GIT

Git is a distributed version control system that allows multiple people to work on a project simultaneously, tracking changes and coordinating updates. It stores project history, enabling users to revert to previous versions and manage different branches for features or fixes. Git is widely used for collaboration, ensuring code integrity and simplifying the process of merging contributions from multiple developers.

Let's Git Started

1. Register a Github account

Register an account with GitHub. It's free!

- https://github.com

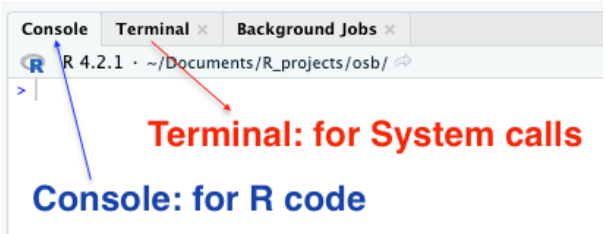
Username advice

- Incorporate your actual name! People like to know who they're dealing with. Also it makes your username easier for people to guess or remember.
- Shorter is better than longer.
- Make it timeless. Don't highlight your current university, employer, or place of residence, e.g. JennyFromTheBlock.

You can change your username later, but better to get this right the first time.

- https://help.github.com/articles/changing-your-github-username/
- https://help.github.com/articles/what-happens-when-i-change-my-username/

We will be switching between the console and the terminal, in class and in assignments. The **Console** is where you can execute R code, while the **Terminal** is where you can execute system functions like git.



2. Git already installed?

Go to the **Terminal** tab in RStudio and enter `git --version` to see its version:

If this instruction gives an error, it's possible that *git* is not installed on your machine. If so, let your instructor know. All machines in the lab should have *git* installed.

> **i** FYI - some common git commands
>
> Here are short definitions for key Git commands. Most of these are built into the RStudio IDE, and we'll use them through RStudio:
>
> 1. **git init**: Initializes a new Git repository in the current directory [**use RStudio**].
> 2. **git add**: Stages changes (files or modifications) for the next commit [**use RStudio**].
> 3. **git commit**: Saves the staged changes to the repository with a message describing the update [**use RStudio**].
> 4. **git status**: Displays the state of the working directory and the staging area, showing untracked, modified, or staged files.
> 5. **git push**: Sends local commits to a remote repository [**use RStudio**].
> 6. **git pull**: Fetches and integrates changes from a remote repository to the local branch [**use RStudio**].
> 7. **git branch**: Lists, creates, or deletes branches in the repository [**use RStudio**].
> 8. **git checkout**: Switches to a different branch or commit in the repository [**use RStudio**].
> 9. **git merge**: Combines the changes from one branch into the current branch.
> 10. **git fetch**: Downloads new data from a remote repository without merging it into the current branch.
> 11. **git log**: Displays the commit history for the current branch.

3. Introduce yourself to Git

> **!** Important
>
> Make sure that the R package `usethis` has been installed. You can check under the packages tab in the file & plots viewer (e.g., do a search).

You can set your Git user name and email from within R (i.e. go back to the **Console** tab):

```
usethis::use_git_config(
  # user.name does not have to be your GitHub user name
  user.name = "Jane Doe"
  # user.email MUST be the email associated with your GitHub account.
  , user.email = "jane@example.org"
)
```

Your git commits will be labelled with this user name, so make it informative to potential collaborators and future you.

4. Set up personal access tokens for HTTPS

The password that you use to login to GitHub's website is NOT an acceptable credential when talking to GitHub as a Git server. You can learn more in their blog post Token authentication requirements for Git operations.

The recommendation to use a personal access token (PAT) is exactly what we cover here. First you need to create your PAT, and you can do this from R (in the **Console**):

```
usethis::create_github_token()
```

The `usethis` approach takes you to a pre-filled form with some pre-selected recommended scopes, which you can look over and adjust before clicking "Generate token".

It is a very good idea to describe the token's purpose in the *Note* field, because one day you might have multiple PATs. We recommend naming each token after its use case, such as the computer or project you are using it for, e.g. "personal-macbook-air" or "lab1-course-8740". In the future, you will find yourself staring at this list of tokens, because inevitably you'll need to re-generate or delete one of them. Make it easy to figure out which token you've come here to fiddle with.

> Tip
>
> If this is your first time generating a PAT, just accept the defaults and scroll to the bottom of the page and click the green **Generate token** button.

4.1 Click "Generate token".

You won't be able to see this token again, so don't close or navigate away from this browser window until you store the PAT. Copy the PAT to the clipboard or a text file in RStudio.

Treat this PAT like a password! Do not ever hard-wire your PAT into your code! A PAT should always be retrieved implicitly, for example, from the Git credential store, a safe place, where command line Git, RStudio, and R packages can discover it.

4.2 Save your PAT

- Copy the generated PAT to a secure, long-term system for storing secrets, like 1Password, LastPass or KeePass, or
- email it to yourself, or
- copy it onto a piece of scrap paper.

4.3 Store your PAT in the Git credential store

Finally, we store the PAT in a safe place where command line Git, RStudio, and R packages can discover it. To do this call `gitcreds::gitcreds_set()`. If you don't have a PAT stored already, it will prompt you to enter your PAT. Paste!

```
gitcreds::gitcreds_set()
```

Instead of saving your PAT you could just re-generate the PAT each lab session and re-store it. If you accept the default 30-day expiration period, this is a workflow you'll be using often anyway.

On github.com, assuming you're signed in, you can manage your personal access tokens from https://github.com/settings/tokens, also reachable via *Settings > Developer settings > Personal access tokens*.

> **!** Important
>
> Given that the machines start from the same initial state each lab session, you will follow the above steps to initial your machine at the start of each lab session.

5. How Git works

Git has three storages locally: a Working directory, Staging Area, and a Local repository.

1. **Working Directory**: is where you work, and your files live ("untracked"). GIT is not aware of these files.
2. **Staging Area**: When you stage your changes, GIT will start tracking and saving your changes with files. These changes are stored in the .git directory.
3. **Local Repository**: is the area where everything is saved (commits) in the .git directory. So, when you want to move your files from Staging Area to Local Repository, you can use the git commit command. After this, your Staging area will be empty. If you want to see what is in the Local repository, try git log.

The workflow looks like this:

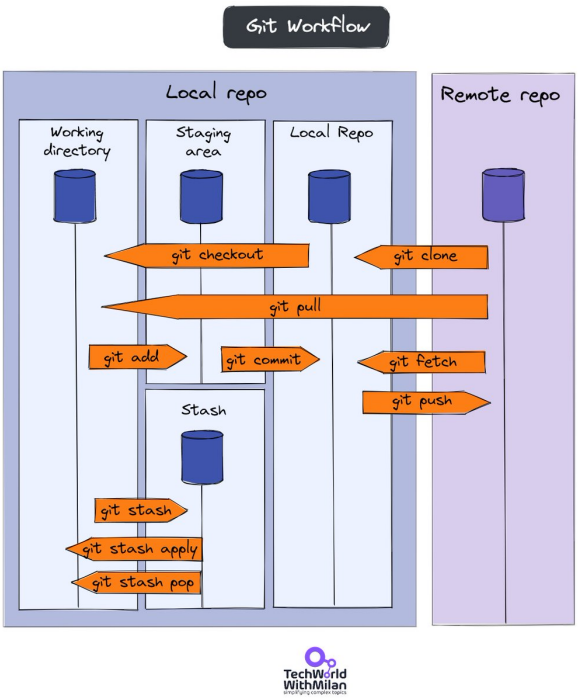


Figure 1: Git workflow

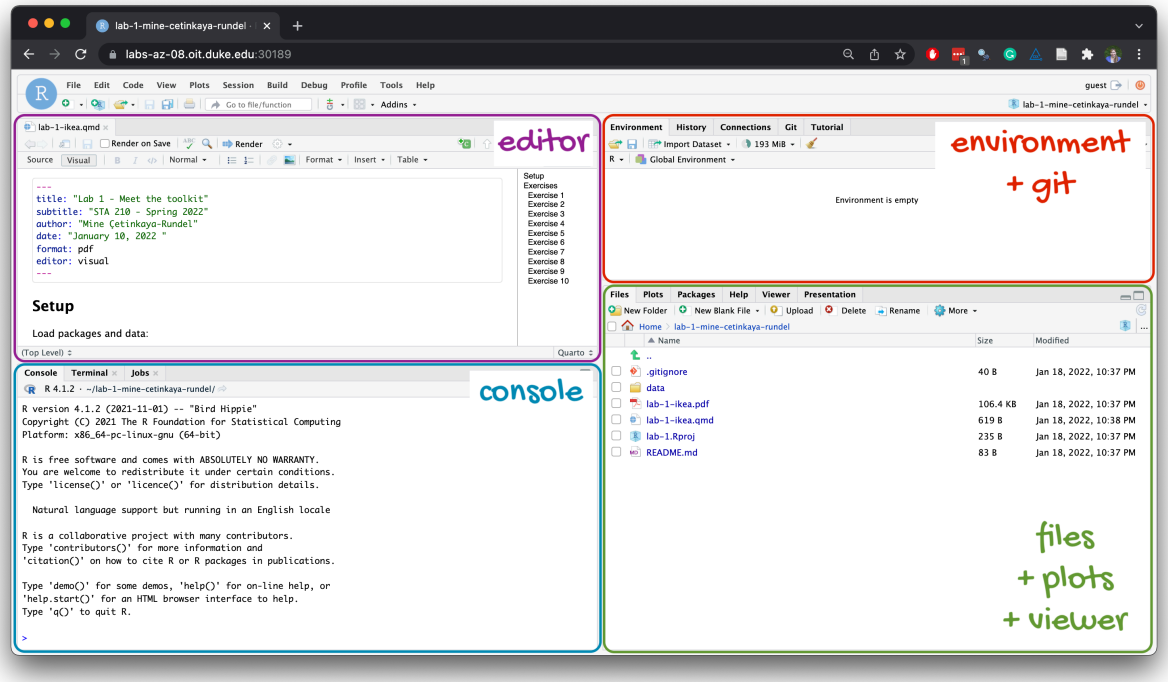
You are now ready interact with GitHub via RStudio!

Clone the repo & start a new RStudio project

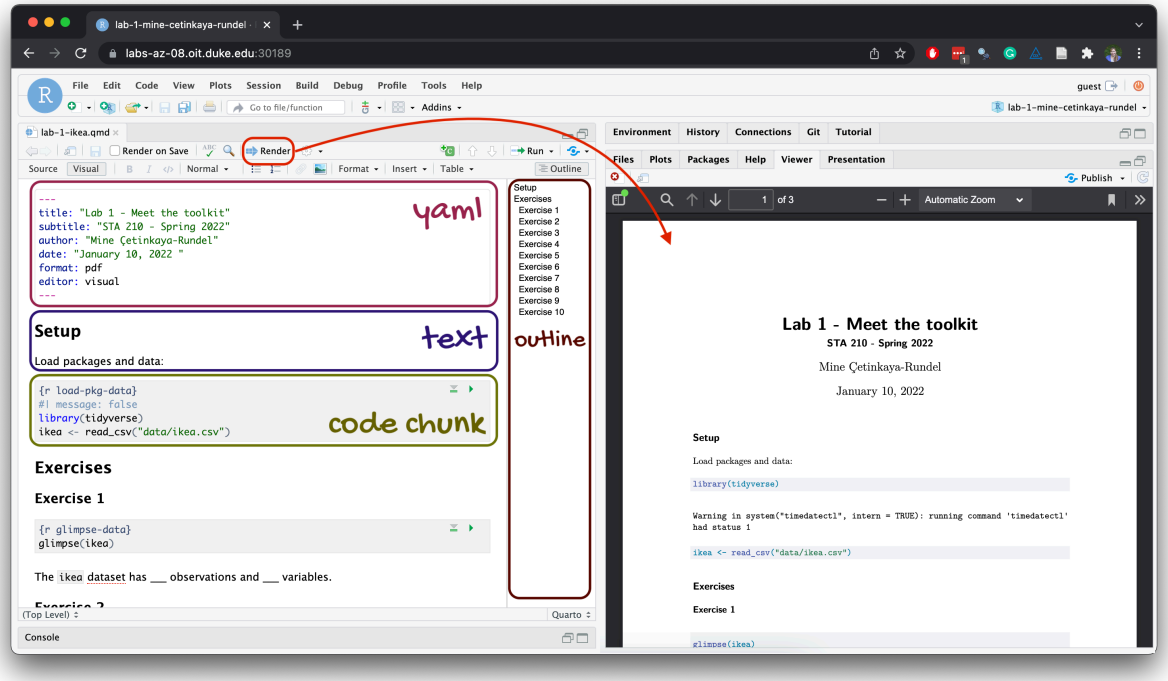
1. First make sure you are logged into your own Github account on a web browser.
2. Next, in a new browser tab, go to the course organization site on GitHub at BSMM-8740-Fall-2024 and click on your personal repository for the lab, quiz, or exam. These will be created just before each assignment starts. The repository contains the starter documents you need to complete the lab.
3. Click on the green **CODE** button, select **Use HTTPS** (this might already be selected by default, and if it is, you'll see the text **Clone with HTTPS**). Click on the clipboard icon to copy the repo URL.
4. In RStudio, go to *File ->New Project ->Version Control ->Git*.
5. Copy and paste the URL of your assignment repo (the clipboard copy you made in step 4) into the dialog box *Repository URL*. Tab to the next text box and the project directory name should be automatically populated, but **make sure you select a directory** in *Create project as a subdirectory of*. If you can't find your project code on the computer, it's likely you did not specify where the project folder should be created. **Don't make this mistake**.
6. Finally, click *Create Project*, and the files from your GitHub repo will be displayed in the *Files* pane in RStudio.
7. Open the template R Markdown file (should be a *.qmd file). This is where you will write up your code and narrative for the assignment.

R and R Studio

Below are the components of the RStudio IDE.



Below are the components of a Quarto (.qmd) file.



YAML

The top portion of your R Markdown file (between the three dashed lines) is called **YAML**. It stands for "YAML Ain't Markup Language". It is a human friendly data serialization standard for all programming languages. All you need to know is that this area is called the YAML (we will refer to it as such) and that it contains meta information about your document.

> **!** Important
>
> In each lab, quiz, and exam you'll work from a R project based on your personal repository at the course organization site at BSMM-8740-Fall-2024 on GitHub. To start, open the Quarto (`.qmd`) file in the project, change the author name to your name, set the date field in the YAML, and at least once before the deadline render the document to ensure that your code executes properly.

Committing changes

Now, go to the Git pane in your RStudio instance. This will be in the top right hand corner in a separate tab.

If you have made changes to your *.qmd file, you should see it listed here. Click on it to select it in this list and then click on **Diff**. This shows you the *diff*erence between the last committed state of the document and its current state including changes. You should see deletions in red and additions in green.

If you're happy with these changes, we'll prepare the changes to be pushed to your remote repository. First, **stage** your changes by checking the appropriate box on the files you want to prepare. Next, write

a meaningful commit message (for instance, "updated author name") in the **Commit message** box. Finally, click **Commit**. Note that every commit needs to have a commit message associated with it.

You don't have to commit after every change, as this would get quite tedious. You should commit states that are *meaningful to you* for inspection, comparison, or restoration. Be sure to commit at the end of lab sessions, and before the submission deadline.

In the first few assignments we will tell you exactly when to commit and in some cases, what commit message to use.

Push changes

Now that you have made an update and committed this change, it's time to push these changes to your repo on GitHub.

In order to push your changes to GitHub, you must have **staged** your changes, and **committed them** to be pushed. Then click on **Push**.

To make sure all the changes went to GitHub. You can go to your GitHub repo (at the course site) and refresh the page. You should see your commit message next to the updated files. If you see this, all your changes are on GitHub and you're good to go!

More on the basic use of git here.