

Version Control with Git



Ben R. Fitzpatrick

PhD Candidate, Statistical Science, Mathematical Sciences School, Queensland University of Technology

0000-0003-1916-0939

github.com/brfitzpatrick/

@benfitzpatrick

Version Control Software

Have you ever put numbers or dates at the end of a file name to keep different versions of it?

- If yes then you have already used version control!

Have you ever used track changes and comments to take turns editing a MS Word document with one or more others?

- If yes then you have collaboratively edited a file!

Version Control Software:

- formalizes these concepts
- can do a lot of the organisational work for you
- makes reverting to previous versions without losing work easy

Version Control when Working Alone

Version Control for Solo Authoring File

- You essentially have a time stamped undo button which will allow you to go review or revert to previous versions of the file
- you can even make multiple child versions fo the same file say for different audiences or to trial different orders and styles in which to write a report or program

Version Control when Collaborating

Greatly simplifies your life Control over which changes different contributors make get added to the definitive version of a file support for file to split into two child copies which can then be edited towards very different end points but still having the option to systematically recombine them at any stage

Why Git?

Git is free and open source

Git is available for most operating systems

Git is Distributed and Fast

Two major code hosting services (GitHub & BitBucket) support version control with Git and both services have free account options

Git is Distributed Version Control

Every contributor has a copy of the entire database (all revisions of all files) two contributors can both work on the files in their copy of the database independently then their combined modifications can be merged systematically

Why Git on the Command Line?

Makes discrete components of the workflow obvious this in turn will enable you to migrate easily to one of the many GUIs

The workflows we will practise today will work exactly the same way on MS Windows, MacOS and GNU+Linux

We have now been using a command line interface for 1.5 days to interact with the R program it's time to take it to the next level

Plan for this Module - Part 1

Solo Version Control

- Set up Git on your laptops to communicate with the GitHub servers
- Create a local 'clone' of a remote repository
- Make some changes to your local copy of the files
- commit these changes to the git version control system
- push these changes to your repository
- make some more changes
- revert to a previous version of the file

Plan for this Module - Part 2

Collaborating with Git & GitHub

- fork
- branch
- edit
- commit
- pull request
- merge

Creating a Repository on the GitHub Servers

Log into the GitHub Web Service

The screenshot shows the GitHub profile of Ben R. Fitzpatrick. The page layout includes a header with the GitHub logo, a search bar, and navigation links for Pull requests, Issues, and Gist. The profile section on the left features a profile picture, the user's name, username, affiliation (Queensland University of Technology), location (Brisbane, Australia), website, and join date. Below this are statistics for Followers, Starred, and Following. The main content area shows the 'Repositories' tab selected, with a search bar and a 'New' button. A green arrow labeled '1.' points to the 'Repositories' tab, and another green arrow labeled '2.' points to the 'New' button.

Search GitHub

Pull requests Issues Gist

Contribution Repositories Public activity

Find a repository Search All Public Private Sources Forks Mirrors

New

Intro to R

Material for an introductory Short Course on the R Language and Environment for Statistical Computing and Graphics.

Updated 2 hours ago

fork_for_ben

forked from sk6aus6/fork_for_ben

Updated 2 days ago

fork_this_repo

practise collaborating with GitHub

Updated 4 days ago

Ben R. Fitzpatrick

brfitzpatrick

Queensland University of Tec...

Brisbane, Australia


https://bragqut.wordpress.co...

Joined on 19 Dec 2013




0 Followers 0 Starred 0 Following



Creating a Repository on the GitHub Servers


Complete the Details



[Pull requests](#) [Issues](#) [Gist](#)


  


Owner
  **brfitzpatrick** ▼

Repository name
 

Great repository names are short and memorable. Need inspiration? How about [scaling-octo-ironman](#).


Description (optional)

☒  **Public**
Anyone can see this repository. You choose who can commit.

☐  **Private**
You choose who can see and commit to this repository.


☒ **Initialize this repository with a README**
This will let you immediately clone the repository to your computer. Skip this step if you're importing an existing repository.

▼




▼ 


Creating a Repository on the GitHub Servers




View your New Repository

 Search

[Pull requests](#) [Issues](#) [Gist](#)


  


 **brfritzpatrick / my_new_repo**


 Unwatch **1**  Star **0**  Fork **0**


Description




Website
 [Save](#) or [Cancel](#)

 **1** commit



 **1** branch


 **0** releases


 **1** contributor


  branch: **master** **my_new_repo / +** 

Initial commit

 **brfritzpatrick** authored just now latest commit 4930beee35 


 [LICENSE](#) Initial commit just now


 [README.md](#) Initial commit just now


 **README.md**


my_new_repo


<> Code


 [Issues](#) **0**

 [Pull requests](#) **0**


 [Wiki](#)


 [Pulse](#)


 [Graphs](#)

 [Settings](#)

SSH clone URL



You can clone with [HTTPS](#), [SSH](#), or [Subversion](#) 

 **Download ZIP**

Cloning your new Repository to your Hard Drive

First, create a folder on your Hard Drive in which to store your Git Repositories.

We are now going to use the Git command line application to 'clone' your new repository from the GitHub server to your hard drive.

Git is distributed version control so a Git 'clone' is a complete copy of the entirety of the repository i.e.

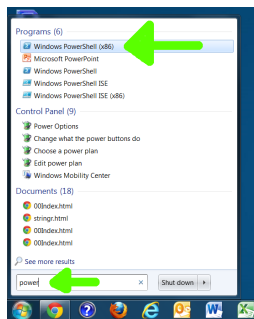
- all the files
- the entire history of snapshots of files states created each time you committed to the repository

Being a distributed version control system Git doesn't require you to be connected to the GitHub servers to work on your files and commit them to your branch of the repository.

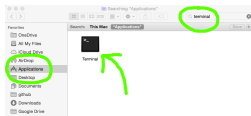
Git on the Command Line

Accessing a command line interface in your OS of choice

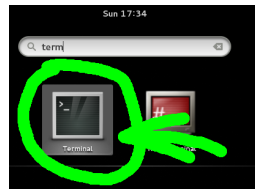
MS Windows
Open a 'PowerShell'



Mac OS X & later
Open a 'Terminal'

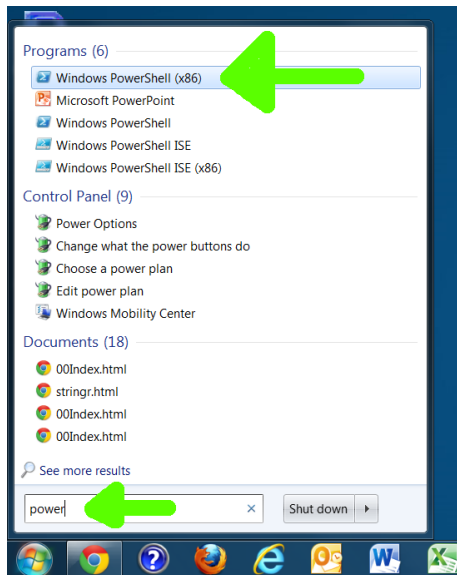


GNU+Linux
Open a 'Terminal'



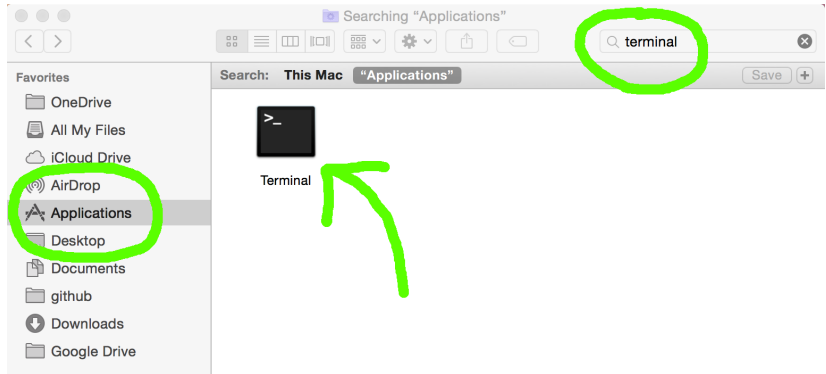
Accessing a command line interface from MS Windows

Open a 'PowerShell' Powershell



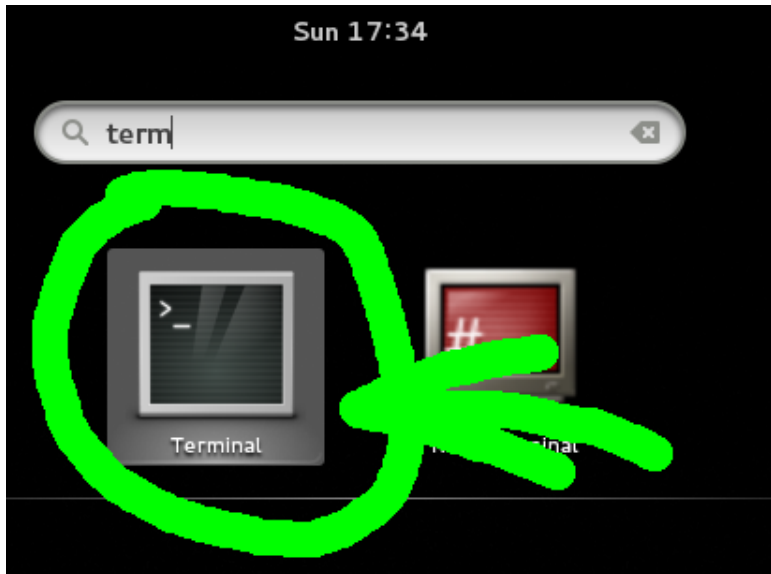
Accessing a command line interface from MacOS

Open a 'Terminal'



Accessing a command line interface from GNU+Linux

Open a 'Terminal'



Configuring Git for the first time

All Users

```
> git config --global user.name "Your Name"  
> git config --global user.email you@mail.com
```

Configuring Git for the first time

Choosing a Global Editor

The global editor is used to write your commit messages.

Default is Vim but Vim is a little heavy on keyboard short cuts for some...

Many of the below can also function as an IDE for authoring R code if you prefer one of them to RStudio.

Other Options:

- Notepad (available on all Windows PCs)
- TextEdit (available on most Macs)
- Atom: <https://atom.io/docs/v1.0.0/getting-started-installing-atom>
- Sublime: <http://www.sublimetext.com/2>
- TextMate: <http://macromates.com/download>
- Emacs:

```
sudo apt-get install emacs
```

Configuring Git for the first time

Set a Text Editor of your choice (you'll need it installed)

Use one of the below

Notepad:

```
> git config --global core.editor notepad.exe
```

TextEdit:

```
> git config --global core.editor 'open -t -n -W'
```

Atom:

```
> git config --global core.editor "atom --wait"
```

Sublime:

```
> git config --global core.editor "subl -n -w"
```

TextMate:

```
> git config --global core.editor "mate -w"
```

Emacs:

```
> git config --global core.editor "emacs"
```

Cloning Your Repository from the GitHub Servers

Set the working directory to the location on your hard drive to which you would like the repository cloned:

Powershell Users

```
> C:  
> cd C:\Users\username\Documents\GitHub_Repos\  
> dir
```

Terminal Users

```
> cd /home/ben/Documents/GitHub_Repos  
> ls
```

Copy HTTPS URL to use when cloning repository

This screenshot shows the GitHub interface for a repository named 'my_new_repo' by user 'brfritzpatrick'. The repository has 1 commit, 1 branch, 0 releases, and 1 contributor. The 'Code' button is highlighted with a green arrow, and the 'Copy to clipboard' button is also highlighted with a green arrow.

Repository Information:

- Repository: brfritzpatrick / my_new_repo
- Unwatch: 1
- Star: 0
- Fork: 0

Description:

Short description of this repository

Website:

Website for this repository (optional)

Save or **Cancel**

Repository Statistics:

- 1 commit
- 1 branch
- 0 releases
- 1 contributor

Branches:

- branch: master

Commits:

Commit	Author	Time
Initial commit	brfritzpatrick	33 minutes ago

Files:

- LICENSE
- README.md

README.md

my_new_repo

Code

- Issues: 0
- Pull requests: 0
- Wiki
- Pulse
- Graphs
- Settings

HTTPS clone URL

https://github.com/brfritzpatrick/my_new_repo

You can clone with **HTTPS** or **Subversion**

Copy to clipboard

Download ZIP

Clone your Repository: GitHub Servers → your Hard Drive

Use the HTTPS URL you copied earlier:

HTTPS clone URL

`https://github.com.`



You can clone with [HTTPS](#) or [Subversion](#). 

Copy to clipboard

All Users

```
> git clone https://github.com/.../my_new_repo
.git
> cd ./my_new_repo/
> ls
> git status
```

Files in a directory which you are version controlling with Git can exist in one of three states:

- **committed** data stored in the database for the associated repository
- **modified** local copy of a file (in your working directory) is different to the most recent version of that file stored in the database for the associated repository i.e. you have changed something but not committed the changes (yet)
- **staged** the local copy of a file which you have modified is marked to be added to the database in the next commit snapshot you send to the database

- you add files or modify existing files in your local copy of the repository
- you stage these modified files ready to be committed to the database for the repository
- you perform a commit which takes the files as they were when staged and stores a snapshot of them in the database for the repository

- ❶ Open your favourite program for authoring R code (e.g. RStudio)
- ❷ Create an new R script
- ❸ Save your R Script in the 'clone' of your repository

```
> git status
On branch master
Your branch is up-to-date with 'origin/master'.
Untracked files:
  (use "git add <file>..." to include in what
   will be committed)
```

We have to tell Git that we want it to track the changes we make to this new file

We have to tell Git that we want it to track the changes we make to this new file

```
> git add filename.R
> git status
On branch master
Your branch is up-to-date with 'origin/master'.
Changes to be committed:
  (use "git reset HEAD <file >..." to unstage)

new file:   filename.R
```

We can still change our mind about adding the file to the repository at this stage quite easily.

Once you're ready to 'commit' this change to the permanent record of changes in this repository we make a 'commit'

```
> git commit  
[master 311acfb] Initial Commit of some R code.  
1 files changed, 0 insertions(+), 0 deletions  
(-) create mode 100644 filename.R
```

You will be prompted to write a short description of the changes you are committing - these become invaluable as your project grows and if you are collaborating. Once you've written a commit message, save it (and close the text editor if you used one). You should see confirmation of the commit immediately below the git commit line.

Now that you've committed some changes to your local clone of the repository this local version will be ahead of the version on the GitHub Server

```
> git status
On branch master
Your branch is ahead of 'origin/master' by 1
commit.
  (use "git push" to publish your local commits)
```

Seeing as we are all currently connected to the internet, it's a good time to 'push' these changes to GitHub server ('origin/master' in the default setup) to bring the remote copy of this repository up to date.

pushing to the remote servers

```
> git push
Counting objects: 3, done.
Delta compression using up to 8 threads.
Compressing objects: 100\% (2/2), done.
Writing objects: 100\% (3/3), 353 bytes | 0 bytes/s
Total 3 (delta 0), reused 0 (delta 0)
To git@github.com:brfitzpatrick/my_new_repo.git
 4930bee..99d61f1  master -> master
```

If you return to the page for your repository on the GitHub website and refresh the page you should see your most recent commit listed on the repository page.

the whole process

Furthermore, now that we have 'committed' and 'pushed' our most recent changes our local copy of the repository and the remote copy of the repository on the GitHub servers will be identical

```
> git status
```

On branch master

Your branch is up-to-date with 'origin/master'.
nothing to commit, working directory clean

To revert to a previous version of a file that you have 'snapshot' of from a previous 'commit'

Click on the file name on the GitHub website and click the 'History' button:

Provided we have committed all changes to the file then it is safe to use the checkout command which will overwrite the file in the current local working directory with the file from the previous 'commit'.

You can think of commits a bit like save points, if we have two we can move between them but if we load an old save without first making a current save we will lose the unsaved changes

choose a commit you'd like to go back to...copy the SHA

```
git checkout 99d61f19d85ae7aec691feb81ca8aef59f6a0719
```

and open 'filename.R' and our changes are gone

checkout the most recent commit to get them back

if you want to go back to a previous version of a file and try something new without overwriting your most recent versions you can 'checkout' and old 'commit' to a new 'branch' of the repository

One way to safely experiment with past versions of a file is to create a new 'branch' in the repository in which to do so

branches are separate lines of development of the same files

let's make a new 'testing3' branch checking out a previous version of the file filename.R

```
> git checkout 99d61f19d85ae7aec691feb81ca8aef59f6a0
```

```
> git push --set-upstream origin testing3
```

we can then move between branches with the checkout command

```
> git checkout master
```

```
> git checkout testing3
```

Merging Branches

To merge the 'master' and 'testing3' branches

```
> git checkout master  
> git merge testing3
```

if you get a merge conflict use a mergetool to resolve the conflict (you should have one installed by default from when you installed Git)

```
> git mergetool
```

Forking

Fork a repository Use the Sync button in Windows/MacOS client to get new changes from server (and submit any changes you have made)

Create a Repository, Add Some Files

- Log into your Github account
- Click the Repositories Tab
- Click the 'New' button (it's green)
- name your repository
- make it public (we can do a private one later)
- initialize repository with a README
- add a license GPL or MIT are easy FOSS licenses
- clone the repository to your hard drive
- add a file to your local clone of the repository
- commit it to the repository
- push your changes to the remote repository

Fork a Friends Repository, Add Some Files

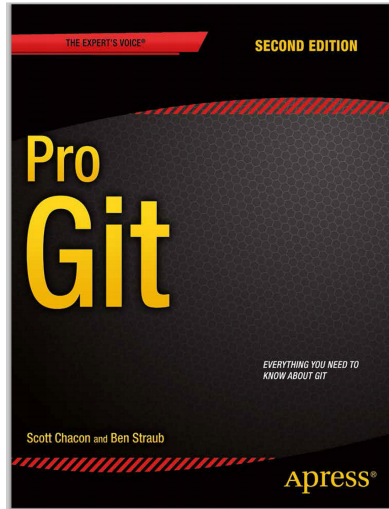
- search for a friend's github repository
- on their repository page click fork
- clone your fork of their repository to your hard drive
- edit one of their files
- push your changes to their repo

Accepting and rejecting Pull Requests

Merging your friends' branches

Recommended Further Reading

<http://git-scm.com/book/en/v2>



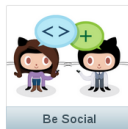
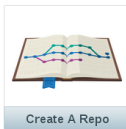
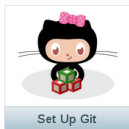
[?]

Recommended Further Reading:

<https://help.github.com/>

GitHub Help

Version ▾ Contact Support Return to GitHub



Sometimes you just need a little help.

How can we help?



Common Issues

- › Why are my contributions not showing up on my profile?
- › Why is Git always asking for my password?
- › Dealing with non-fast-forward errors
- › Error: Repository not found
- › Do you have custom plans?
- › HTTPS cloning errors
- › What is my disk quota?
- › What are the limits for viewing content and diffs in my repository?
- › Remove sensitive data
- › How do I access my organization account?

References

Image Credits

- Git Logo by Jason Long
<http://git-scm.com/downloads/logos>
- GitHub Logo
- R Logo