MPP-E1180 Lecture 2: Files, File Structures, Version Control, & Collaboration

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Objectives for the week

- Importance of (text) files and understanding files structures for reproducible research
- Understanding files paths (conventions, best practices)
- Accessing the file system from R
- Introduction to Git/GitHub for version control
- Git/GitHub for collaboration

Remember: Practical Tips for Reproducible Research

- Document Everything!
- Everything is a (text) file.
- All files should be human readable.
- Explicitly tie your files together.
- Have a plan to organise, store, and make your files available.

Importance of understanding files/file structures

- This topic may seem kind of . . . dry.
- Why not just click and drag files?

Importance of understanding files/file structures

- **Reproducibility**: other researchers only have your files. If they are **well organised** and the **links** between the files are **explicitly stated** then they can better understand what you did.
    - Most clear way of explicitly stating links is **dynamically** using file paths in your source code.
- **The software tools of really reproducible research**: R, RMarkdown, LaTeX, etc. all assume that you understand file paths.
- **You**: well organised files will be easier for you to find/understand/use in 6 months.

Why text files?

- Basically files are ultimately text files.
  - E.g. a website is typically just a series of connected `.html`, `.js`, and `.css` files.
  - These are text files! Despite different file extensions.
- Text files are **versitile**.
  - Store your code (`.csv`), store your analysis code (`.R`), store your presentation markup (`.Rmd`, `.tex`, `.bib`).
- They are **simple** and are **not dependent on particular software**. Any text editor can open them.
  - Helps **future-proof** research.
- Easy to **version control**.

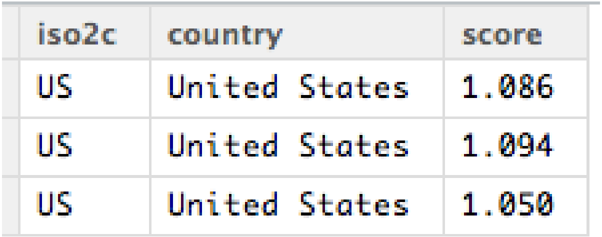
CSV Example

CSV (Comma Separated Values)

- All columns are separated by commas ,.
- All rows are separated by new lines.

```
iso2c, country, score
US,United States,1.086
US,United States,1.094
US,United States,1.050
```

Makes:



iso2c	country	score
US	United States	1.086
US	United States	1.094
US	United States	1.050

Text files best practices

- Use RStudio or some **text editor** (personal current favourite: atom.io) to edit text files.
  - Never open/edit using MS Word!
  - Word will add a lot of hidden background text that is likely to cause problems with R and other software. R/etc doesn't understand Word's instructions.

Text files best practices

- Document your text files, including **informative header**.
    - Use **comment characters** (R: #, Markdown/HTML: <!-- -->)
    - For example:

```
#####################
# R source to gather World Bank data
# Christopher Gandrud
# 18 September 2014
# MIT License
####################

2 + 2 # Inline comment
```

Text files best practices

- Keep line length to about 80 characters.
    - In Markdown/LaTeX paragraph breaks only exist if there are **two line breaks**.
    - Most text editors, including RStudio have a character ruler.
    - Improves version control.

```
This is treated as
only one paragraph.

This is treated as

two paragraphs.
```

File paths

- Files are organised **hierarchically** into (upside down) trees.

```
Root
|_
    Parent
    |_
        Child1
        Child2
```

Root

Root directories are the first level of a disk.

They are the root out of which the file tree grows.

Naming Conventions:

Linux/Mac: `/`, e.g. `/git_repos` means that the `git_repos` directory is a child of the root directory.

Windows: the disk is partitioned, e.g. the C partition is denoted `C:\`. `C:\git_repos` indicates that the `git_repos` directory is a child of the `C:\` partition.

Sub (child) directories

Sub (child) directories are denoted with a / in Linux/Mac and \ in Windows, e.g.:

```
# Linux/Mac
/git_repos/Project1

# Windows
C:\git_repos\Project1
```

R tip:

- In R for Windows you either use two backslashes \\ (\ is the R **escape character**).
- Alternatively, use / in **relative paths** in R for Windows, it will know what you mean.

Working directories

A **working directory** is the directory where the program looks for files/other directories.

Always remember the working directory. Otherwise you may open/save files that you do not want to open/save or save them to places you don't want them saved.

Working directories

In R:

```r
# Find working directory
getwd()
```

```
## [1] "/git_repositories/SyllabusAndLectures/LectureSlides
```

```r
# List all files in the working directory
list.files()
```

```
## [1] "img"              "Lecture2.html" "Lecture2.Rmd"
```

```r
# Set root as working directory
setwd('/')
```

Extra: in the Terminal Shell

```
# Find working directory
pwd

# Set root as working directory
cd /
```

Relative vs. Absolute file paths

Use **relative file paths** when possible.

- **Absolute file path**: the entire path on a particular system,
  - E.g. `/git_repos/Project1/Paper.Rmd`
- **Relative file path**: the path relative to the working directory.
  - E.g. if `/git_repos` is the working directory then the relative path for `Paper.Rmd` is `Project1/Paper.Rmd`.

Why?

- Your scripts will run easily on other computers. Enhances reproducibility, easier for your collaborators, easier for you when you use another computer.

File & directory name conventions

- **Don’t use spaces** in your file names. The can create problems for programs that treat spaces as an indication that the path has ended.
- Alternatives:
  - `CamelCase`
  - `file_underscore`

Load files into R

There are a number of R commands to load files, depending on the file type.

- Load Data: `read.table`, `read.csv` `read.dta` `xlsx::read.xlsx`, `repmis::source_data`

```
read.csv('data/TestData.csv')
```

- Save Data: `write.csv`, `write.dta`
- Load and run R source code: `source`

```
source('source/Analysis1.R')
```

URLs

URLs are also file paths for files on the internet.

You can use them the same way as local file paths.

```
Disproportionality <- repmis::source_data("http://bit.ly/Ss
```

```
## Downloading data from: http://bit.ly/Ss6zDO
##
## SHA-1 hash of the downloaded data file is:
## dc8110d6dff32f682bd2f2fdbacb89e37b94f95d
```

Version Control with Git

Why version control?

- Detailed log of all changes.
- Clear attribution of work (who contributed what).
- Easy to revert back to previous versions.

Git vs. GitHub

What is Git?

- Git is an open source command line program for version control.

What is GitHub?

- A company that hosts Git repositories and enables ‘social coding’.
- Other services are available, e.g. BitBucket
- Note: ultimately your locally stored repositories are yours separate from GitHub.

GUI GitHub

What is GitHub for Mac/Windows?

- A GUI (graphical user interface version of Git).
- Makes it easier to use.
- Ultimately just does command line Git.

Getting started with Git

Note: using command line (Shell), but all of these things can be done in the GitHub GUI.

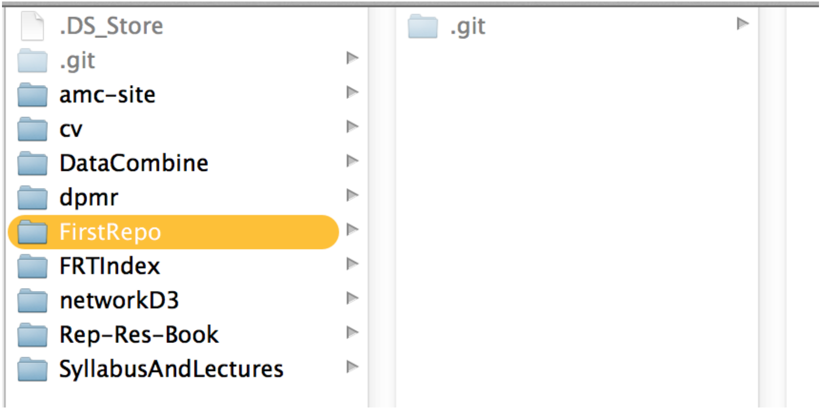
First lets create a directory (`FirstRepo`) that will become our **Git repository** (i.e. parent directory)

```
# Make repository directory
mkdir /git_repositories/FirstRepo

# Change working directory
cd /git_repositories/FirstRepo

# Begin version control by initialising as a Git repo
git init
```

Getting started with Git



.DS_Store
.git
amc–site
cv
DataCombine
dpmr
FirstRepo
FRTIndex
networkD3
Rep–Res–Book
SyllabusAndLectures

.git

Getting started with Git

Add a text file to the repo.

```
# Create a new file called README.md
echo "# My first repo" > README.md

# Check Git status
git status

# On branch master
#
# Initial commit
#
# Untracked files:
#   (use "git add <file>..." to include in what will be com
#
#    README.md
```

Getting started with Git

Begin tracking changes, by **staging** the repo's files.

```
git add .
```

Make some changes to `README.md`. These changes will not be logged by Git until they are **Committed**

```
git commit -am 'author name added to README'
```

- `a`: all changes are committed
- `m`: add a Git commit message. Try to be **informative**.

Also, compare to previous commits with `git diff`

Git Logg

You can view all previous commits with `git log`

```
git log
```

```
commit 3c49e3f1d2f03513c1554bb36d034562312b5bed
Author: christophergandrud <christopher.gandrud@gmail.co>
Date:   Tue Sep 9 15:54:44 2014 +0200

    author name added to README
```

Git Checkout

Each commit is given a **unique SHA-1 hash**.

The hash in the previous example was `3c49e3f1d2f03513c1554bb36d034562312b5bed`.

You can switch back to any previous commit with `git checkout` and the commit hash or `--` for the last commit.

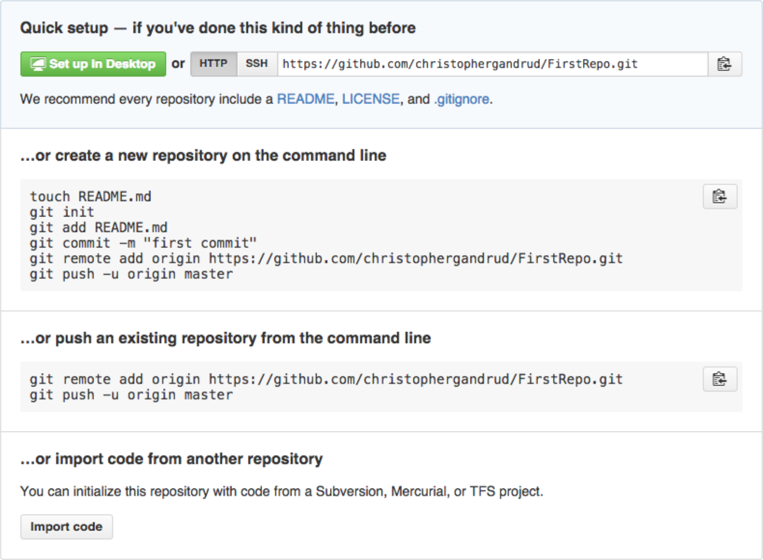
```
git checkout --
```

Add to GitHub

So far the repo is only on your own computer.

To add it to GitHub:

1. Create a new repository on GitHub. Give it the same name as you local repo (i.e. `FirstRepo`). Do not initialise with any files.
2. Follow the instructions:



Quick setup — if you've done this kind of thing before

https://github.com/christophergandrud/FirstRepo.git

We recommend every repository include a README, LICENSE, and .gitignore.

...or create a new repository on the command line

```
touch README.md
git init
git add README.md
git commit -m "first commit"
git remote add origin https://github.com/christophergandrud/FirstRepo.git
git push -u origin master
```

...or push an existing repository from the command line

```
git remote add origin https://github.com/christophergandrud/FirstRepo.git
git push -u origin master
```

...or import code from another repository

You can initialize this repository with code from a Subversion, Mercurial, or TFS project.

Updating From Remote Repositories (1)

After you commit a change to the **local** repository you need to **push** the changes to GitHub:

```
git push origin master
```

- `origin`: the remote repo on GitHub
- `master` is the master branch (we'll get to this in a second)

Updating From Remote Repositories (2)

If there are changes on the remote repo, then you will need to **pull** and **merge** them.

```
git pull origin master
```

```
Unpacking objects: 100% (3/3), done.
From https://github.com/christophergandrud/FirstRepo
 * branch            master     -> FETCH_HEAD
   3c49e3f..fe3cc0a  master     -> origin/master
Updating 3c49e3f..fe3cc0a
Fast-forward
 README.md | 4 +++-
 1 file changed, 3 insertions(+), 1 deletion(-)
```

Git will tell you if there are any **merge confilcts**. You will need to sort these out.

Comparing Commits on GitHub

View a file's `History`.

Branches

You can create multiple **branches** in your repo.

These allow you to:

- Make changes to a project without affecting the **master** branch
- A branch called **gh-pages** pushed to GitHub will become a hosted website.

Branches Example

Create a new branch called `TestBranch`

```
git checkout -B TestBranch
```

You can make `add` files and `commit` changes.

When you think that the changes are ready to be merged with the `master` branch:

```
git commit -am 'last changes to TestBranch, ready for maste

git checkout master

git merge TestBranch

# Delete the branch if you want to
git branch -D TestBranch
```

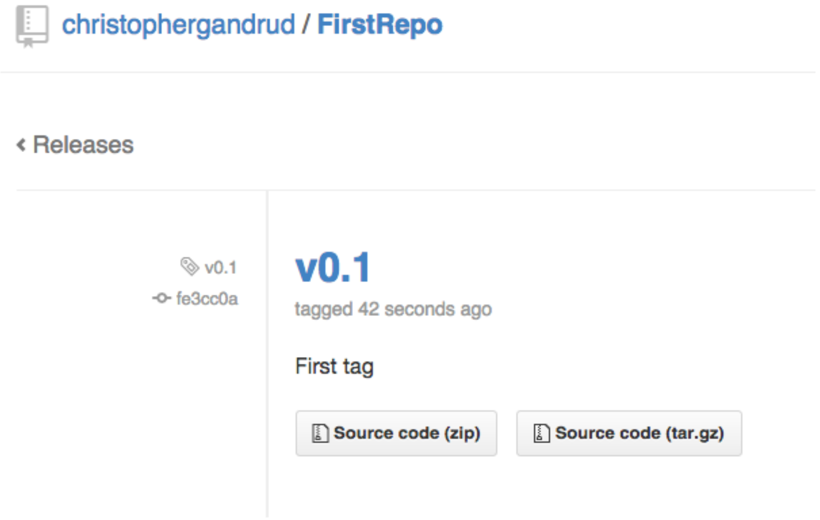
Tags

You can **tag** a particular commit so that it is easy to find.

You need to tag your assignments when you turn them in.

```
git tag -a v0.1 -m 'First tag'

git push --tags
```



christophergandrud / FirstRepo

‹ Releases

v0.1
fe3cc0a

v0.1

tagged 42 seconds ago

First tag

Tags and DOI

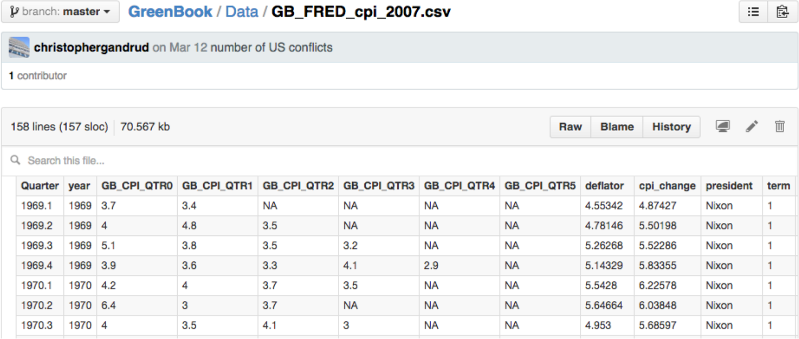
You can use GitHub tags to create **Digital Object Identifiers**.

Use for **citing** (particular version of) research.

See `https://guides.github.com/activities/citable-code/`

Data on GitHub

CSV files are rendered in the browser:



GreenBook / Data / GB_FRED_cpi_2007.csv

christophergandrud on Mar 12 number of US conflicts

1 contributor

158 lines (157 sloc) | 70.567 kb

Quarter	year	GB_CPI_QTR0	GB_CPI_QTR1	GB_CPI_QTR2	GB_CPI_QTR3	GB_CPI_QTR4	GB_CPI_QTR5	deflator	cpi_change	president	term
1969.1	1969	3.7	3.4	NA	NA	NA	NA	4.55342	4.87427	Nixon	1
1969.2	1969	4	4.8	3.5	NA	NA	NA	4.78146	5.50198	Nixon	1
1969.3	1969	5.1	3.8	3.5	3.2	NA	NA	5.26268	5.52286	Nixon	1
1969.4	1969	3.9	3.6	3.3	4.1	2.9	NA	5.14329	5.83355	Nixon	1
1970.1	1970	4.2	4	3.7	3.5	NA	NA	5.5428	6.22578	Nixon	1
1970.2	1970	6.4	3	3.7	NA	NA	NA	5.64664	6.03848	Nixon	1
1970.3	1970	4	3.5	4.1	3	NA	NA	4.953	5.68597	Nixon	1

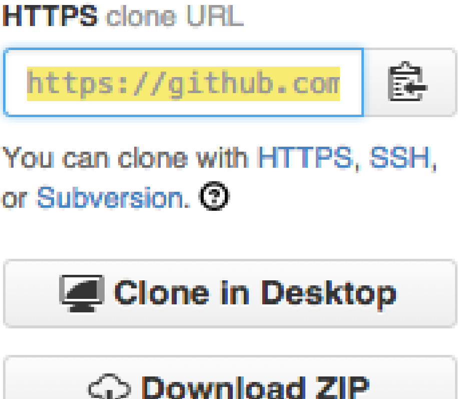
Collaborating on GitHub: Official Collaborators

You can add **official collaborators** to the repo on GitHub:

Settings > Collaborators > Enter collaborator's GitHub username

Now the will have read/write privelages (they can **push** as well as **pull**)

They should **clone** the repo.



HTTPS clone URL

https://github.com

You can clone with HTTPS, SSH, or Subversion.

GitHub Issues

A good way to communicate is to use GitHub Issues.

Creates an open and public record of thoughts/issues that anyone can contribute to.

Forking/Pull Requests

Fork: You can copy a repo and then build on it by **forking** it.

- This maintains entire version history, contributors, etc,

Pull: Anyone (non-official contributors) can make a **pull request**.

Simplest way is to click edit () on someone else's repo. Begin editing.

Note:

- Need approval from a repo owner
- Once the request is accepted, the change is **automatically merged** into master.

Seminar: Files/File Paths

- Play around with the file system from R and the Shell
    - Find the working directory, change the working directory, explore the files in the working directory.
    - If you have any data files, try to load them into R.
    - If not download `https://github.com/christophergandrud/Rep-Res-ExampleProject1` and load `Data/MainData.csv` into R.

Seminar: Git/GitHub

- Create a new local repository and push it to GitHub.
- Add your neighbour as a collaborator.
- Push/Pull commits.
- Open and close issues.
- Fork a neighour's repo.
- Make a pull request to another neighour's repo.
- Accept (or reject) a pull request.