Version Control with git and GitHub

un-do and re-do for research projects

Robert Forkel

Quantitative Methods – Spring School 2016

Max Planck Institute for the Science of Human History

Table of contents

1. Version Control

2. git

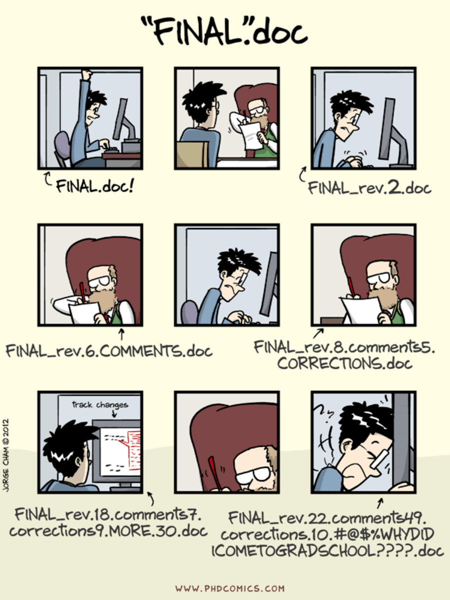
3. GitHub

4. An Example

Version Control

Version Control – which problem does it solve?

There are only two hard things in Computer Science: cache invalidation and naming things. *(Phil Karlton)*



"Piled Higher and Deeper" by Jorge Cham, www.phdcomics.com

Version Control – just save the changes

Instead, we could keep the same file name, but record changes:

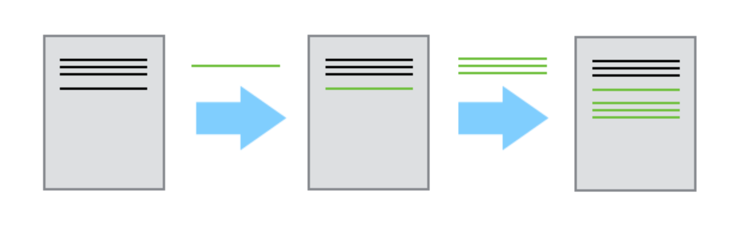


Figure 2: Version control systems save changes – and thus allow un-do and re-do!

Version Control – the basics

- So in the simplest case, version control systems track **what** changed **when**.
- Adding comments whenever you save a state adds the **why**.
- Working collaboratively on documents requires adding the **who**.
- Modern version control systems track changes of a whole directory tree – not just of a file.
- **Note:** Version control is not the same as backup!
- But if you backup your repository properly, you get a wayback machine added on top of a backup.

Version Control – terminology

change set group of changes to files that will be added to a single commit in a version control repository.

commit record a change set in a version control repository. As a noun, the result of commiting, i.e. a recorded change set in a repository.

repository Some disc space where a vcs stores the full history of commits of a project and information about who changed what, when.

merge (a repository): To reconcile two sets of changes to a repository.

conflict A change made by one user of a version control system that is incompatible with changes made by other users. Helping users resolve conflicts is one of version control's major tasks.

Adapted from the Software Carpentry lesson on git.

git

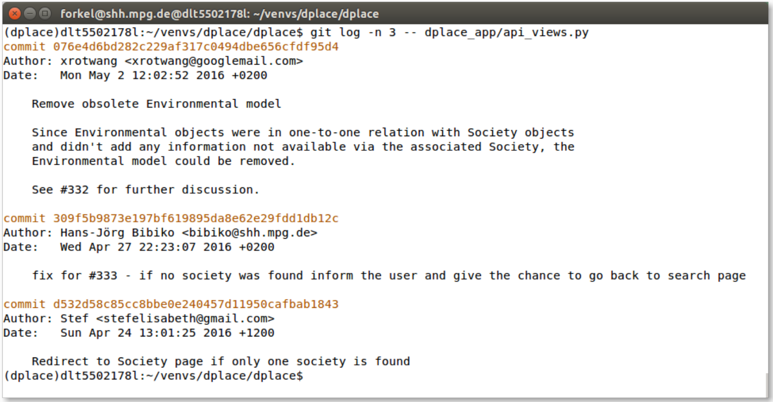
What is `git`?

`git` is a dvcs – a distributed version control system.

- So it does all the things mentioned above …
- …in a distributed way, i.e.:
  - every repository copy (clone) contains the complete history
  - **commit** = save a change (add/edit/delete) in your local copy
  - **pull/push/synchronize** = exchange changes with other copies

git

`git` does all the things outlined above:

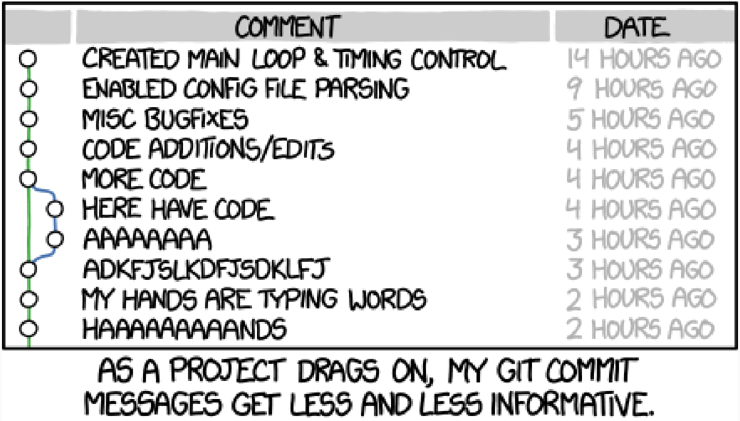


```
(dplace)dlt5502178l:~/venvs/dplace/dplace$ git log -n 3 -- dplace_app/api_views.py
commit 076e4d6bd282c229af317c0494dbe656cfdf95d4
Author: xrotwang <xrotwang@googlemail.com>
Date:   Mon May 2 12:02:52 2016 +0200

    Remove obsolete Environmental model

    Since Environmental objects were in one-to-one relation with Society objects
    and didn't add any information not available via the associated Society, the
    Environmental model could be removed.

    See #332 for further discussion.

commit 309f5b9873e197bf619895da8e62e29fdd1db12c
Author: Hans-Jörg Bibiko <bibiko@shh.mpg.de>
Date:   Wed Apr 27 22:23:07 2016 +0200

    fix for #333 - if no society was found inform the user and give the chance to go back to search page

commit d532d58c85cc8bbe0e240457d11950cafbab1843
Author: Stef <stefelisabeth@gmail.com>
Date:   Sun Apr 24 13:01:25 2016 +1200

    Redirect to Society page if only one society is found
(dplace)dlt5502178l:~/venvs/dplace/dplace$
```

Figure 3: `git log` command

git

Of course this requires some discipline …



	COMMENT	DATE
○	CREATED MAIN LOOP & TIMING CONTROL	14 HOURS AGO
○	ENABLED CONFIG FILE PARSING	9 HOURS AGO
○	MISC BUGFIXES	5 HOURS AGO
○	CODE ADDITIONS/EDITS	4 HOURS AGO
○	MORE CODE	4 HOURS AGO
○	HERE HAVE CODE	4 HOURS AGO
○	AAAAAAAA	3 HOURS AGO
○	ADKFJSLKDFJSDKLFJ	3 HOURS AGO
○	MY HANDS ARE TYPING WORDS	2 HOURS AGO
○	HAAAAAAAANDS	2 HOURS AGO

AS A PROJECT DRAGS ON, MY GIT COMMIT MESSAGES GET LESS AND LESS INFORMATIVE.

Figure 4: "Git Commit" by xkcd, https://xkcd.com/1296/

What goes into the repository?

Technically all files could be put under version control.

- your code, of course
- configuration files!
- the raw data, preferably in formats amenable to diff
- output of `pip freeze` or the equivalent command in R

What goes into the repository?

But bonus points (automatic merging, meaningful diffs) for line-based text formats:

- documentation in markdown, e.g. `README.md`
- LaTeX, BibTeX
- CSV
- nexus, newick
- INI
- IPython Notebooks, i.e. pretty-printed JSON

What goes into the repository?

Rule of thumb: Whatever can be generated automatically doesn't go in version control.

But: In research, output of one workflow step is often input for the next. To make it possible to execute the workflow starting anywhere, keep intermediate results as well in version control. Also often, manual editing of intermediate artefacts is necessary, and version control is the right tool to track this!

Resolving conflicts

What if multiple users make changes to the same file?

- If the file has a line-based (plain-text) format and the users changed different sections, chances are high that git can automatically **merge** the changes correctly.
- If they conflict for the same line(s) and you understand the file, you can semi-manually resolve the conflict with a merge/diff-tool picking lines from either version.
- Otherwise pick/create the ‘right’ version by hand and **commit** that to the repository.

GitHub

What is GitHub?

- **GitHub** is a commercial hosting service for git repositories.
- It provides a rich web-interface for git repositories (browsing & comparing files/history, wikis, bug tracking, reviews, comments).
- It also provides **GitHub Desktop** – a desktop application (for Windows and OSX) as a well-integrated GUI for git and GitHub.

First steps

- download & install https://desktop.github.com
- alternatively, install git and set it up to work with GitHub https://help.github.com/articles/set-up-git/
- sign up for a user account at https://github.com
- visit and clone https://github.com/shh-dlce/qmss-2016
- Follow the Software Carpentry lesson on “Version Control with git” at http://swcarpentry.github.io/git-novice/index.html

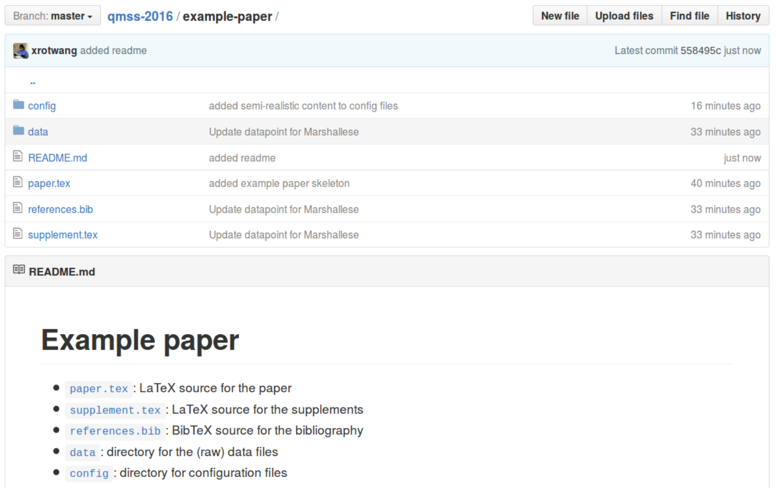
Collaboration

git and GitHub is becoming the de-facto standard for collaboration in software development and research, and is already quite well integrated

- On your desktop: GitHub Desktop (see above)
- in RStudio: http://www.datasurg.net/2015/07/13/rstudio-and-github/
- in Overleaf: https://www.overleaf.com/blog/195-new-collaborate-online-and-offline-with-overleaf-and-git-beta

An Example

Repository layout



xrotwang added readme — Latest commit 558495c just now

..		
config	added semi-realistic content to config files	16 minutes ago
data	Update datapoint for Marshallese	33 minutes ago
README.md	added readme	just now
paper.tex	added example paper skeleton	40 minutes ago
references.bib	Update datapoint for Marshallese	33 minutes ago
supplement.tex	Update datapoint for Marshallese	33 minutes ago

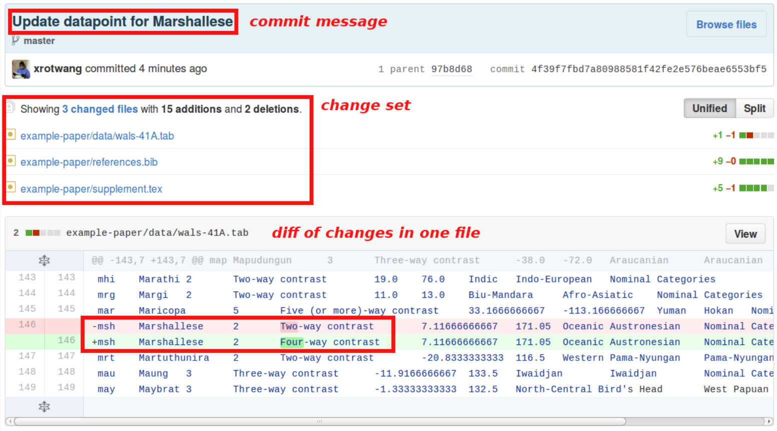
README.md

Example paper

- `paper.tex` : LaTeX source for the paper
- `supplement.tex` : LaTeX source for the supplements
- `references.bib` : BibTeX source for the bibliography
- `data` : directory for the (raw) data files
- `config` : directory for configuration files

Figure 5: Exemplary repository layout.

Transparent data modification



Update datapoint for Marshallese

commit message

Browse files

master

xrotwang committed 4 minutes ago

1 parent 97b8d68 commit 4f39f7fbd7a80988581f42fe2e576beae6553bf5

Showing 3 changed files with 15 additions and 2 deletions.

change set

Unified Split

example-paper/data/wals-41A.tab +1 −1

example-paper/references.bib +9 −0

example-paper/supplement.tex +5 −1

2 example-paper/data/wals-41A.tab

diff of changes in one file

View

```
          @@ -143,7 +143,7 @@ map Mapudungun       3          Three-way contrast      -38.0   -72.0   Araucanian       Araucanian
143  143   mhi     Marathi 2       Two-way contrast        19.0    76.0    Indic   Indo-European   Nominal Categories
144  144   mrg     Margi   2       Two-way contrast        11.0    13.0    Biu-Mandara     Afro-Asiatic    Nominal Categories
145  145   mar     Maricopa        5       Five (or more)-way contrast     33.1666666667   -113.166666667  Yuman   Hokan   Nomi
146       -msh     Marshallese     2       Two-way contrast        7.11666666667   171.05  Oceanic Austronesian    Nominal Cate
     146  +msh     Marshallese     2       Four-way contrast       7.11666666667   171.05  Oceanic Austronesian    Nominal Cate
147  147   mrt     Martuthunira    2       Two-way contrast        -20.8333333333  116.5   Western Pama-Nyungan    Pama-Nyungan
148  148   mau     Maung   3       Three-way contrast      -11.9166666667  133.5   Iwaidjan        Iwaidjan        Nominal Cate
149  149   may     Maybrat 3       Three-way contrast      -1.33333333333  132.5   North-Central Bird's Head       West Papuan
```

Figure 6: Logically related changes bundled in one commit