

# Git and GitHub: A Guide for Economists

Frank Pinter

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# Outline

The importance of version control

Using version control

Using Git by yourself

Using Git for collaboration

# What is version control?

Version control is a way to keep track of changes to code, text, and documents. And data and outputs.

- ▶ It gives you an organized revision history
- ▶ It lets you experiment without fear
- ▶ It lets you go back and forth between many different versions of the same file, and see a list of the differences
- ▶ It makes (the technical aspects of) collaboration a breeze
- ▶ It lets you and your collaborators work on different versions and then merge them

# What is Git?

- ▶ Git is a program that does version control
- ▶ It is the most popular version control program in software development
- ▶ It is easy to set up and get started
- ▶ There are many programs that add intuitive interfaces on top of Git
- ▶ Git integrates seamlessly with online collaboration tools like GitHub and GitLab

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## Using it yourself

Git isn't just useful for collaboration. It also helps you keep your own projects organized.

# Life without version control

You're writing a paper and you have a regression.

- ▶ Advisor 1 tells you to include a certain variable. You put in lots of work to get the data, clean it, merge it, change the specification, and re-run.
- ▶ Advisor 2 tells you that variable is dumb. You remove it.
- ▶ Then Advisor 2 changes their mind.

What do you do?

# Life without version control

Do you keep every specification you ever tried?

- ▶ The code and the outputs?
- ▶ What if you discover a coding error that affects many of your specifications?
- ▶ How do you organize all the files?



## Version control 0.1: putting dates on things

Does this look familiar?

```
run_regs_11_17_2018_v4_final_final.do
```

“Not one piece of commercial software you have on your PC, your phone, your tablet, your car, or any other modern computing device was written with the ‘date and initial’ method.” (Gentzkow and Shapiro)

## Version control 0.2: Dropbox

- ▶ Dropbox keeps a crude version history.
  - ▶ But there are no labels or comments, and it's not easy to see the differences between files.
  - ▶ So if you want to dig up “the version where I had that other variable” you have to manually look through a bunch of versions.
  - ▶ And good luck if you changed two scripts, not just one.
- ▶ Dropbox lets you and your collaborators stay in sync.
  - ▶ What if you and your coauthor try to change the same script at the same time?
  - ▶ What if you are trying one change and, at the same time, your coauthor is trying a different change?

## Version control 0.2: Dropbox

A Post It note spotted on a grad student's desk:

*Don't forget! At 10:18 am on November 17th, we changed the specification to add new variable.*

Don't live this way.

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# Why use Git?

Git is the dominant version control system today. There are others, but they're generally more work with no benefit.

# What software can I use?

- ▶ GitKraken
- ▶ GitHub Desktop
- ▶ Command line (powerful!)
- ▶ RStudio (for R projects)

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# Getting started



# The Git model

1. You do work in your **working directory**.
2. Then you add it to your **staging area**.
3. Once you've staged all your changes for one discrete task, **commit**.
4. If you have a remote repo, **push** your commit to the remote repo.

## Commits: saving a snapshot

What is “one discrete task”? A collection of changes, across multiple files, that does *one thing*. Examples:

- ▶ Change the formatting of a variable from string to numeric, and treat it properly across multiple scripts
- ▶ Change your regression specification in code, in the output, and in your paper and supporting documentation
- ▶ Add a new function, and tests for that function

# Run tests when you commit

Your code should run properly when you commit.

- ▶ No runtime errors
  - ▶ Test this by running all code that changed, and everything that depends on it
  - ▶ Makefiles automate this process
  - ▶ Only skip if you are sure you didn't change anything important
- ▶ No compilation errors (including  $\text{\LaTeX}$ )
- ▶ Tests should pass
- ▶ Output should be consistent with what you've written
  - ▶ Don't report a negative regression coefficient, and write in words that the estimated coefficient is positive

But it's better to have frequent commits (that might have small mistakes) than to have giant, infrequent commits.

You can also do partial commits (`git add --patch`) which are somewhat advanced.

# What should I include?

1. At a minimum:
  - ▶ Code (.do, .R, .m, .jl, and so on)
  - ▶ Text files (.txt)
  - ▶ L<sup>A</sup>T<sub>E</sub>X documents (.tex)
2. I also recommend:
  - ▶ Raw .csv datasets, if small (<10 MB)
3. These are binary files, so you can't see differences between versions. I recommend including them anyway.
  - ▶ PDF files
  - ▶ Word, Excel, PowerPoint files
4. Some people also include all datasets.
  - ▶ Note that GitHub doesn't allow files larger than 100 MB, or projects with total size larger than 1 GB.

For datasets, look into Git Large File Storage.

# What should I exclude?

In order to avoid driving your coauthors crazy, you **must** tell Git to ignore the junk files:

- ▶ Junk created by  $\text{\LaTeX}$ : \*.synctex.gz, \*.out, \*.log, etc
- ▶ Junk created by R: .RData
- ▶ Junk created by Python: \*.pyc

Exclude files using a file called .gitignore

## Comparing commits: diff

## Branches: trying things out

## Keeping it local vs. using a remote repository

Git doesn't require a remote repository. You can run it 100% on your computer, with no connection to an outside server.

- ▶ This is useful if you have restrictions on your code (for example, you work with confidential health data)
  - ▶ Ask me if you have questions about using Git this way on the NBER cluster
- ▶ But a remote repository helps you keep things backed up seamlessly, and lets you collaborate



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# Repos

# What's GitHub?

## Brief detour: hosting services

- ▶ With a free GitHub account, you can create
  - ▶ as many private repositories as you want
  - ▶ but each private repository can only have three collaborators.
  - ▶ You can also create as many public repositories as you want (and each can have as many collaborators as you want).
- ▶ GitLab is a competing service. With a free GitLab account, you can create as many private repositories as you want, with as many collaborators as you want.
- ▶ It's easy to use GitHub for one project, and GitLab for another

# Conclusion

## Further reading

- ▶ Matt Gentzkow and Jesse Shapiro, “Code and Data for the Social Sciences: A Practitioner’s Guide” (<https://web.stanford.edu/~gentzkow/research/CodeAndData.pdf>). See Chapter 3 for more on why you should use version control.
- ▶ Jesús Fernández-Villaverde’s notes on high-performance computing (see also his class Computational Economics). Chapter 5 ([https://www.sas.upenn.edu/~jesusfv/Chapter\\_HPC\\_5\\_Git.pdf](https://www.sas.upenn.edu/~jesusfv/Chapter_HPC_5_Git.pdf)) is an extended Git tutorial using the command line interface.
- ▶ Hadley Wickham’s book on writing R packages. The chapter on Git and GitHub (<http://r-pkgs.had.co.nz/git.html>) is well-written and not specific to R.