

Version Control and Git

Hydrologic Data Analysis | Kateri Salk

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VERSION CONTROL

This semester, we are going to be incorporating the fundamentals of **version control**, the process by which all changes to code, text, and files are tracked. In this manner, we're also able to maintain data and information to support collaborative projects, but to also make sure your analyses are preserved.

Before coming to class, you were asked to create a GitHub.com account. **GitHub** is the web hosting platform for maintaining our Git repositories. Our version control system for the purposes of this course is **Git**.

GitHub repositories come in two forms: public and private. All the project repositories you will use for this course are public. There may be situations in the future in which you may want to make use of private repositories, in which data and progress are protected from public view. Private repositories can be made public at a later date.

LICENSING

Licensing is also important to specify who and how your code can be used by others. Various license types are available for use with a decision tree available here. For the purposes of this work, we recommend a GNU General Public License version 3. This is a free and widely-trusted *copyleft* license. A copyleft is an arrangement whereby software or artist work may be used, modified, and distributed freely on condition that anything derived from it is bound by the same condition. Unless you plan to charge a fee for use of your code, the GPLv3.0 comes highly recommended.

For more information about licensing your code, check out <https://help.github.com/articles/licensing-a-repository/>

FUNCTIONS IN GIT

There are two ways to diverge code from a main project: **branching** and **forking**. A branch is a temporary segment often used for development. We will not be making use of branching for the purposes of this class, but it is worth spending some time reading about them to see how they can be incorporated into collaborative projects. A fork is a copy or clone of the main project. Forking allows for greater oversight in the merging process and prevents changes being committed to the main project.

INTEGRATING GIT AND RSTUDIO

Personal Access Token

As of August 2021, it is no longer acceptable to use your GitHub username and password to enable your computer to talk to the GitHub website as a Git server. If you try to clone a repository using HTTPS protocol, you will get the following error:

```
remote: Support for password authentication was removed on August 13, 2021. Please use a
personal access token instead. remote: Please see https://github.blog/2020-12-15-token-authentication-re
for more information. fatal: Authentication failed for 'https://github.com/OWNER/REPO.git/'
```

To fix this, you will need to set up a personal access token. Take the following steps:

1. From your profile menu in GitHub (top right corner), select Settings
2. Go to Developer Settings
3. Go to Personal access tokens
4. Click “Generate new token”
5. Add the appropriate information. I suggest “Water Data Analytics” as the note, set to no expiration (or something shorter if this makes you nervous), and check the boxes for “repo”, “workflow” and “user” scope. Then click “Generate Token”.
6. Copy the access token and/or save it somewhere on your computer (like you would store a password).
7. Open your RStudio window and type the following into the console:

```
install.packages("gitcreds") library(gitcreds) gitcreds_set()
```

Paste the token information when prompted. Your RStudio should now allow you to clone the course repository and make updates throughout the semester.

For more information, see the following resources:

<https://happygitwithr.com/https-pat.html> <https://stackoverflow.com/questions/66065099/how-to-update-github-authentication-token-on-rstudio-to-match-the-new-policy>

Forking and Cloning

1. Go to the following repository on GitHub: https://github.com/KateriSalk/Water_Data_Analytics_2022
2. In the upper right corner, click the “fork” button. This will prompt you to create a copy of this repository in your own user account. This is called a fork of the original repository, which you can edit rather than simply download.
3. Clone your repository to your local drive using RStudio.
 - Copy the GitHub repository URL.
 - Click the “Clone or download” button and then the “copy” icon. Make sure the box header lists “Clone with HTTPS” rather than “Clone with SSH.” If not, click the “Use HTTPS” button and then copy the link.
 - Launch RStudio and select “New Project” from the File menu. Choose “Version Control” and “Git.”
 - Paste the repository URL and give your repository a name and a file path. The file path should be one that persists permanently; it cannot be changed later on.

You now have tracked the course repository (i.e., the “upstream”), forked the repository into your own account (i.e., the “remote”), and cloned the repository to your drive (i.e., the “local”). We will be updating each of these repositories as the course progresses.

Note: Clone with SSH is an option as well. For a guide on creating SSH keys, see the Duke Libraries online guide [here](https://git-rfun.library.duke.edu/outline.html#generate_ssh_keys_in_advance_of_the_workshop) and navigate to the “Generate SSH keys” section: https://git-rfun.library.duke.edu/outline.html#generate_ssh_keys_in_advance_of_the_workshop.

Editing, Committing, Pushing

1. Navigate to the “README.md” file in the Files tab and open it.
2. Type your name after “User:” and save.
3. Now that you have edited a file, it should now appear in the Git tab in RStudio. Click the box to the left of the file, where a check mark should now appear.
4. Press the “Commit” button. A new window should appear that shows the changes that have been made to the file.

5. Write a message detailing the edits you've made to the README file. You should always include a commit message to your commits so that your future self and/or your collaborators will know what changes were made. Click "Commit".
6. Click the green upward facing arrow: the "Push" button. Your remote repository is now up to date with your local repository.

The commit command records the changes you've made to files in your project. Commits are useful to track important milestones in your progress. You should always make a commit at least once every time you log onto a project (e.g., once daily). However, simply committing your changes does not save those changes to your remote repository. This is where push comes in. By pushing your new commits to the remote repository, you are ensuring that your local and remote repositories contain the same changes. You must have an internet connection to push, but you can make several commits offline and push them when you regain an internet connection.

Commits and pushes can also be done in the Terminal by typing commands (i.e., the command line). Navigating to the Terminal tab will allow you to type these commands. The relevant commands are:

```
git commit
```

```
git push
```

Note: files must be staged in order to use the command `git commit`, and a commit message must still be used.

If you are using a Mac, you will need to take the following steps to enter your commit message:

1. press "i" to indicate insert
2. write your merge message
3. press "esc" to indicate you are exiting the insertion
4. write ":wq" to indicate write then quit
5. press enter

Pulling from the Remote (your fork of the repo)

If there are changes in your remote repository that you want to incorporate into your local repository, you will need to pull them into your local repository.

1. Click the blue downward facing arrow: the "Pull" button. Your local repository is now up to date with your remote repository.

Pulling from the Upstream (Kateri Salk's repo)

Your instructor will regularly update the course repository. However, this will not update the repository that you've forked into your own user account (i.e., remote) unless you tell it to do so.

Type the following commands into the Terminal window in RStudio (bottom left)

```
git remote add upstream https://github.com/KateriSalk/Water_Data_Analytics_2022
```

```
git pull upstream master
```

An alternate to pull is fetch + merge:

```
git fetch upstream master
```

```
git merge upstream master
```

Note: these steps will update your local repository, but will not update your remote. To bring your remote up to date, you will need to push your changes.

Note: you will not be pushing any of your changes to the upstream remote, as you do not have the appropriate permissions to do so.

Merge

Sometimes, files in your local and remote repositories will have changes that are different. In this case, you will need to merge the files together in a way that incorporates the changes in a manner that you choose (merge). When a merge conflict occurs, you will need to open the conflicted file in RStudio, review any edits that are inconsistent across versions, and make edits to incorporate all desired updates. You may then commit and push.