Open and Reproducible Research: Tools 3

January, 2015

Topics

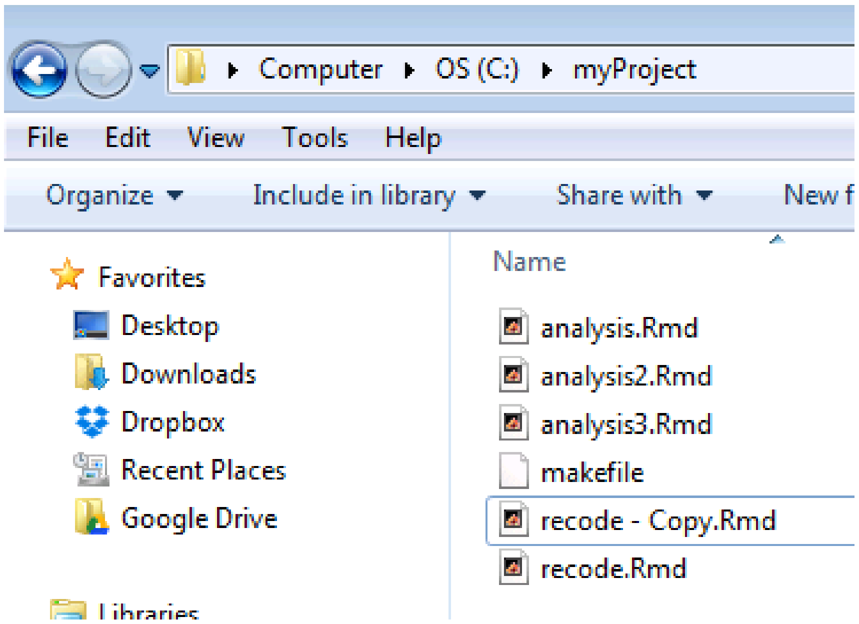
- Git
- Github
- Reproducible research check list

What is git?

- the stupid content tracker
- a fast, scalable, distributed revision control system with an unusually rich command set that provides both high-level operations and full access to internals.
- "I'm an egotistical bastard, and I name all my projects after myself. First 'Linux', now 'git' " — Linus Torvalds according to "Why the 'Git' name?" item in GitFaq. Accessed at https://git.wiki.kernel.org/index.php/GitFaq on Jan, 2015.

Tracking changes of working file(s) over time 1

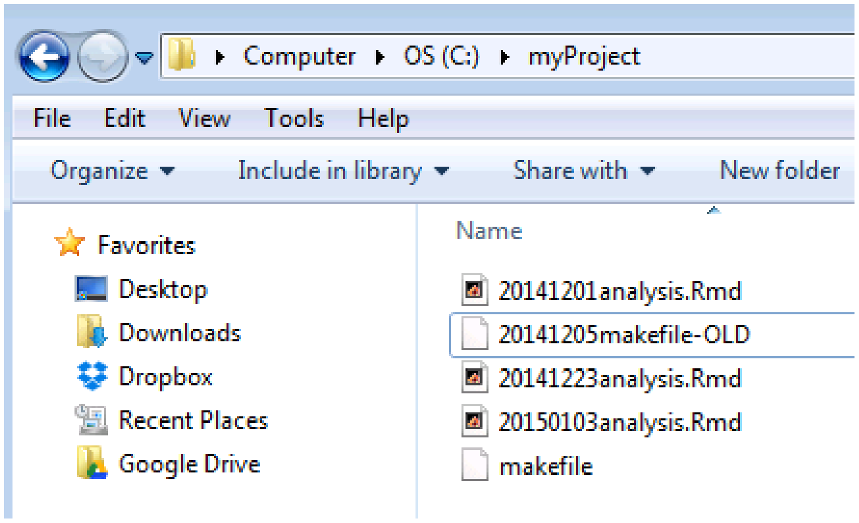
- versioning



- `egsr03.dat`: Egyptian WFS Standard Record Ver 3

Tracking changes over time 2

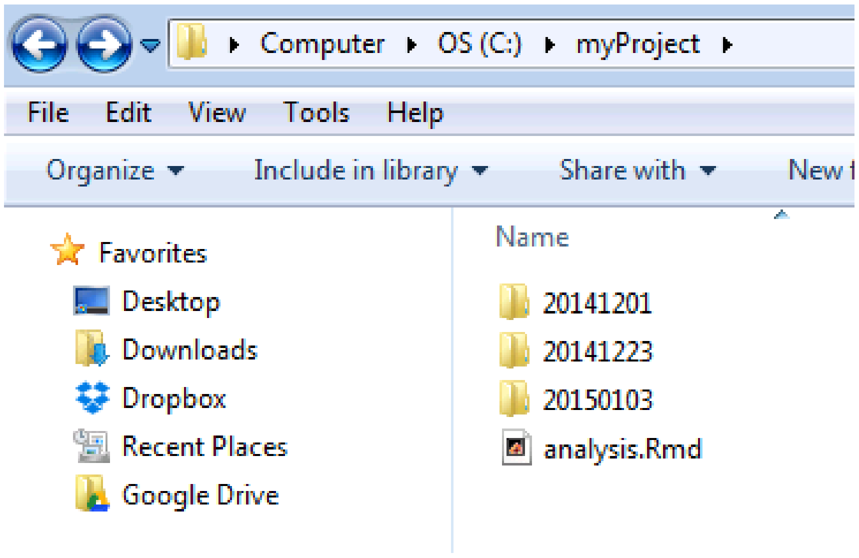
- timestamping



- `504_ideas_2014-05-19T19_04_52Z_public_cleaned.csv`

Tracking changes over time 3

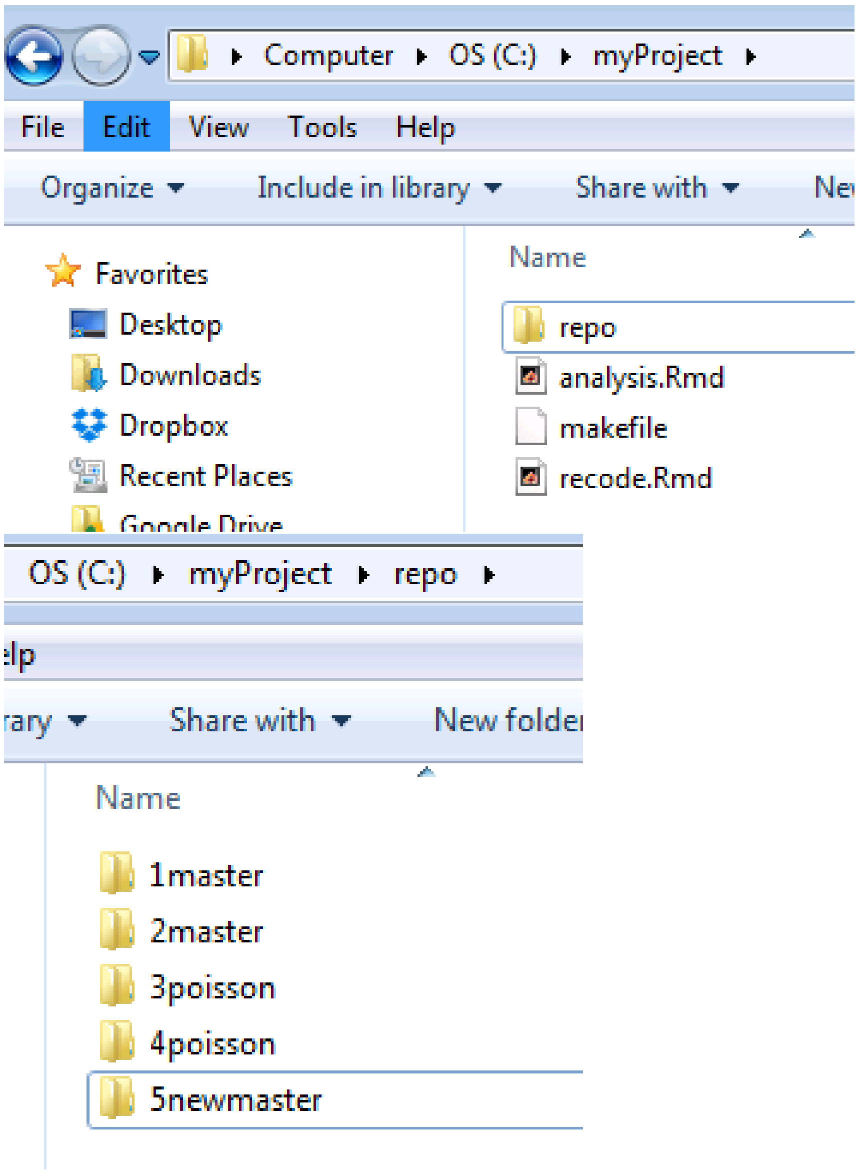
- snapshot: state of a system (here a file) at a particular point in time



- keep only the latest (current) files in the working directory
- `20141201` directory has the `analysis.Rmd` (and any other files) as was on Dec., 1, 2014
- `20141223` directory has the `anaysis.Rmd` (ditto) as was on Dec., 23, 2014

More elaborate snapshots strategy

- put all the snapshots under a subdirectory (repo?)
- snapshot names don't have to be date
- "branches" idea


Computer ▸ OS (C:) ▸ myProject ▸
File Edit View Tools Help
Organize ▾ Include in library ▾ Share with ▾ Ne
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Name
1master
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4poisson
5newmaster

Git as snapshot management system

- each snapshot is called a 'commit'
- Git stores file contents as well as meta-data (file names, who made the snapshot (commit), when, how this snapshot is related to other snapshot, . . .)

- Git stores everything under the (hidden) .git directory
- everything in Git is check-summed before it is stored and is then referred to by that checksum (20-byte SHA-1 hash)
- Git generally only adds information – it is hard to get Git do something undoable or to erase/lose data without Git's knowing
- Git is a distributed system – everybody has their own local copy of the entire history of a project

First-time Setup

- open the cmd.exe (terminal) window
- set name and email

```
git config --global user.name "Mary Smith"
git config --global user.email msmith@example.edu
```

- set text editor

```
git config --global core.editor nano
```

Quiz

Open cmd.exe. Set your global user.name and user.email to your choices; and the core.editor to nano.

Once you've done that, what does the following command returns?

```
git config --global core.editor
```

1. vim
2. chang y. chung
3. cchung@princeton.edu
4. nano

Demonstration: Initial commit

- will demonstrate the following:
  - create a project directory
  - create a R Markdown file (analysis.Rmd)

    - test run it using rscript

- open the windows explorer and cmd.exe window and do:
    - `git init`
    - `git add analysis.Rmd`
    - `git commit -m 'commit for the first time'`
    - `git status` to check the status
    - `git log` to view the history (commits)
- try it yourself

Checking repository status and reviewing project history

- to see where things are at: `git status`
- a new or modified file should be:
    - first staged(cached) using `git add`; and
    - then snapshot by `git commit`
- to see the history (of commits): `git log`

Quiz

Indicate if the following statement is true or false.

in order to make a snapshot of a new or modified file using Git, we need to get the file:

- first staged (cached) using `git add`; and
- then snapshot by `git commit`

Challenge

Create an appropriate `makefile`, and then make another commit with a commit message, "add a makefile"

Once done, then the `git log` should show two commits like so:

```
commit 6b3f0c8bad195b94c99f658b8182a5fa87d1605f
Author: Chang Y. Chung <chang_y_chung@hotmail.com>
Date:   Wed Jan 7 15:20:02 2015 -0500

    add a makefile
```

```
commit e7f3e7bc9220fd552cbe03a0bf89436ea8fe157c
Author: Chang Y. Chung <chang_y_chung@hotmail.com>
Date:   Wed Jan 7 15:09:57 2015 -0500

    commit for the first time
```

Challenge

- practice another commit
  - Open and edit `analysis.Rmd`. Save. Now `git status` reports that `analysis.Rmd` is not staged.
  - Process it by `make` – this will overwrite `analysis.html` if exists. Try `git status` again and confirm that the .Rmd file is not staged and the .html file is not tracked.
  - Issue `git add analysis.*` to stage both the file. Commit with a message, something like "make editorial changes and track html"
- extra
  - Confirm that `git log` now shows three commits.
  - Try options like `git log --oneline`
  - See help using `--help` option like: `git log --help`

Let's take a break

- any questions?

See the differences

- Open the analysis.Rmd and make some changes. I am going to add another sentence on top.
- `git diff analysis.Rmd` shows the differences between the latest working version (not staged yet) and that in the latest commit.
- `git diff --help` shows many different comparisons possible

Undoing

- Commit too early and possibly forget to add some files: `git commit --amend` and example:

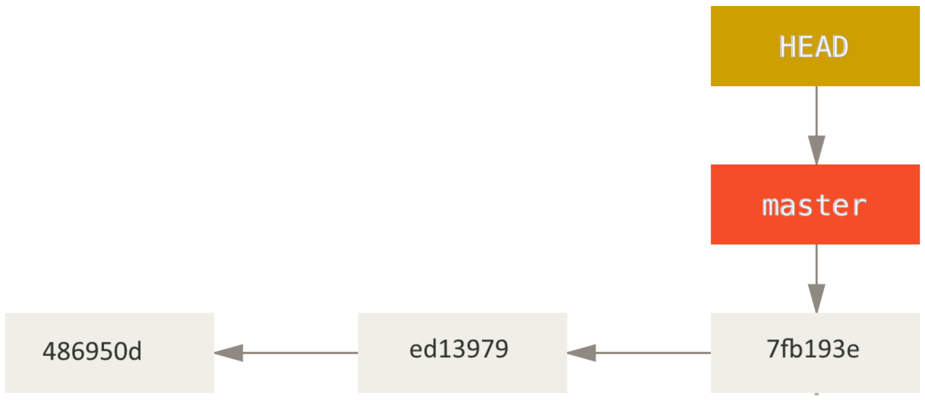
```
git commit -m 'initial commit'

git add some_file_to_add
git commit --amend
```

- Unstaging a staged (`git added`) file: `git reset HEAD file_to_unstage`
- You've modified a file and messed it up. Would like to start over how it was at the last commit: `git checkout -- file_to_revert_back` (See demonstration)

Branching

- a Git repository with three commits and only one (default) branch, master

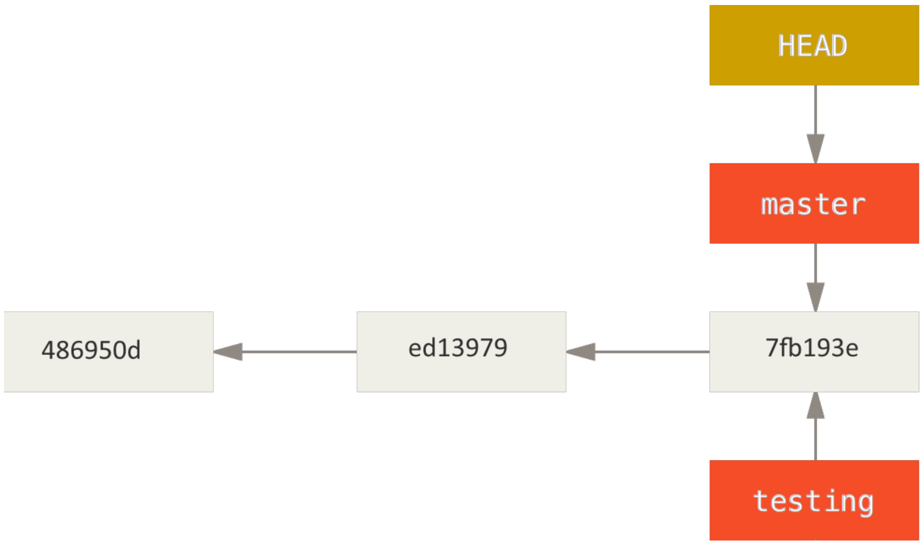
```
> git log --oneline --decorate
7fb193e (HEAD, master) third commit
ed13979 second commit
486950d first commit
> git branch
* master
```



Create a branch

- `git branch testing`

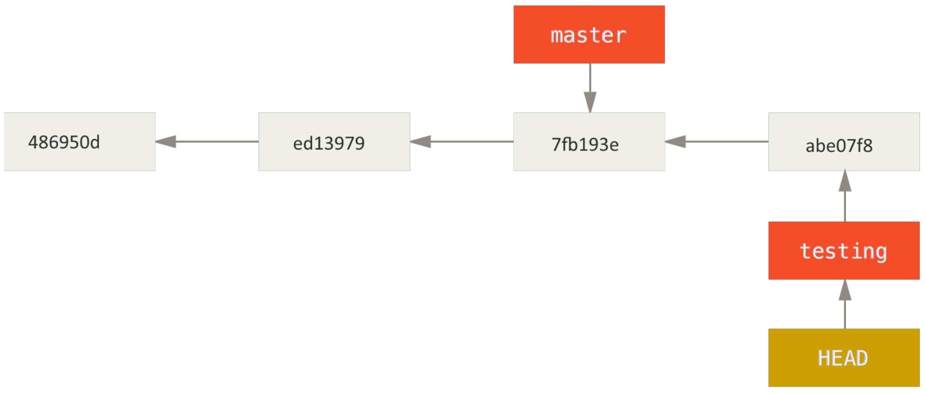
```
> git branch testing
> git log --oneline --decorate
7fb193e (HEAD, testing, master) third commit
ed13979 second commit
486950d first commit
```



Check out a branch

- `git checkout testing` then work as usual, then commit

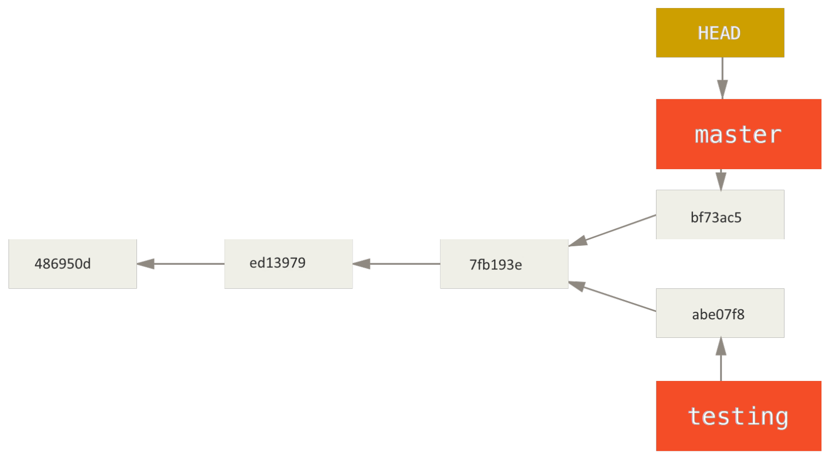
```
> git checkout testing
  (modify files)
> git add ...
> git commit -m ...
> git log --oneline --decorate
abe07f8 (HEAD, testing) testing update
7fb193e (master) third commit
ed13979 second commit
486950d first commit
```



Checkout master

- `git checkout master` bring us back to third commit

```
> git checkout master
  (modify files)
> git add ...
> git commit -m "update master"
```



Merge testing branch into master

```
> git checkout master
> git merge training
Auto-merging myfile.txt
CONFLICT (content): Merge conflict in myfile.txt
Automatic merge failed; fix conflicts and then commit the result.
```

- merge conflict: same part of the file modified differently

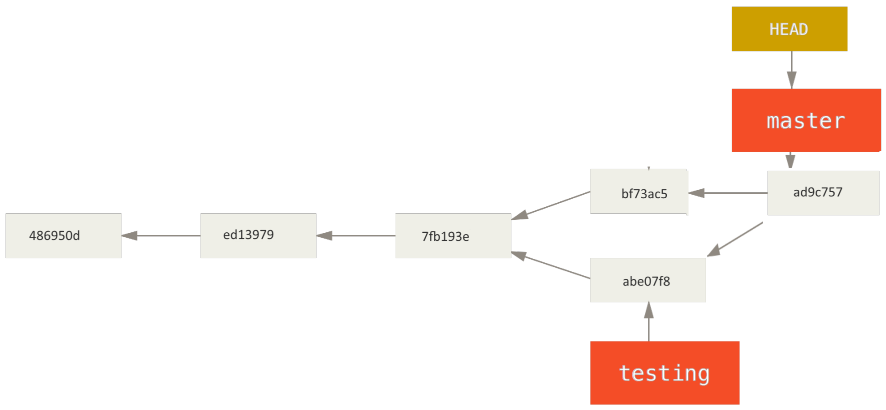
```
> type myfile.txt       | in master             in testing
initial file content    | initial file content  initial file content
second line             | second line           second line
third line              | third line            third line
<<<<<<< HEAD            | master update         testing update
master update           |
=======                |
testing update         |
>>>>>>> testing        |
```

Resolve merge conflict

- manually edit conflicting part and remove `<<<<<<<<`, `========`, and `>>>>>>>>` lines completely
- and then stage that file, and commit

```
  (editing)
> type myfile.txt
initial file content
second line
third line
master and testing updates
> git add myfile.txt
> git commit -m "merged"
[master ad9c757] merged
```

After merge



Quiz

Indicate if the following statement is true or false:

1. In version control (VC), branching means "you diverge from the main line of development and continue to do work without messing with that main line" (T/F)
2. A branch in Git is simply a pointer to one of the commits (T/F)
3. If no merge conflicts (i.e., the same part of the same file has been modified differently depending on the branch), Git can merge branches quickly and easily (T/F)
4. Git remote branches are pointers to the branches in remote repositories, e.g. `origin/master` (T/F)

GitHub

- GitHub is the best place to share code with friends, co-workers, and complete strangers – https://github.com/about
- a web-based Git repository hosting service launched in 2008, founded by Tom Preston-Werner, Chris Wanstrath, and PJ Hyett
- GitHub is like facebook for programmers – Karl W. Broman hadley, yihui, rdpeng, torvalds, matz, mbostock, jgm, . . .

Cloning

- a public repository on GitHub can be easily `clone`ed
- get a copy of all the slides for this workshop

```
cd desktop
git clone https://github.com/Chang-Y-Chung/rr
```

Push to a GitHub repo

Requirements - a GitHub account (sign up)

Pushing your local repo to GitHub requires three steps: 1. Create a new repo on GitHub 2. `git remote` to set a remote branch pointing to your GitHub repo 3. `git push` to actually upload files to GitHub repo

- Git remote branches are pointers to branches in your remote repositories.
- If you `clone` a GitHub repository, then the local repo will have a remote branch `origin/master` automatically setup
- If you have permission to write to the GitHub repo, then you can `git push` to it.