current `README`. It is just the name of the repository in big letters.

When you use the pencil tool to update the `README`, it will ask you to commit changes, like what happens when we did the `.gitignore`. Simply commit and add. Now, look at the new `README` on the cloud.



Let's look at the local copy of the `README.md` file on the computer.



So we just made an edit on the web app, why did it not transfer to the desktop version? To get it to transfer, we need `git pull` in the terminal. ***You should ALWAYS pull before you push!*** This is especially true if you know that you have made a change on the cloud, on a different computer, or if a co-author has made changes.

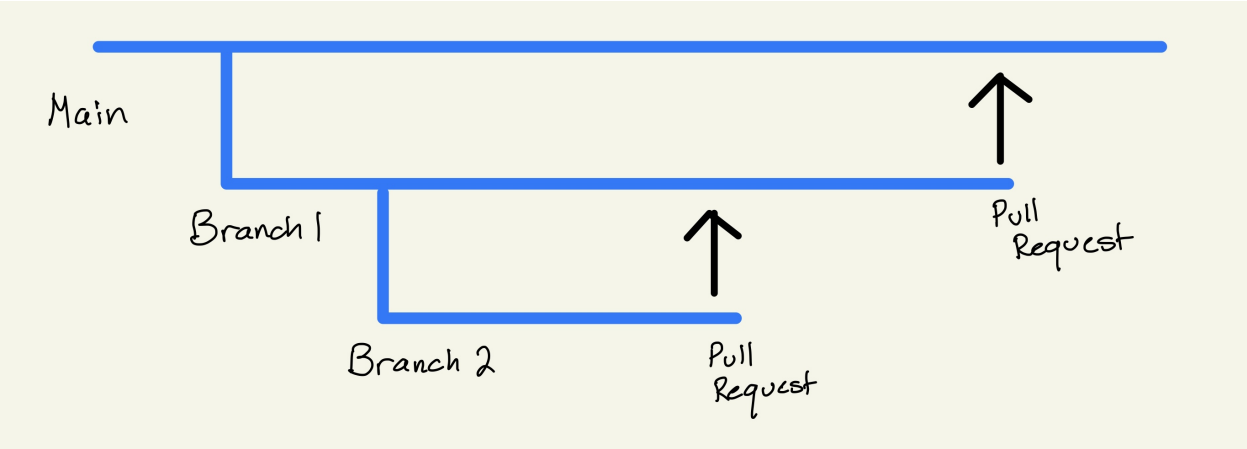
To fetch the changes, simply type `git pull` into the terminal.

```
(base) jenniferlin@Jennifers-iMac hello_git % git pull
remote: Enumerating objects: 5, done.
remote: Counting objects: 100% (5/5), done.
remote: Compressing objects: 100% (3/3), done.
remote: Total 3 (delta 1), reused 0 (delta 0), pack-reused 0
Unpacking objects: 100% (3/3), 728 bytes | 242.00 KiB/s, done.
From https://github.com/lin-jennifer/hello_git
   8f13b12..df4dee1  main       -> origin/main
Updating 8f13b12..df4dee1
Fast-forward
 README.md | 4 +++-
 1 file changed, 3 insertions(+), 1 deletion(-)
(base) jenniferlin@Jennifers-iMac hello_git %
```

As you can see, the results in the terminal will let you know what files changed and how much was changed.

Branches

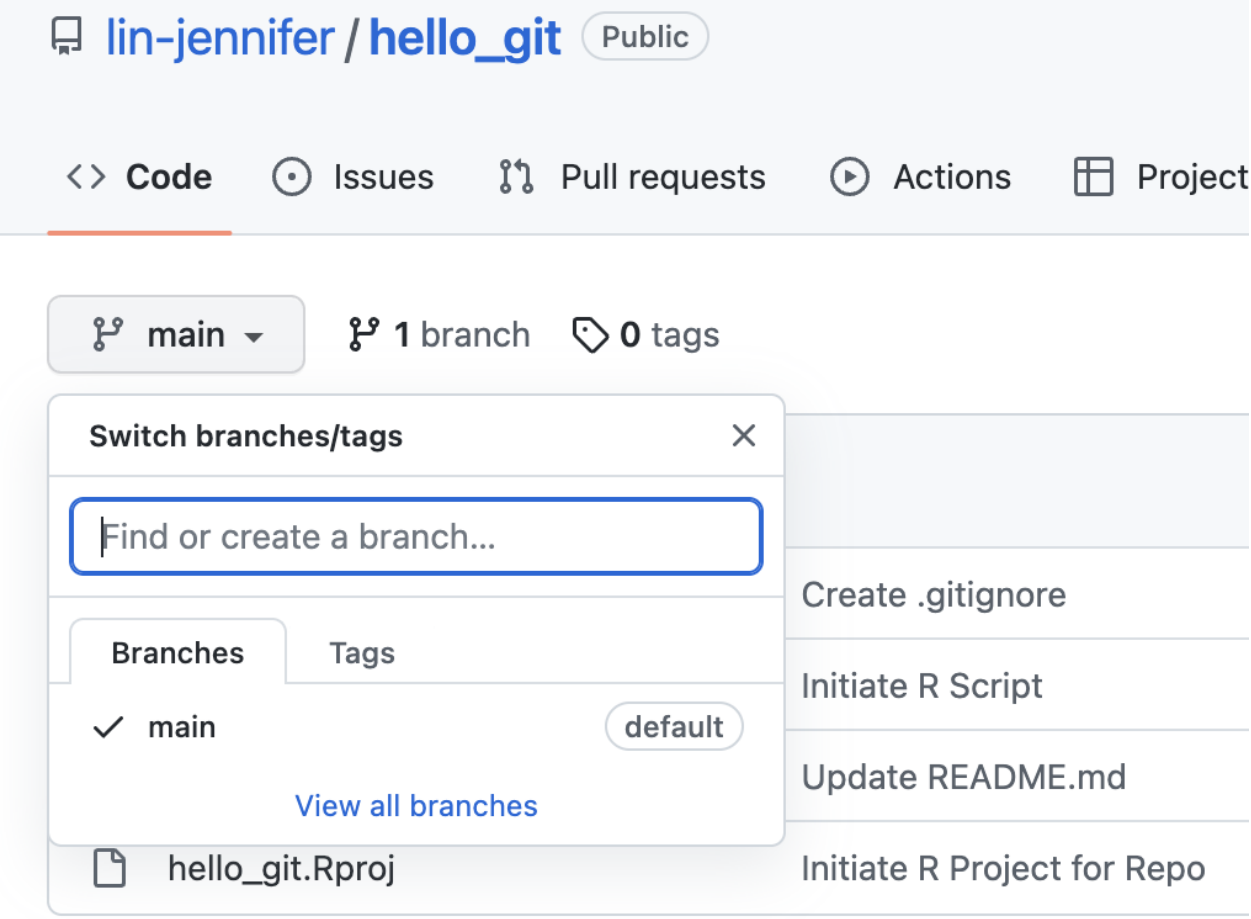
A useful feature of GitHub is in branches. You can work on various parts of a project on the side without showing it to your co-authors on the main branch and merge it once you are ready. To understand branches, you need to first understand how `git` works in theory.



When you create a repository, you are working in the `main` branch.[2] You can create branches off of the main branch to write drafts, troubleshoot code, and more, before making it official on the main branch. When you are ready to bring work from a branch to the main, you can use a pull request.

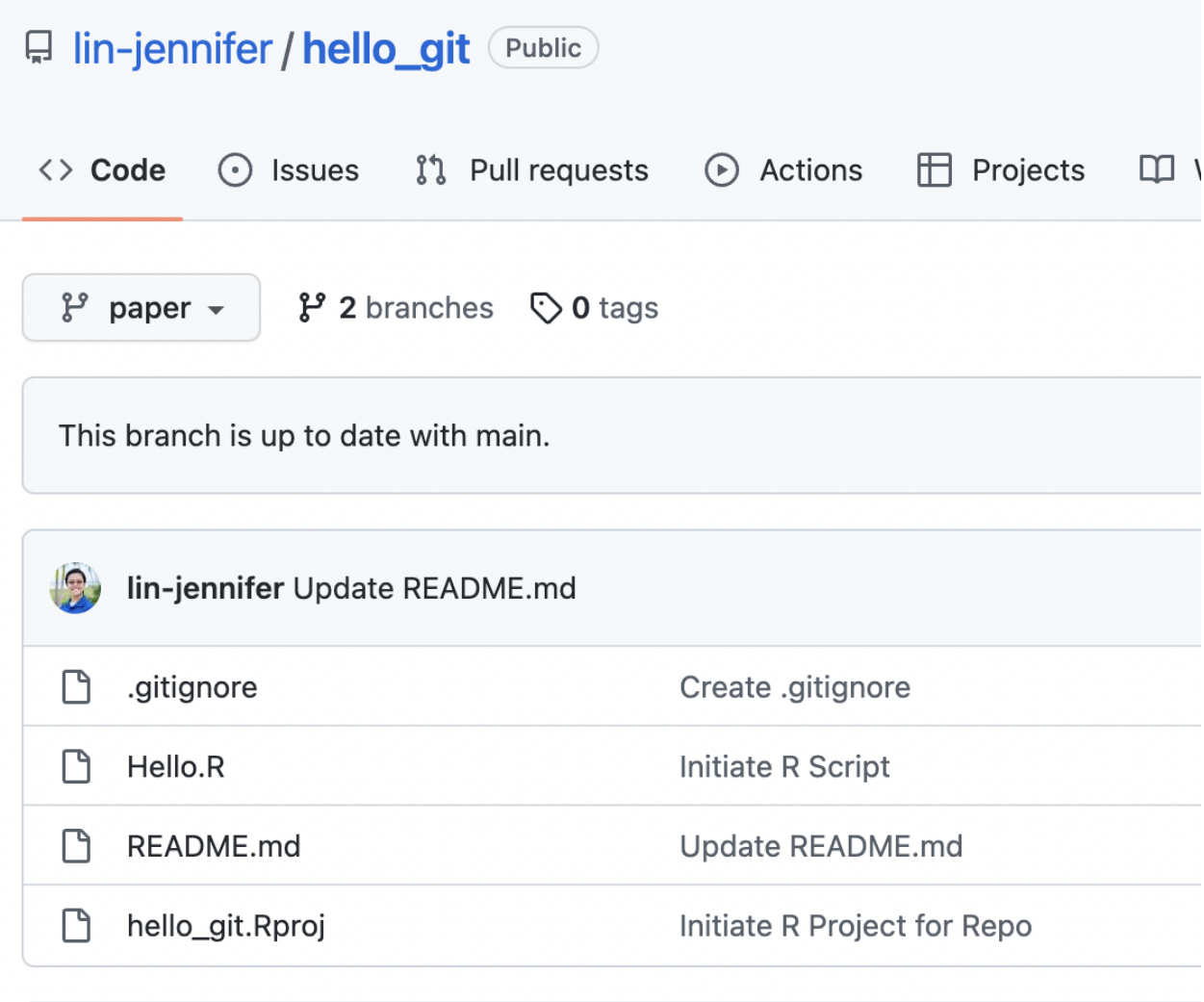
So let's take a look at the branches that we have for the `hello_git` repository

[2]The `main` branch was once called `master` so older `git` tutorials and documents might have `master`. But both reference the same thing.



Create a Branch

Suppose that I want to work on the draft of a paper on a different branch because it is just me putting my ideas down. It is super preliminary and my co-author, much less the public, should see it. Let's create a branch called `paper` by typing that into the dialog box. Once we hit "Create", the app jumps to the branch and we can see that because the dropdown that we just used is now named `paper` rather than `main`.



Beneath the menu of branches, we see a note that says "This branch is up to date with main." Excellent. Now, lets go back out to the terminal and open up this branch on the desktop version of this folder.

Working with Branches on Local Computer

First, we need to run a `git pull` to pull the information about the new branch. Then, we use the command `git checkout + branchname` to access the branch.

```
(base) jenniferlin@Jennifers-iMac hello_git % git pull
From https://github.com/lin-jennifer/hello_git
 * [new branch]      paper      -> origin/paper
Already up to date.
(base) jenniferlin@Jennifers-iMac hello_git % git checkout paper
Branch 'paper' set up to track remote branch 'paper' from 'origin'.
Switched to a new branch 'paper'
(base) jenniferlin@Jennifers-iMac hello_git %
```

Go ahead and open up the folder on your computer, from where you first stored it. You will

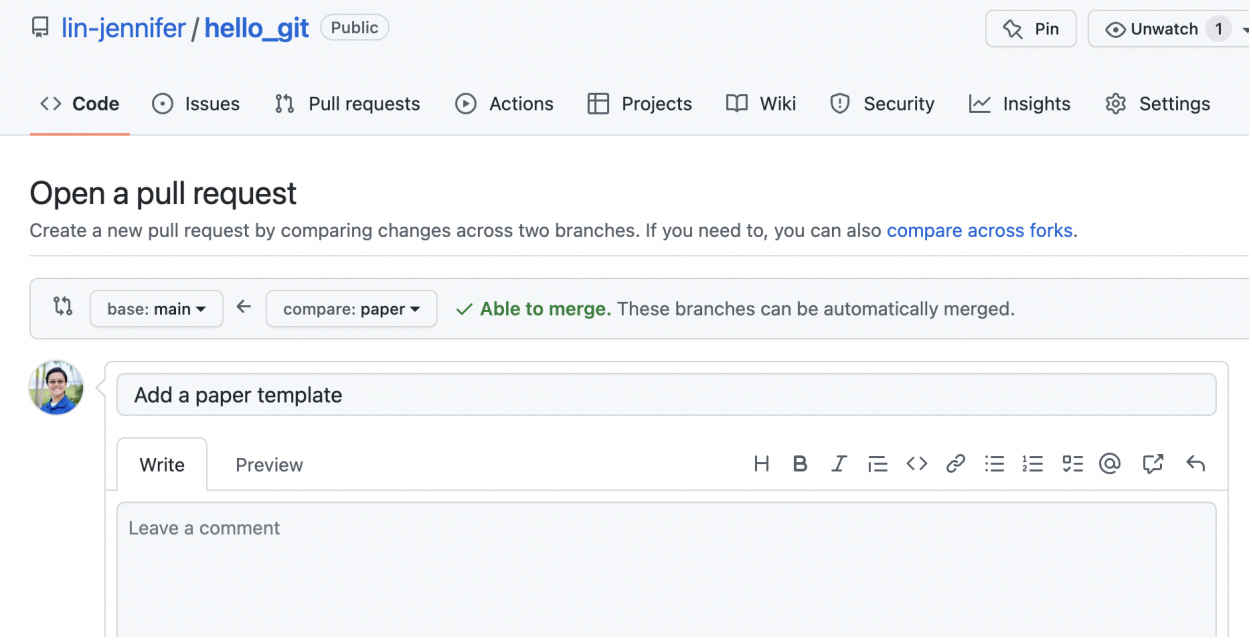
notice that things look the same. Let's change that. Let's make a few changes, like create a folder for the paper and insert a LaTeX document using this Basic Template from Overleaf. Once you have a folder and a document, let's add and commit it to the `paper` branch using the same steps as above.

```
(base) jenniferlin@Jennifers-iMac hello_git % git checkout paper
Switched to branch 'paper'
Your branch is up to date with 'origin/paper'.
(base) jenniferlin@Jennifers-iMac hello_git % git status
On branch paper
Your branch is up to date with 'origin/paper'.

Untracked files:
  (use "git add <file>..." to include in what will be committed)
        Paper/

nothing added to commit but untracked files present (use "git add" to track)
(base) jenniferlin@Jennifers-iMac hello_git % git add .
(base) jenniferlin@Jennifers-iMac hello_git % git commit -m "Add a paper templa
te"
[paper 9bb91c0] Add a paper template
 1 file changed, 39 insertions(+)
 create mode 100644 Paper/Paper.tex
(base) jenniferlin@Jennifers-iMac hello_git % git push
Enumerating objects: 5, done.
Counting objects: 100% (5/5), done.
Delta compression using up to 8 threads
Compressing objects: 100% (3/3), done.
Writing objects: 100% (4/4), 592 bytes | 592.00 KiB/s, done.
Total 4 (delta 1), reused 0 (delta 0), pack-reused 0
remote: Resolving deltas: 100% (1/1), completed with 1 local object.
To https://github.com/lin-jennifer/hello_git.git
   df4dee1..9bb91c0  paper -> paper
(base) jenniferlin@Jennifers-iMac hello_git %
```

Pull Requests

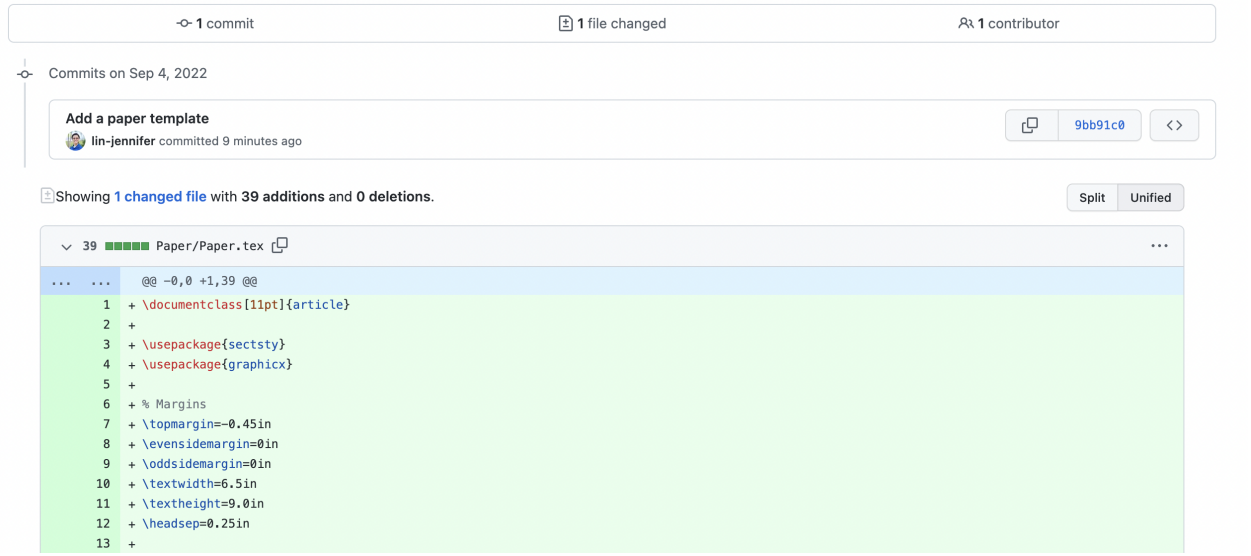
When we go back to the GitHub page, we get a message telling us that the `paper` branch is one commit ahead of main. That is true, because we just made a commit. We then get this option for "Compare & Pull Request".

Suppose that you are happy with the paper and you want to bring it to the main branch so that your co-authors can see the brilliant work that you have been doing on the side. To do this, we will click on that green "Compare & Pull Request" button. When we do, we get the following:

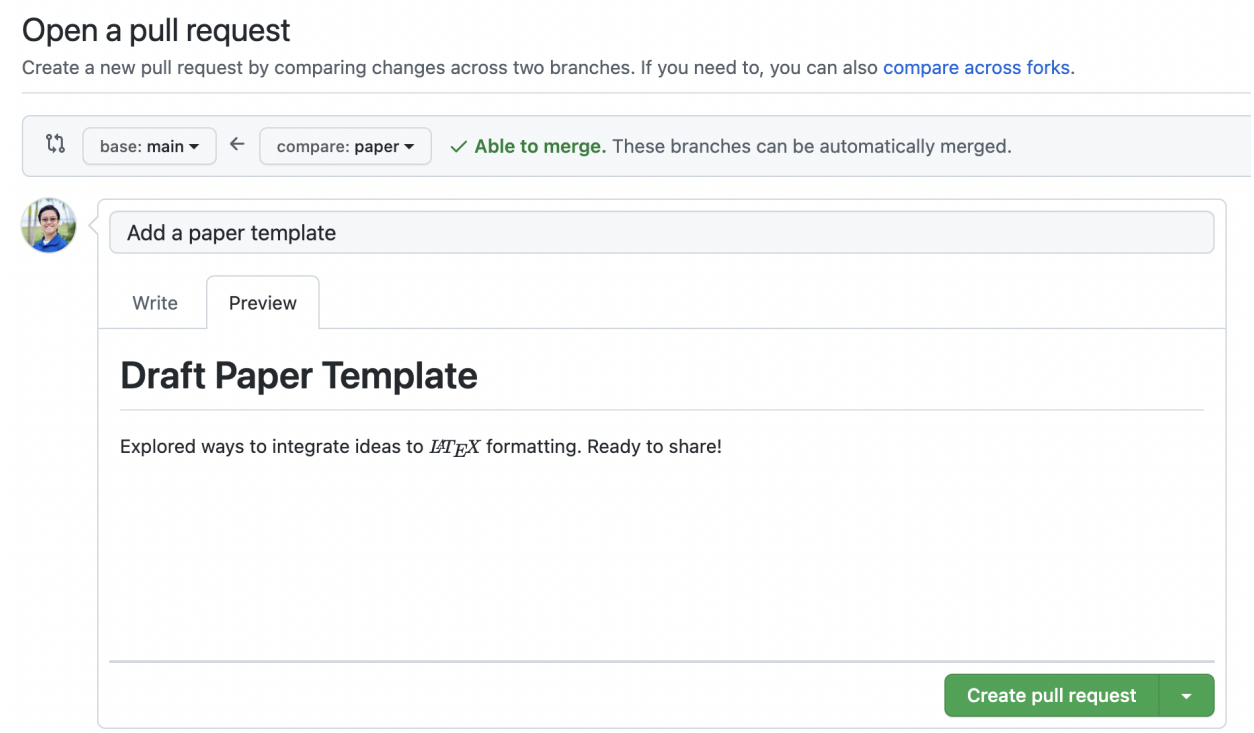


It tells us that we are comparing the `paper` branch to the `main` branch and that we can merge. But there is nothing that shows what changed. Instead, we see a dialog box with the commit message that I used to make the commit of the paper folder to the branch. For now, this is all fine and good. Let's scroll down.

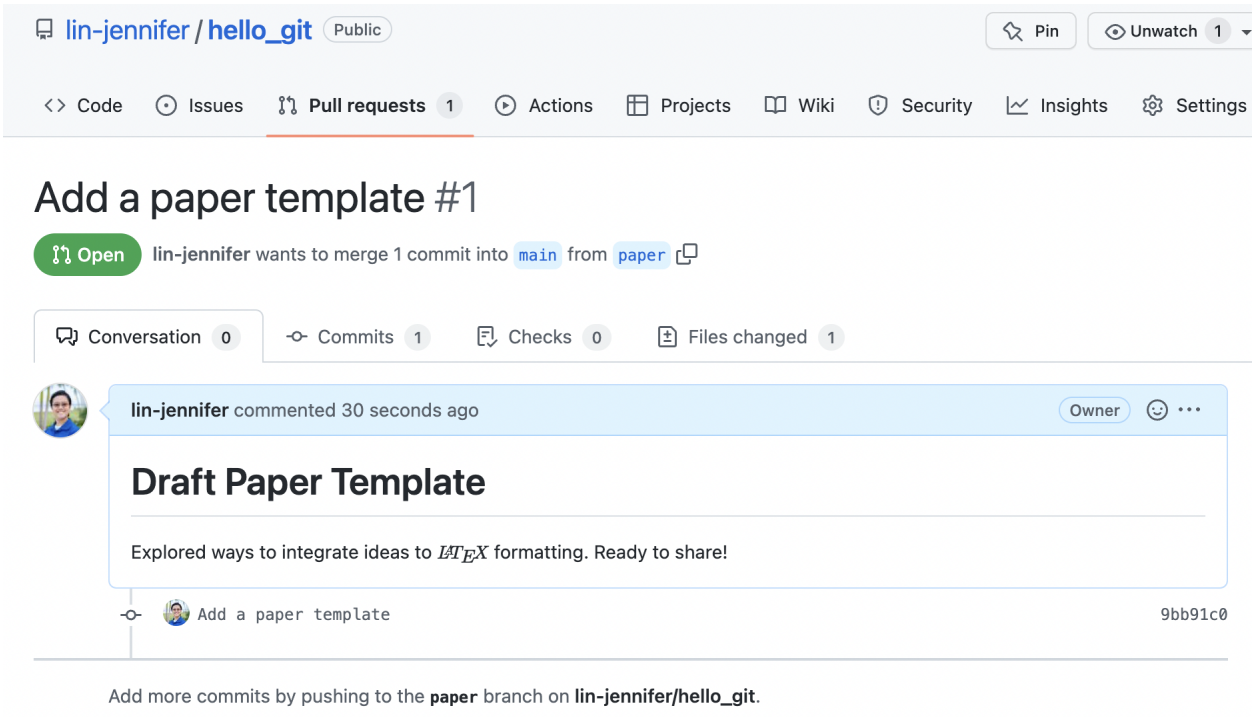
Further down on the page, we can see the version tracking at work. We see that one file has been changed and the number of commits. We also can see the changes in the file itself.



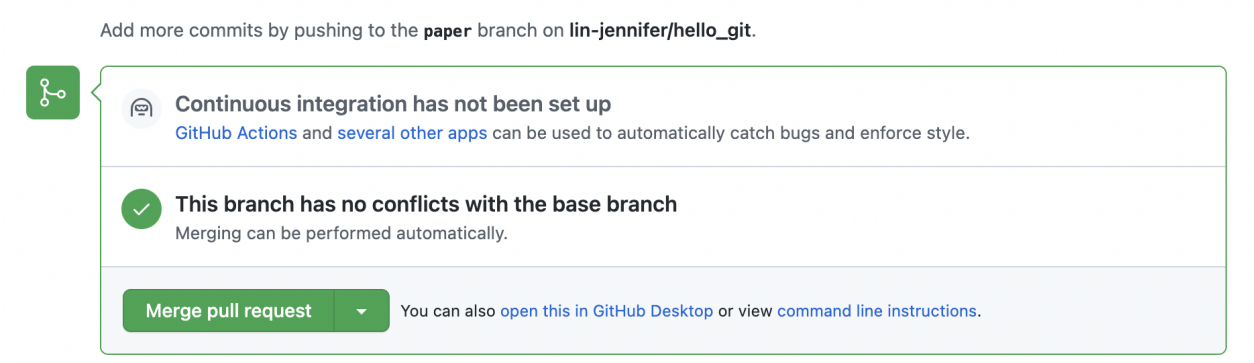
Great. This is essentially what we want. Let's go back up to the comment box on top. It provides you a space to leave a comment, formatted in markdown, so I will. I type in markdown and here is what it looks like in Preview.



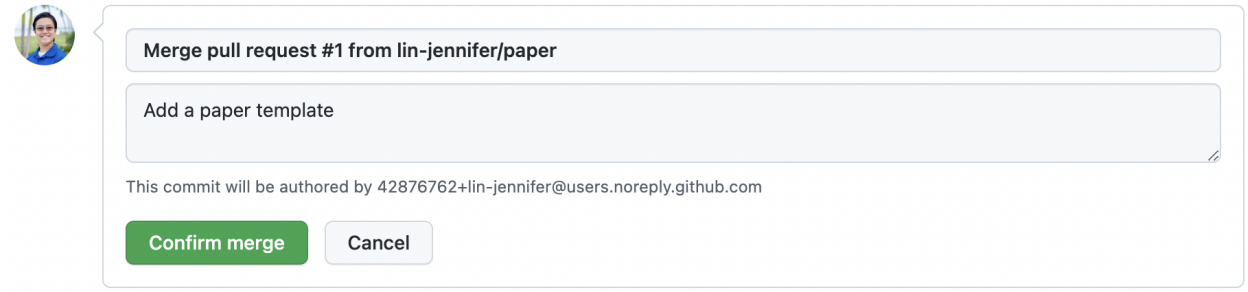
Ok. Now we are ready to click the "Create Pull Request" button. Once we do, you can see that there is now an open pull request and the comments that were inserted from the draft stage are now on top.



When we scroll down a little, we can see that GitHub has automatically told us whether we are good to go with merging the `paper` branch and the `main` branch.

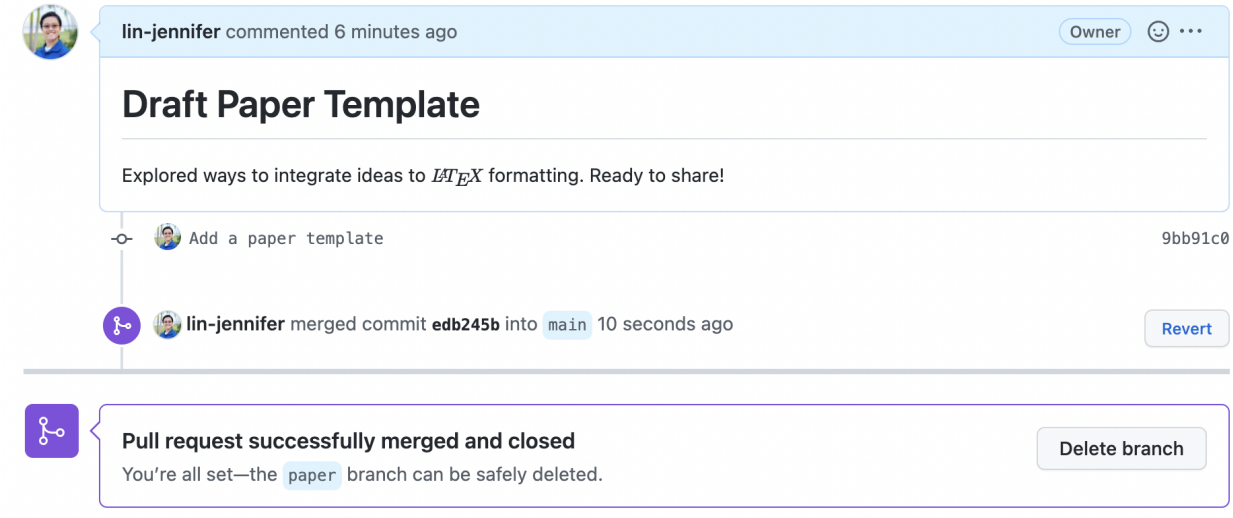


Since we have been given the green light, let's go ahead and do the merge. It will then prompt us to make sure that we are making the right choice. We are! So click "Confirm merge".



Now that the branch has been merged successfully, we are given the option to delete the branch. I will leave that decision to you. You can save or delete, its a personal choice.

But notice that once you confirm the merge, you just made a commit to the `main` branch. Remember, this means that the paper folder is in the `main` branch online but it is not on your `main` branch on your computer.



Let's go out to the terminal to fix this. Using `git checkout main` and `git pull` we can get the entire repository up to date on the local version.

```
(base) jenniferlin@Jennifers-iMac hello_git % git checkout main
Switched to branch 'main'
Your branch is up to date with 'origin/main'.
(base) jenniferlin@Jennifers-iMac hello_git % git pull
remote: Enumerating objects: 1, done.
remote: Counting objects: 100% (1/1), done.
remote: Total 1 (delta 0), reused 0 (delta 0), pack-reused 0
Unpacking objects: 100% (1/1), 634 bytes | 634.00 KiB/s, done.
From https://github.com/lin-jennifer/hello_git
   df4dee1..edb245b  main       -> origin/main
Updating df4dee1..edb245b
Fast-forward
 Paper/Paper.tex | 39 ++++++++++++++++++++++++++++++++++++++++
 1 file changed, 39 insertions(+)
 create mode 100644 Paper/Paper.tex
(base) jenniferlin@Jennifers-iMac hello_git %
```

Finding an Older Version

Now that we merged the paper to the `main` branch, everyone on the team can see it as the official draft. Now, suppose one of your co-authors goes in to make some edits but you don't want those changes. You and the team decide to revert to a previous version of the file. Here is how we do it.

NOTE that reverting to a different version of a file reverts the ENTIRE repository. So if you commit multiple files under one commit, you WILL revert on ALL of those files. *Use this step WISELY!!!*

To start, first, let's change the paper, compile it and commit the revisions. As an aside, remember that when you compile LaTeX documents, there are a host of auxiliary files that you do not need. But there is the PDF file that you need. Notice how `.gitignore` treats it.

```
(base) jenniferlin@Jennifers-iMac hello_git % git status
On branch main
Your branch is up to date with 'origin/main'.

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working directory)
        modified:   Paper/Paper.tex

Untracked files:
  (use "git add <file>..." to include in what will be committed)
        Paper/Paper.pdf

no changes added to commit (use "git add" and/or "git commit -a")
(base) jenniferlin@Jennifers-iMac hello_git % git add .
(base) jenniferlin@Jennifers-iMac hello_git % git commit -m "Modified paper te
mplate"
[main 29b0fd8] Modified paper template
 2 files changed, 4 insertions(+), 5 deletions(-)
 create mode 100644 Paper/Paper.pdf
(base) jenniferlin@Jennifers-iMac hello_git % git push
Enumerating objects: 8, done.
Counting objects: 100% (8/8), done.
Delta compression using up to 8 threads
Compressing objects: 100% (5/5), done.
Writing objects: 100% (5/5), 42.68 KiB | 42.68 MiB/s, done.
Total 5 (delta 2), reused 0 (delta 0), pack-reused 0
remote: Resolving deltas: 100% (2/2), completed with 2 local objects.
To https://github.com/lin-jennifer/hello_git.git
   edb245b..29b0fd8  main -> main
(base) jenniferlin@Jennifers-iMac hello_git %
```

Here, we are only interested in the `.tex` file and the `.pdf` output and those are the only two files that we are committing. Excellent.

Now, let's make another change to the `.tex` file and commit that.

```
(base) jenniferlin@Jennifers-iMac hello_git % git status
On branch main
Your branch is up to date with 'origin/main'.

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working directory)
        modified:   Paper/Paper.tex

no changes added to commit (use "git add" and/or "git commit -a")
(base) jenniferlin@Jennifers-iMac hello_git % git add .
(base) jenniferlin@Jennifers-iMac hello_git % git commit -m "Change Title"
[main 1254ebc] Change Title
 1 file changed, 1 insertion(+), 1 deletion(-)
(base) jenniferlin@Jennifers-iMac hello_git % git push
Enumerating objects: 7, done.
Counting objects: 100% (7/7), done.
Delta compression using up to 8 threads
Compressing objects: 100% (4/4), done.
Writing objects: 100% (4/4), 387 bytes | 387.00 KiB/s, done.
Total 4 (delta 2), reused 0 (delta 0), pack-reused 0
remote: Resolving deltas: 100% (2/2), completed with 2 local objects.
To https://github.com/lin-jennifer/hello_git.git
   29b0fd8..1254ebc  main -> main
(base) jenniferlin@Jennifers-iMac hello_git %
```

But suppose that the group wants to go back to the old version, which is the one before we made this title change. Let's find where that version is, in the grand scheme of things. We can use `git log` for that.

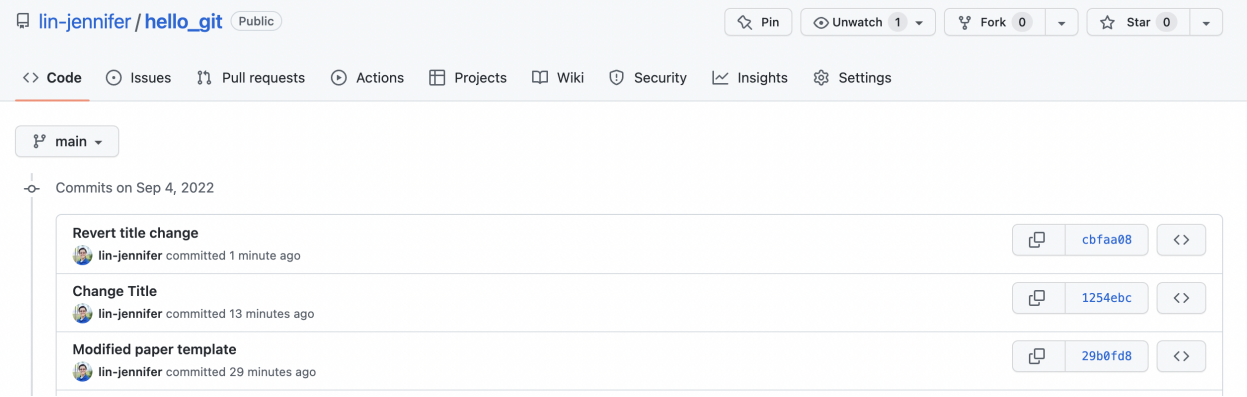
```
(base) jenniferlin@Jennifers-iMac hello_git % git log
commit 1254ebc7c44114115bdc551b1e17822ebc845f1a (HEAD -> main, origin/main, orig
in/HEAD)
Author: lin-jennifer <jennifer.lin16@ncf.edu>
Date:   Sun Sep 4 20:41:38 2022 -0500

    Change Title

commit 29b0fd851239cf478cf44905ccd1f27894642a8e
Author: lin-jennifer <jennifer.lin16@ncf.edu>
Date:   Sun Sep 4 20:25:18 2022 -0500

    Modified paper template

commit edb245bd6b4c222ba03d6917cabdefd1d7986b7d
Merge: df4dee1 9bb91c0
Author: Jennifer Lin <42876762+lin-jennifer@users.noreply.github.com>
Date:   Sun Sep 4 20:10:07 2022 -0500
```

Here is the one we want to revert to:

```
commit 29b0fd851239cf478cf44905ccd1f27894642a8e
Author: lin-jennifer <jennifer.lin16@ncf.edu>
Date:   Sun Sep 4 20:25:18 2022 -0500

    Modified paper template
```

Notice the long commit code. This is the unique identifier for each version of the repository. To go back to any commit, we first need to copy this code. Then, get out of the log by pressing `q` on the keyboard. Finally, use `git revert + commit code` to revert the changes. Here is where the Mac gets a bit tricky. When you run Revert, it will prompt you to provide a commit message. But Terminal can freeze. Get out of terminal, reenter, use `cd` and point the terminal to your git repository and use `git status` to commit the changes.

You can go to the commit log on the GitHub website or the file itself to see your changes undone.

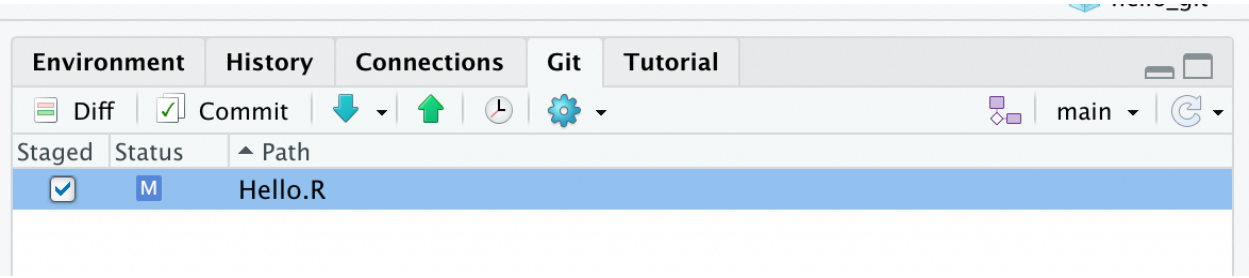


Git Point and Click

If the whole Terminal and Web App is not your taste, you have other options to interact with `git`. Most text editors have their connections to `git` that operate quite similarly as the Terminal but are more point and click friendly.

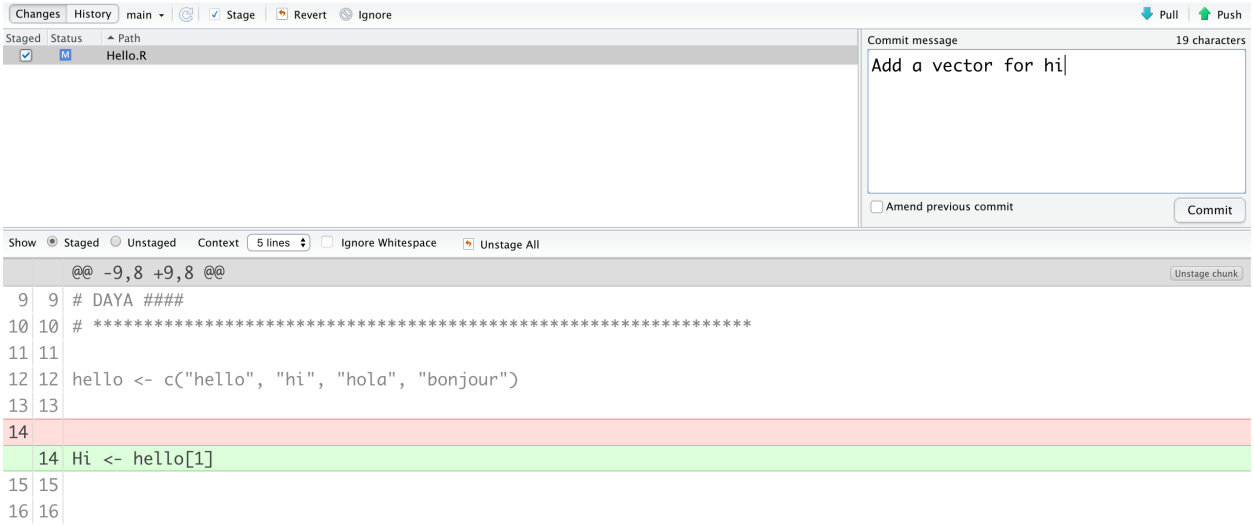
GitHub and R Studio

One of the ways to point and click is with R Studio. In our example, we created an R project in the repository. We can use R Studio to demonstrate it's point and click capacities. Let's revisit the R script and make some changes.

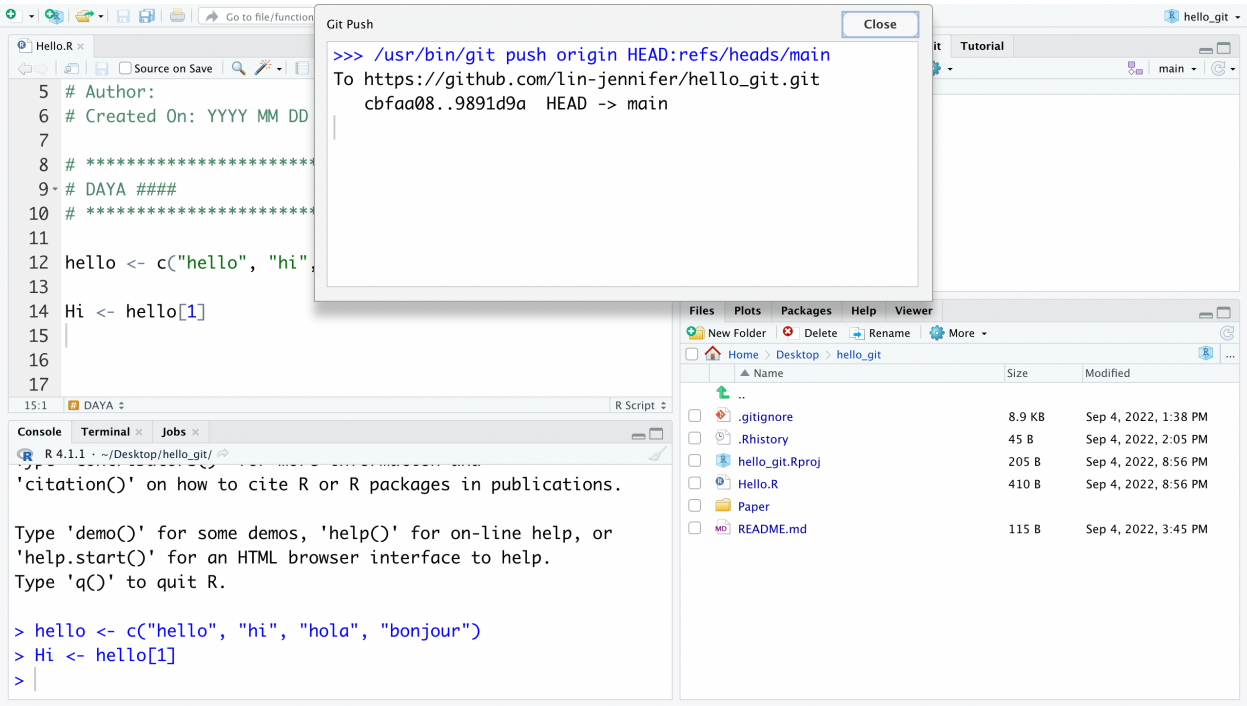


Using the Git tab on the upper right hand corner, we can make commits to Git. NOTE that this only works if you open an R project in a folder that is a GitHub repository.

We can commit by hitting the "Commit" button and a window will pop up and will ask for a commit message, while showing the changes that were made.



We can hit "Commit" and close the window. To push, press the green arrow that points up on the same menu bar where you found "Commit". Here is that result:



To pull, the blue down arrow is what you would need. Notice that there is also a dropdown for your branches. Now, we are on `main` but if you click that, you can also see your other branches.

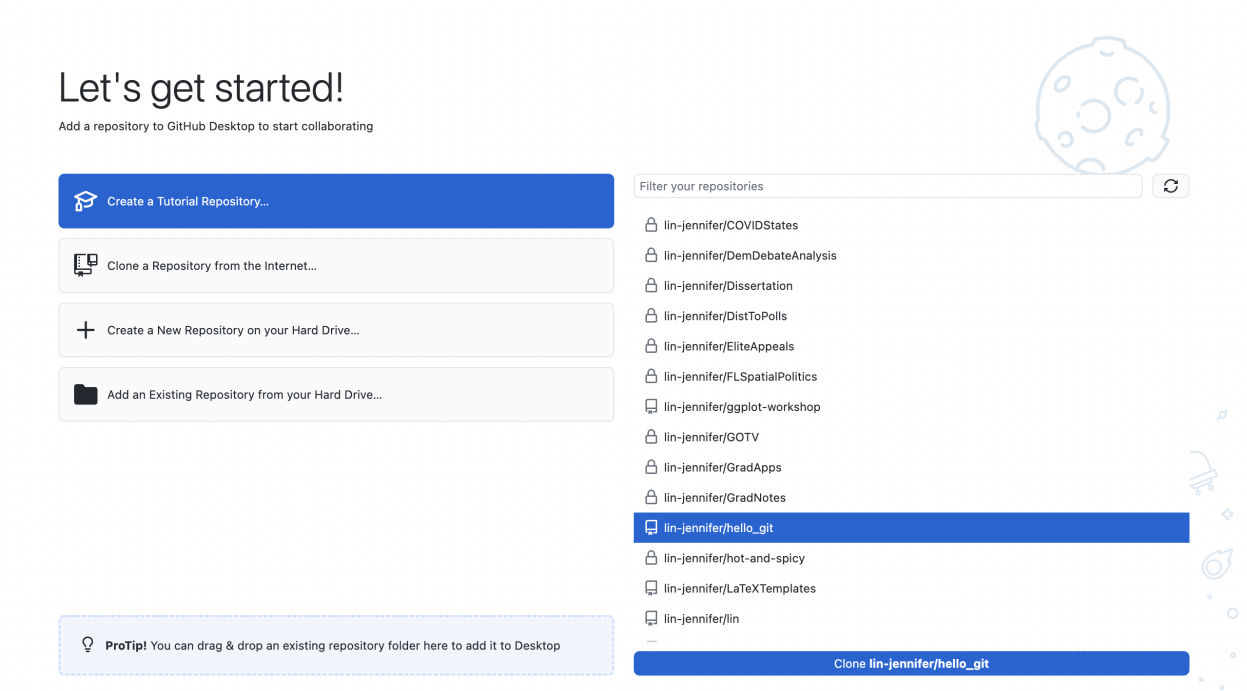
GitHub Desktop

Besides that, there is an app called GitHub Desktop that is even more point and click than the R version. It is very user friendly.

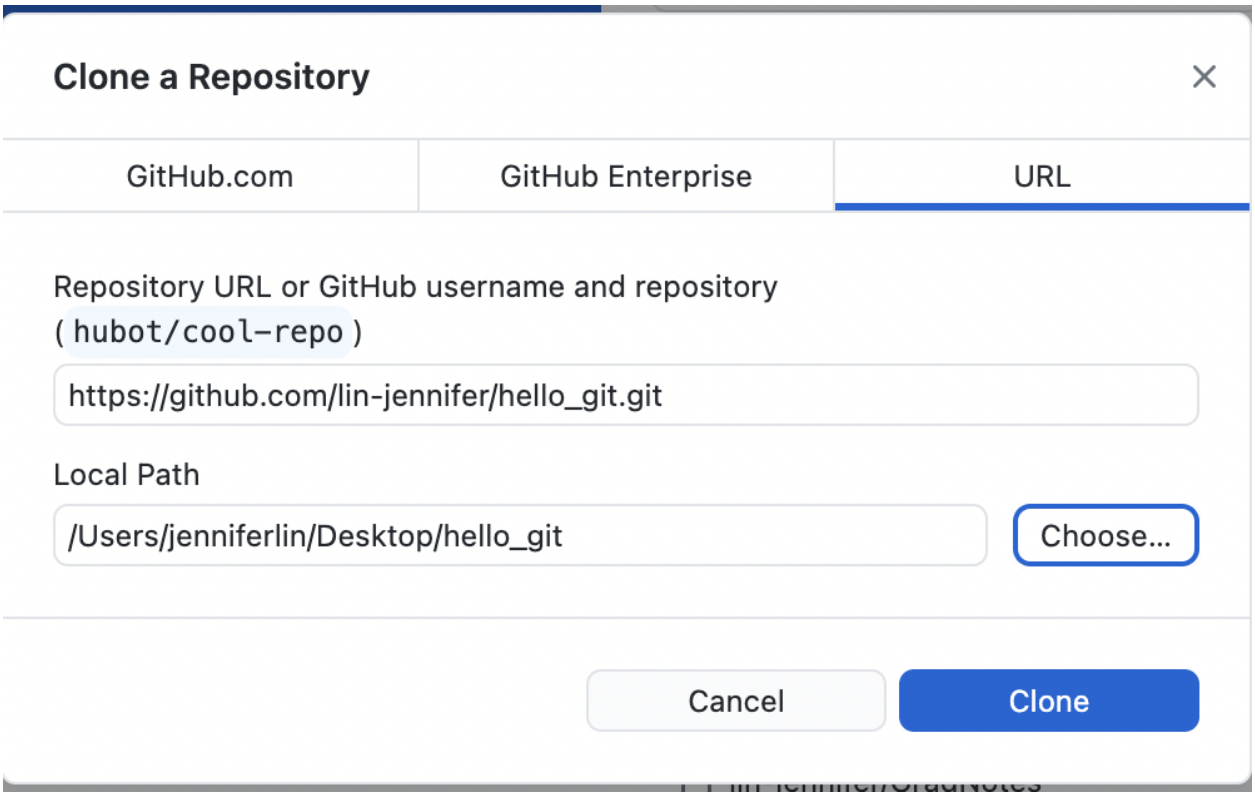
So let's open up GitHub desktop. Once you log in, you will see options to get started with creating your own repository, among others. Since I already have a repository created and working from before, I am just going to clone it in.[3] Notice that you need to clone it on the Desktop App in order to use GitHub Desktop. Most of the repositories on the list in the opening page live on my computer already but I cannot integrate them with the Desktop unless I clone them on the Desktop app.

To clone, select the repository you want to clone. Here, I will use the `hello_git` one that we worked on throughout this demonstration.

[3]My GitHub is rather public with many private repositories but at least this demonstration let's you see how much I have used GitHub over the years. All my projects and course notes are all included in here.

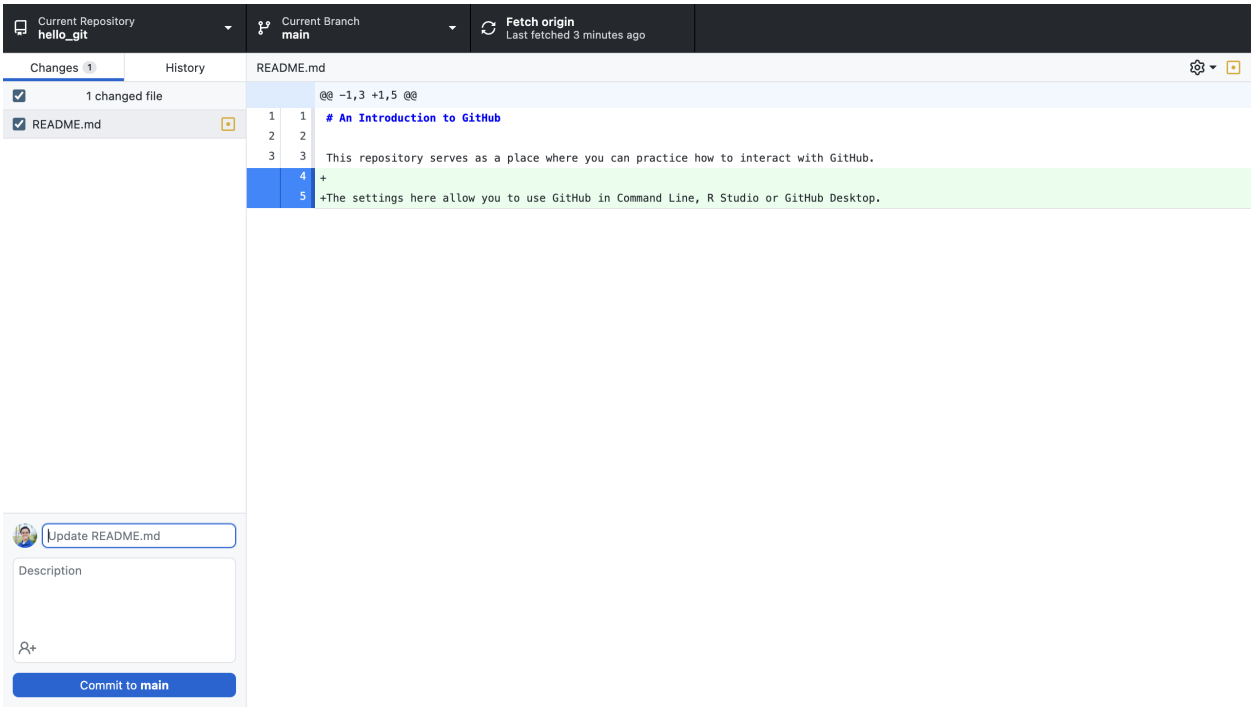


To clone, you wee the same URL that we copied in the `git clone` demonstration above. As we did above, we need to pick a file path. The default is your Documents folder, but I don't want that. I want my Desktop and so I will indicate as such.

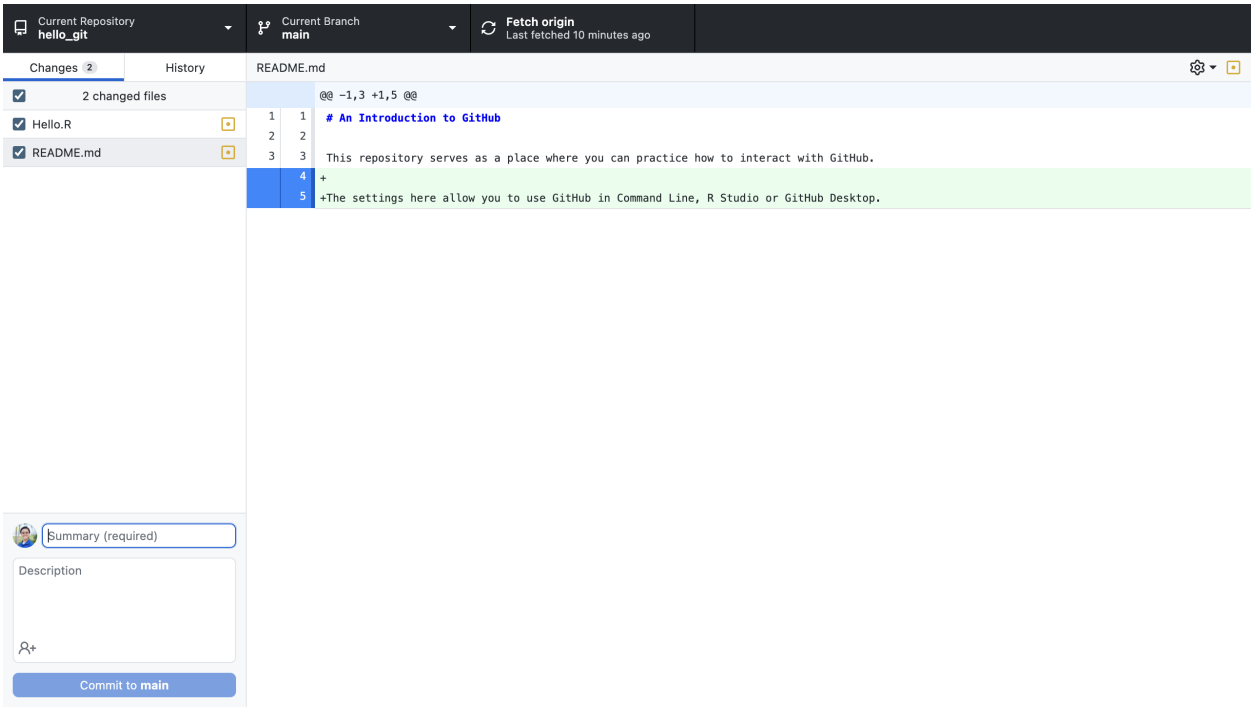


Now, when you go out to your destination, you will see the file cloned there if it is not there

already. I am going to open up the `hello_git` folder and make a change. I will add another note to the `README.md` file. It does not matter what you add or change. When you make those changes and save them to your computer, inside the folder for the repository, GitHub Desktop will immediately recognize it and show that there is a change to be committed.

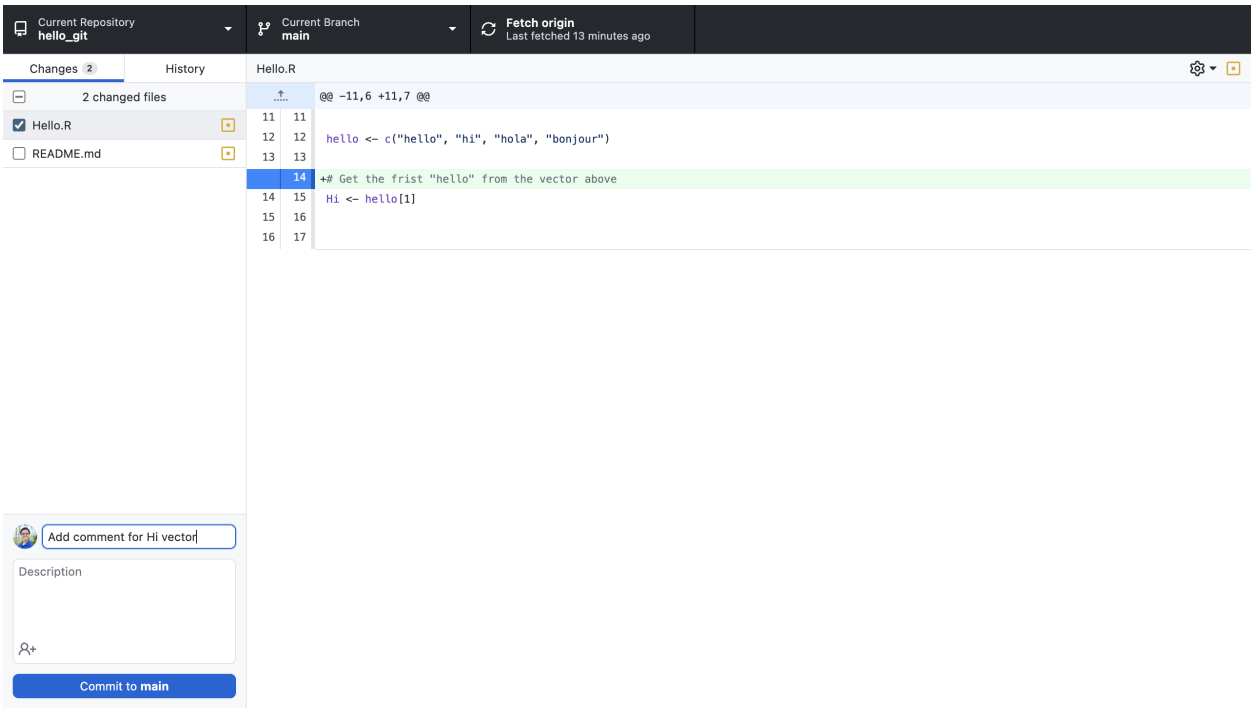


Immediately, you will see a few sections that might look familiar from earlier sections. There is a list of the files that changed, which is similar to `git status`, information on what changed, similar to the diff tool on the GitHub website, and a window on the bottom left hand corner for you to leave a commit message. I am going to hold off on the commit for now and I am going to open up the R script in this folder and make another change. This is to demonstrate separate adds with separate commit messages, as I did in previous sections.



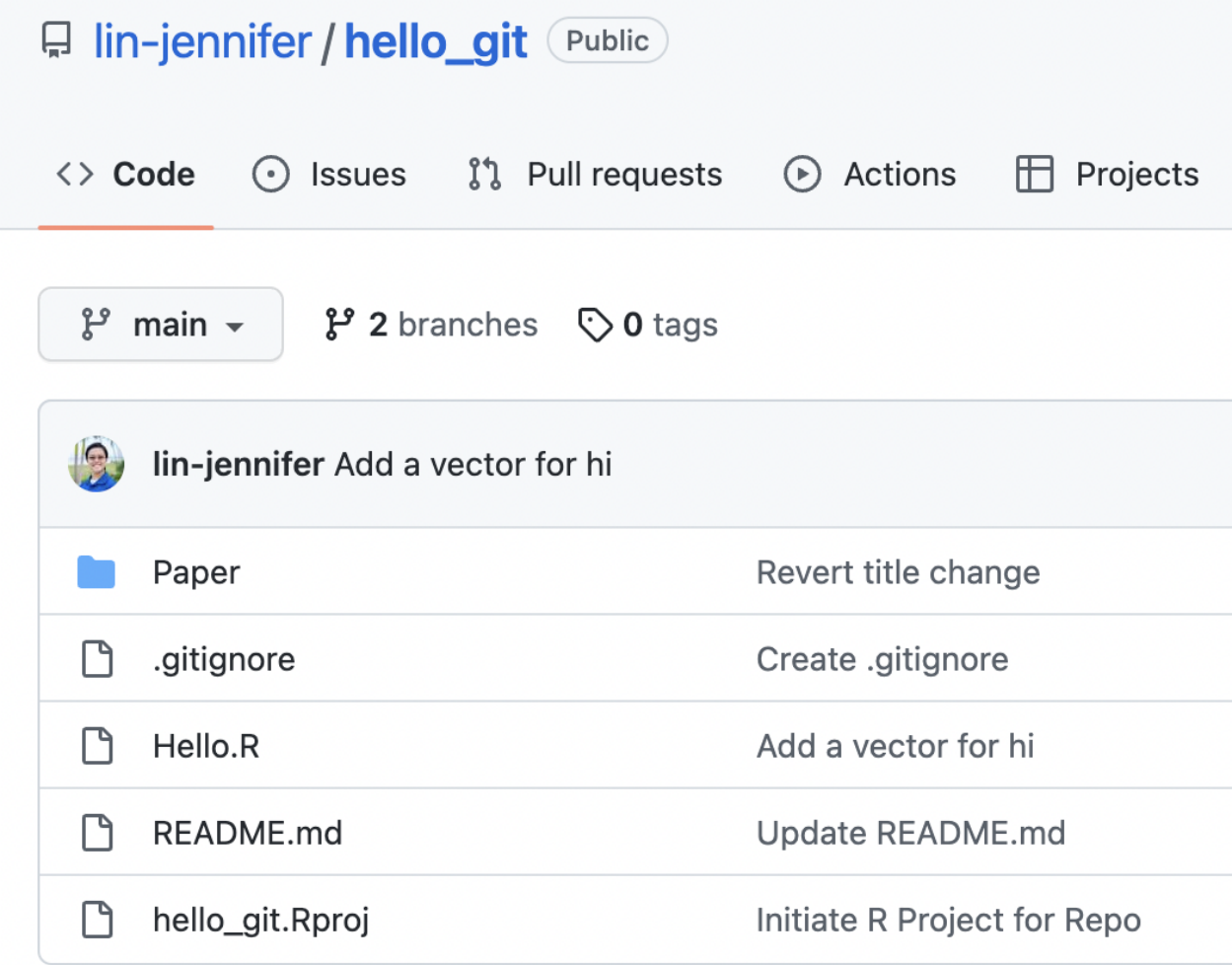
When I had just updated the README, I get a default commit message taht said "Update README.md". Now, I no longer get a default message. Also, notice that both files are checked. This is the same as `git add .` in the earlier sections. I want to change that. Let's commit the changes on the R file first and the README second.

To do that, I am going to un-check the README and just look at the R script. I will write a commit message that is not the default "Update Hello.R" and press "Commit to Main".

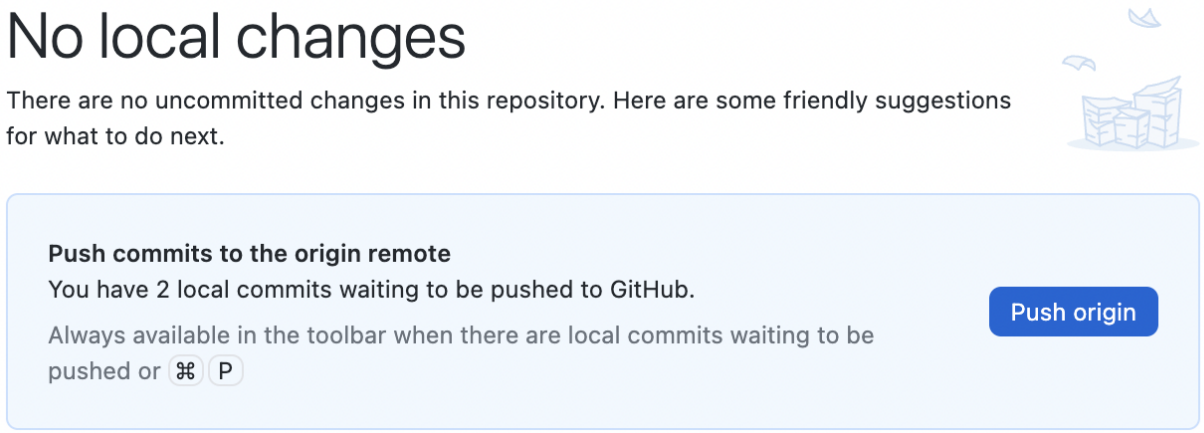


Now I will commit the second using another custom message ("Add Note on GitHub Possibilities").

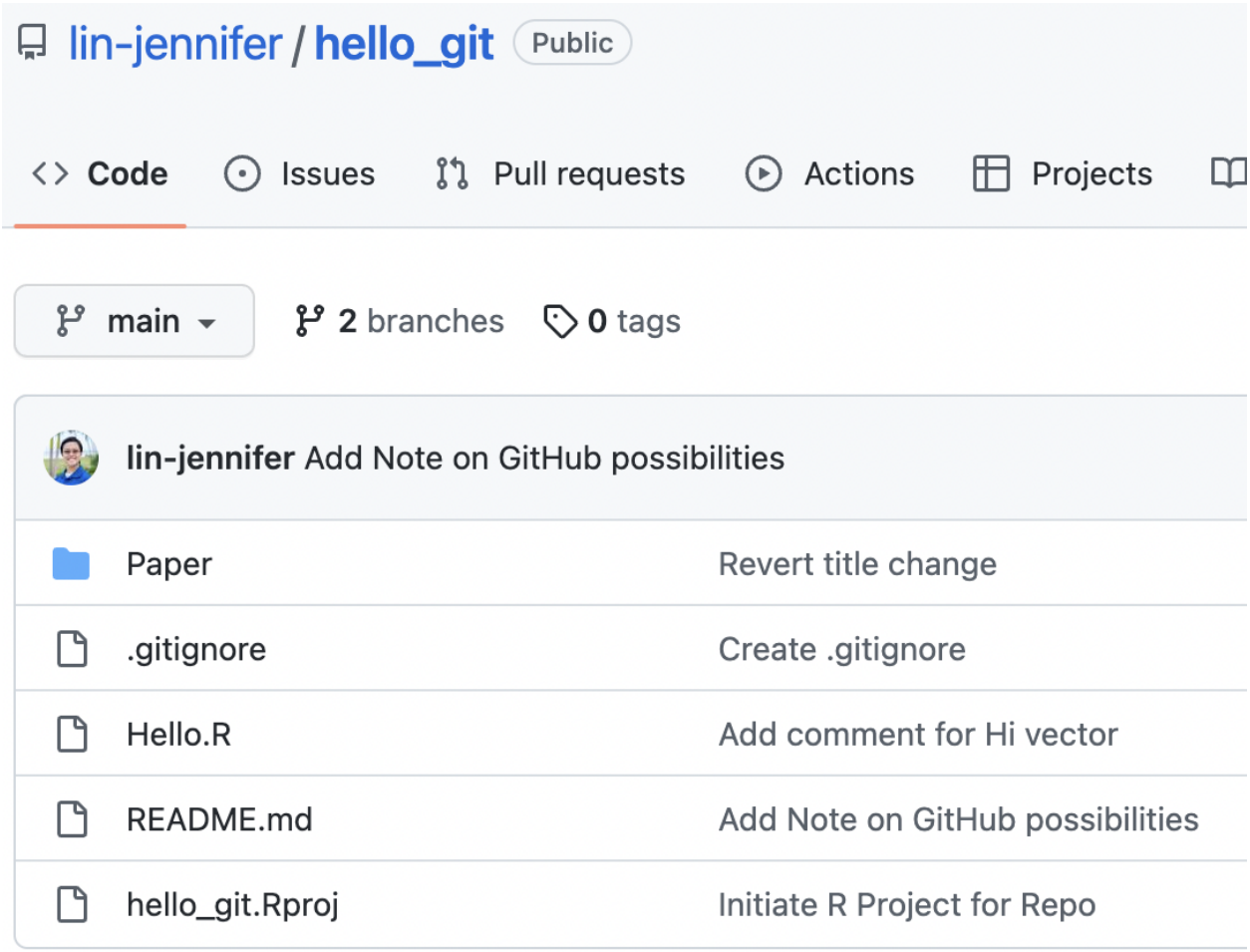
To see the results, let's take a detour to the GitHub Web App.



Notice the commit messages. The most recent one is always the one next to your account name. I should have "Add Note on GitHub Possibilities" next to my name, but I do not. This means that something did not push. To Push, go to GitHub Desktop and finish adding all of your files. Once you do, you will see the following:



Click the blue button to push. Now, let's see the result on the Web App.



Much better! Notice that both of the commit messages that we wrote using GitHub Desktop added with one push. This is possible to do with command line and with R Studio as well.

Concluding Thoughts

`git` is a powerful tool. It can potentially save you some time at some point, and it can also help you save some computer storage space with all the versions that you are creating. However, like all powerful tools, `git` and GitHub are not useful if you don't use it. Committing and pushing, and writing good commit messages takes time and practice.

The major commands of `git pull`, `git status`, `git add`, `git commit -m "Message"`and `git push` will almost become second nature if you use it enough. In this tutorial, I showed you the three main methods that people use to interact with GitHub and `git`. This is to say, too, that if you wanted the main highlight from this tutorial, these five commands will serve you well in the long run if you become familiar with it. And, this is also to say that you can have your own preferences for what works for you. You are managing your own workflow after all, so you should not work to the tastes of others.

If, after reading this tutorial, you are not finding the version tracking and comparison tools that `git` has to offer to be appealing, then perhaps, I can point you to some references that might convince your otherwise. You might still be asking "Why Bother?" My answer is "why not?" But, for a more elaborate answer, I would recommend checking out Kieran Healy's book *A Plain Person's Guide to Plain Text Social Science*. In here, he covers version control, plain text editors, and overall, why you should bother with plain text tools for your research workflow.