Introduction to Git and GitHub

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What is git?

- In technical terms, git is a distributed version control system that is often used to keep track of software development.
- In not so technical terms, it is a personal archivist/time machine that keeps track of all the changes you make in a (writing or data analysis) project.
- Normally, when you save progress on an analysis, the old version of that analysis is lost.
- With git: you continue to save your progress, but you also tell git to remember intermediate states by 'committing' to all the changes that have happened.

Why should I use git?

- Git allows you to not only save your work, but to save different versions of your work through time.
- Imagine that you were working on writing up an analysis, but wanted to save a version of your work at the end of the day every day so that you could go back to it at any time.
- You would likely have a series of files that looks like this at the end of three days:

```
audpc_2016-05-25.Rmd
audpc_2016-05-26.Rmd
audpc_2016-05-27.Rmd
```

Why should I use git?

After three days, it's manageable, but after 20 days, it's difficult to remember what you did between day 6 and day 7. With git, you only need one file:

`audpc.Rmd`

Because you've been recording your progress with git, you not only have access to all the different versions of your files, but you also have a sensible log of everything that's been done to the file. Here's what the output of one such `git log` looks like:

Why should I use git?

```
commit b8392d0b47528091d4b1a4883d677ed02bdbbe32
Author: Zhian Kamvar <kamvarz@science.oregonstate.edu>
Date:   Wed May 25 14:04:11 2016 -0700

    Make figure for publication

commit e3bb7501bf09d597532007b02a8a4fb5bff8ca15
Author: Zhian Kamvar <kamvarz@science.oregonstate.edu>
Date:   Tue May 24 13:41:48 2016 -0700

    Calculate audpc

commit 8379234d4c70367dc08d52eabddfc02ef67244fe
Author: Zhian Kamvar <kamvarz@science.oregonstate.edu>
Date:   Mon May 23 13:05:05 2016 -0700

    Add field data and packages
```

Explanation

- In this log, you can see three entries on three consecutive days with a message associated with it
- We can see that on Tuesday, data and packages were added, Wednesday, the AUDPC calculation was performed, and on Thursday, a figure was created.
- With git, if a file is deleted or you edited it in a way that makes no sense, it's easy to recover, giving you the freedom to try out new things without risk of losing all of your work.

How do I install git?

- This process differs depending whether or not you're on Windows, OSX, or Linux.
- Luckily for you, descriptions for all of these have been consolidated into one easy to read document by Jenny Bryan at UBC: http://happygitwithr.com/install-git.html
- Please go there and follow the instructions carefully depending on your operating system.
- Note for OSX users, if you don't have Xcode installed, it may take a while. Ensure that you have a good and fast internet connection.

Your first git repository

- Git is usually used on the command line and takes some practice to use effectively
- RStudio has a simple menu that makes it easy to do the most common tasks.
- This part will walk you through, in pictures and words, how to create your first git repository using R and RStudio.

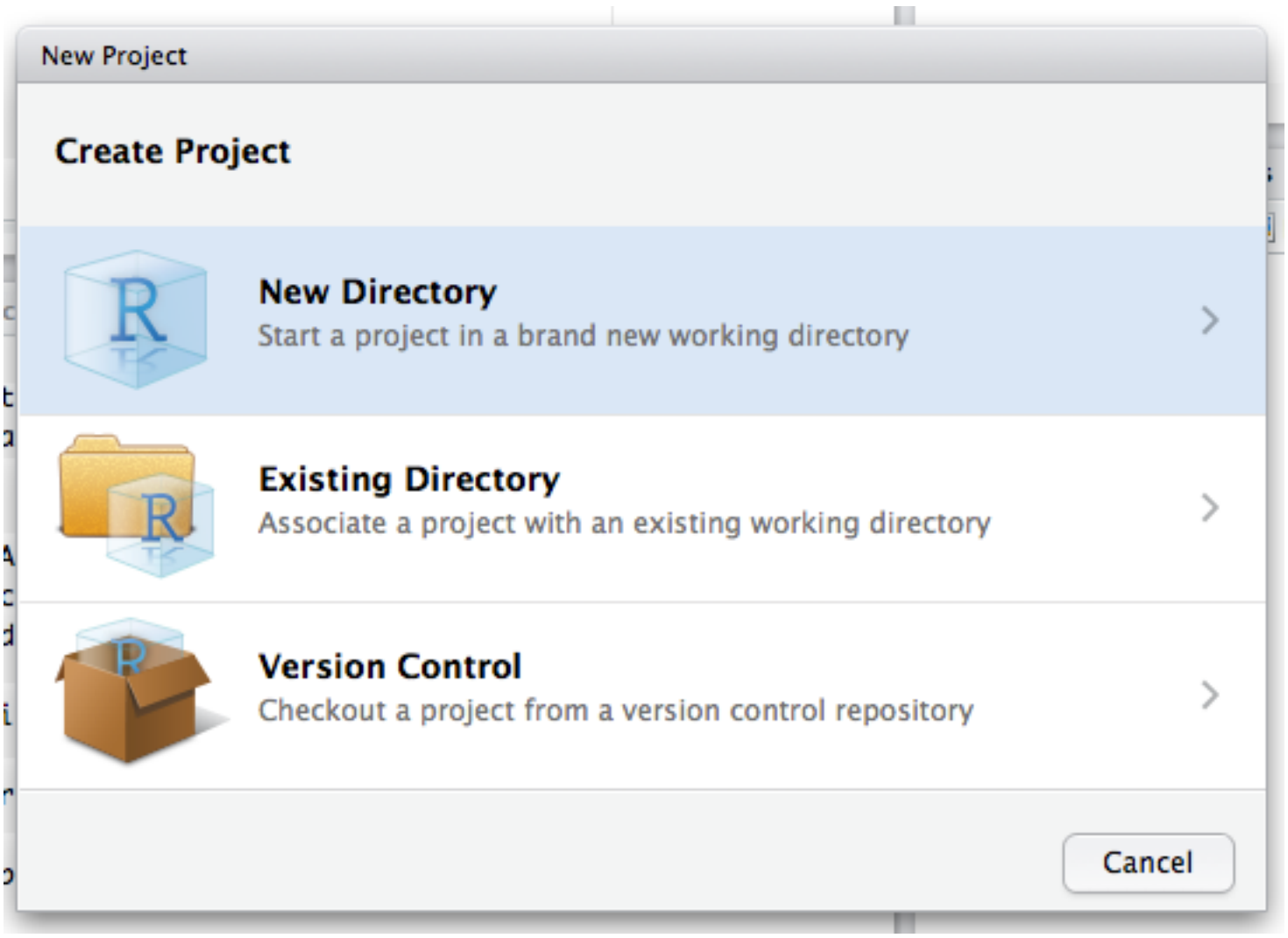
It is assumed that you have correctly set up git and RStudio to talk to each other.

telling RStudio to make a git repository

In this step, we are going to create a new R project in a new folder on your computer and initialize it as a git repository (on the command line, this would be **git init**).

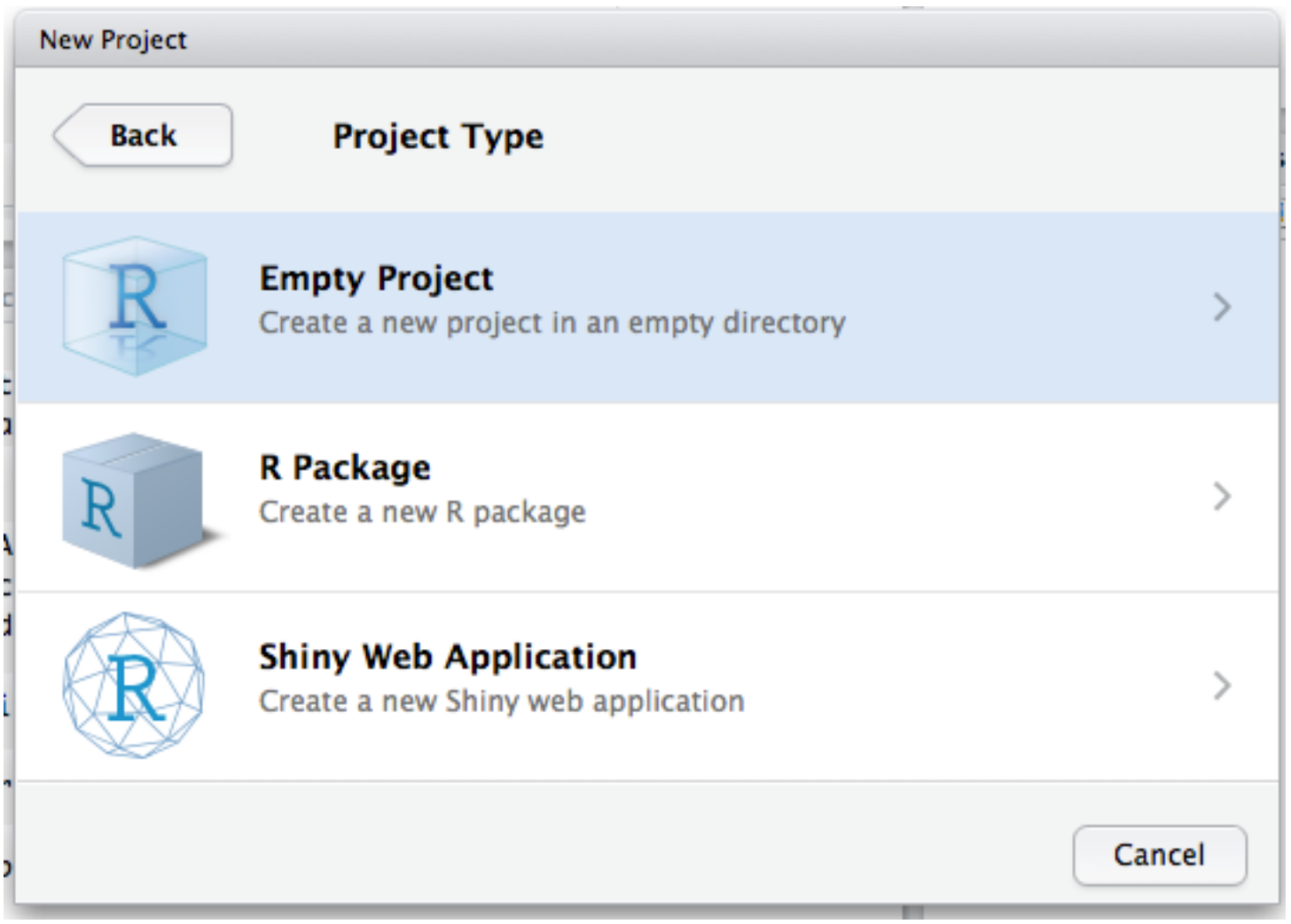
git init: Making a folder into a repository

First thing's first, you should select **File > New Project...** from the menu bar. When you have done that, this window will appear:



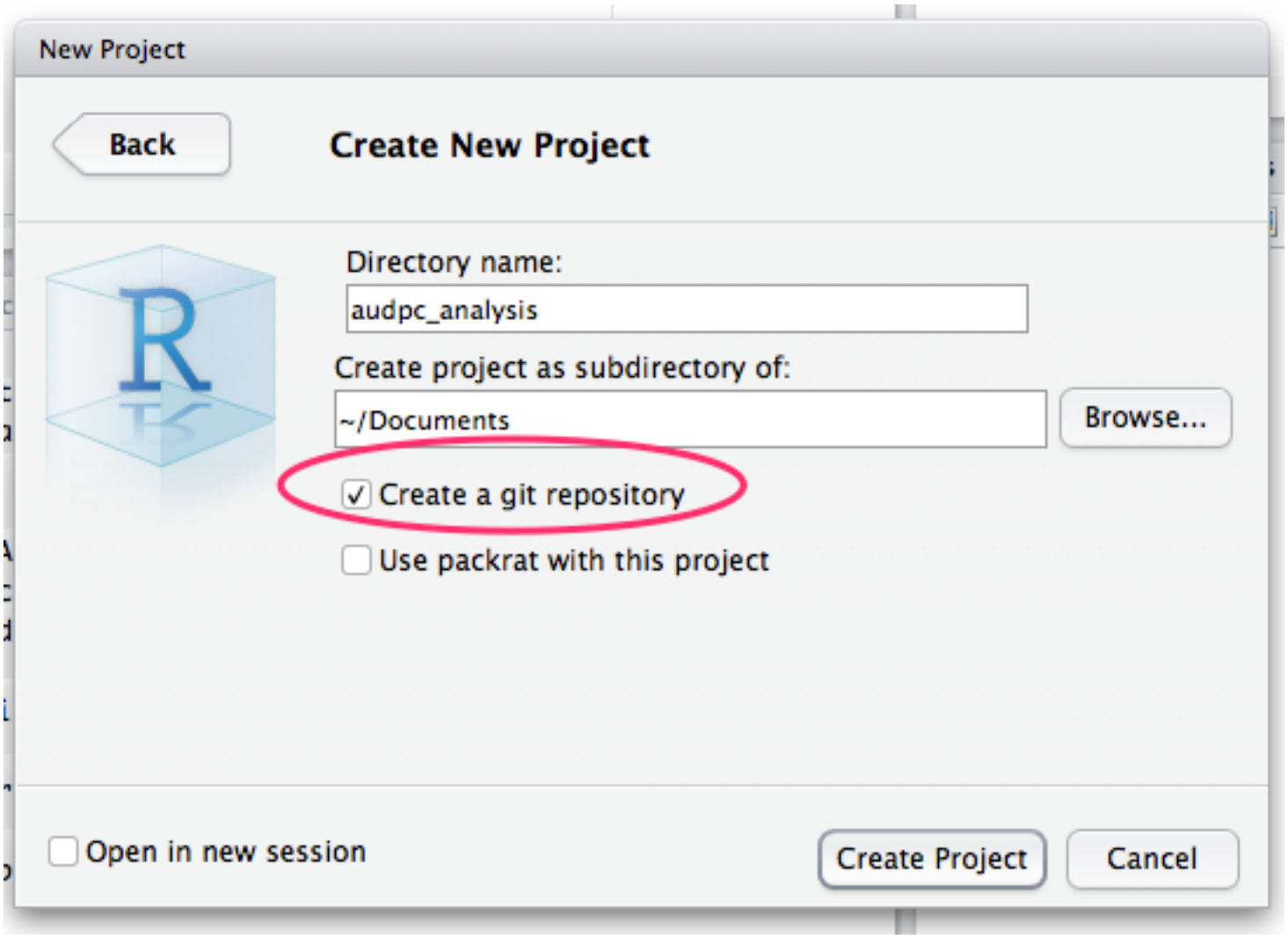
Select **New Directory**. If you already had your analyses and data ready, you would choose "Existing Directory".

Now you should see this window:



Select **Empty Project**.

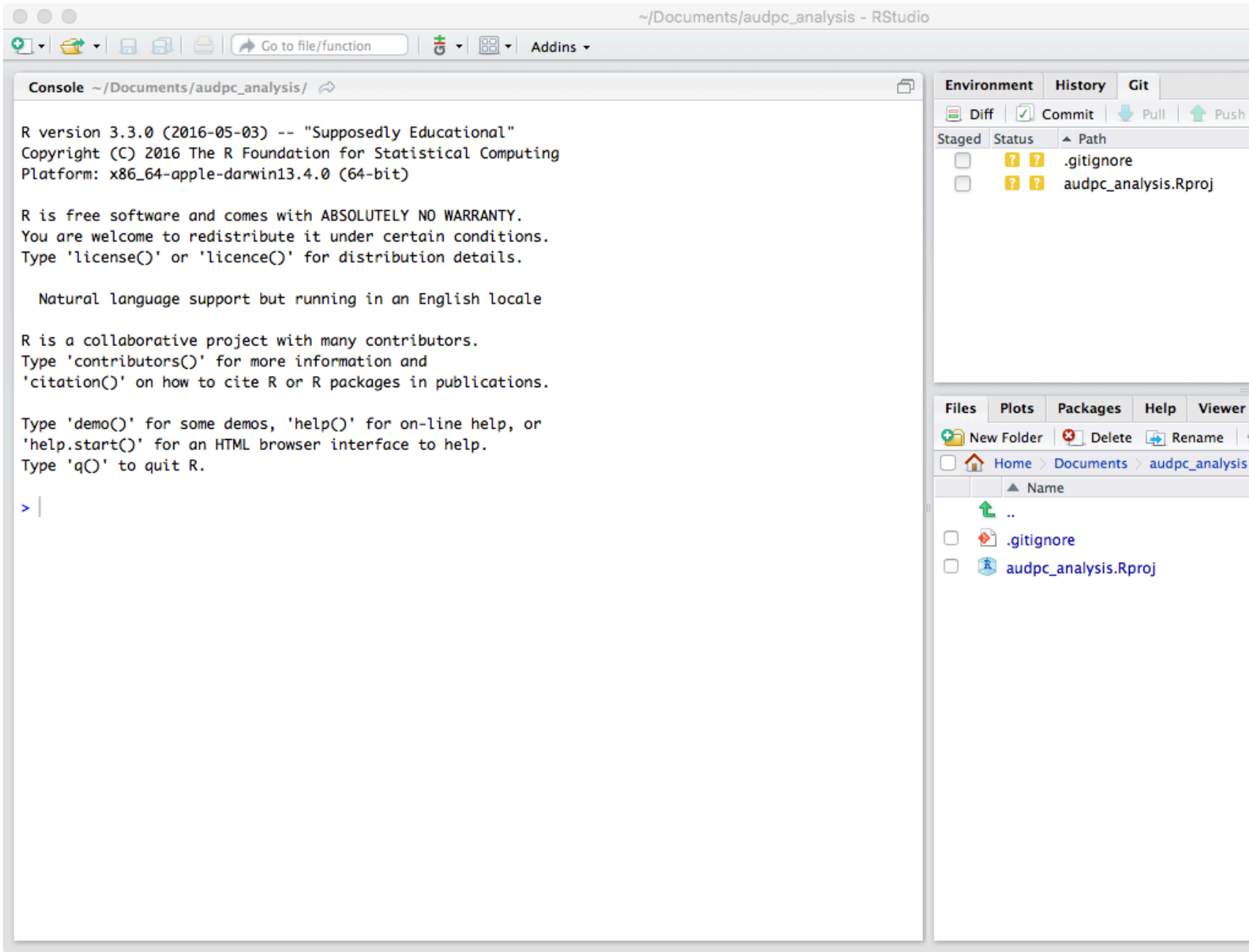
Now you see this window:



If you are unable to check the box labeled Create git repository, make sure that your RStudio is set up with git.

In the Directory Name box, type "audpc_analysis". This will put the folder "audpc_analysis" inside of your Documents folder. The most important part is to make sure that the **Create git repository** box is checked.

Hit the button labeled **Create Project**, the RStudio window will refresh and you should see this:



Now you have your first git repository! On the upper right hand side, you see the git pane.

In it you see that you have two files:

- .gitignore
- audpc_analysis.Rproj

- The file `.gitignore` tells git what it doesn't need to keep track of. By default, these are things like your .Rhistory and .Rdata files.

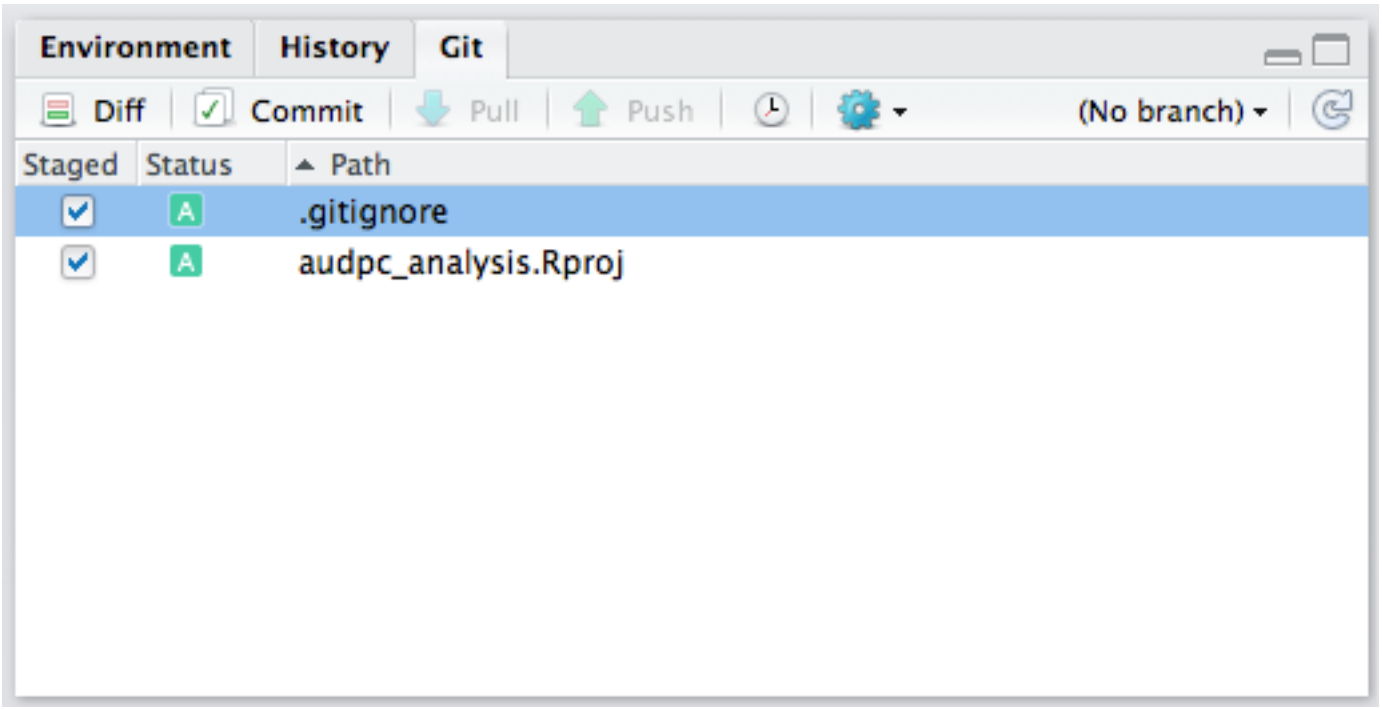
- The file audpc_analysis.Rproj is the file that tells RStudio that you are in an R project and that it should start RStudio in that folder when you have that project open.

Notice, however that there are two yellow blocks with question marks inside of them under a column labeled "Status". This is letting you know that there are files there that git sees, but isn't keeping track of.

To let git know that we want to keep track of these files, we need to add them first with **git add**.

git add: Telling git to keep track of files

Click the check boxes under the "Staged" column and the yellow boxes will change to one green box that says "A" inside:

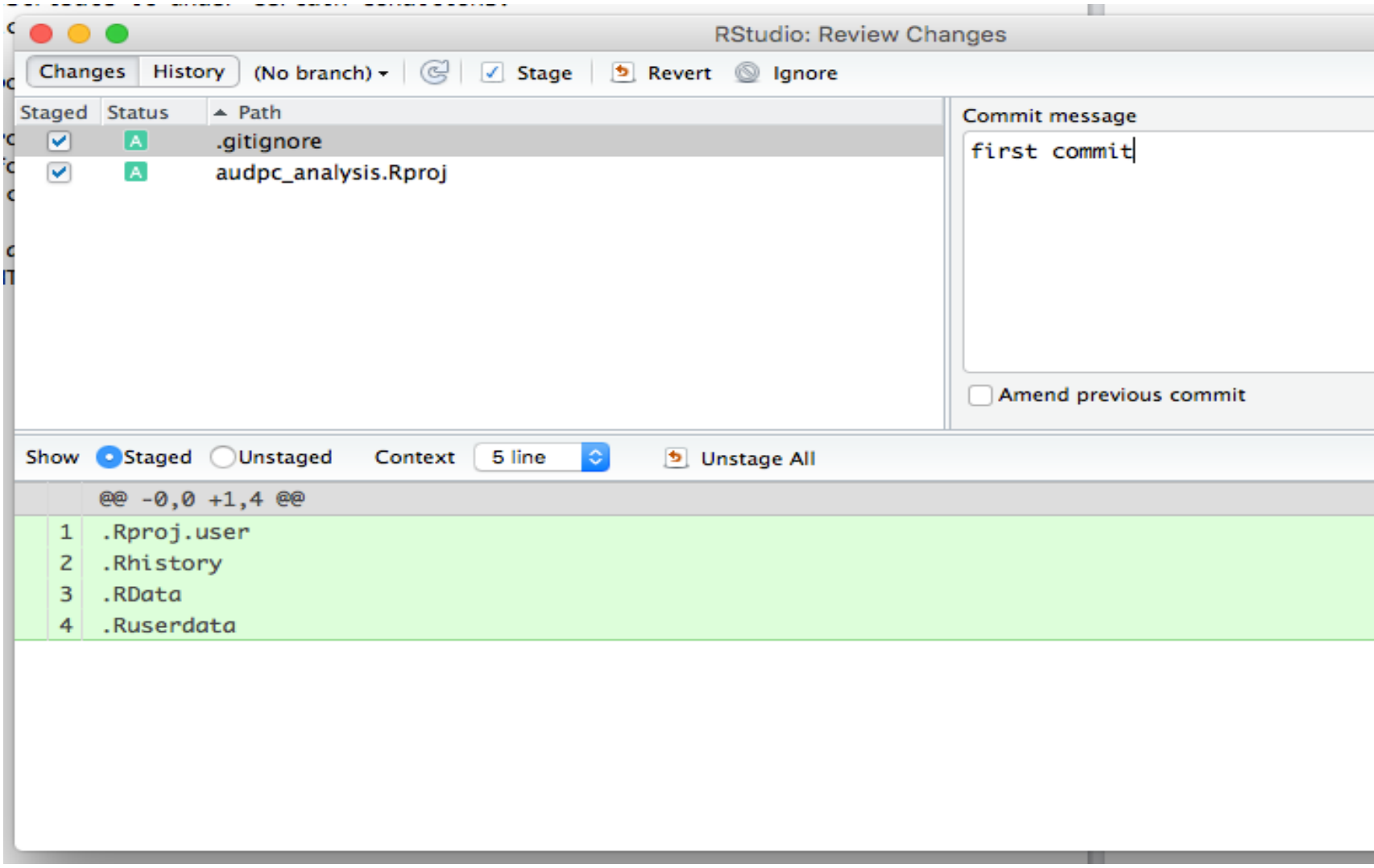


This means that you are telling git that you want to add these files to your repository.

It's important to know that, while you have told git you want to add them, it wants to know that you are serious about adding these files, so it wants you to **commit** to adding these files with **git commit**.

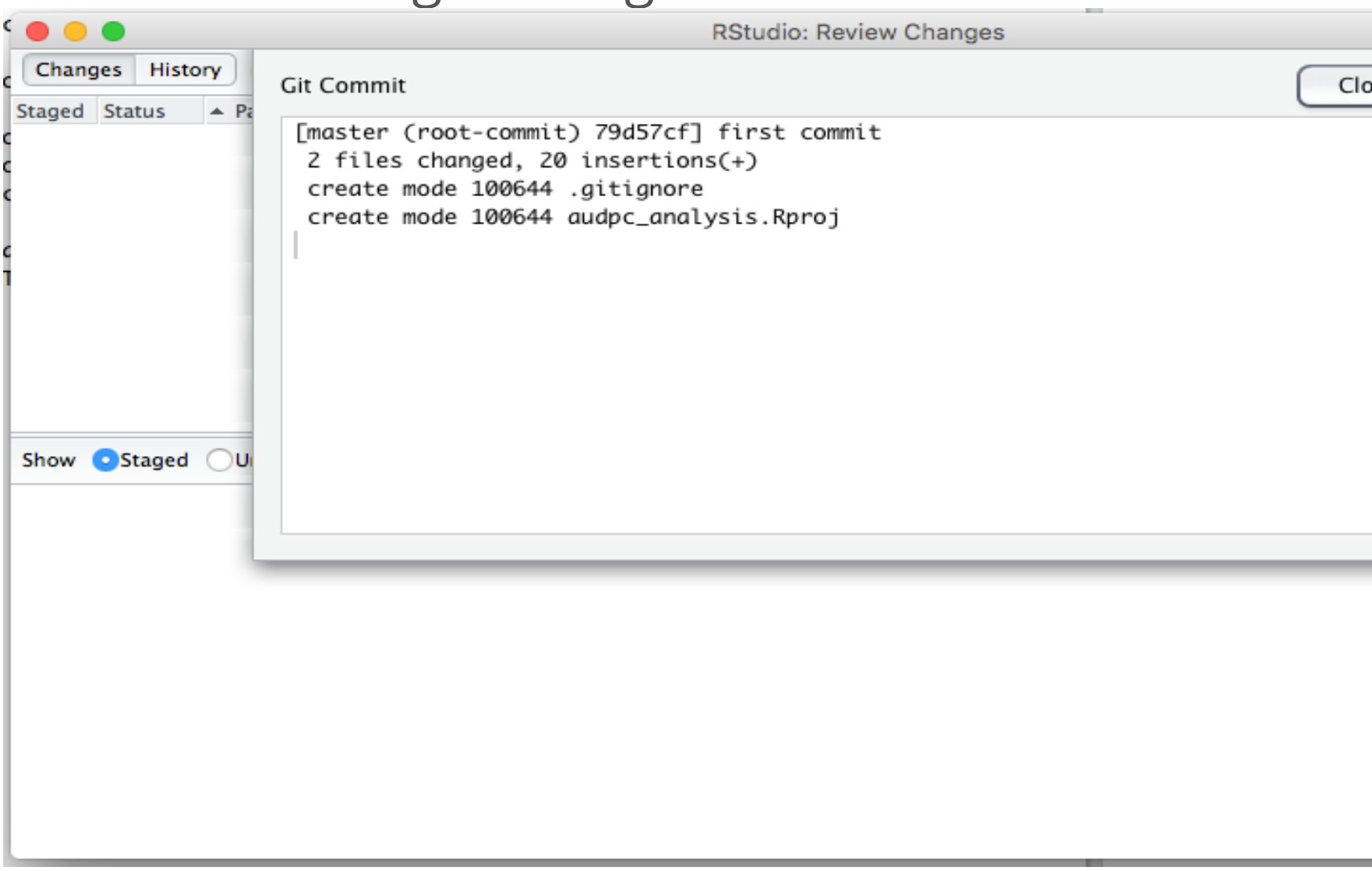
git commit: Saving this point in time

You can commit to adding these files by clicking on the **Commit** button in that pane. When you do, this window will pop up:



Here, you can see what files you will be committing and also the specific parts of the file that have changed. Green lines are those that have been added and red for those that were deleted. We don't see any red here because nothing has been deleted.

In the upper right, you have a message box. For each commit, you should write a message as to why you are making that commit. This allows you to look back through your history and understand why you made the changes you did. Write a message in the box and then click on the button that says **Commit**. You should see the following message:



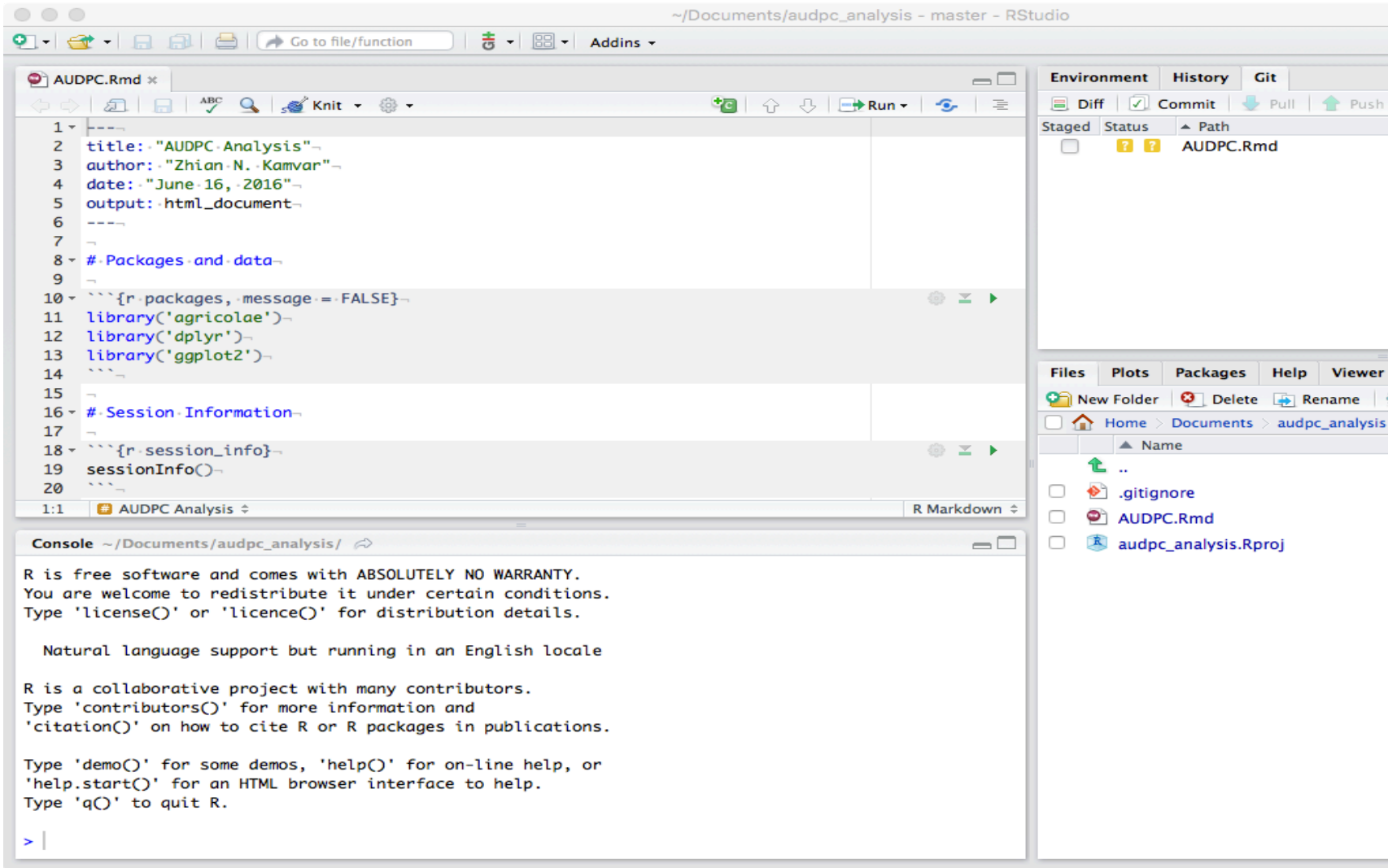
Pro Tip! Commit messages should be like email subject lines: short and to the point. If you want to write more, add a blank line after your message and then write as much as you want (see below).

Now you have your git repository set up with the basic things needed to work with git and RStudio. The next step is to set up your analysis.

Step 2: adding a new Rmd file and making changes

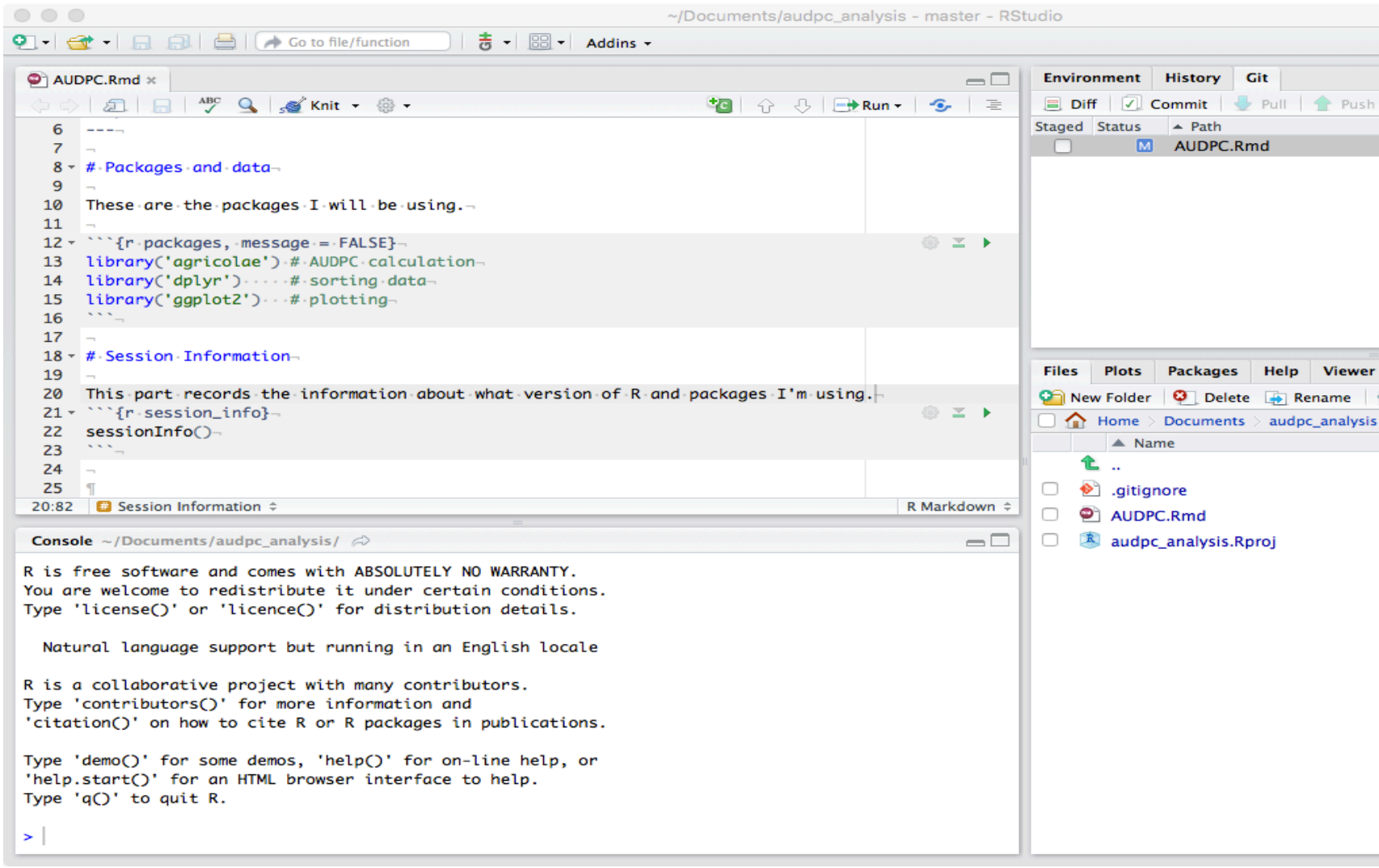
1. Create a new Rmarkdown file by using the menu item **File > New File > R Markdown**
2. Give it a title like "AUDPC Analysis"
3. Save it in your folder as "AUDPC.Rmd"
4. Delete the demo script
5. Add a section and code chunk loading 'acricolae', 'dplyr', and 'ggplot2'
6. Add a section for the session information.
7. Save the file.

Your new file should look like this:



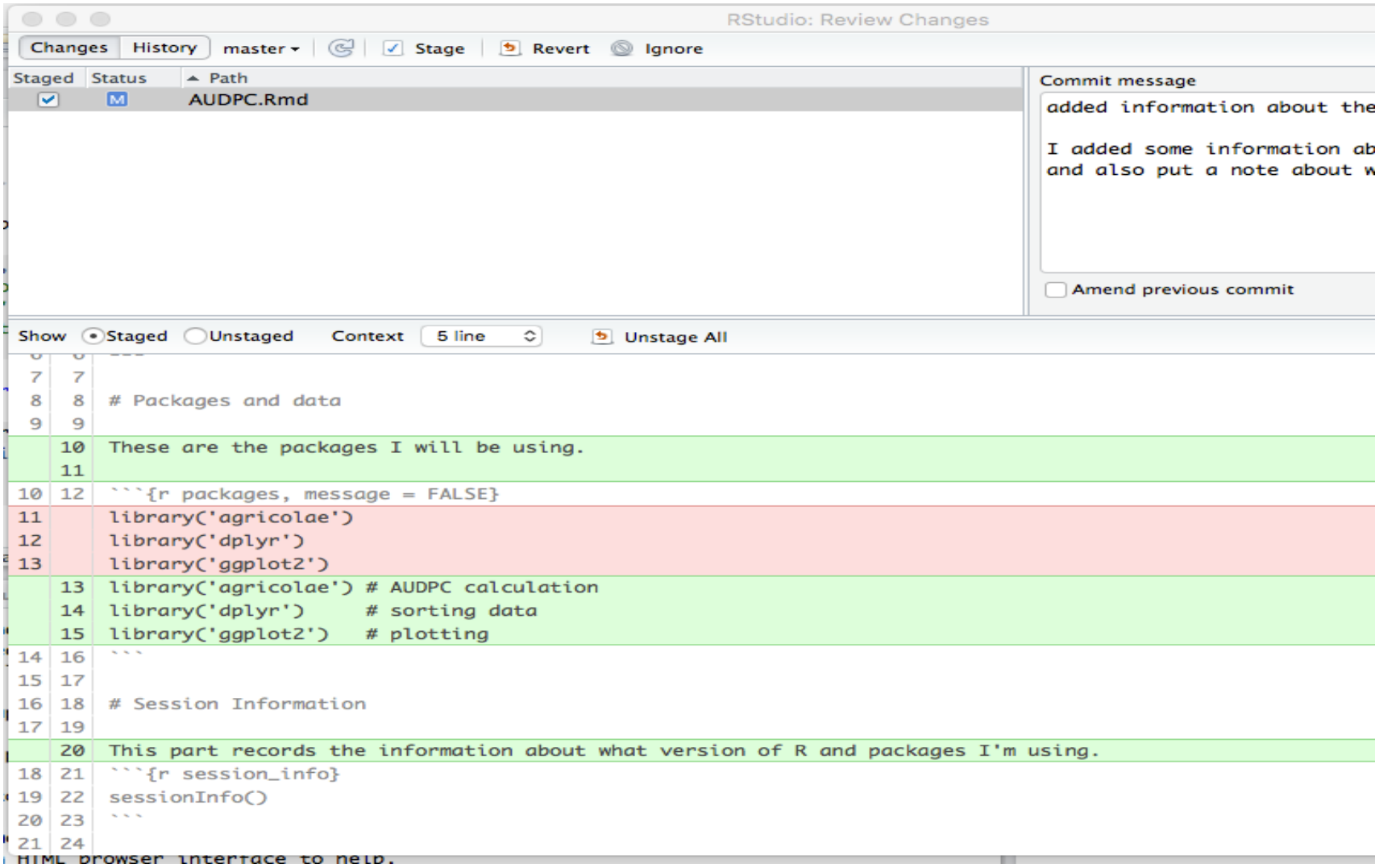
Now you should **add** and **commit** that file just like you did for the others before, but add a different commit message: "add AUDPC Rmd file".

When you've done that, add some text explaining what the chunks are doing and why you are using the specific packages like so:

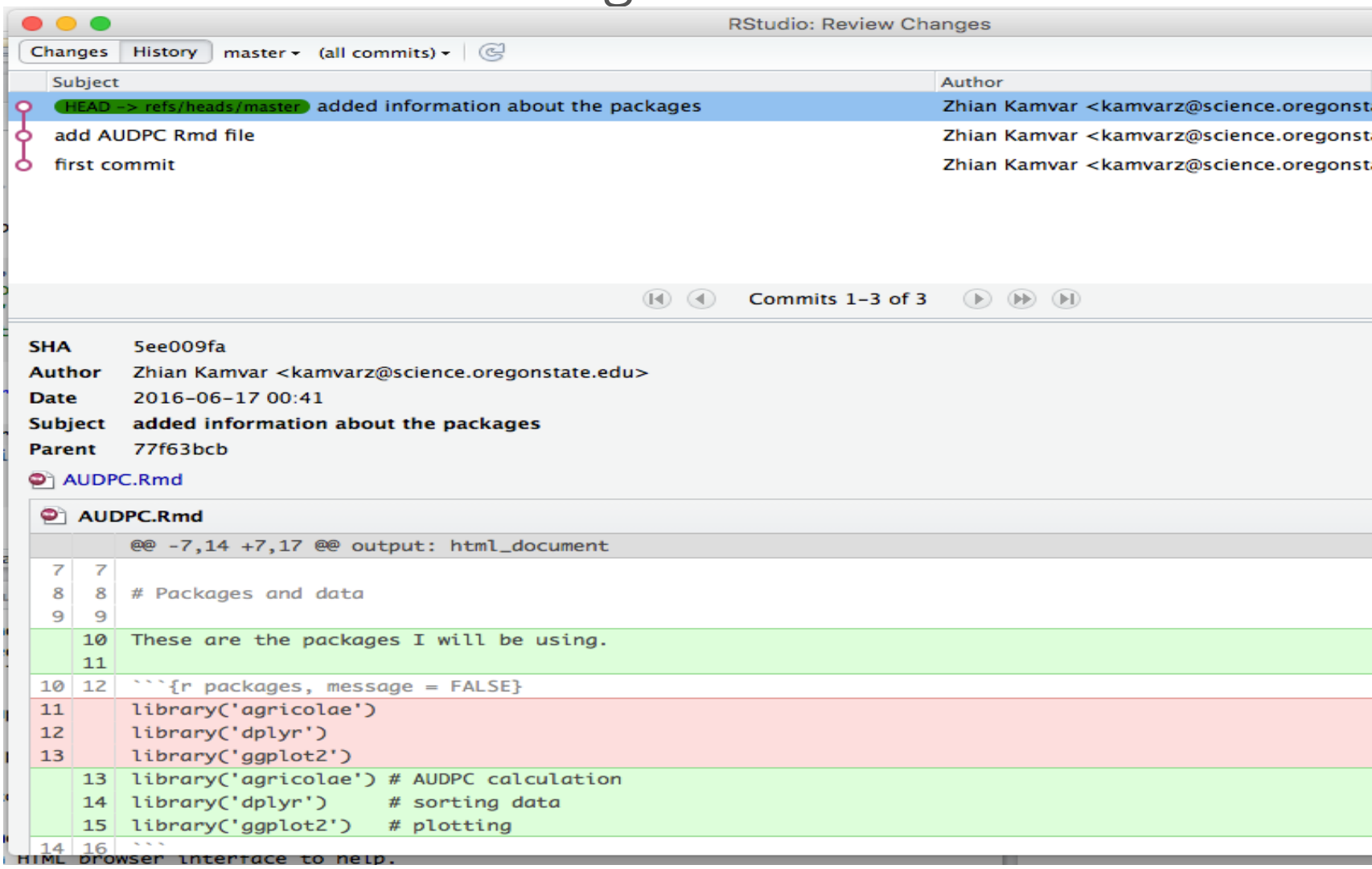


Notice that, in the above image, the indicator for the file in the git pane is now a blue box with an "M" in the middle. This means that you have modified a file that git is tracking. **Add** that file by clicking on the check box, hit the **Commit** button, and then add a commit message saying what you did.

Here's an example:



Now hit the **Commit** button and then click on the button at the top that says **History**. You should see the following:



This is a history of all the commits that you have made in this repository for the analysis. You can see when you made changes to the file and reasoning behind why you made these changes.

Conclusions

This was not meant to be a comprehensive tutorial on everything related to git, but it should be enough to get you started. We hope that, after reading this tutorial, you have the resources you need to keep track of your analyses using git and explore reproducible research.

The next step is to utilize GitHub so that you can collaborate and store your git repositories remotely.

GitHub

GitHub is an online service that allows you to keep your projects on the web and collaborate with others. In more technical terms, it serves as a **remote repository** for your projects. In terms of storing things remotely, this is similar to Dropbox or Google Drive, but that's where the similarities end. With GitHub, like git, you are in control of all the changes that are made. This section will take you through the process of setting up an account with GitHub and it will teach you a few new terms such as **clone**, **push**, **pull**, and **fork**.

Step 1: Sign up for a GitHub account

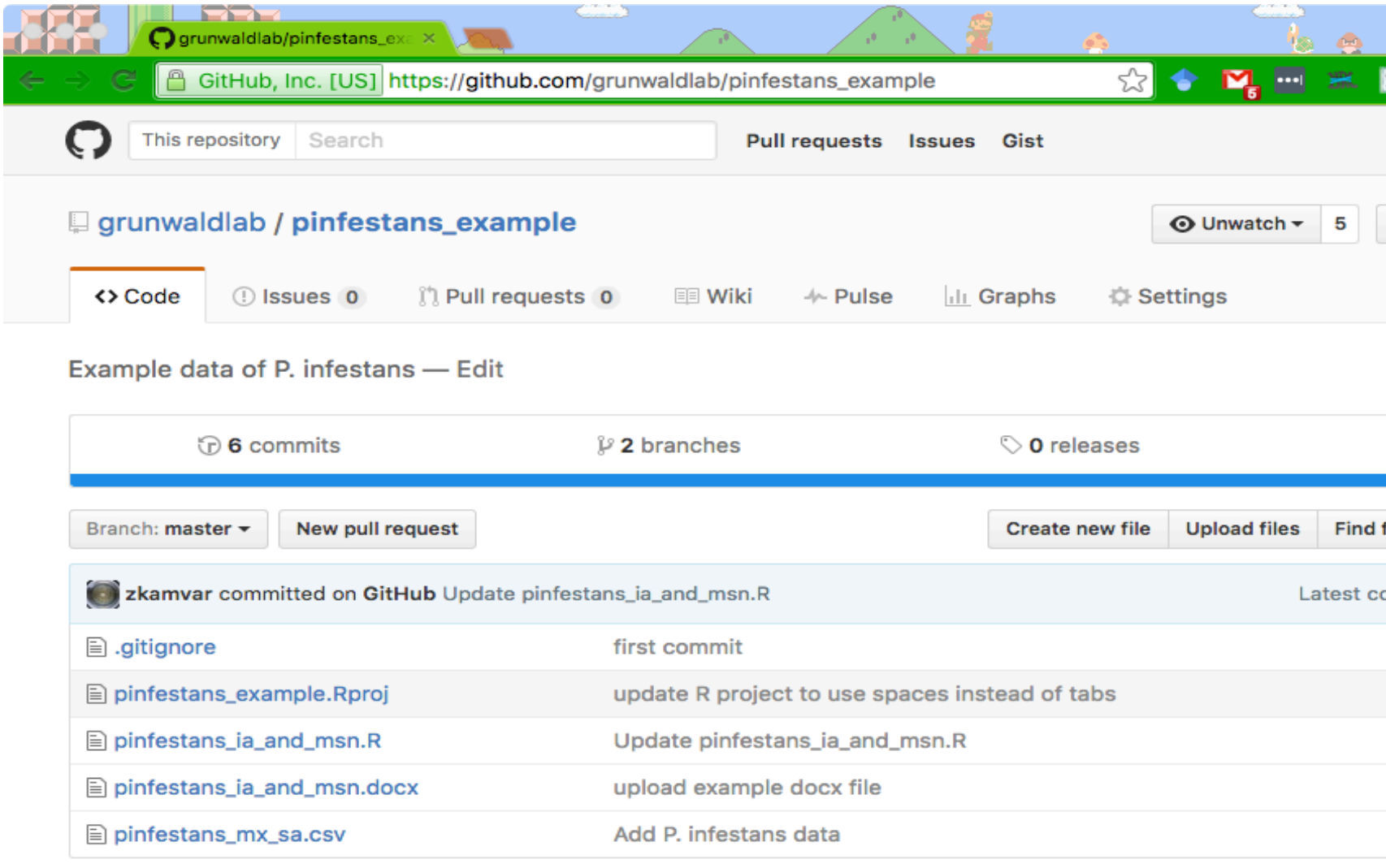
If you haven't already done so, you should sign up for a GitHub account. Note that you do not need to have git installed on your computer to do this. You can sign up for a GitHub account by clicking on this link: https://github.com

Step 2: Fork a repo

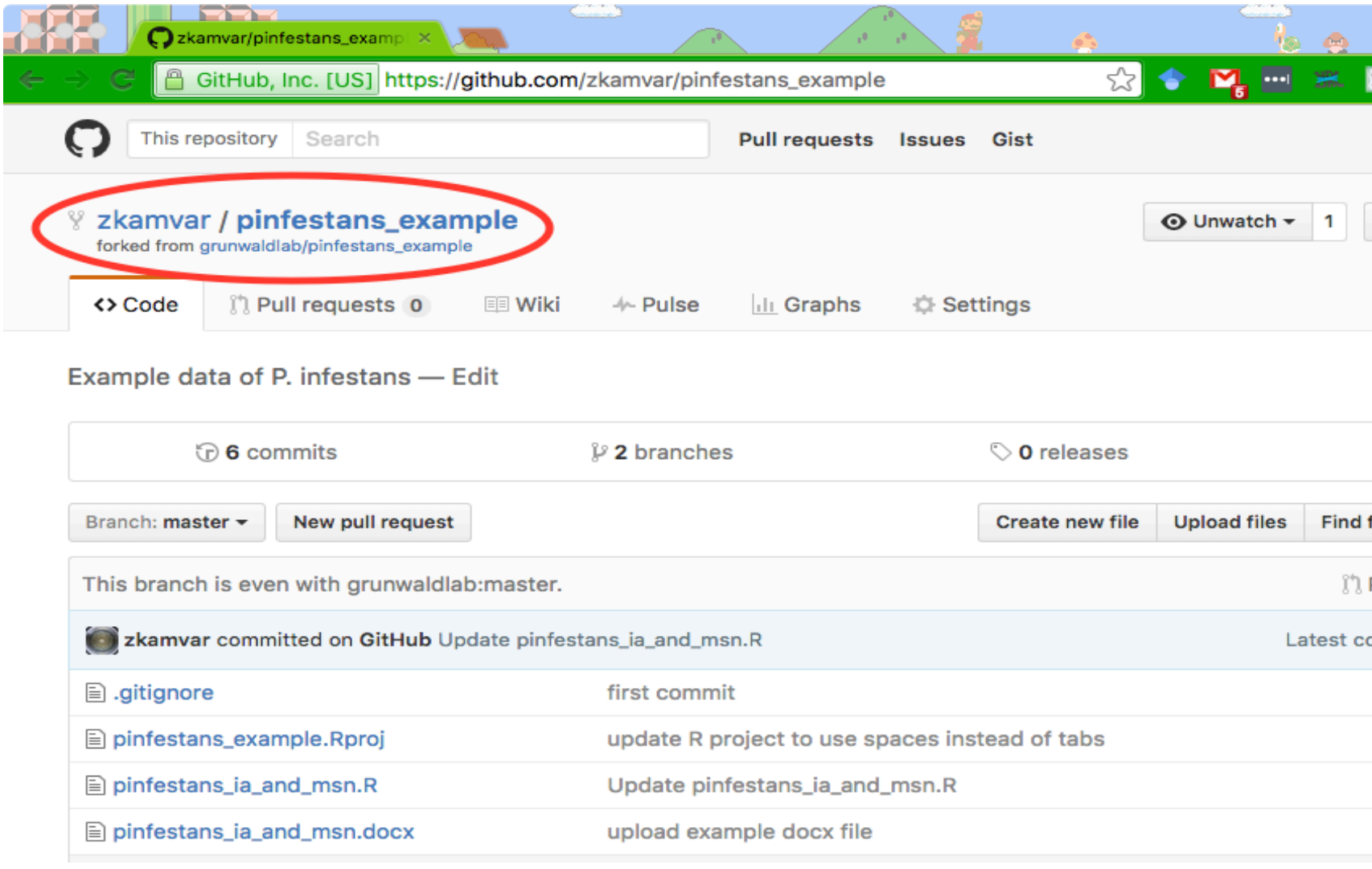
We've already presented two examples of handling reproducible research in R. Both of these are on GitHub:

- AUDPC of :
  https://github.com/grunwaldlab/audpc_example
- Index of Association of :
  https://github.com/grunwaldlab/pinfestans_examp

These repositories live in the grunwaldlab account on GitHub, but you can have a copy for yourself. To do this, you create a **fork** of the repository into your own account. You can do this by using the **fork** button in the top right corner of the webpage:



After you click this button, GitHub will copy that repository to your account and take you there:



Notice that the username has changed and it says "forked from grunwaldlab/pinfestans_example".

Try it!

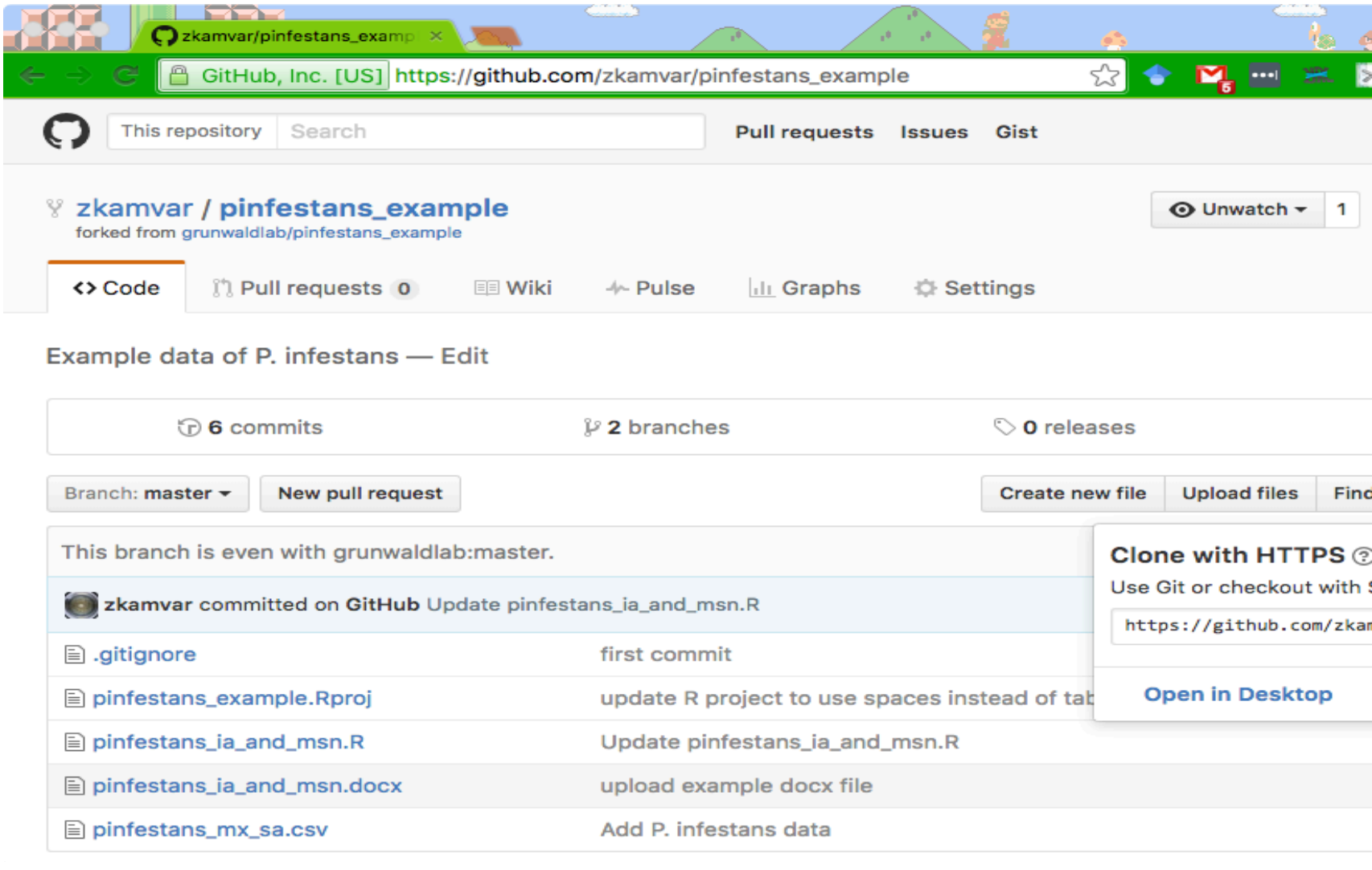
Fork both of these repositories to your own account! If you have written your README.md from the Markdown exercise, upload it to the AUDPC repository and commit that change.

Step 3: Clone your fork

This step requires that you have successfully installed git, signed up for a GitHub account, and have installed a git client such as Git Kraken, Sourcetree, or GitHub Desktop

A clone is an exact copy of a git repository. This will contain all of the files within the repository as well as the entire history.

In this step, you download the repository to your computer. You do this by clicking on the green button to the right of your screen:



You can copy the URL and use your git client to download the repository to your computer.

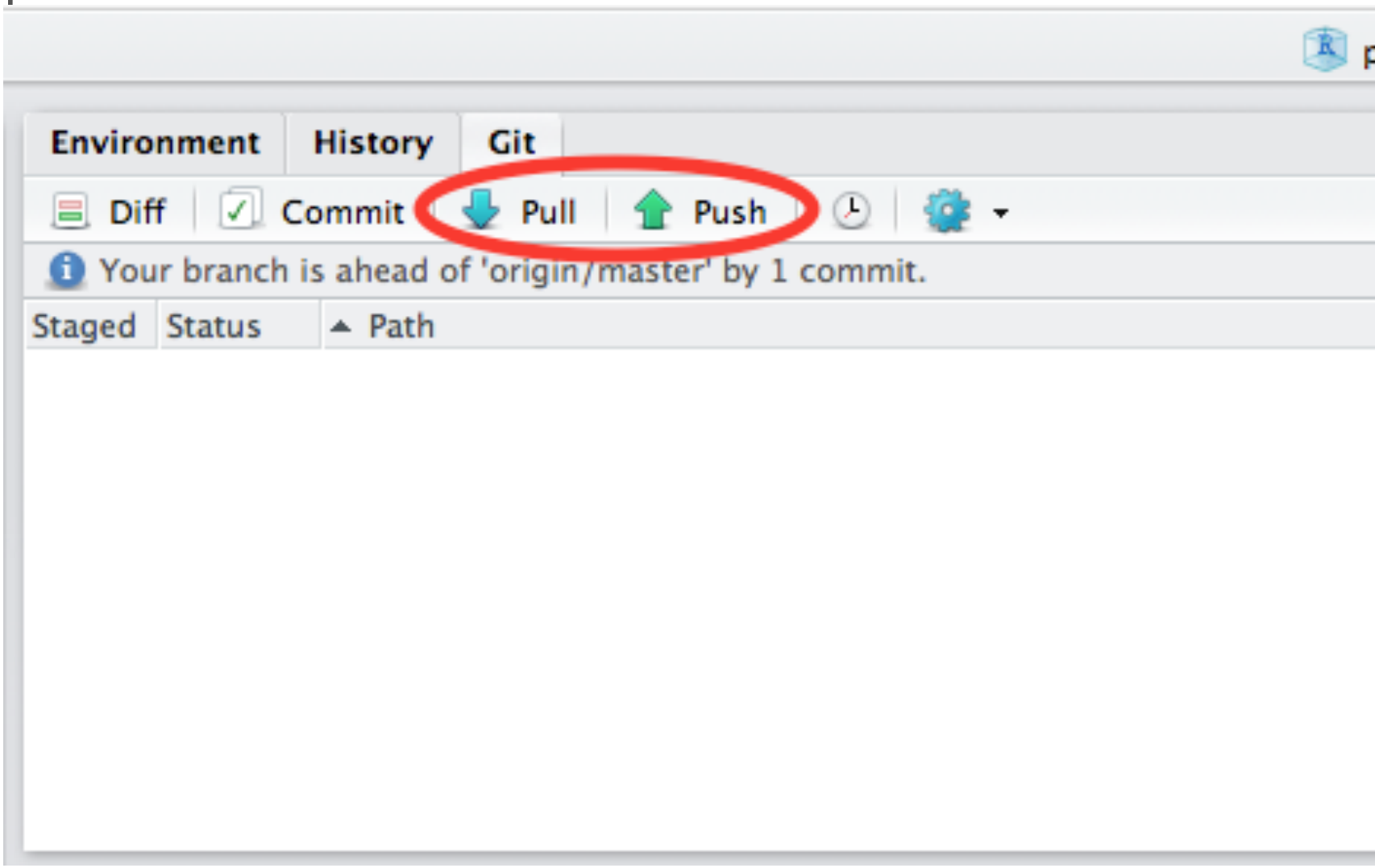
Step 4: Pushing and Pulling

This step requires that you have correctly set up either SSH or HTTPS configuration for your repository. Follow the links above for more inforamtion.

To move your changes to and from GitHub, you need to either **push** the changes you've made on your computer to GitHub or **pull** the changes from GitHub to your computer. Unlike Dropbox or Google Drive, this is not an automatic process. While this may not sound desirable, it allows you to only send stuff to GitHub that actually works and makes sense, preventing you from accidentally sending borked up analyses to the cloud.

Try it! exercise

In your newly cloned repository, change something in your README.md file (or add one if it's not there!), and then add and commit it. Now your local copy is one commit ahead of the remote. To update the remote, you should **push** your changes to the remote. You can either use your git client or RStudio to do this using the pull and push buttons in your "Git" pane:



Go to your GitHub repository and see that the changes have successfully been made.

Conclusions

We've given you a short introduction to using GitHub. Not only does using this technology allow your research to become more reproducible, but by sharing your analyses, it also allows other researchers to learn how analyses are being done in R, furthering reproducible research.

Interfaces

Git is primarily a program on the command line, but there are several graphical user interfaces that are available for it:

- GitHub Desktop
- Sourcetree
- Git Kraken

Tutorials

There are often a plethora of tutorials at your fingertips with a simple Google search of "learn git". As this particular tutorial is only designed to introduce you to git, we recommend browsing through these and seeing which ones work well for you.

Here are a few that we've found to be helpful:

- Try Git (from GitHub)
- Happy Git and GitHub for the useR
- UBC's STAT 545 page on Git, GitHub, and RStudio (This has been field tested with students with varying degrees of computer literacy)
- Hadely Wickham's take on git
- Getting Started with Github and Rstudio

Glossary

clone: create a local copy of a remote repository on your computer

fork: a copy of someone else's repository for you to work on

git add: tell git that you are going to commit certain files

git commit: record the state of your project at that moment in time

git init: initialize a git repository in a folder

pull: find all new changes in a remote repository and attempt to merge them with your local changes

push: send changes (commits) to a remote repository

remote repository: a git repository hosted on another computer or server