Introduction to Git and GitHub
Part 1

Kendra Oudyk (she/her)

Many parts of this presentation are inspired / based on these great resources

- Chacon, S., & Straub, B. (2014). *Pro git.* Springer Nature. Available at https://git-scm.com/book/en/v2
- The Carpentries. (2021). *Version Control with Git.* https://swcarpentry.github.io/git-novice/.

Land Acknowledgement

University of British Columbia, Point Grey Campus (**Vancouver**)

We would like to begin by acknowledging that the land on which we gather is the traditional, ancestral, and unceded territory of the **xwməθkwəy̓əm** (Musqueam) People.

University of British Columbia, Okanagan Campus (**Kelowna**)

We would like to begin by acknowledging that the land on which we gather is the unceded territory of the **Syilx** (Okanagan) Peoples.

Find out about the land where you live at https://native-land.ca/

Who am I?

- Multiple fields of study / research
  - BMus → MA → PhD (Neuroscience) → MLIS (Library Studies)

- I love teaching
  - Certified Carpentries instructor
  - Taught Git/GitHub >10x

- Also:
  - Disabled
  - Colour-grapheme synesthesia
  - I have a cat

Who are you?

- Subject areas
  - 1-5 words to explain what you study / research to a teenager

- Programming experience
  - Never / a few times
  - Monthly
  - Weekly
  - Daily

- What kinds of files do you edit in a text editor?
  - E.g., .txt, .md, .py, .r, .tex

Side note on learning strategies

- **Dual coding**
  - Hence the visualizations alongside the terminal
  - Draw diagrams

- **Active retrieval**
  - Try to remember before looking something up

- **Immediate feedback**
  - Make low-stakes mistakes
  - Volunteer incorrect answers here

- **Spaced practice**
  - Keep practicing (e.g., put code for courses on GitHub)
  - Attend workshops again

These slides complement the **self-paced** materials on the Research Commons website

https://ubc-library-rc.github.io/intro-git/

Goals

Part 1

- What is distributed version control?
- Why is Git useful?
- Track your own work with Git

Part 2 (next week)

- Share your work on GitHub (simple / linear collaboration)
- Collaborate through GitHub (complex / nonlinear collaboration)
- Navigating GitHub
- Try it out!

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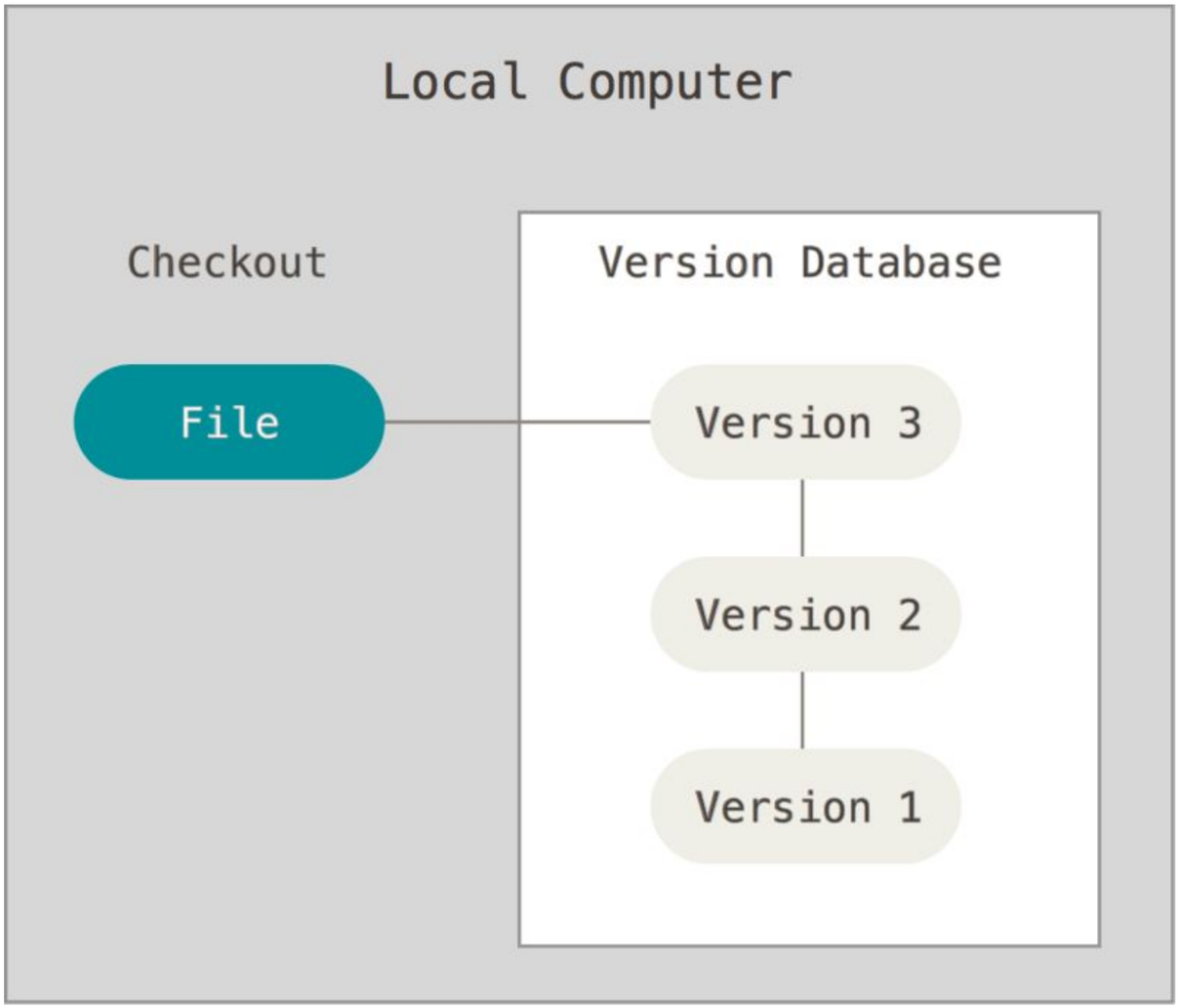
Version control

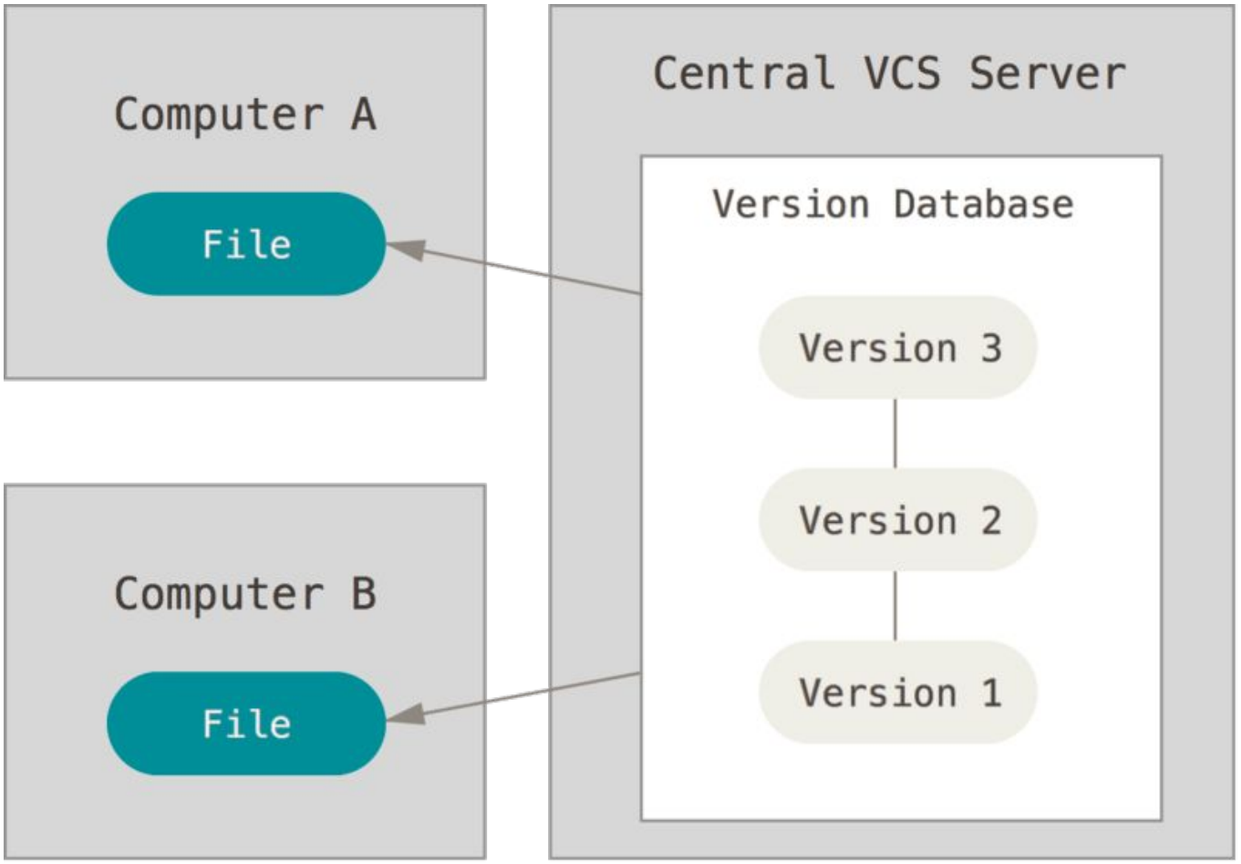
- Tracks **changes** to files
- Lets you recall different **versions** of files
- Becomes more essential as **collaborative projects** grow
- Can track almost **any type** of file (works best on text-based files)
- There are different **types** of version control

Local version control



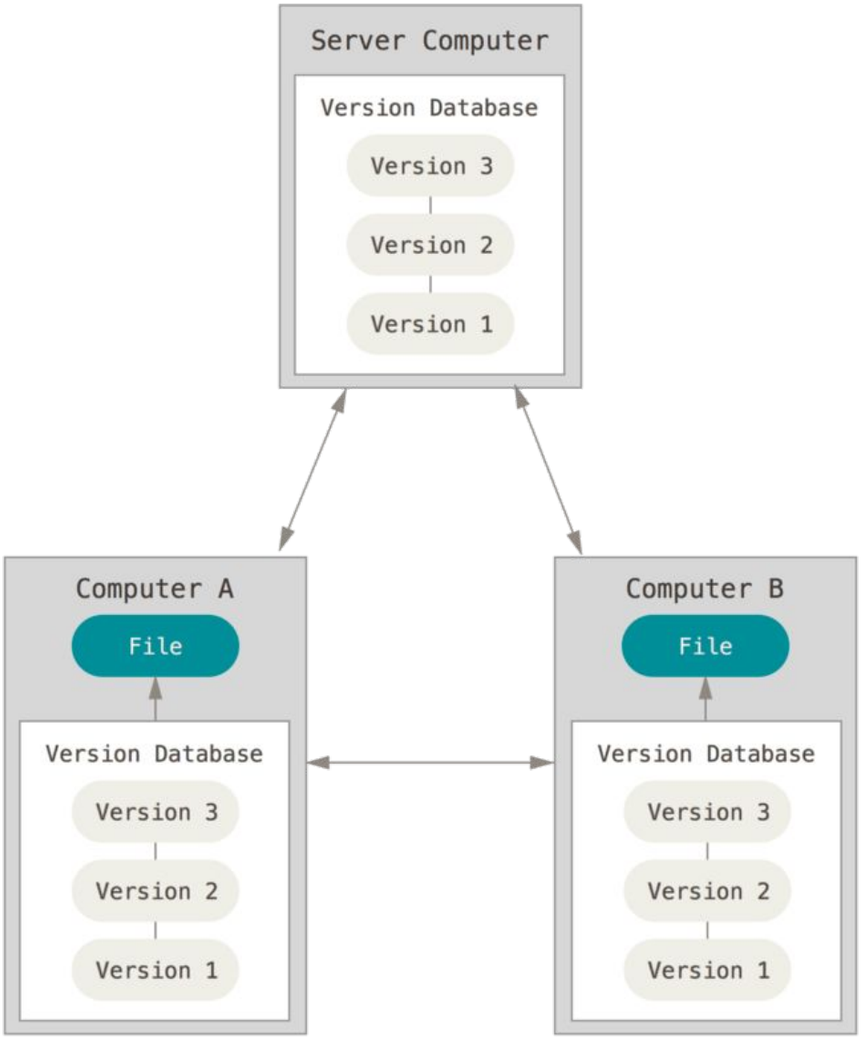
But how do we collaborate?

Centralized version control



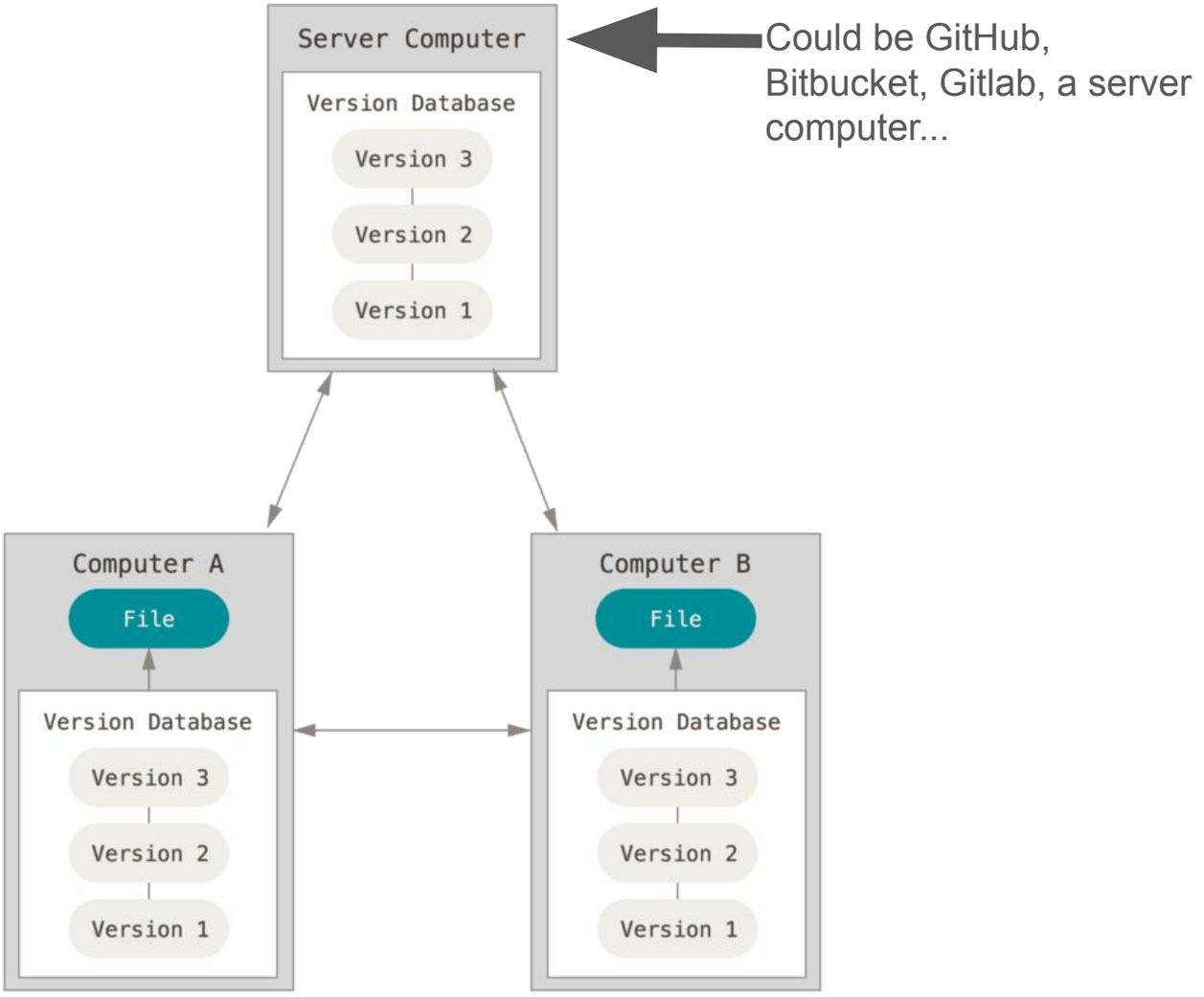
But what if the server crashes?

Distributed version control



Git vs. GitHub

- Git is the "**language**" we use to do version control.
- GitHub **hosts** git repositories online.



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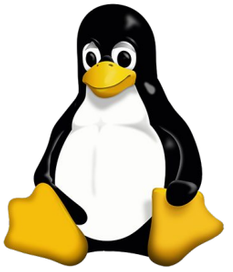
git was made for Linux



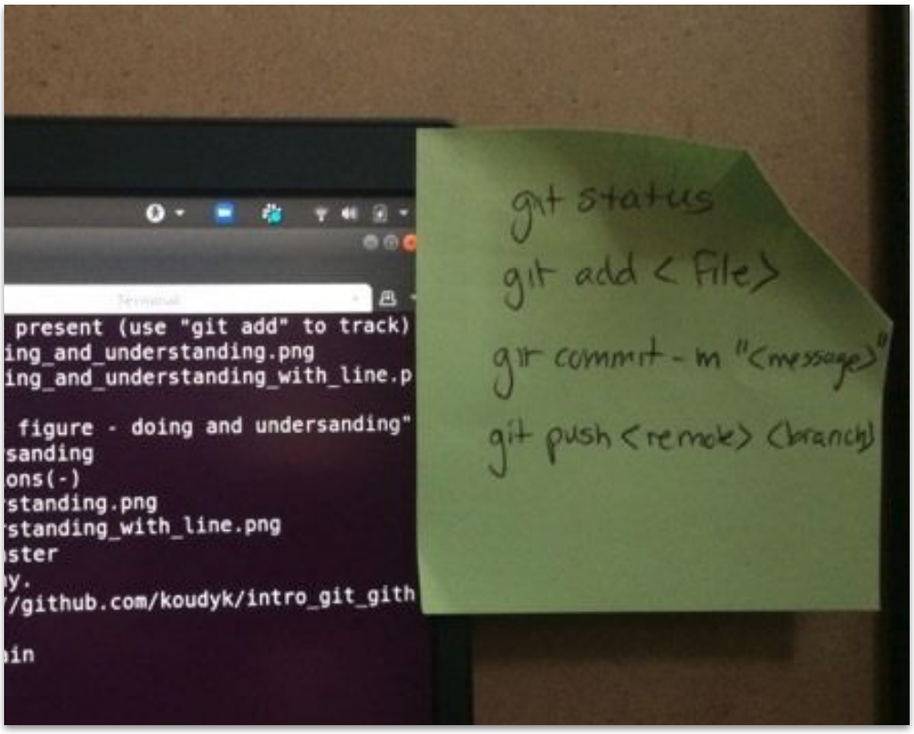
i.e., a huge open-source project.

- In the last month, “1067 authors have pushed 5,329 commits…” [https://github.com/torvalds/linux/pulse/monthly, as of 2021-07-14]

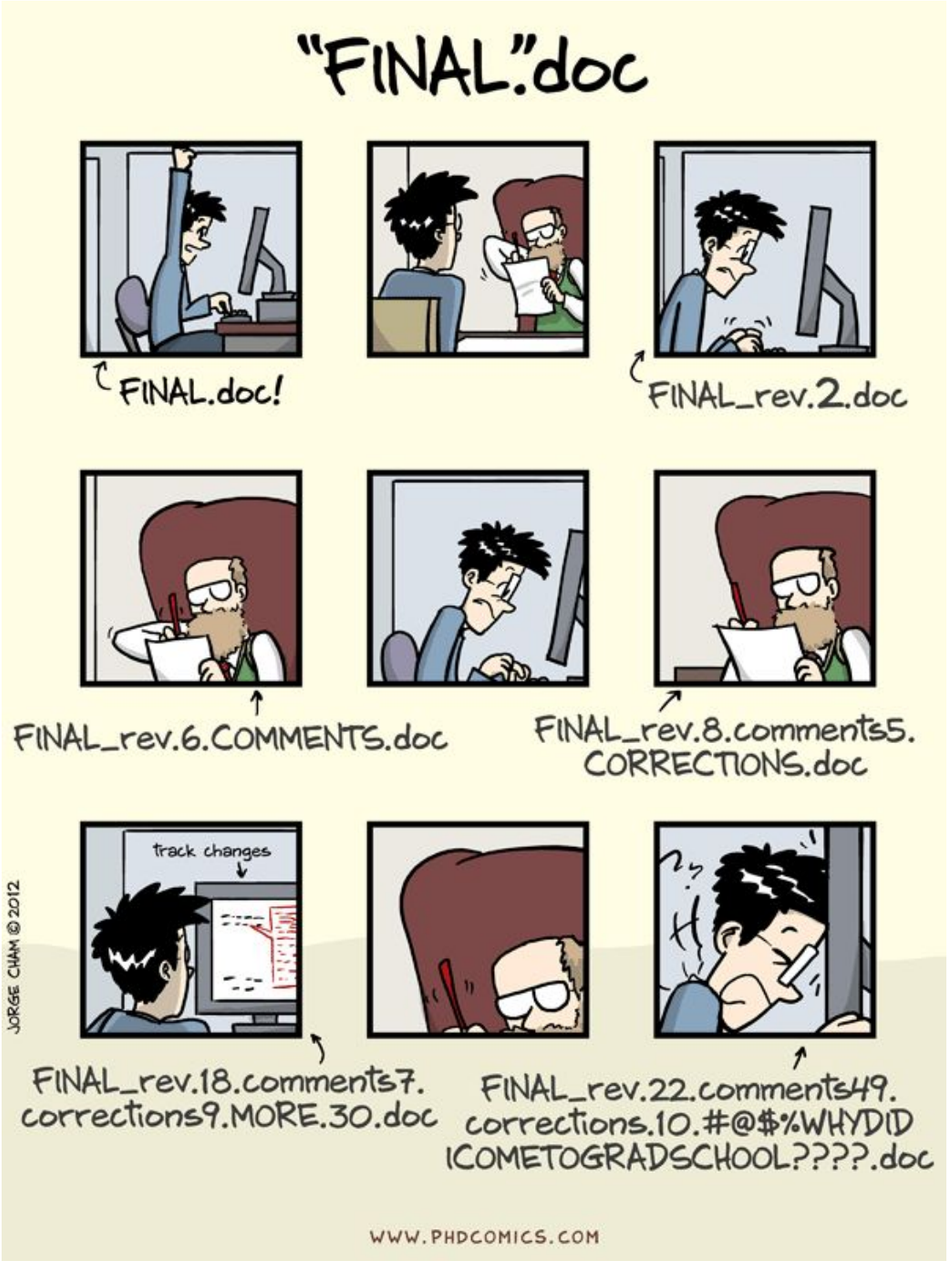
It is designed to be

- Simple and fast
- Fully distributed
- Able to support non-linear development
- Scalable

You won’t need all its features

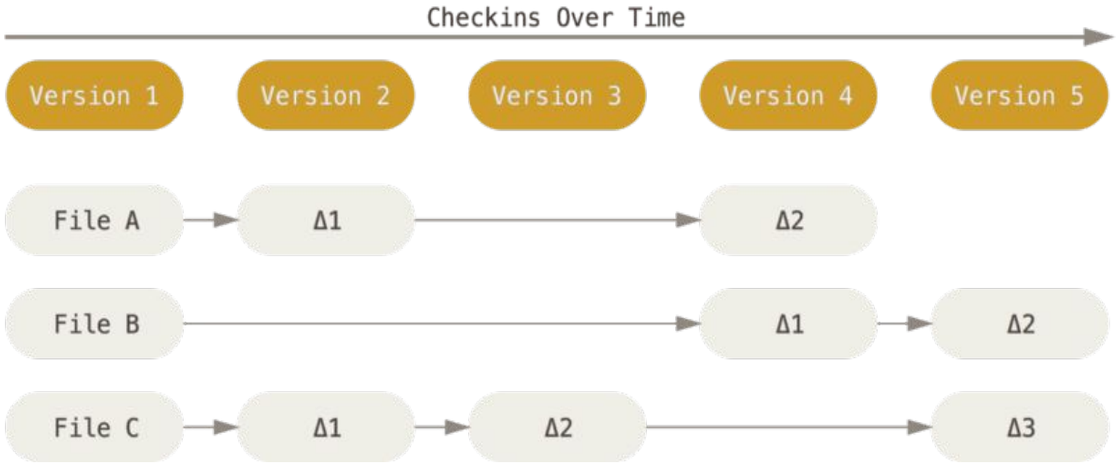


An intuitive user experience

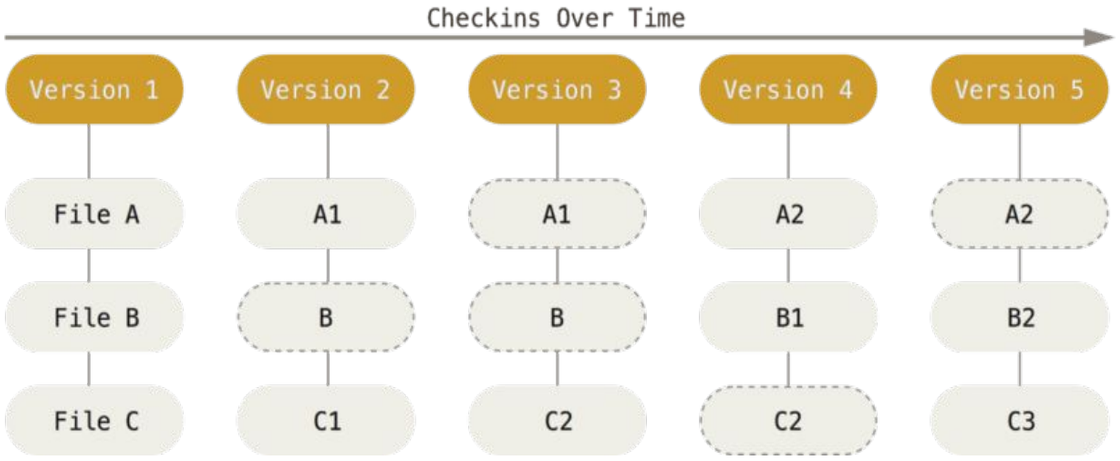


How does git do this?

“Delta-based version control” (other version control systems)



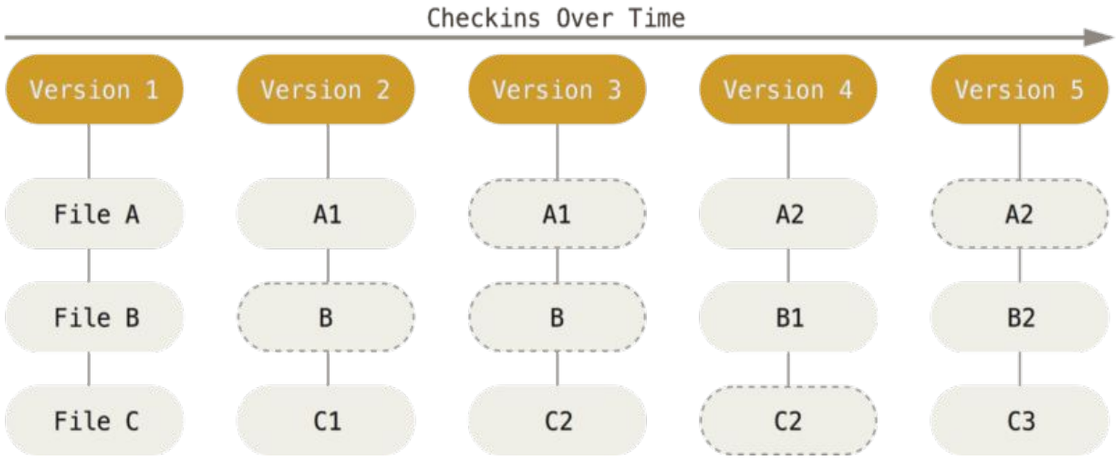
Stream of **snapshots** (git)



Git is reliable

- It doesn’t rely on filenames to keep track of files

- It converts the contents of a file/directory → hash
  - E.g., `24b9da6552252987aa493b52f8696cd6d3b00373`
  - It is unique and deterministic (1-way)
  - Changed file content → changed hash



Most developers use git for version control

Stack Overflow developer survey

- 2015 (16,694 responses)
- 2017 (30,730 responses)
- 2018 (74,298 responses)

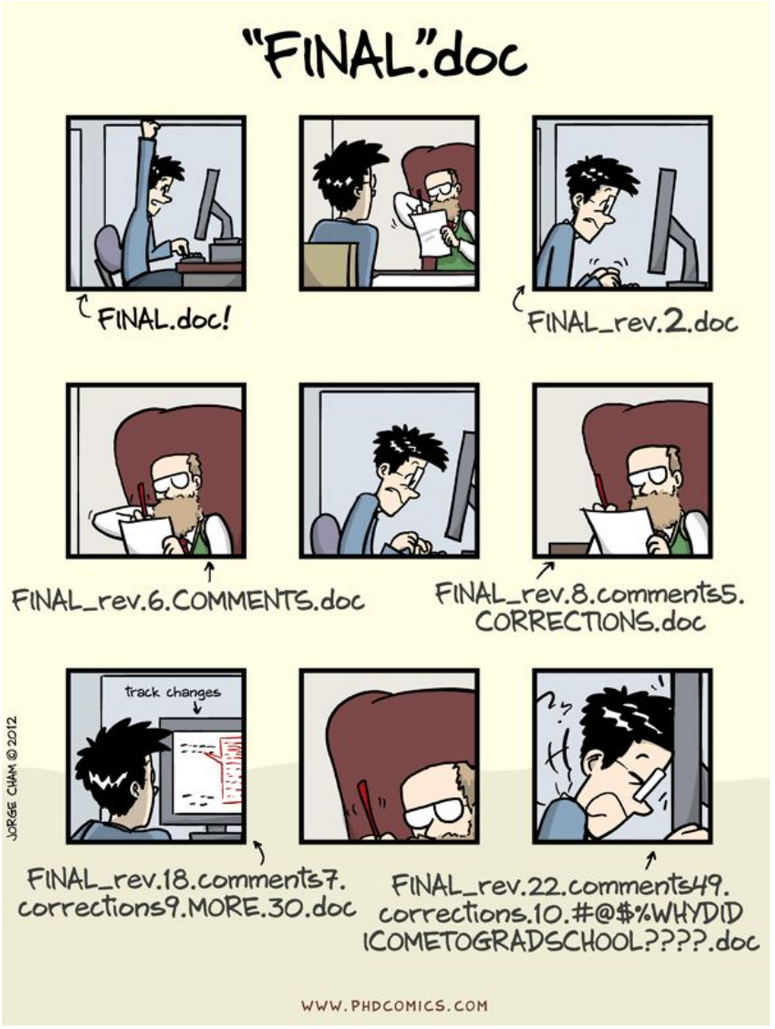
Name	2015	2017	2018
Git	69.3%	69.2%	87.2%
Subversion	36.9%	9.1%	16.1%
TFVC	12.2%	7.3%	10.9%
Mercurial	7.9%	1.9%	3.6%
CVS	4.2%	[i]	[i]
Perforce	3.3%	[i]	[i]
VSS	[i]	0.6%	[i]
ClearCase	[i]	0.4%	[i]
Zip file backups	[i]	2.0%	7.9%
Raw network sharing	[i]	1.7%	7.9%
Other	5.8%	3.0%	[i]
None	9.3%	4.8%	4.8%

But we’re not developers

But we're not developers… right?

- We (hopefully) want to do our research in a way that is **open, reproducible,** and **collaborative**

- Do you have your own system that does this?
  (I certainly don't, not for lack of trying)



“Science, after all, aspires to be distributed, open-source knowledge development.”

Science as Amateur Software Development

McElreath, R. (2020, September 26). *Science as amateur software development* [video]. YouTube. https://www.youtube.com/watch?v=zwRdO9_GGhY

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Check if you're ready

If you're **stuck** on a step, enter the step **letter** in the **comments** on Zoom

☑️ A) Can you open a bash shell?

- Open a terminal, type `echo $SHELL` and press ENTER.
- The output should be `/bin/bash`

☑️ B) Do you have git installed?

- In the bash terminal, `git --version` and press ENTER.
- The output should be `git version X` (where the X is the version number)
- *Don't worry if you don't have the exact same version as I do*

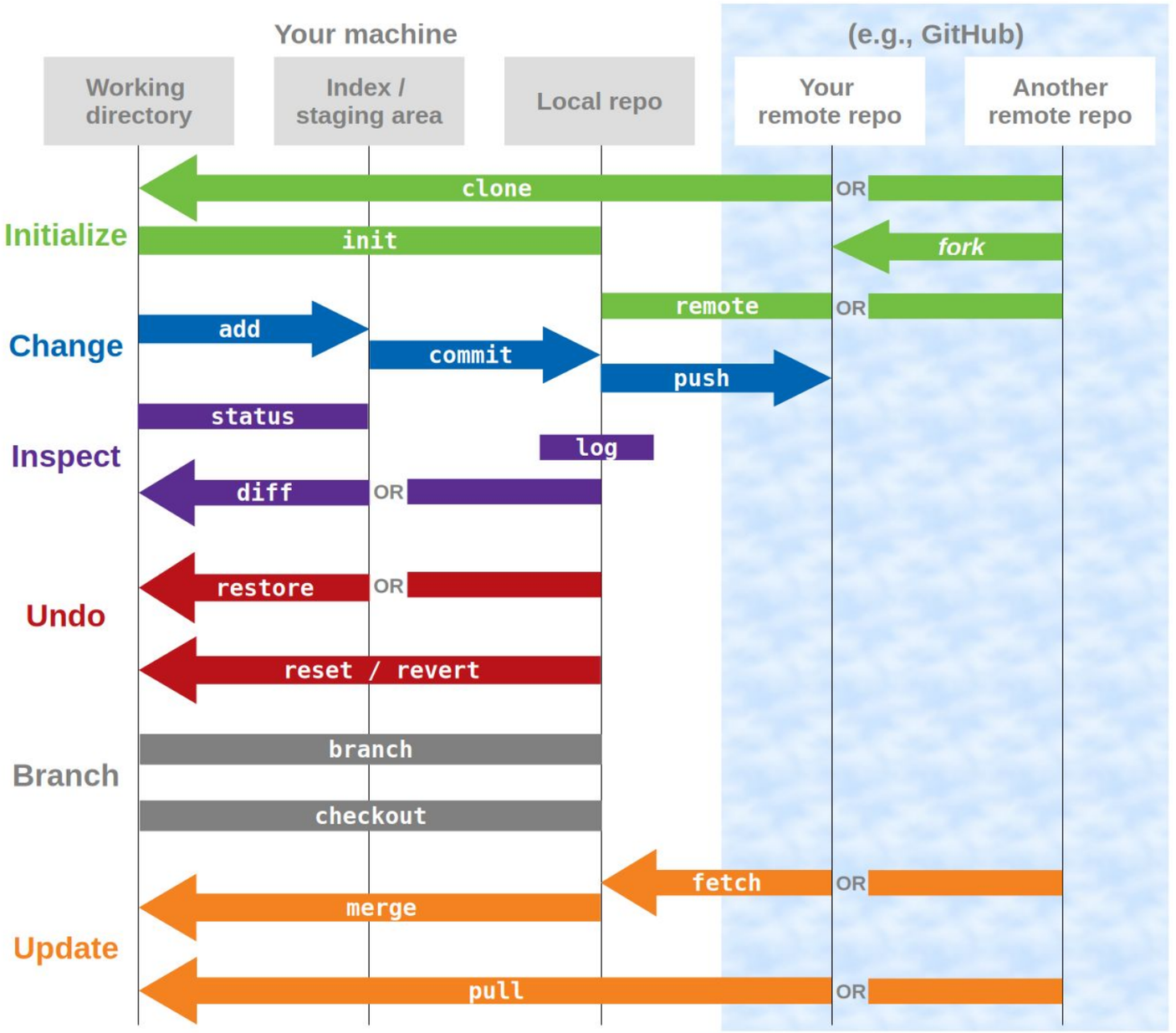
☑️ C) Do you have git configured?

- In the bash terminal, type `git config --list` and press ENTER
- You should see your **name** and **email**
  (and other things that aren't essential to configure)
- The email should be the one you used to sign up for **GitHub**

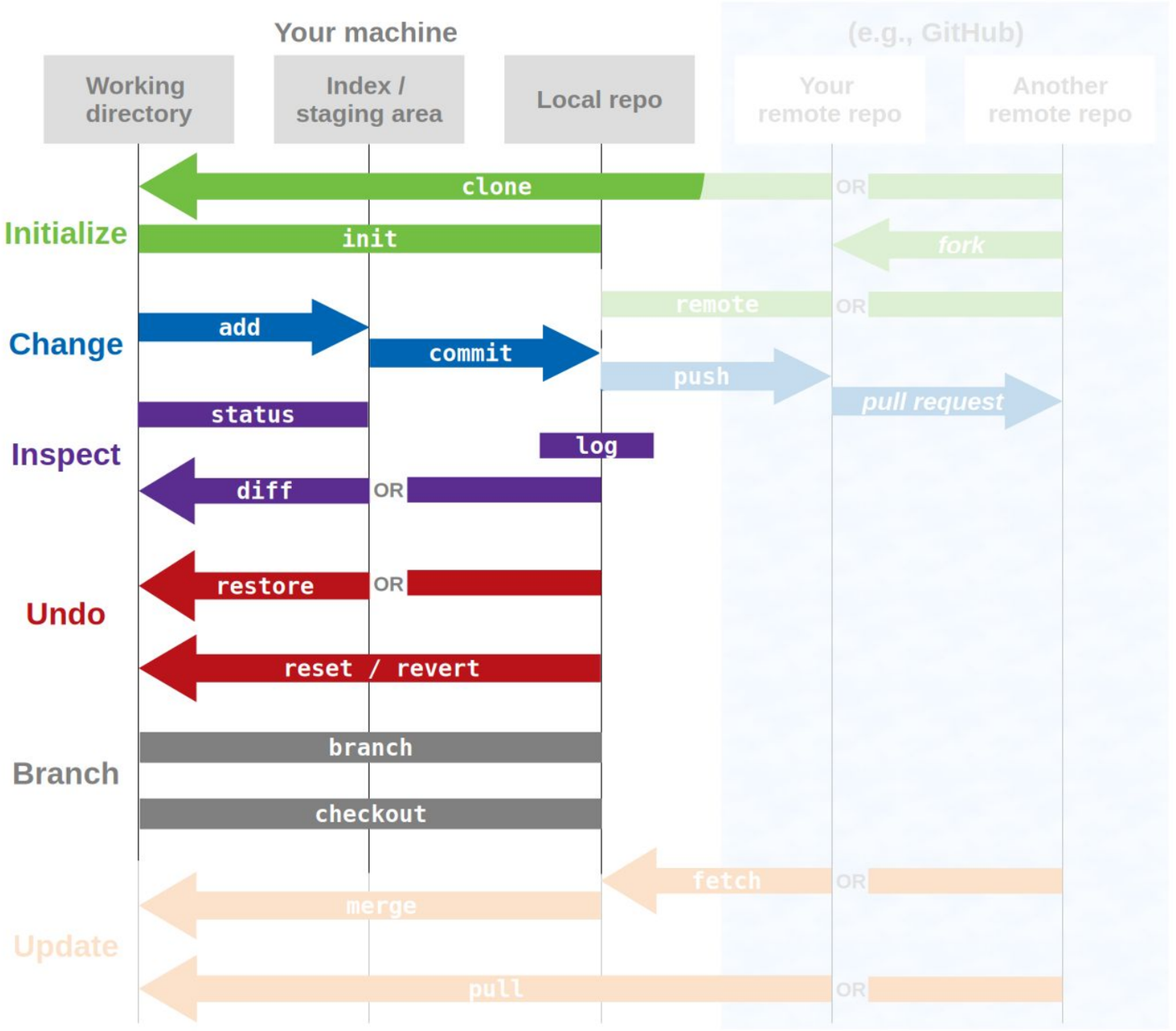
☑️ D) Can you open a text editor? E.g.,

- Linux: gedit, nano
- macOS: textedit
- Windows: notepad

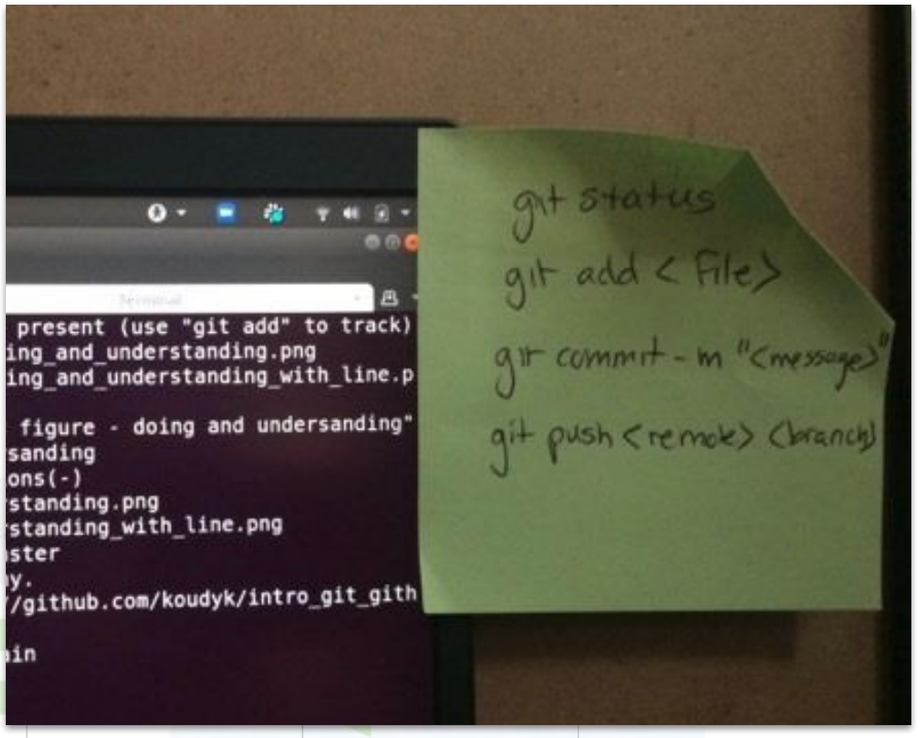
The commands we'll cover **today and next week**

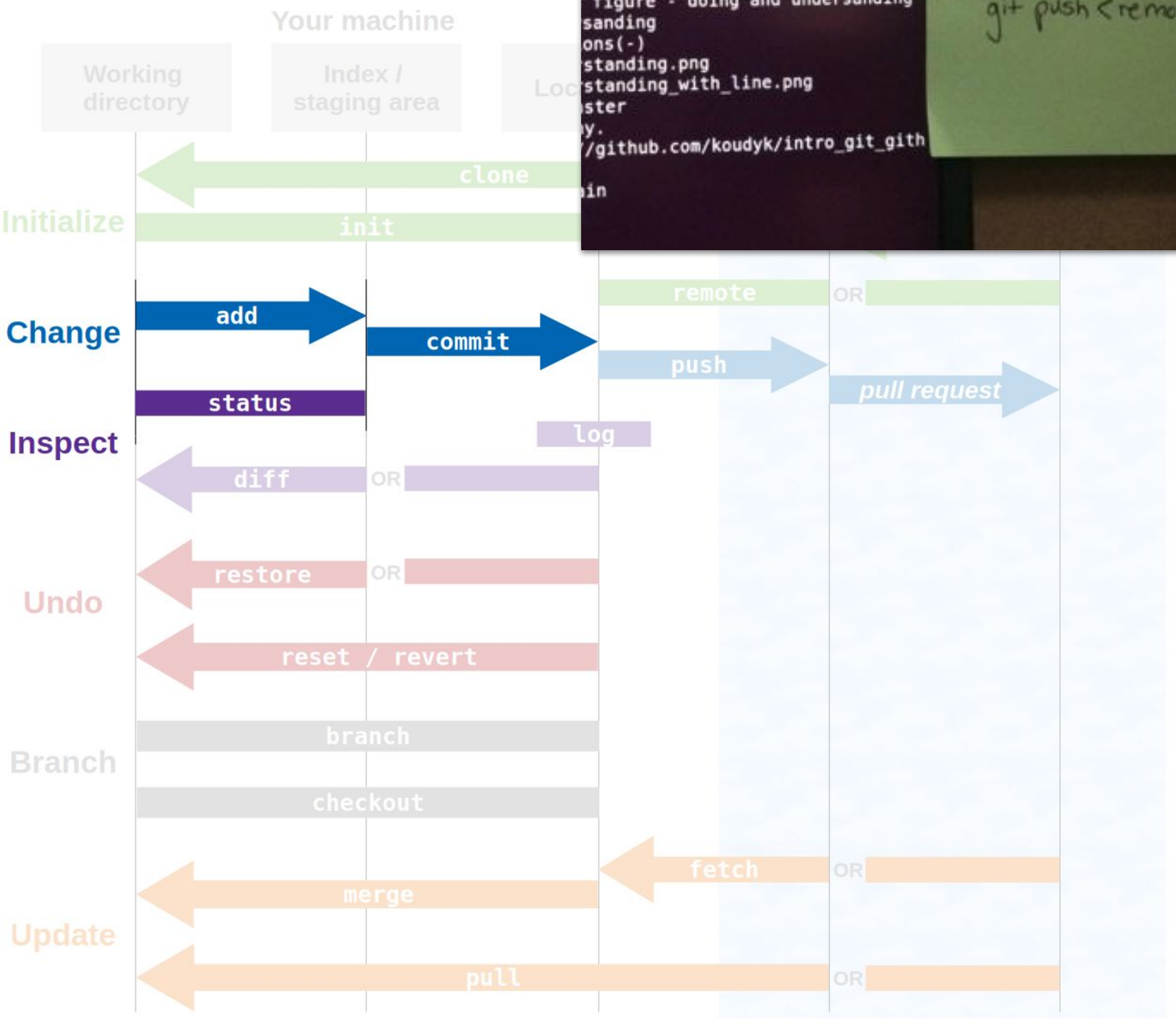


The commands we'll cover **today**



The commands **you'll need**



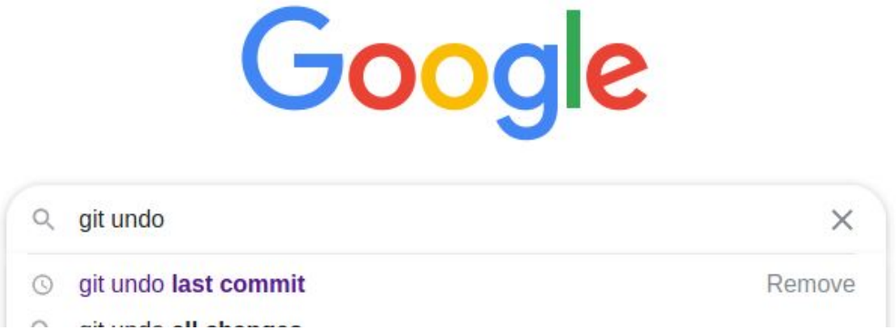


(Everything else you can look up when you need it)

First, how to get help

- In the terminal
  (if you know the verb and want to know what it does or what are its options)
  `git help <verb>`
  `git <verb> --help or git <verb> -h`
  `man git-<verb>`
  TIP: press ‘q’ to exit the manual in the terminal

- Look it up

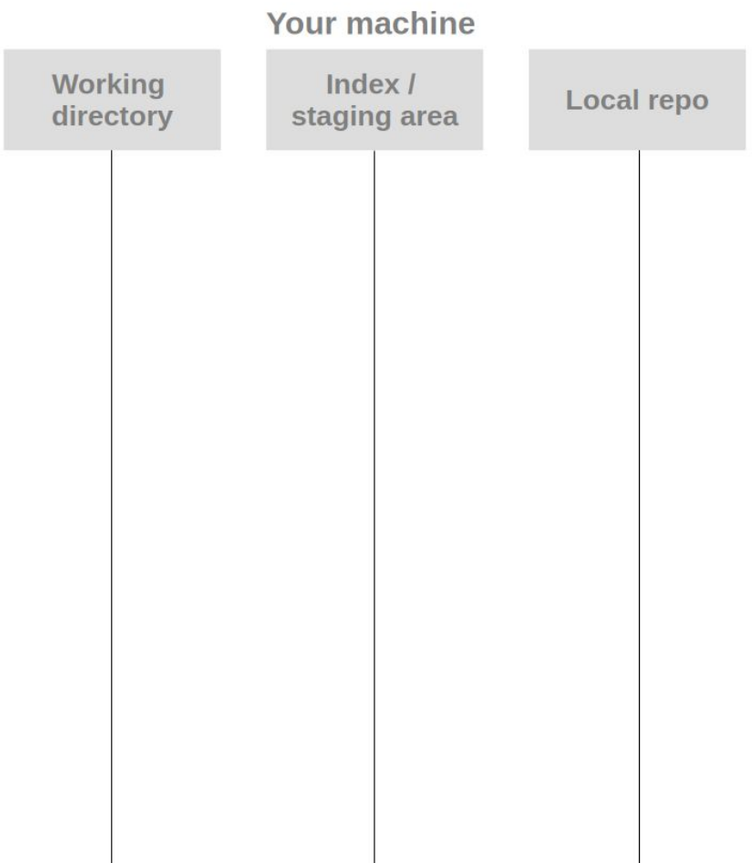


3 parts of a Git project

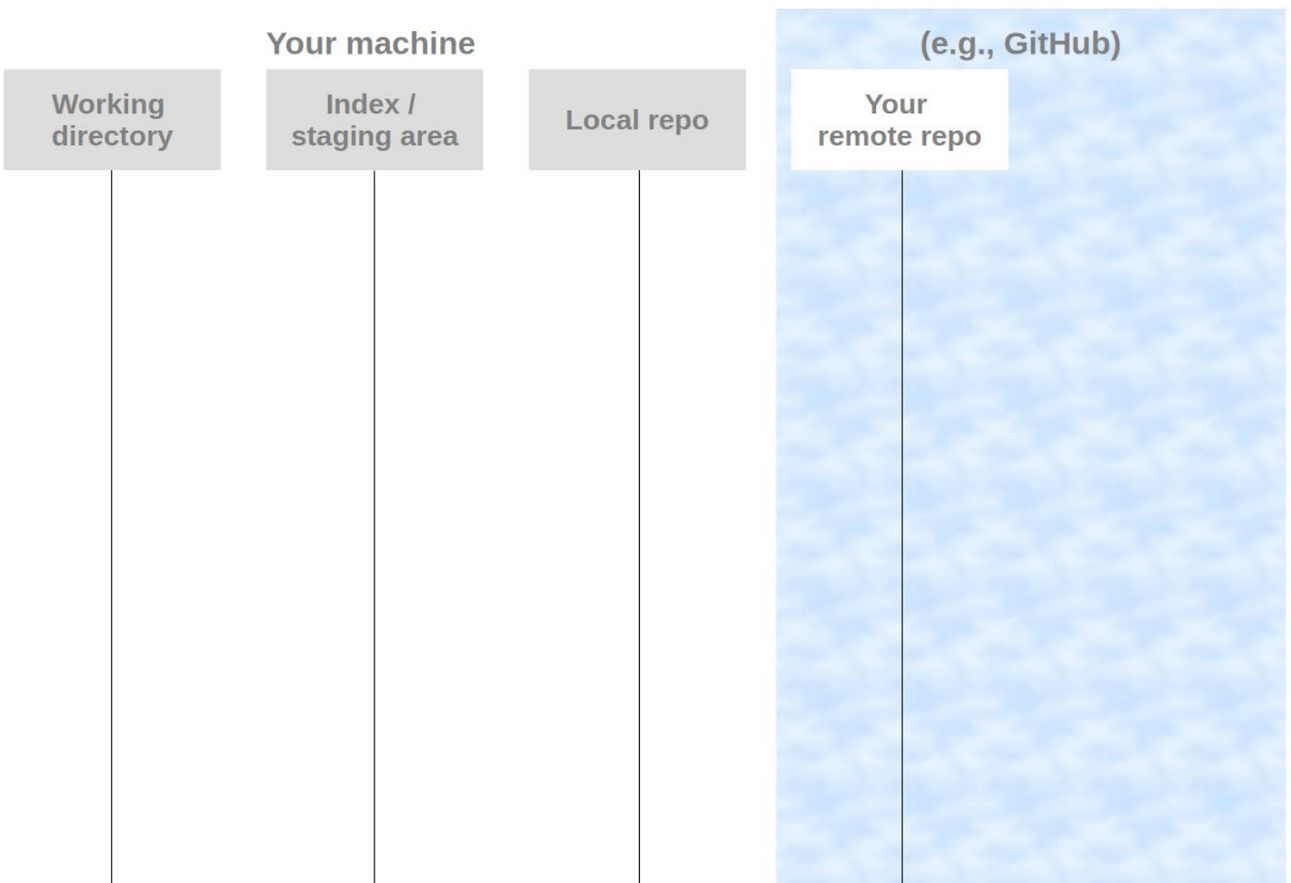
1. **Working directory**
   The version of the project that you're working on

2. **Staging area / Index**
   What will be in your next snapshot

3. **Local repository (i.e., `.git/` folder)**
   Metadata and objects that make up the snapshots



Peek forward: Where’s GitHub?



Starting a git repo

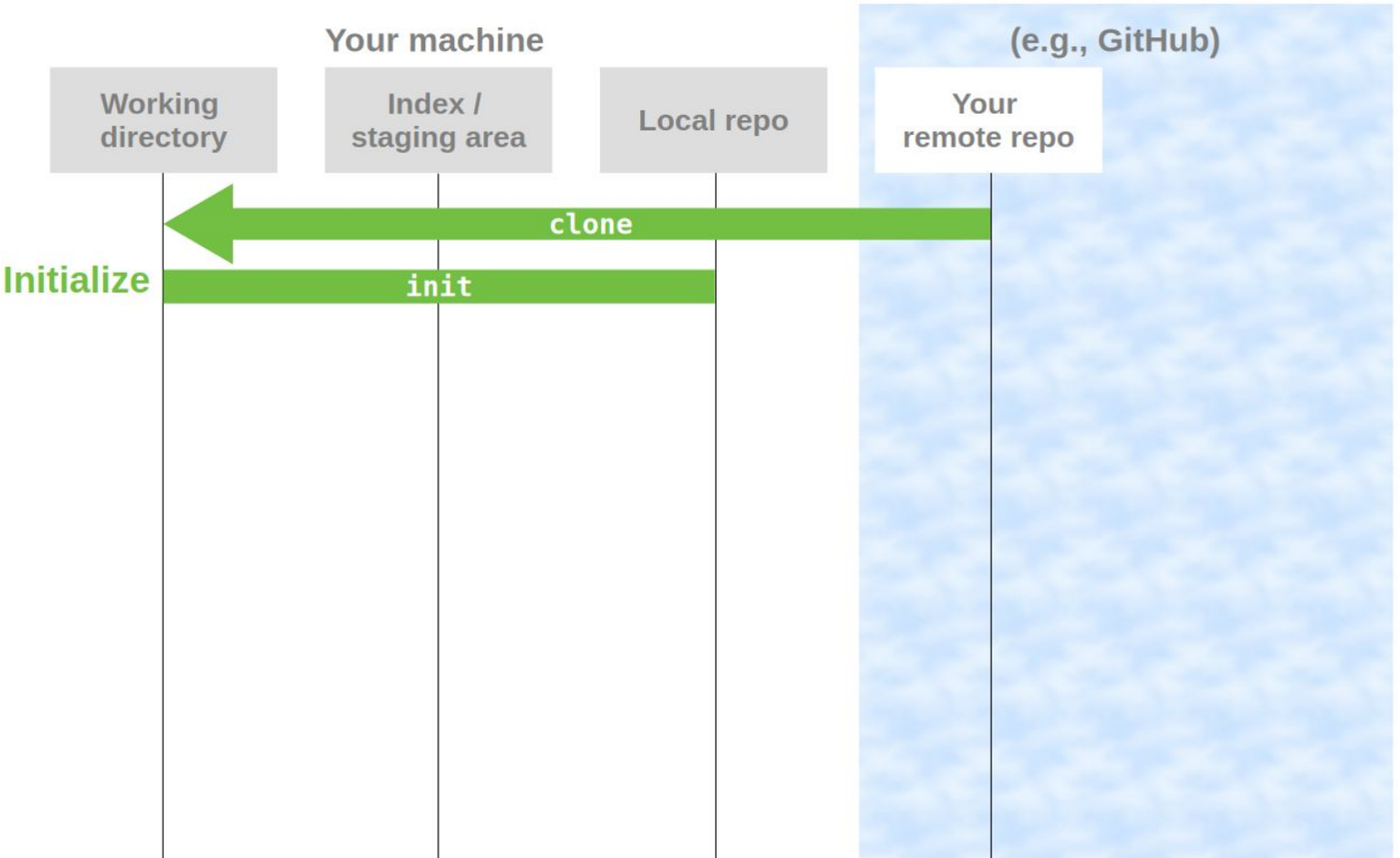
2 options

1. **Make an existing folder into a git repo**

   ```
   cd <directory>
   git init
   ```

2. **Clone an existing repo (e.g., from GitHub)**

   ```
   git clone <repo URL>
   ```



3 file states

1. **Modified**
   You made a change to the file

2. **Staged**
   You indicated that you want the modified file in your next snapshot

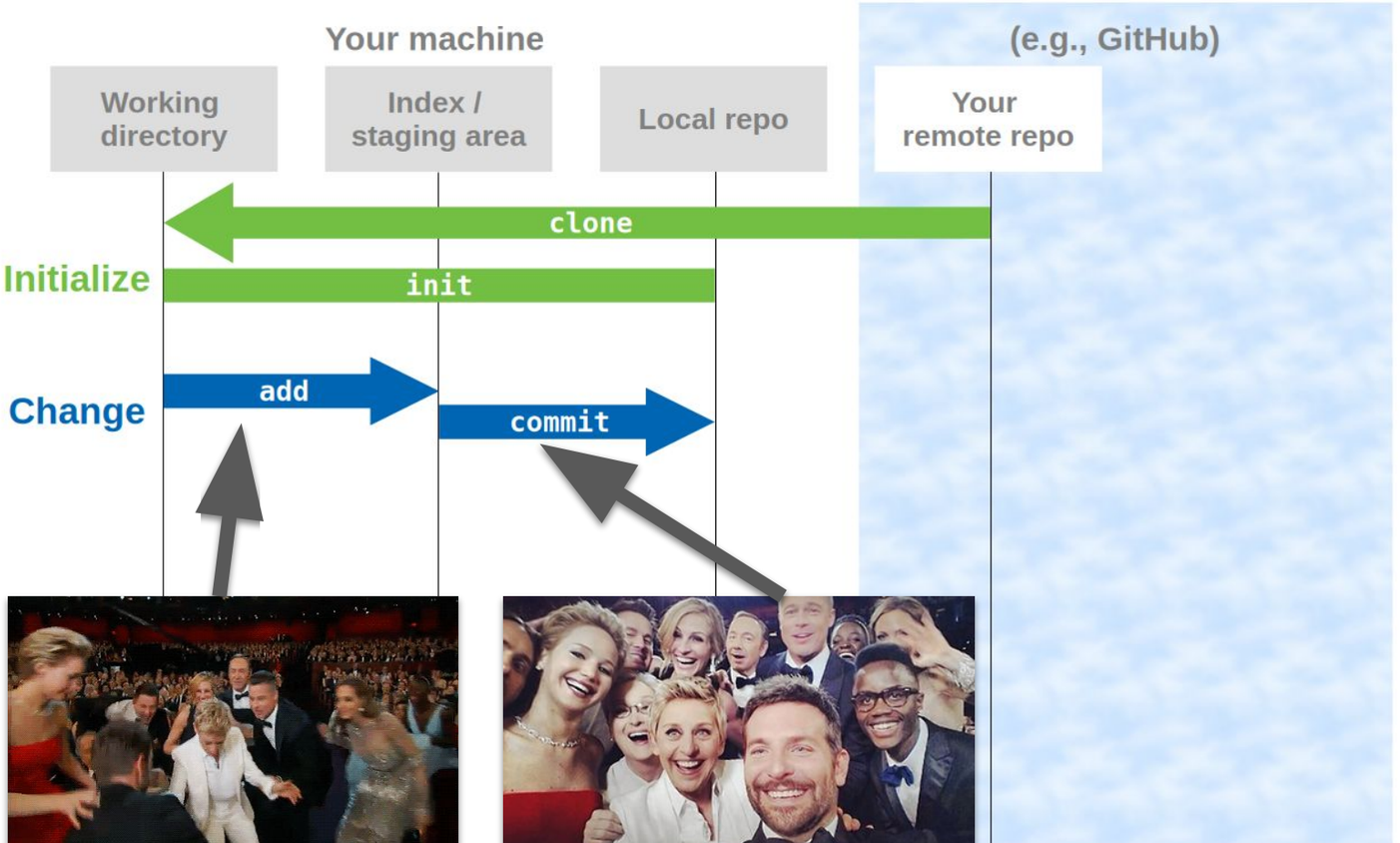
3. **Committed**
   You took the snapshot

3-step basic workflow

1. **Modify**
   Change a file in your working tree

2. **Stage**
   `git add <filename>`

3. **Commit**
   `git commit -m "<short, informative commit message>"`



Inspecting

(useful commands that don't *do* anything)

- Check the status of the files in your repo

  `git status`

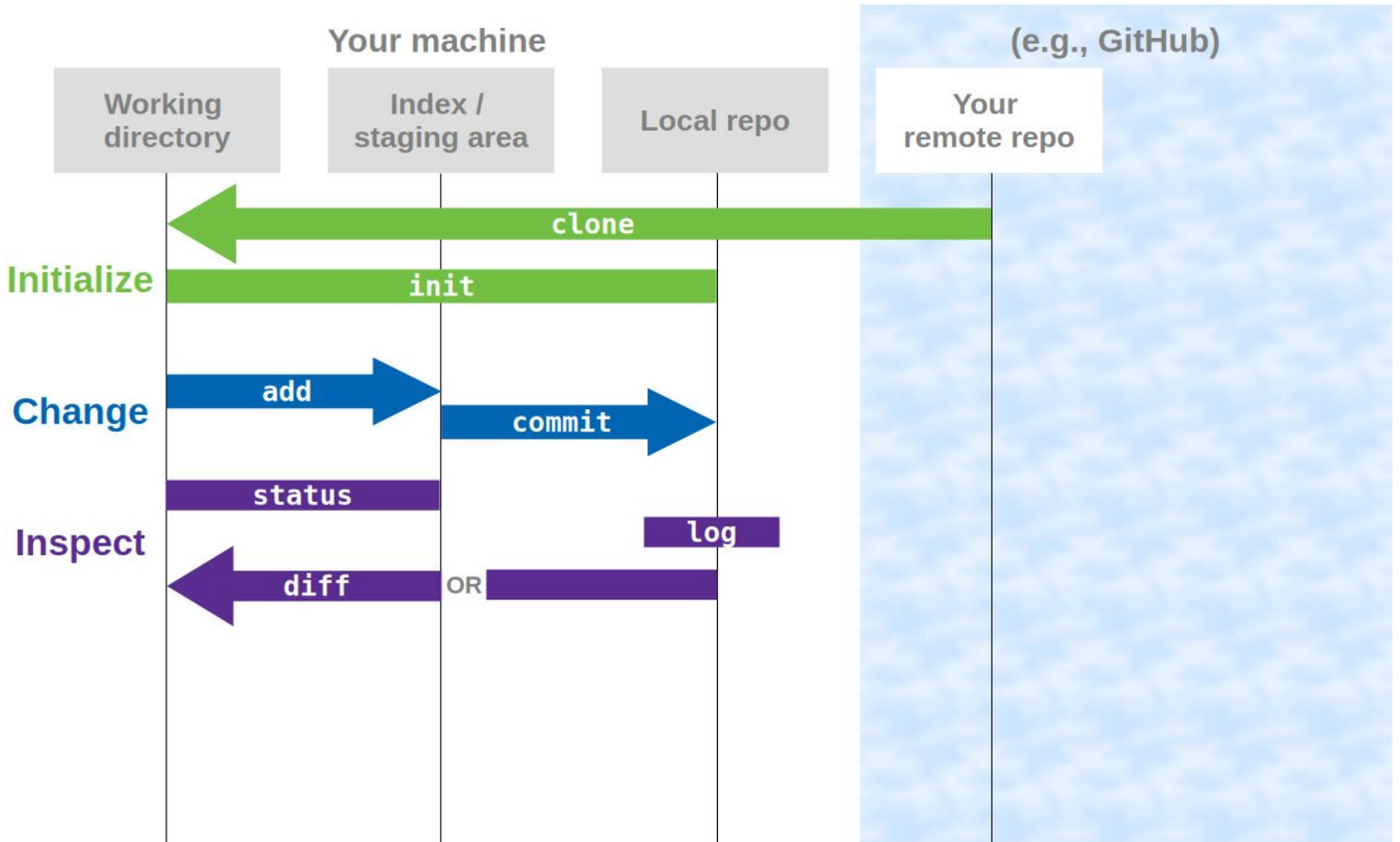
- See what changed

  `git diff`

- See the history of your repo

  `git log`

  Note: type 'q' to exit the log



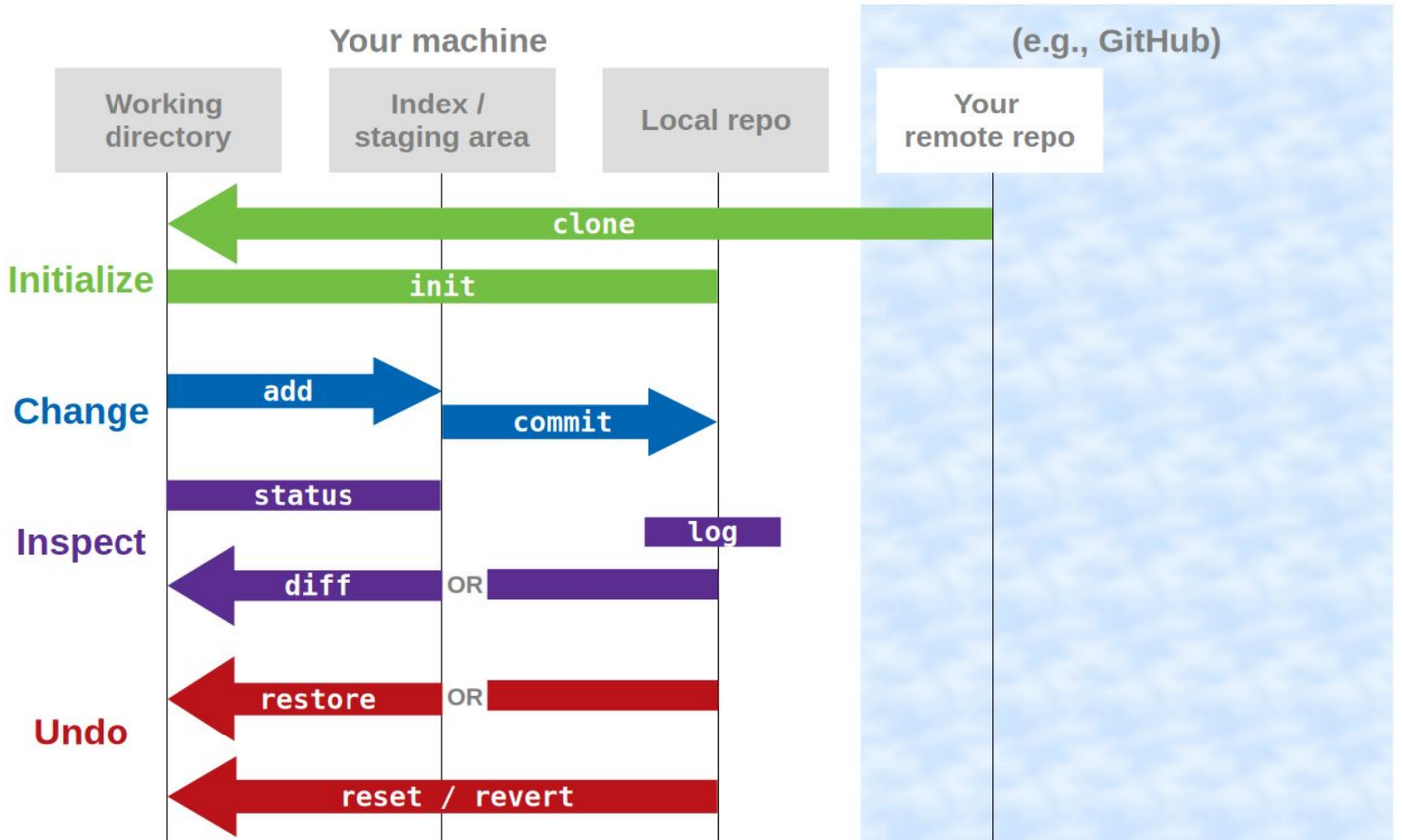
Common undoing goals

- **Unmodify** a file
  `git restore <file>` or `git checkout -- <file>`

- **Unstage** a file
  `git restore --staged <file>` or `git reset HEAD <file>`

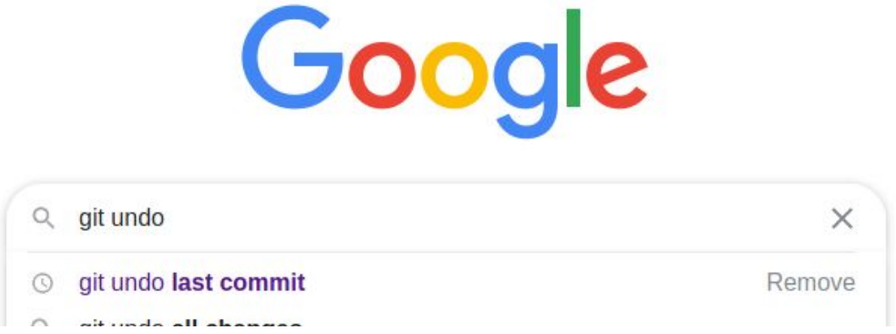
- Forgot a file in the last **commit**
  `git add <file>`
  `git commit --amend`

- Undo the last **commit**
  `git reset HEAD~`



Undoing can feel intimidating

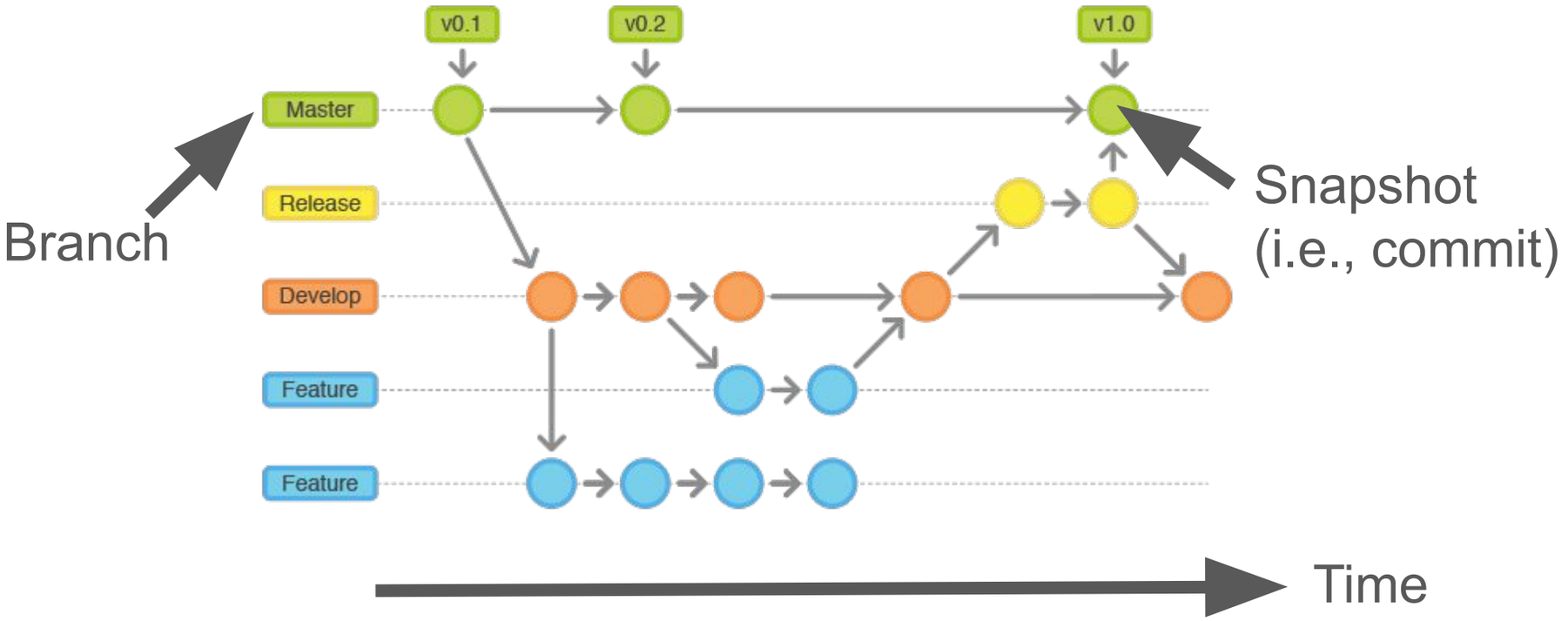
- Don’t try to memorize all the commands
- Try it out on a sandbox repo first
- Use `git checkout <commit hash> -b <branch name>` to start a new branch at the point you want to revert to in order to see what it would be like
- For minor recent fixes, try reading the output of `git status`
- Look it up; someone probably had your question before



Branches

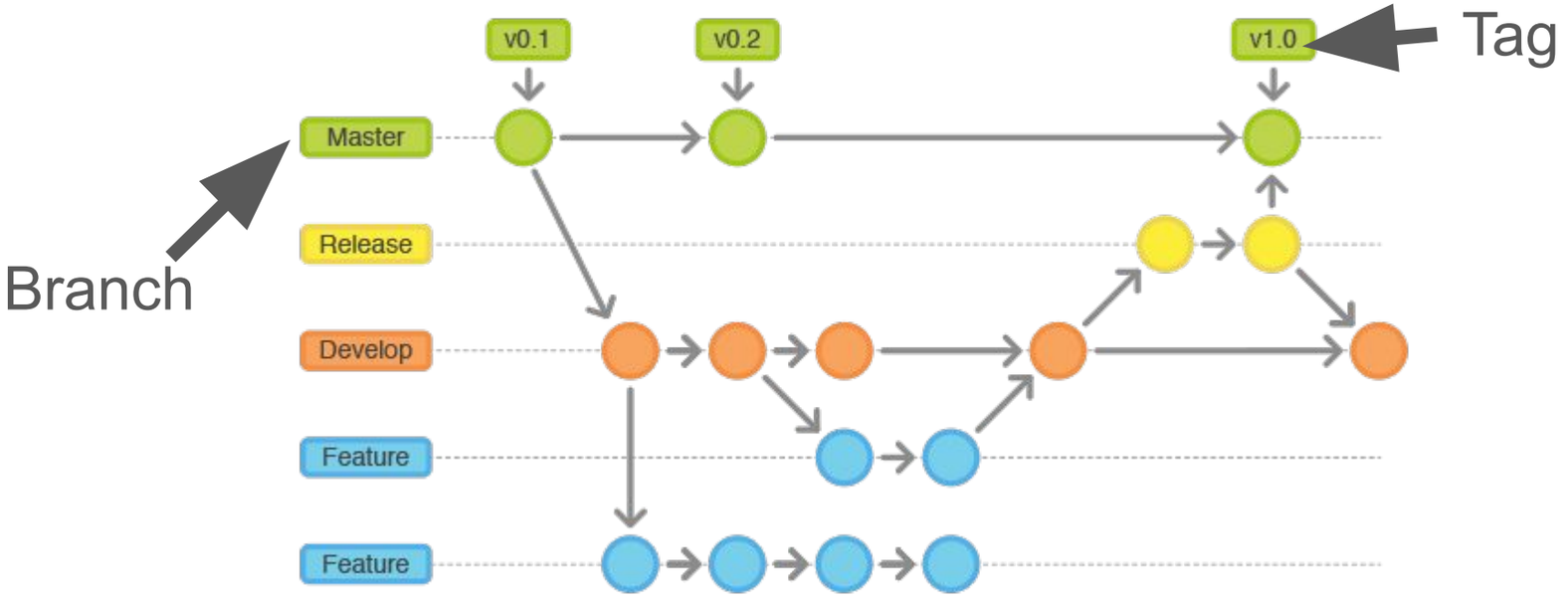
- For nonlinear development
- To collaborate
  - Linux: In the last month, “1067 authors have pushed 5,329 commits…” [https://github.com/torvalds/linux/pulse/monthly, as of 2021-07-14]
- To try new things on your own

Branches



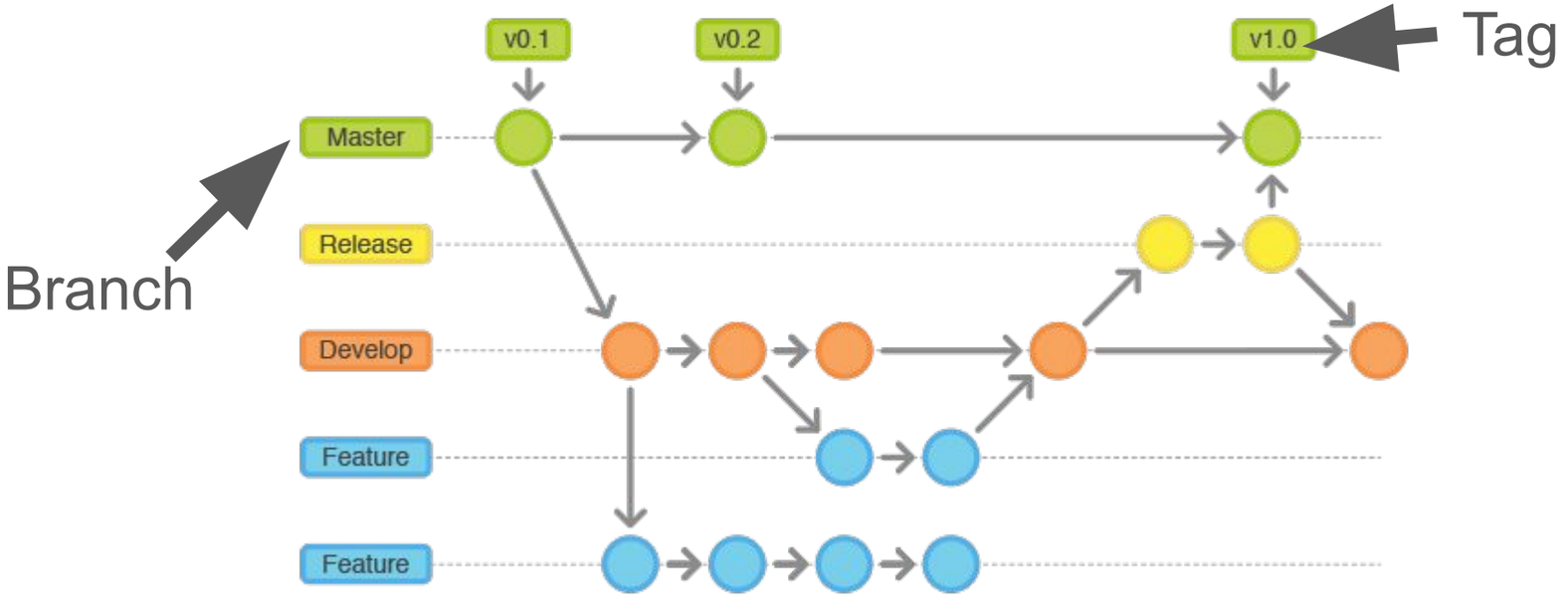
Tip: GitHub has a great way of viewing a project's "network"

Branches vs tags



	What is it for?	
Branch	**Marks a line of development** E..g, a new feature, a collaborator's contribution	
Tag	**Marks an important point in history** E..g, a version of a software package, a paper publication	

Branches vs tags

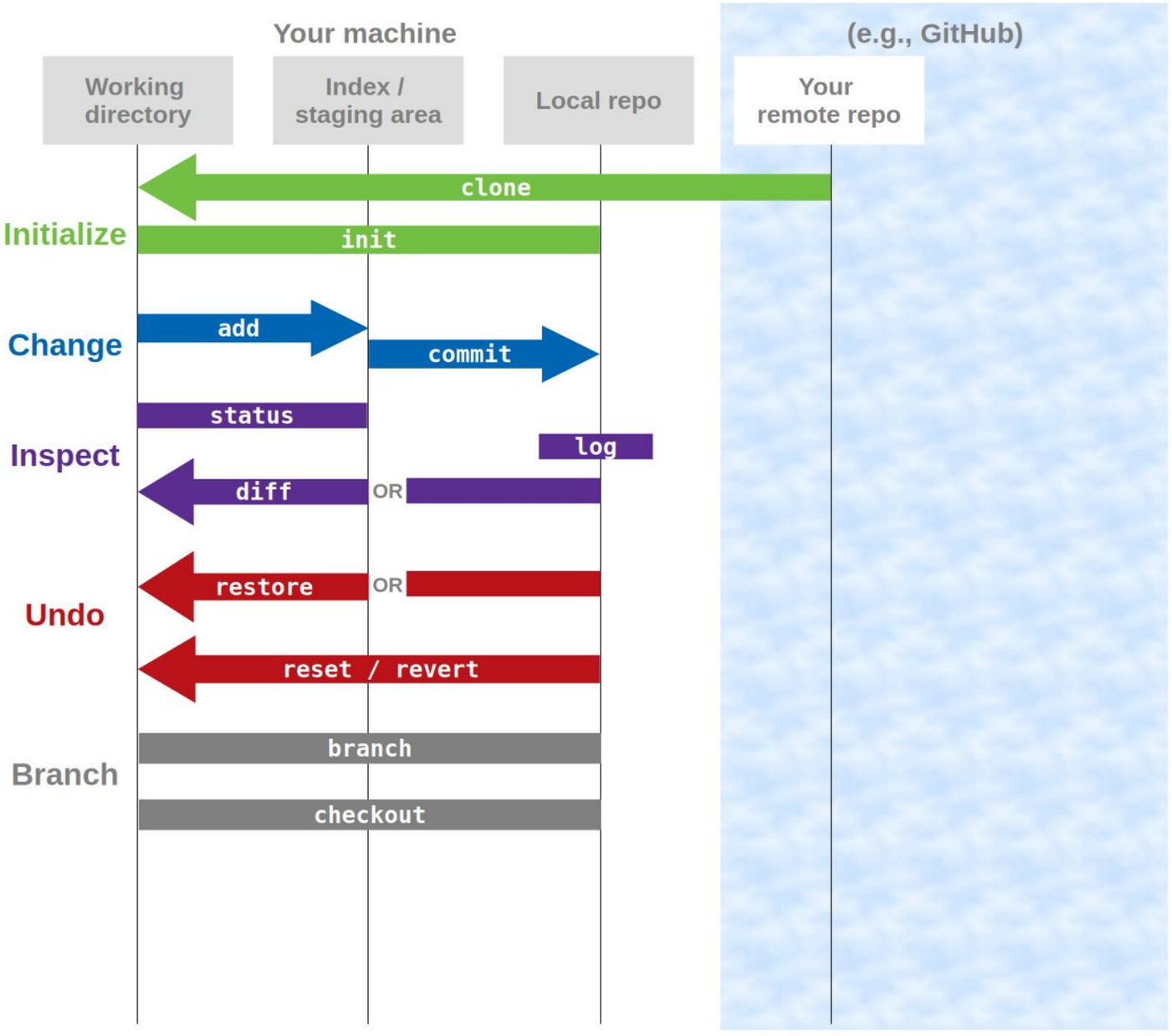


	What is it for?	What *exactly* is it?
Branch	**Marks a line of development** E..g, a new feature, a collaborator's contribution	**A text file** Filename: branch name Contents: commit hash for the latest commit in that branch
Tag	**Marks an important point in history** E..g, a version of a software package, a paper publication	**A text file** Filename: tag name Contents: commit hash for the commit when the tag was created

Branches

- See which branch you're on
  `git branch`
- Start a new branch
  `git branch <branch name>`
- Change branches
  `git checkout <branch name>`
- Merge a branch into your current branch
  `git merge <branch name>`

Branches

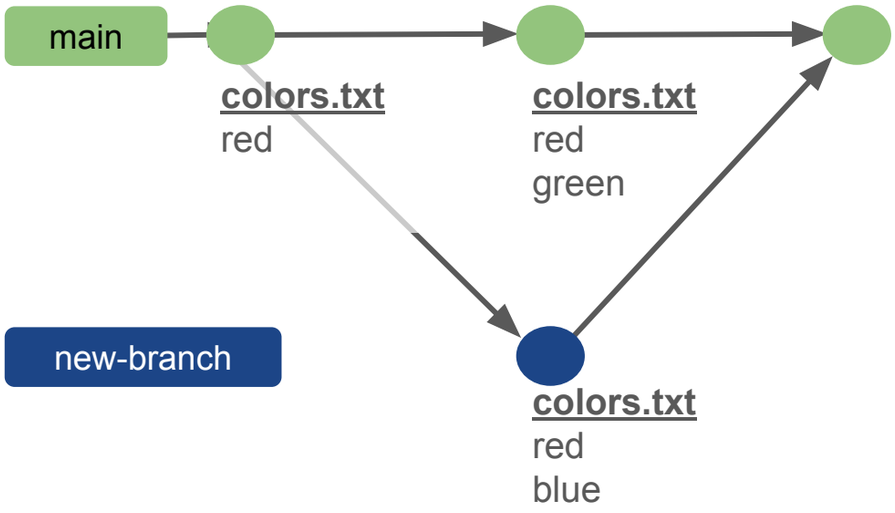

Your machine
(e.g., GitHub)
Working directory
Index / staging area
Local repo
Your remote repo
clone
Initialize
init
Change
add
commit
status
Inspect
log
diff
OR
restore
OR
Undo
reset / revert
branch
Branch
checkout

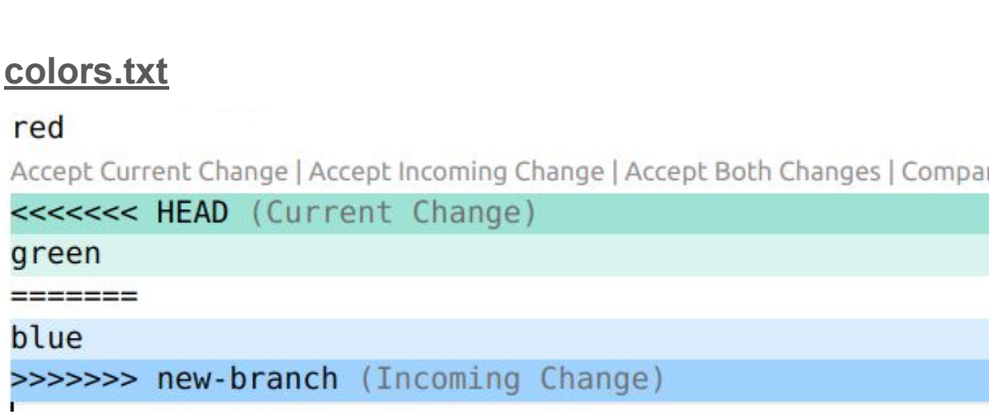
Merge conflicts

- What if **several people** edit the same line of code?
  (or **you** edit the same line of code on different branches)

  → **merge conflict**

- Someone needs to **manually resolve it**





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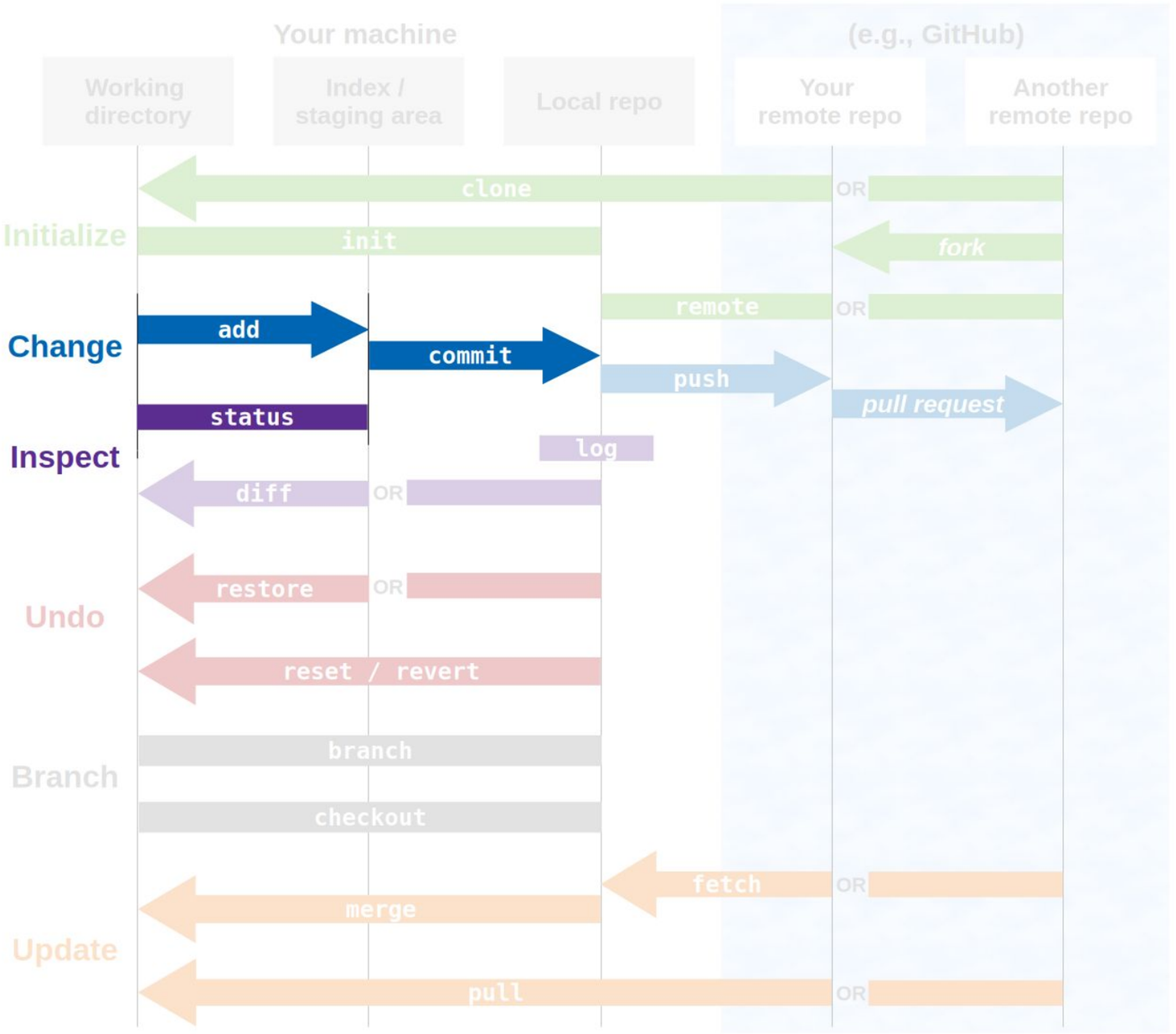

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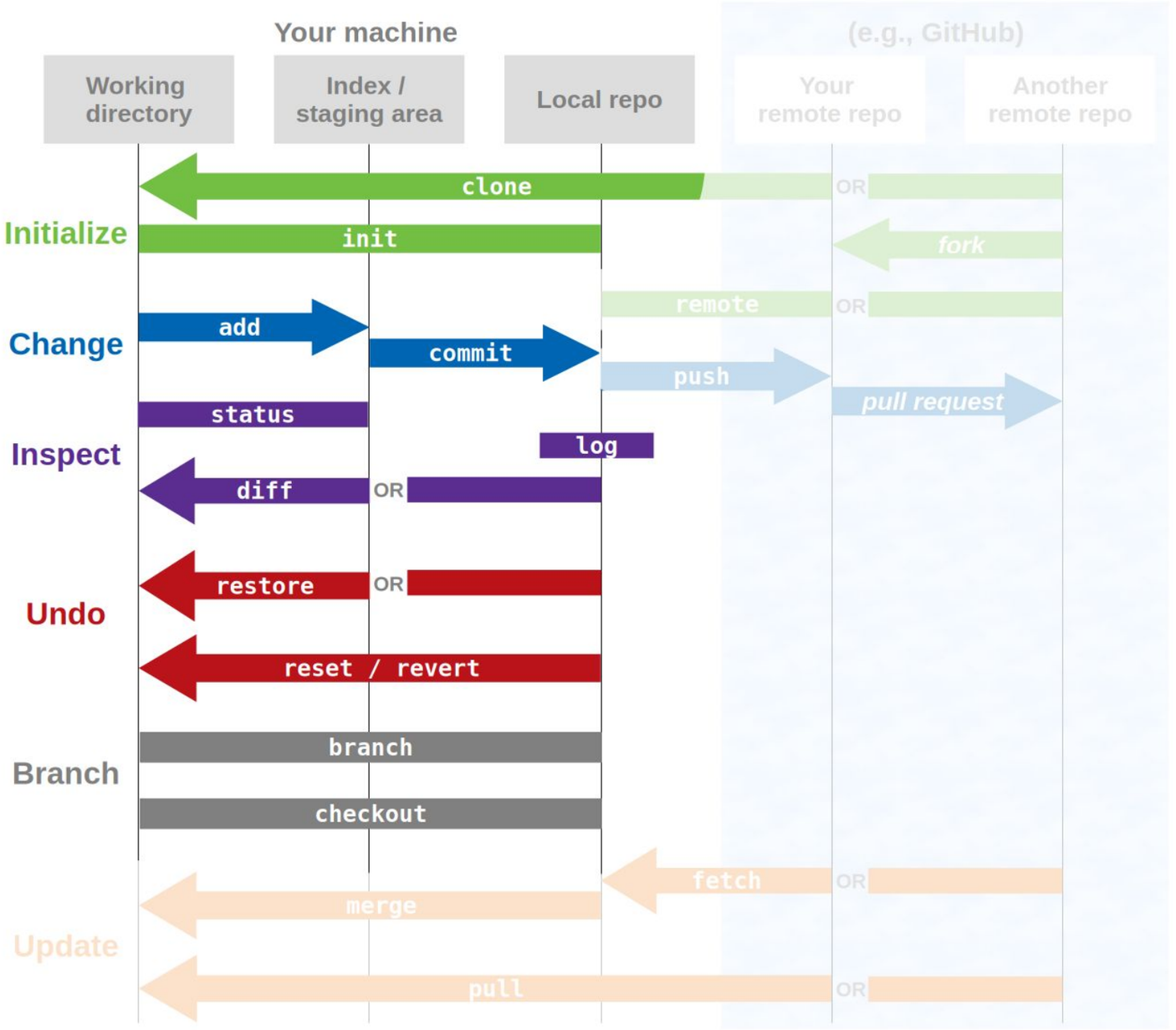
The commands we covered **today**



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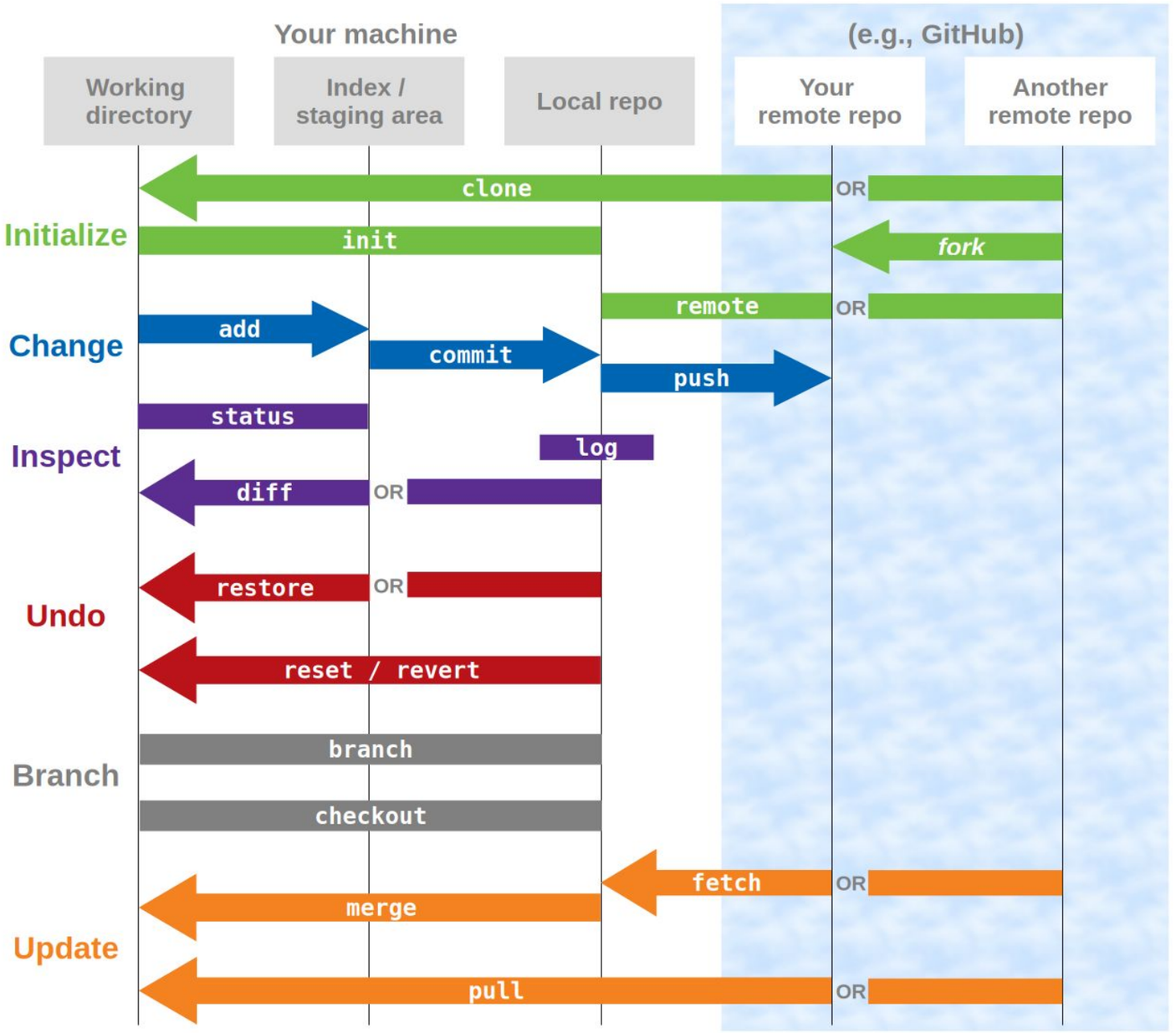
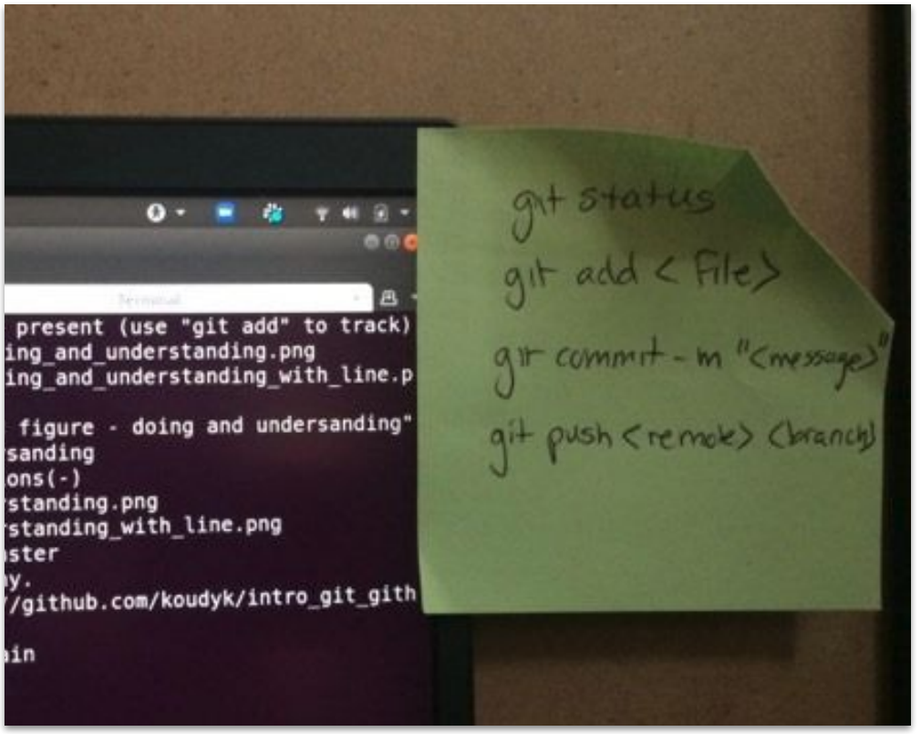
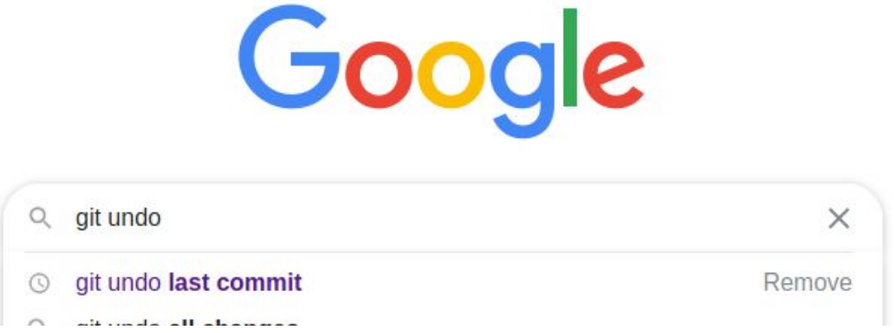


My advice


present (use "git add" to track)
ing_and_understanding.png
ing_and_understanding_with_line.p
figure - doing and undersanding"
sanding
ons(-)
standing.png
standing_with_line.png
ster
y.
/github.com/koudyk/intro_git_gith
in
git status
git add <file>
git commit -m "<message>"
git push <remote> <branch>


Google
git undo
git undo last commit
Remove

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- **Collaborate through GitHub (complex / nonlinear collaboration)**
- **Navigating GitHub**
- **Try it out!**

Acknowledgements

Many parts of this presentation are inspired / based on these great resources:

- Chacon, S., & Straub, B. (2014). Pro git. Springer Nature. Available at https://git-scm.com/book/en/v2
- The Carpentries. (2021). Version Control with Git. https://swcarpentry.github.io/git-nov....

Figure references

Here are the sources of some figures on my slides:

- The Carpentries. (2021). Version Control with Git. https://swcarpentry.github.io/git-nov....
- Chacon, S., & Straub, B. (2014). Pro git. Springer Nature. Available at https://git-scm.com/book/en/v2
- www.phdcomics.com 15 - https://en.wikipedia.org/wiki/Git
- McElreath, R. (2020, September 26). Science as amateur software development [video]. YouTube. • Science as Amateur Software Development

The end

Basic Bash

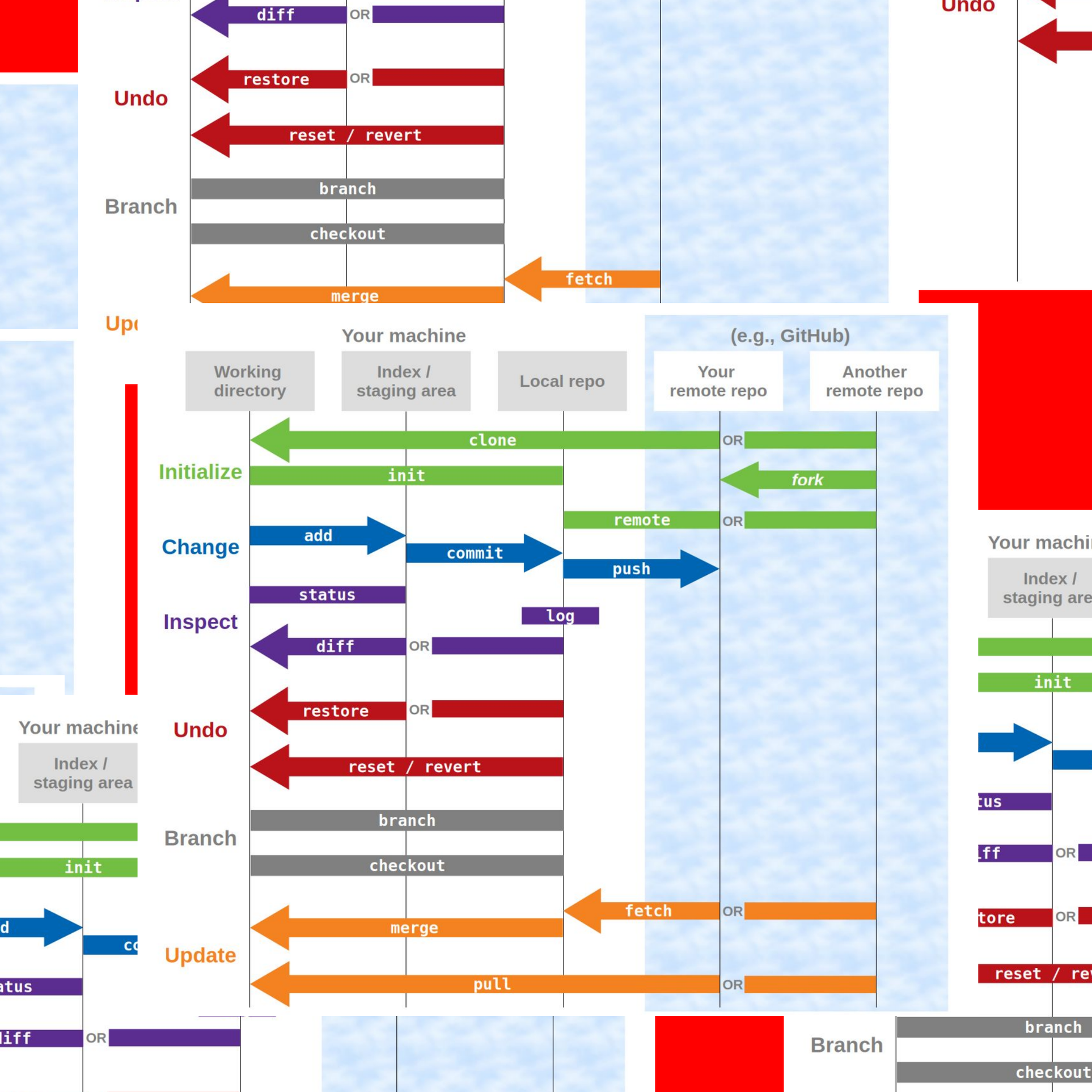
- `cd <directory path>` changes directories (aka folders)
  - `.` represents the current directory
  - `..` represents the directory one level up

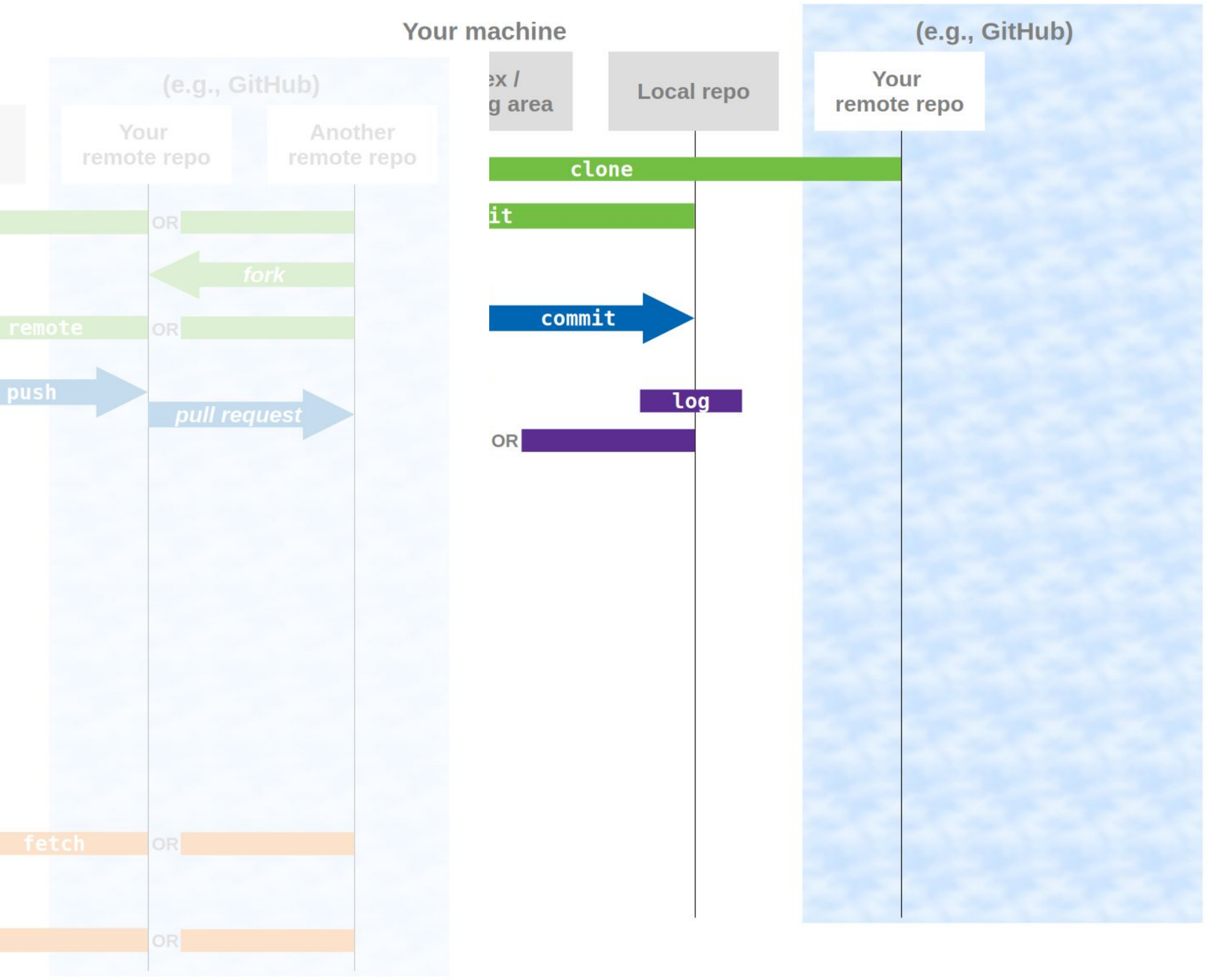
- `mkdir <directory path>` makes a new directory

- `touch <filename>` creates a new file

- `ls` lists the directory's contents
  - `ls -a` includes hidden files

- `<text editor name>` opens a text editor
  - `<text editor name> <filename>` opens a file in a text editor


diff
OR
restore
OR
Undo
reset / revert
branch
Branch
checkout
fetch
merge
Your machine
(e.g., GitHub)
Working directory
Index / staging area
Local repo
Your remote repo
Another remote repo
clone
OR
Initialize
init
fork
remote
OR
Change
add
commit
push
status
Inspect
log
diff
OR
restore
OR
Undo
reset / revert
branch
Branch
checkout
fetch
OR
merge
Update
pull
OR


Your machine
(e.g., GitHub)
(e.g., GitHub)
Your
remote repo
Another
remote repo
ex /
g area
Local repo
Your
remote repo
clone
it
OR
fork
commit
remote
OR
push
pull request
log
OR
fetch
OR
OR