Version Control With Git

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What is Git?

- ▶ Version control software keeps track of all the versions or revisions to a set of files in an efficient and orderly manner.
- ▶ Git is version control software, initially developed for version control of the Linux operating system kernel.
- ▶ It is now extremely widely used for almost all kinds of software development projects.
- ▶ Git is characterized by the following features or goals:
  - ▶ Nonlinear development.
  - ▶ Distributed and decentralized.
  - ▶ Speed and efficiency.
  - ▶ Open source.

How Git works internally (very briefly)

- ▶ Git works on whole "projects", which are simply directories, not individual files.
- ▶ Each project is completely self-contained, and completely independent of every other.
- ▶ It keeps a "snapshot" of the state of the project as it develops. These are *commits*.
- ▶ Git copies every version of every file in every commit. Calculates its sha-1 hash. Compresses it. Names it by its hash. These are known as *blobs*.
- ▶ It creates a hash tree (Merkle tree) from the files in each commit (the *tree object*).
- ▶ Each commit stores the tree hash, parent commit, author info, log message, etc, and calculate it sha-1 hash.

Distributed and decentralized

- ▶ The Git project is completely self-contained. All the meta data and history of the project is contained in .git.
- ▶ There is no centralized server. No synchronization. No edit locks.
- ▶ Collaboration is via cloning and re-emerging.
- ▶ E.g. a project can be *cloned*, developed independently, and possibly re-merged.
- ▶ Usually developers use a *remote* host with a "bare" repository, clone it, develop locally, *commit* and then *push* back to and *pull* from the remote host. The *push* and *pull* are merges.
- ▶ GitHub is one of the most widely used hosting sites (but there are others, e.g. BitBucket; and running your own git hosting server is simple and inexpensive).

What should we (academics, researchers, scientists) care?

- ▶ The minimal requirements for project development for individuals or small teams.
  - ▶ One *single source of truth.*
  - ▶ All past versions are stored; allowing for indefinite undoing.
  - ▶ Parallel development.
- ▶ In addition, Git provides
  - ▶ A development log
  - ▶ Nonlinear workflows.
  - ▶ Robustness and fault toleration.
  - ▶ Multiple remote server options.
  - ▶ Free and open source and cross platform.
  - ▶ The *de facto* standard for version control.

Git: Tiny tutorial

▶ Start by cloning a remote repository:

```
git clone https://github.com/yihui/knitr.git
cd knitr
git log # Read all the commit logs
```

▶ Work as normal, i.e. edit files, create new files, delete files.
▶ You now *stage* your changes, e.g.

```
git add foo.file.1 foo.file.2 # for edits or new files
git rm foo.file.3 # for removed files
```

▶ You then *commit* these:

```
git commit # Editor opens for your log msg
```

Git: Tiny tutorial (2)

▶ Pull down any recent changes by others from the remote:

```
git pull
git log # If new changes, read their logs
```

▶ Now, push your own changes to the remote

```
git push # requires permissions
```

▶ Undo changes:

```
git reset a381f2f # move back "head"
git revert a381f2f # applies new change to revert
```

References