Open and Reproducible Research: Tools 3

January, 2015

Topics

- Git
- Github
- Reproducible research check list

What is git?

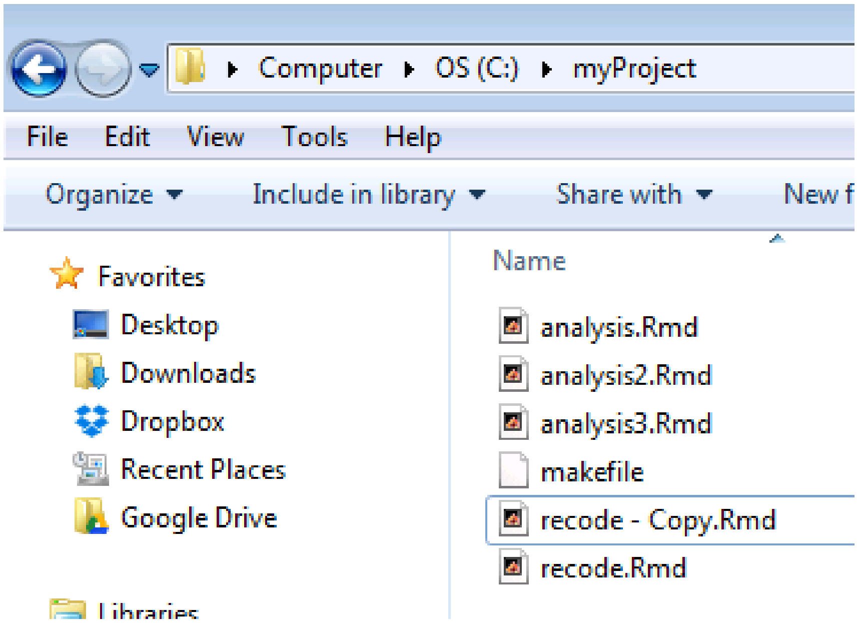
- the stupid content tracker

- 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

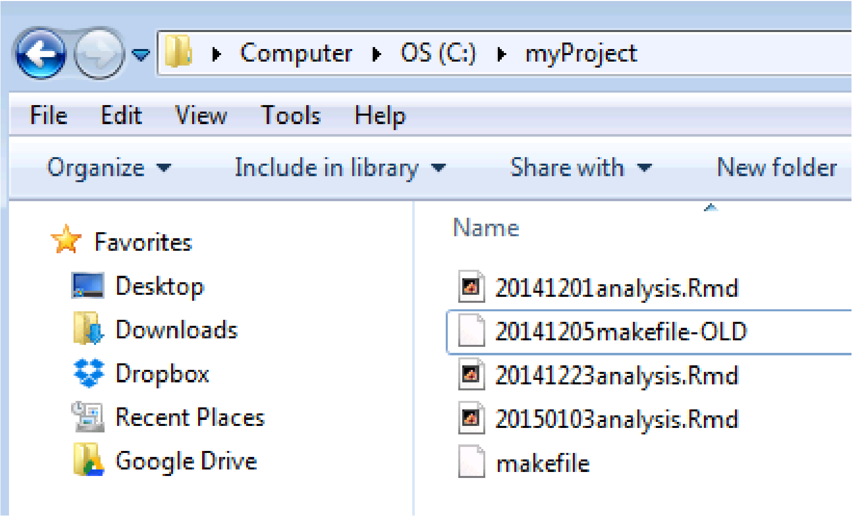


analysis.Rmd
analysis2.Rmd
analysis3.Rmd
makefile
recode - Copy.Rmd
recode.Rmd

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

Tracking changes over time 2

- timestamping

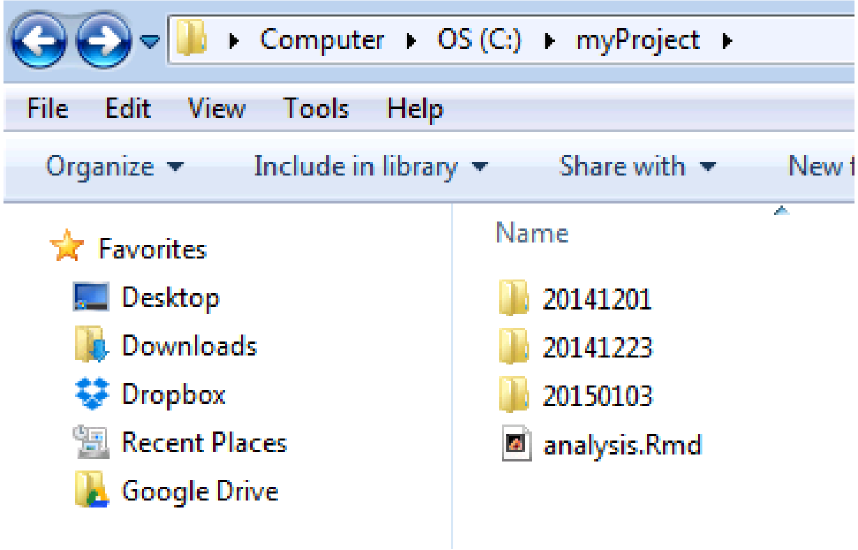


20141201analysis.Rmd
20141205makefile-OLD
20141223analysis.Rmd
20150103analysis.Rmd
makefile

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

Tracking changes over time 3

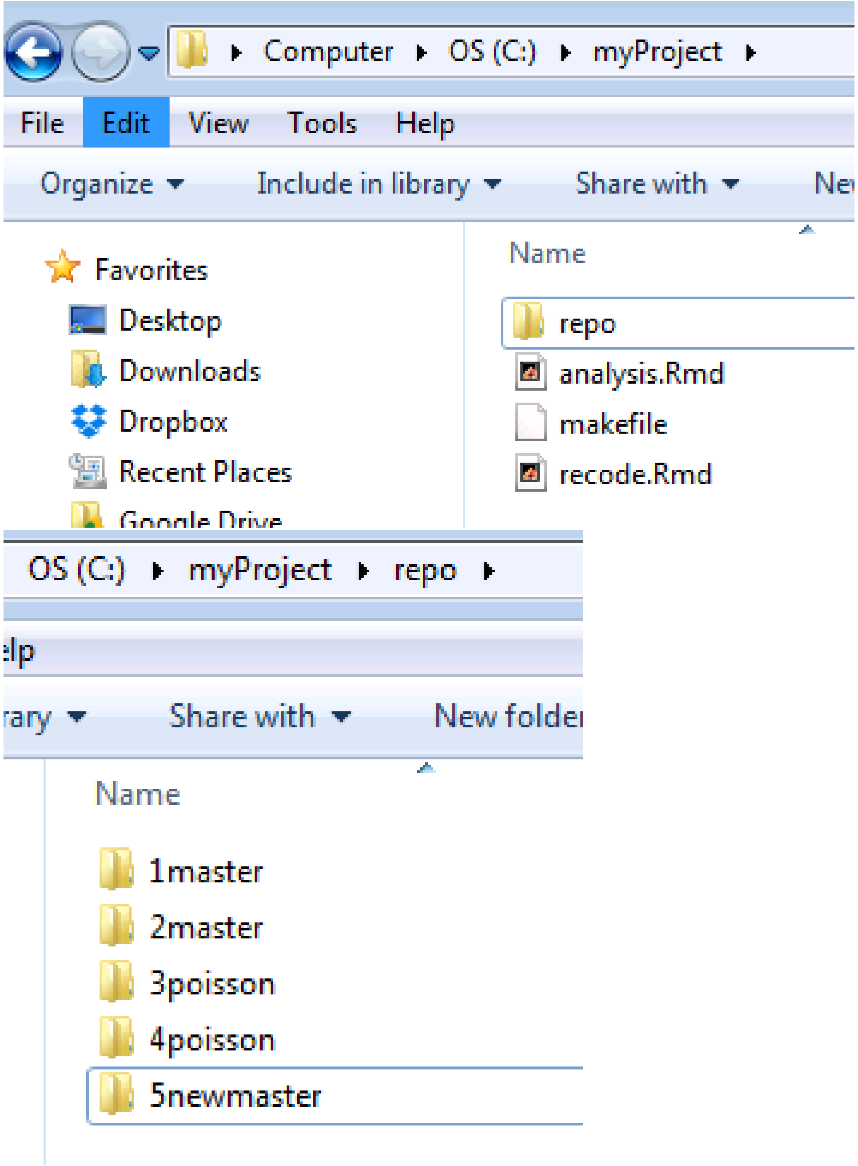
- snapshot: state of a system (here a file) at a particular point in time



- 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



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:

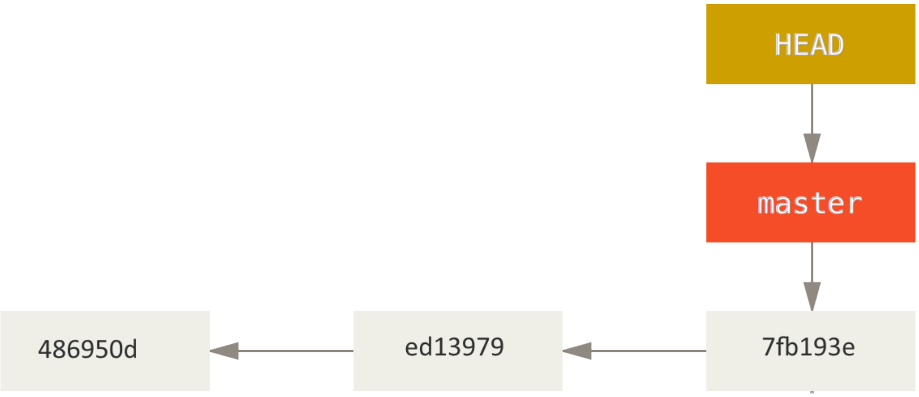
```
git commit -m 'initial commit'

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

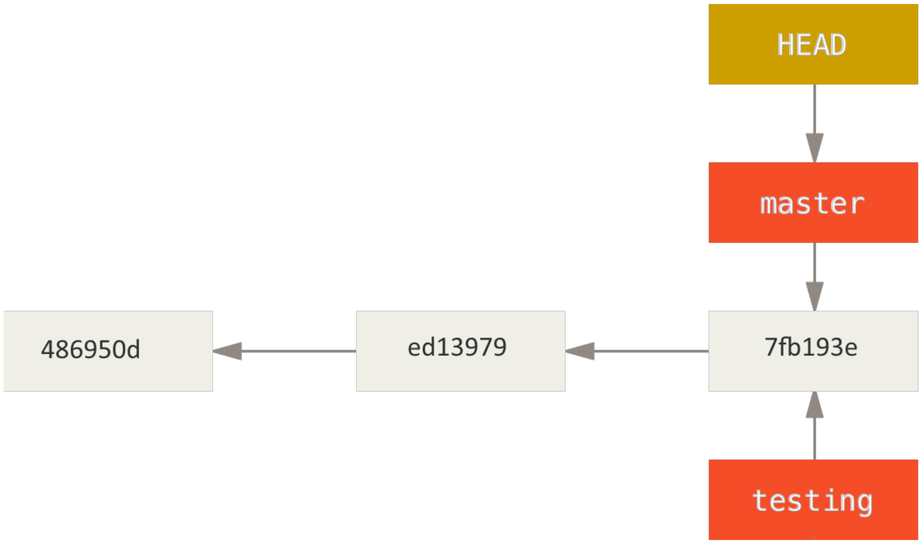
```
> git log --oneline --decorate
7fb193e (HEAD, master) third commit
ed13979 second commit
486950d first commit
> git branch
* master
```



Create a branch

- `git branch testing`

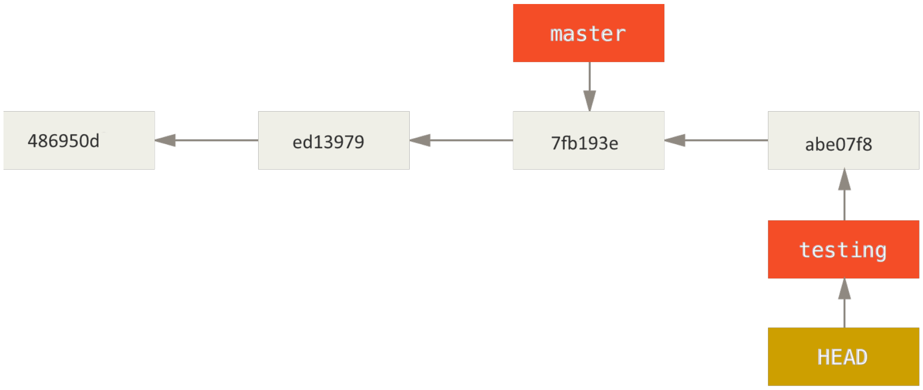
```
> git branch testing
> git log --oneline --decorate
7fb193e (HEAD, testing, master) third commit
ed13979 second commit
486950d first commit
```



Check out a branch

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

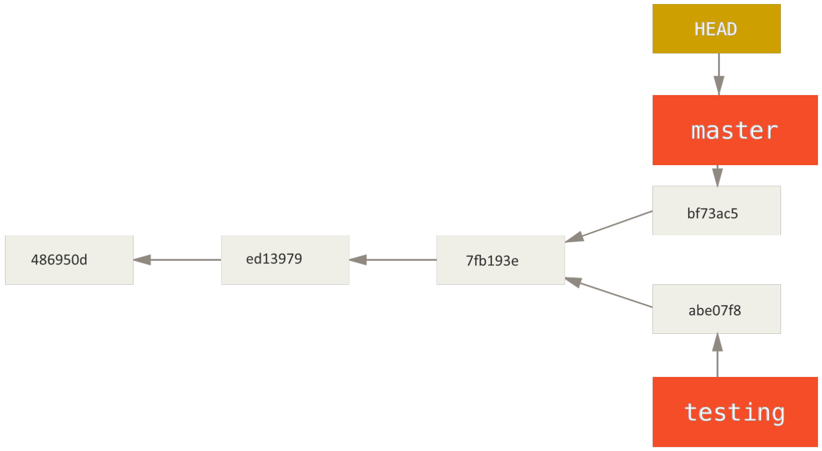
```
> git checkout testing
  (modify files)
> git add ...
> git commit -m ...
> git log --oneline --decorate
abe07f8 (HEAD, testing) testing update
7fb193e (master) third commit
ed13979 second commit
486950d first commit
```



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

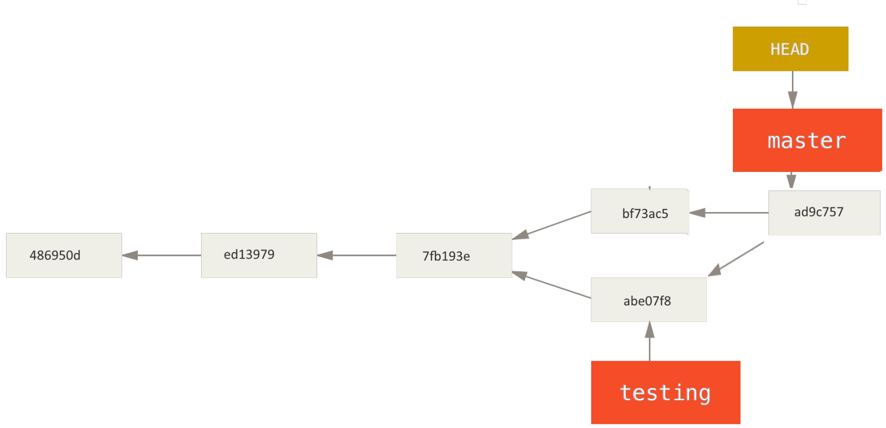
```
> type myfile.txt       | in master             in testing
initial file content    | initial file content   initial file content
second line             | second line            second line
third line              | third line             third line
<<<<<<< HEAD            | master update       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

Requirement: a GitHub account (sign up)

```
> git init
> git add (many files including presentation .rmd and .html)
> git commit -m "initial commit"
> git remote add origin https://github.com/Chang-Y-Chung/rr.git
> git push -u origin master
Username for 'https://github.com':
Password for 'https://chang-y-chung@github.com':
To https://github.com/Chang-Y-Chung/rr.git
 * [new branch]      master -> master
Branch master set up to track remote branch master from origin.
```

Pull from a GitHub repo

Once set up in the previous slide, pulling down any updates from GitHub gets simple:

```
> git pull
Already up-to-date.
```

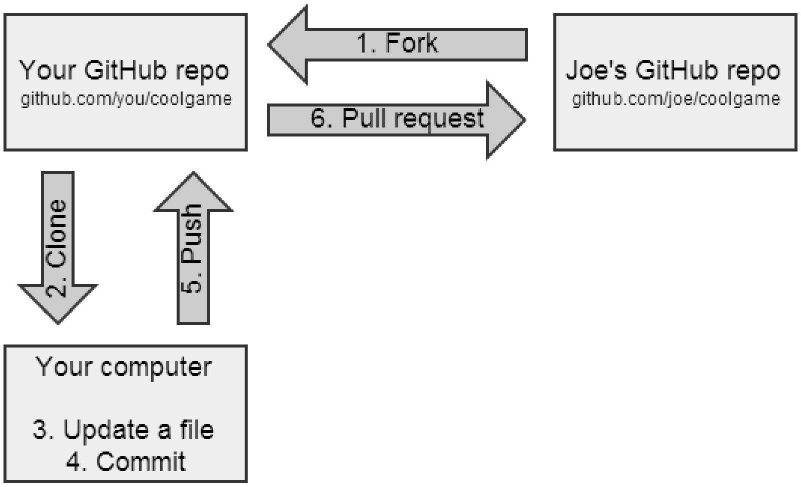
- `git pull` does both `git fetch` and `git merge`

Pull request

- Creating PR: A potential collaborator
  - makes a copy of a GitHub repo under own GitHub account ("Forking")
  - pull down to local repo
  - create a PR branch and fix a bug or implement a feature
  - push the change back to own GitHub repo and
  - send the original project account a PR
- Reviewing/Accepting PR: Original project owner
  - once received a pull request, review code and documentation
  - if it is OK, then pull from the PR branch of the collaborator's GitHub repo into local master
  - once merged, push it back up to the project GitHub repo

Creating pull request

- Diagram from Kevin Markham's simple guide to forks



- GitHub Help on Collaborating
- Hadley Wickham's writing on RStudio, Git and GitHub.

Git/GitHub Learning Resources

- Chacon and Straub (2014) Pro Git. Available at http://git-scm.com/book/en/v2
- Karl Broman's tutorials http://kbroman.org/pages/tutorials.html
- Gregg Pollack's Try Git video and hands-on at Code School https://www.codeschool.com/courses/try-git
- Kevin Markham's YouTube channel https://www.youtube.com/user/dataschool

Reproducible Research Checklist

1. Are we doing good science?
2. Was any part of this analysis done by hand?
3. Have we taught a computer to do as much as possible (i.e. coded)?
4. Are we using a version control system?
5. Have we documented our software environment?
6. Have we saved any output that we cannot reconstruct from original data + code?
7. How far back in the analysis pipeline can we go before our results are no longer (automatically) reproducible?

Roger Peng (2014) "Reproducible Research Checklist" Lecture note for the Coursera Course titled "Reproducible Research". Accessed at https://github.com/rdpeng/courses on Jan, 2015.

Quiz

True or False?

1. If any part of the analysis was done by hand, then the research is not reproducible. (T/F)
2. It is a good idea to call `sessionInfo()` in your R code. (T/F)
3. Always make sure to call `set.seed()`; Feel free to call `date()`. (T/F)

The End

- Any questions?
- Please fill out the feedback form. Thanks a lot!