# Version Control

RETRACEABLE CODE HISTORY USING GIT

# The dumb and smart way for code history

- Dumb: just store a daily backup of your files…
  - Impossible for collaboration
  - Super-duper error prone
  - Large overhead

paper.tex
paper_final.tex
paper_really_final.tex
paper_v1.tex
paper_v2.tex
paper_v2_richard.tex
paper_v3_with_richards_comments.tex

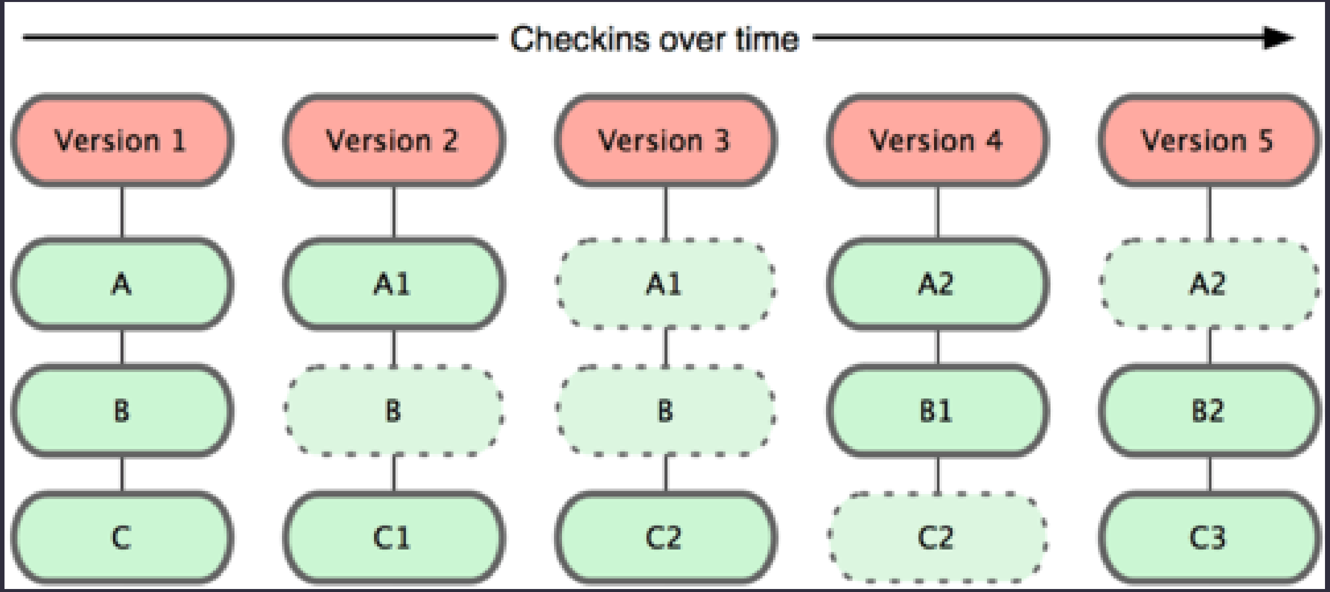
dumb system!

- Smart: Version Control System
  - Tracks changes in every file in the project ***without*** renaming the file
  - Allows reverting to previous versions of files or entire project without loosing current versions
  - Allows several different instances of your codebase to coexist
  - Facilitates collaborative editing of files by different parties safely
  - Allows tracking who made which changes to the project, hence accessing the chain of blame

- Because in this course you will be modifying your code base a lot, it's good to start by learning the system that makes code modification safe and re-traceable

# git

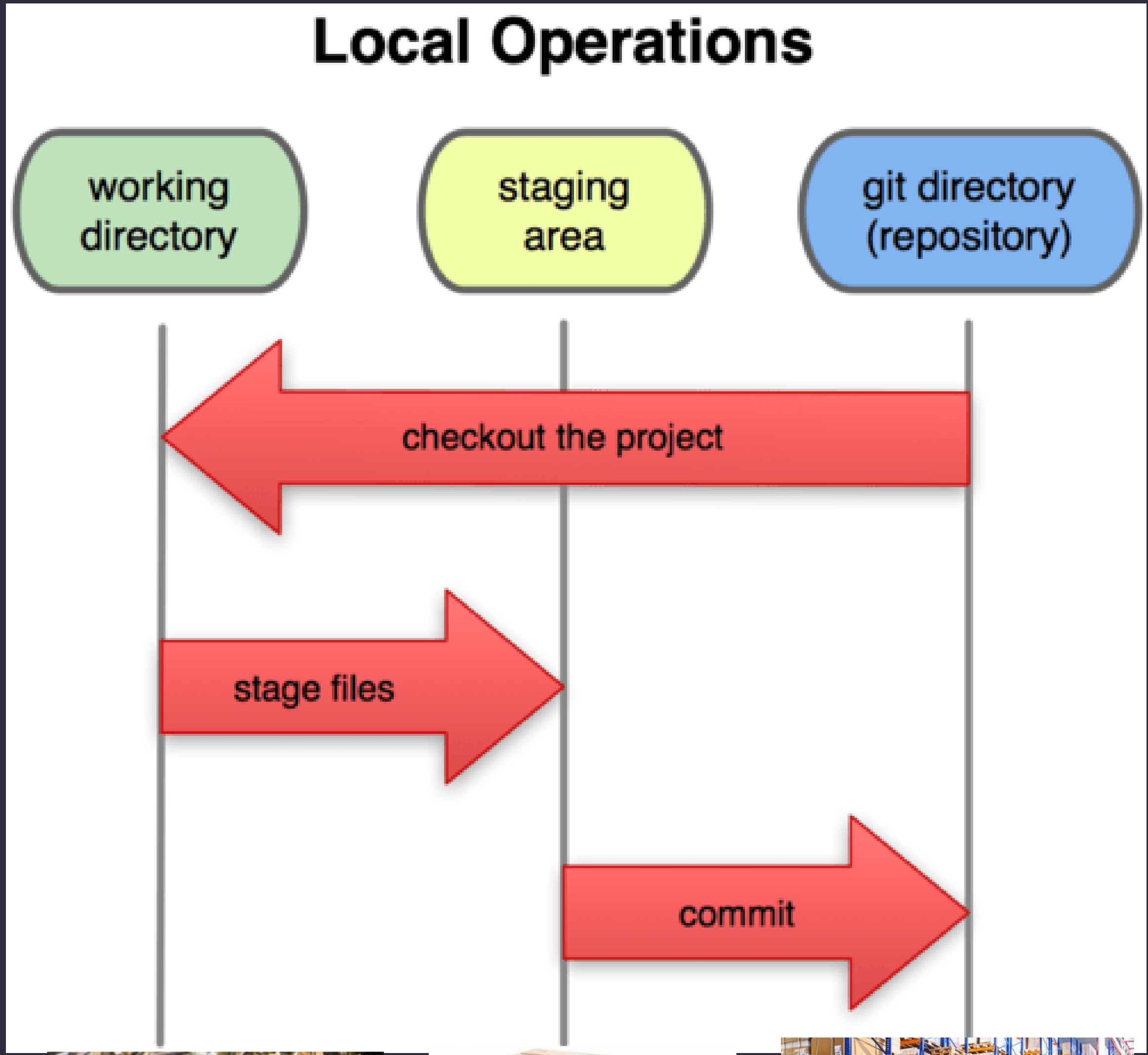
- git is a command line tool that is the most used version control system
- It is efficient, because it ***only stores differences*** from previous states



- Any folder can become a git repository via the command `git init`
- Everything is re-traceable, everything can be recovered (even if it is deleted!)
- ***git is the closest thing to time travel humanity has***

## git basics: the three states

- Your files can be in three states: modified, staged or committed
- Modified means that you have changed the file but have not committed it to your git history yet
- Staged means that you have marked a modified file in its current version to go into your next commit snapshot
- Committed means that the code is safely stored in the git "history" of your local codebase



## git basics: editing, staging, committing

- You edit your files normally, doing a change in your IDE
  - This puts your files in the modified state

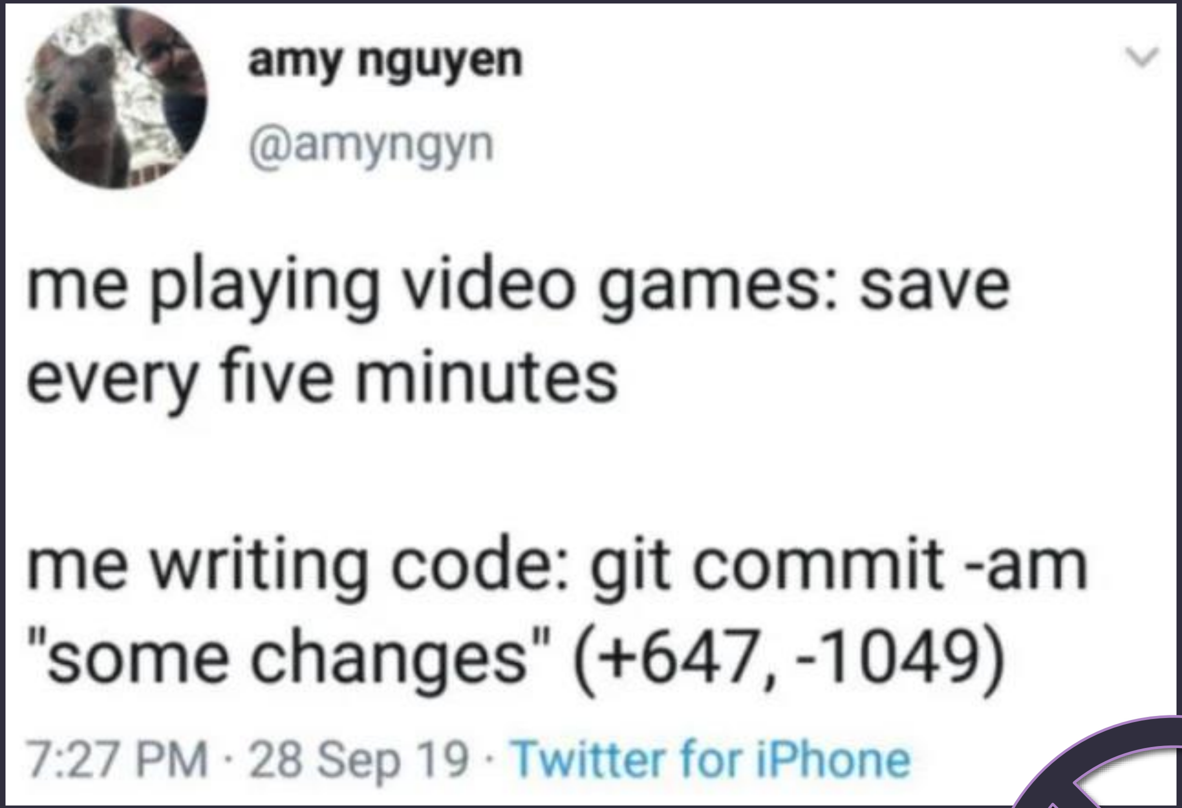
- The command `git status` shows the status of your current git state

- You then "add" your files to the staged state with the command `git add <filename>` or `git add *.txt` or `git add .` (everything)

- To move your staged files into a committed state, simply `git commit` (an editor will open for a commit message)

## git basics: commit descriptions & frequency

- After `git commit` you get an editor to write a description of the commit
  - The first line of this description is called the "commit message"
  - Alternatively, you can do `git commit -m "commit message"`
- The message is the most important part of the description: get it right!
  - Must be short, to the point, and not contain useless information like commit author, date, branch, etc. (all of these can be found with the formal tools of git)
- If you want a description besides the main message, leave an empty line after the first, and then write as much text as you wish
- In other git environments (git GUIs, GitHub, …) there is a separate textbox for the message and the rest of the description already in the GUI
- ***Commit regularly!***
  - Any change that you can summarize in a sentence should be a commit!
  - Need several sentences to summarize a change in code?  
    Probably you should have committed more often!


amy nguyen
@amyngyn

me playing video games: save every five minutes

me writing code: git commit -am "some changes" (+647, -1049)

7:27 PM · 28 Sep 19 · Twitter for iPhone

When you commit after a long time and don't remember what you've done

```
git commit -m "some changes"
```

NO!

# git basics: amend, reset, blame

- Sometimes you commit something but immediately notice a “typo” or a “one-liner” change. You can immediately add a change to the existing commit using `git amend`

- The main strength of keeping all this history is going back to a previous stage!
- With `git reset <commit>` you bring your code base back into the selected commit!
  - With flag `--soft`: makes reverted differences unstaged changes
  - With flag `--hard`: deletes all differences versus reverted stage
  - See documentation on [git resest online](#) for many more possibilities!
  - We will discuss a safer, better recommended way to time travel in a couple of slides

- Git allows you to find out who, and when, edited a file with `git blame <file>`
  - used by bad people that like to blame other people
  - JUST KIDDING, extremely useful tool: author of change = most likely to know why change

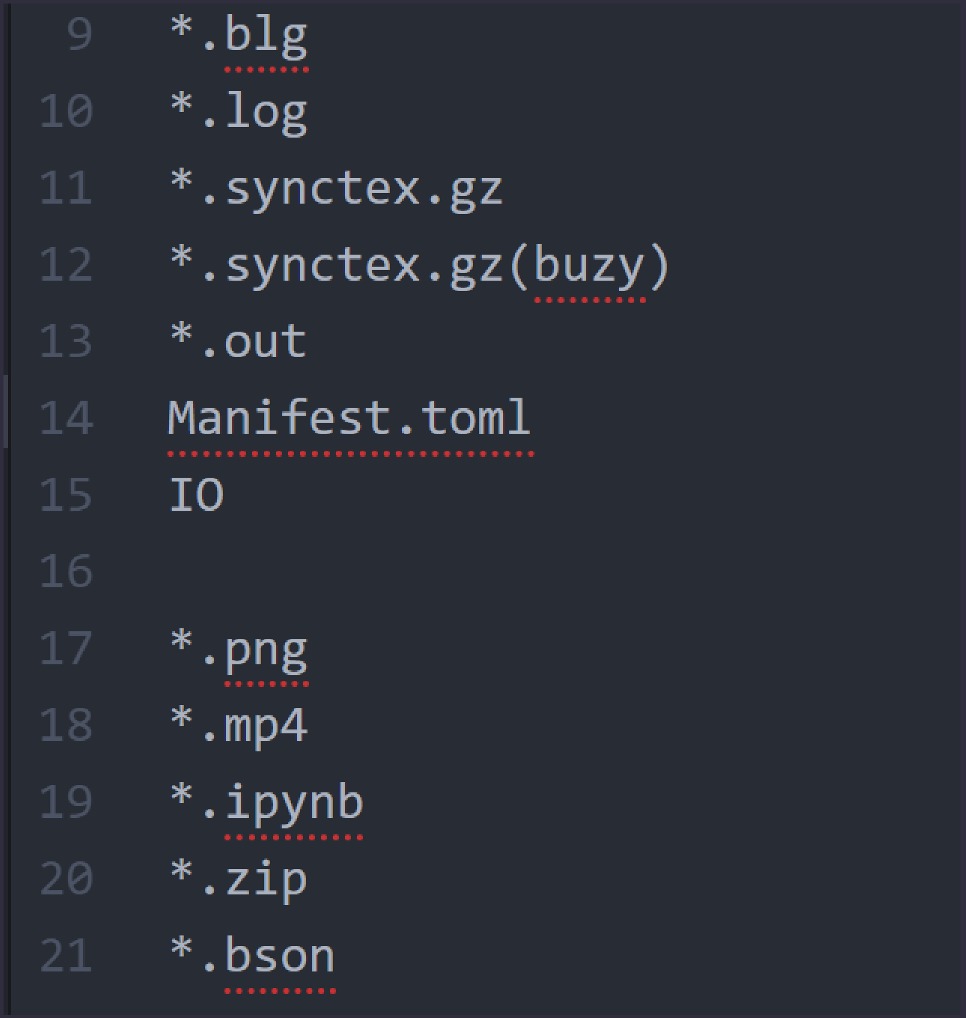
git reset --hard

## Exercise: git basics

1. If git isn't installed on your machine, do it
2. Create a local folder and in it initialize a git repository: `git init`
3. Configure your user name and email
   - `git config --global user.name "My Name"`
   - `git config --global user.email name@example.com`
4. Create a file "test.txt" and in it write something in the 1st line only.
5. Use `git status` and see that indeed the file pops up as modified
6. Stage (git add) and commit the file with appropriate commit message!
7. Now edit the "test.txt" and add a 2nd line of text. Commit the change.
8. Oh noes, your change was really bad! Reset to previous commit!
   1. First, do a soft revert. Change the final character of the second line into 'a'. Commit. Now you have a version of the "test.txt" that has 2 lines, the second ending in 'a'.
   2. Now, revert again, but do a hard revert. You lost everything in the 2nd line. That's okay.

## git basics: file size warning!

- git is an excellent tool for text-based files
- git is a bad tool for binary files, videos, etc.
- Since nothing is ever deleted from your history if you add a large file to your git commit, this file will forever burden your repository
- Plan what you really need to version, and add things you don't want to version into the .gitignore file! Things there are untracked



```
*.blg
*.log
*.synctex.gz
*.synctex.gz(buzy)
*.out
Manifest.toml
IO

*.png
*.mp4
*.ipynb
*.zip
*.bson
```

## git basics: tags, branches, and merging

- Tags allow you to “mark” a specific commit with a special name. You can revert to tags just as well as to any other commit. E.g. tag “submitted” for the version of the code submitted for publication

- You can also make several ***branches*** of your code base with `git branch <name>`
  - Branches are different instances of the code base that can be developed independently
  - You can jump from one branch to another at any point using `git checkout branch-name`
  - One branch is always `main`, to which all other development branches are merged into
  - Branches are ***the best way to work with git!***

- A branch can be ***merged*** into another branch, which simply “adds” the changes tracked by one branch to the other
  - If both branches contain commits that state changes on the same file+line: ***merge conflict***
  - The conflict must be manually resolved by a human which decides which change survives

GIT PUSH
MY PROJECT
GIT PUSH
GIT MERGE CONFLICT
imgflip.com

# Different ways to merge

1. Merge commit: all history kept + 1 extra commit for "merging"
2. Squash merge: no history retained, all changes become a single commit
3. Rebase: all commits individually added 1 by 1 to the merging branch

- Live showcase at https://git-school.github.io/visualizing-git/

- DataFrames.jl maintainers recommend: ***always squash***
  - In most pull requests the history of the final "product" doesn't matter. Only the product.
  - Makes it much easier to cherry pick changes (cherry-picking not discussed here)
  - Rebasing in collaborative projects will bring in countless unnecessary commits very quickly

- Rebasing can be useful in solo projects or with small teams!
  - Retaining full history can be used to justify choices made or better blame people!

- In every case best practice is to keep feature branches ***small and focused!***

# Exercise: git merge & conflict

- Now you are in branch \`main\`. Create a second branch \`bad\` and switch to it
- Add a 2nd line to \`test.txt\`. Commit.
- Checkout back to \`main\` branch. 2nd line doesn't exist. Create third branch \`feature\`.
- In \`feature\`, open again \`test.txt\` and add a ***different*** 2nd line. Commit.
- Now merge \`feature\` into \`main\`. Use the "rebase" way of merging.
- Now 2nd line of \`test.txt\` is also in \`main\`!
- Second part: conflict management
- Then, switch to \`bad\`. The 2nd line that was in \`main\` is now different, and is the "old" 2nd line you have added in \`bad\`.
- Try to merge \`bad\` into \`main\`, but you'll see it is not possible: Conflict!
- Conflicts must be resolved explicitly in an editor (that e.g. git provides)
- Resolve the change by making the 2nd line of \`bad\` the 3rd line of the file. Then merge \`bad\` into \`main\`.
- By the end you should have a \`test.txt\` with 3 lines of text!

## Safer way to time travel

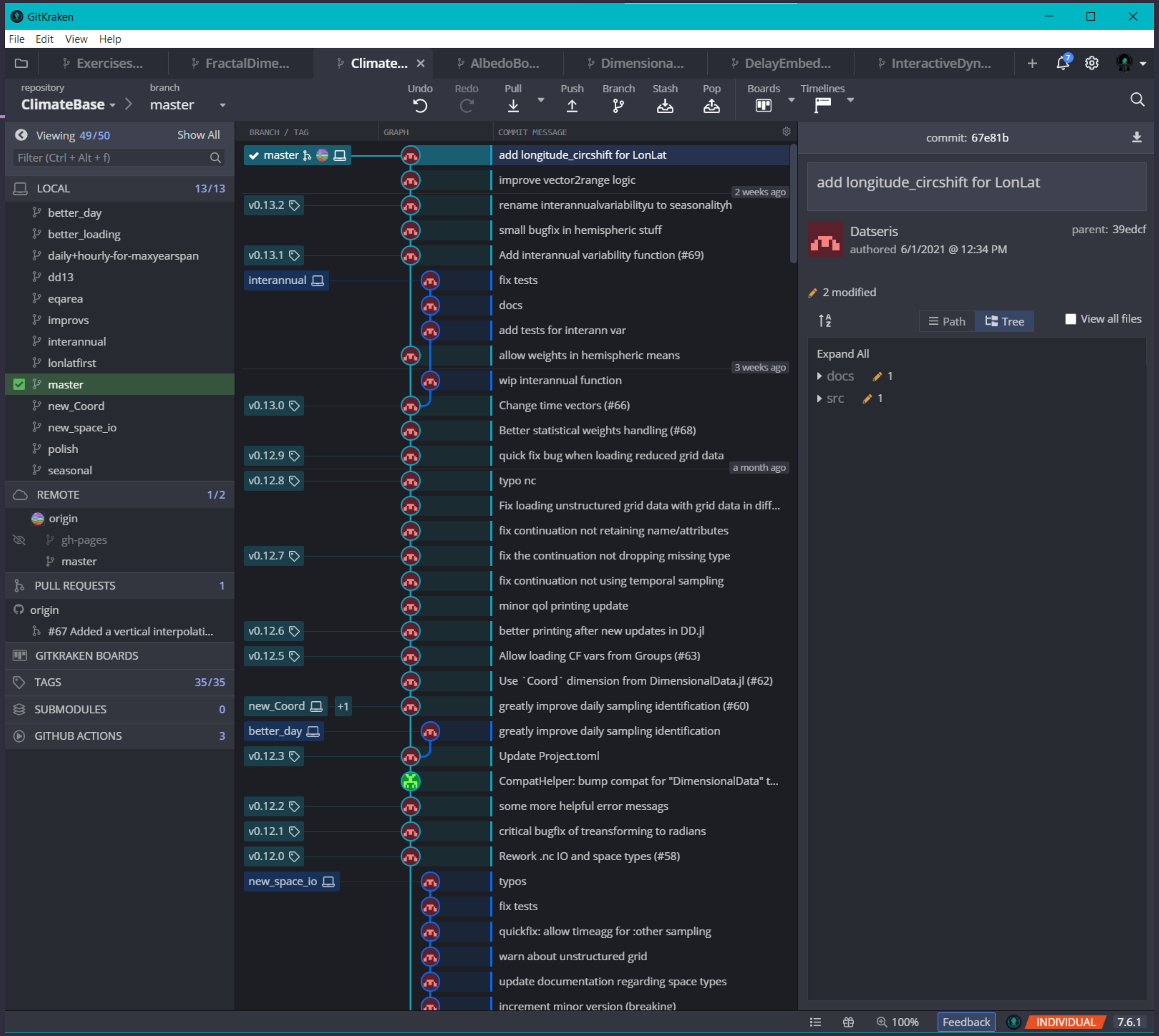
- If you are only using one branch `main` and you reset --hard, you will lose ALL commits that you have done on `main` branch.
  - And sometimes, this happens as a unfortunate mistake!

- Multiple branches is a much safer way to work with git, and hence, a much safer way to time travel is with:
  ```
  git checkout -b <new_branch_name> <commit_id|tag|branch>
  ```
  - Will create a new branch at the specified commit/tag, and also bring the "head" (current status of your files) into the commit/tag you specified
  - Leaves the original branch completely unaffected

- ***Important: don't "time travel" with git if there are modified files on current status!***

# GitKraken

- GitKraken is an exceptional GUI based git manager
  - Free for local projects
  - Free for remote projects
  - Not free for remote & private!
- Absolutely spectacular!!!
  - I'm not endorsed by GitKraken
- VSCode has also very good integrated git support (fully free) but its timeline view isn't as nice as GitKraken


GitKraken
File Edit View Help
Exercises... FractalDime... Climate... AlbedoBo... Dimensiona... DelayEmbed... InteractiveDyn...
Undo Redo Pull Push Branch Stash Pop Boards Timelines

repository ClimateBase · branch master

Viewing 49/50 · Show All

Filter (Ctrl + Alt + f)

LOCAL 13/13
- better_day
- better_loading
- daily+hourly-for-maxyearspan
- dd13
- eqarea
- improvs
- interannual
- lonlatfirst
- master
- new_Coord
- new_space_io
- polish
- seasonal

REMOTE 1/2
- origin
  - gh-pages
  - master

PULL REQUESTS 1
- origin
  - #67 Added a vertical interpolati...

GITKRAKEN BOARDS

TAGS 35/35

SUBMODULES 0

GITHUB ACTIONS 3

| BRANCH / TAG | COMMIT MESSAGE | |
|---|---|---|
| master | add longitude_circshift for LonLat | |
| | improve vector2range logic | 2 weeks ago |
| v0.13.2 | rename interannualvariabilityu to seasonalityh | |
| | small bugfix in hemispheric stuff | |
| v0.13.1 | Add interannual variability function (#69) | |
| interannual | fix tests | |
| | docs | |
| | add tests for interann var | |
| | allow weights in hemispheric means | 3 weeks ago |
| | wip interannual function | |
| v0.13.0 | Change time vectors (#66) | |
| | Better statistical weights handling (#68) | |
| v0.12.9 | quick fix bug when loading reduced grid data | a month ago |
| v0.12.8 | typo nc | |
| | Fix loading unstructured grid data with grid data in diff... | |
| | fix continuation not retaining name/attributes | |
| v0.12.7 | fix the continuation not dropping missing type | |
| | fix continuation not using temporal sampling | |
| | minor qol printing update | |
| v0.12.6 | better printing after new updates in DD.jl | |
| v0.12.5 | Allow loading CF vars from Groups (#63) | |
| | Use `Coord` dimension from DimensionalData.jl (#62) | |
| new_Coord +1 | greatly improve daily sampling identification (#60) | |
| better_day | greatly improve daily sampling identification | |
| v0.12.3 | Update Project.toml | |
| | CompatHelper: bump compat for "DimensionalData" t... | |
| v0.12.2 | some more helpful error messages | |
| v0.12.1 | critical bugfix of transforming to radians | |
| v0.12.0 | Rework .nc IO and space types (#58) | |
| new_space_io | typos | |
| | fix tests | |
| | quickfix: allow timeagg for :other sampling | |
| | warn about unstructured grid | |
| | update documentation regarding space types | |
| | increment minor version (breaking) | |

commit: 67e81b

add longitude_circshift for LonLat

Datseris authored 6/1/2021 @ 12:34 PM · parent: 39edcf

2 modified

Path · Tree · View all files

Expand All
- docs 1
- src 1

100% · Feedback · INDIVIDUAL · 7.6.1

## Your code → re-traceable & safe

- Initialize a git repository for your code.
  - Make sure default branch is `main` instead of `master` if you are using an old version of git
  - Use `git branch -M <oldname> <newname>` if necessary
- Think of the .gitignore file, and appropriately ignore files that are part of your code but should not be tracked (e.g., binary files, plots, input data, …)
- Add to the git repository the initial version of the code
- Commit all files, and then create a tag on this new commit
  - Name suggestions: shame, neverlookback, pliz_help_me, a_star_is_born, …
- From now on, all exercises on your own code base must be solved by making a branch for the exercise solution, developing the solution on the branch, and then merging the branch into `main`!