Version Control: git

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Learning objectives

- What version control is
- Why we should use version control
- Why we choose use git
- Know the basic elements of git workflow
    - How to save history
    - How to undo mistakes
    - Know about the basic components
        - work directory
        - staging area
        - local repository
        - remote repository

What is version control:

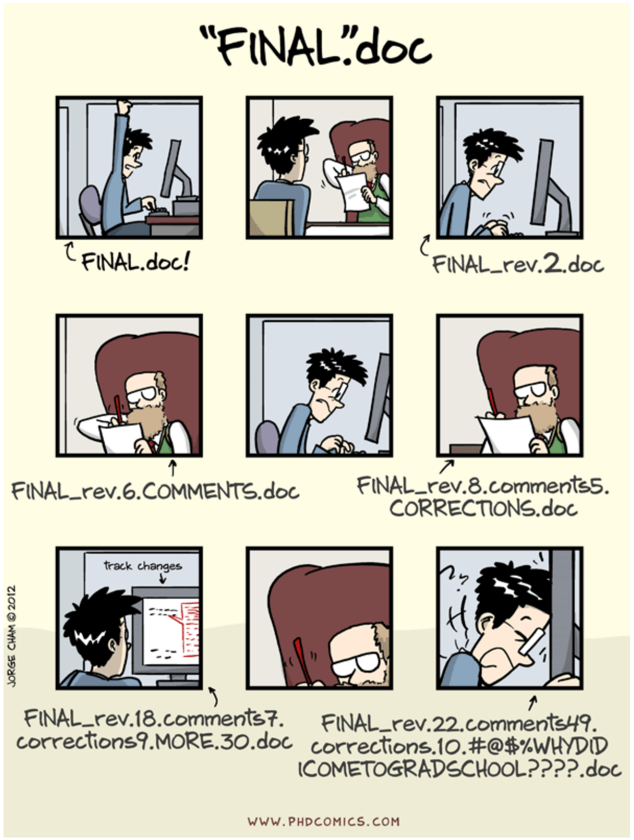
-

- A Version Control System (VCS) is a frame works that tracks the history of a project
- The history of a project is a sequence of versions

```
1 -> 2 -> 3 ...
```

- At any point in time we can go back to a previous version
- A VCS allows you to compare different versions
- A VCS allows several users to work on the same project files simultaneously

Why use version control



A manual VCS

```
$ cp -r Project Project.save
```

… work

```
$ cp -r Project Project.save.v2
```

… work

```
$ cp -r Project Project.save.v2.new
```

Version control systems of the past

RCS (Revision Control System)

- A file-level local version control system

```
$ date > latest_update.txt

$ ci latest_update.txt
latest_update.txt,v  <--  latest_update.txt
enter description, terminated with single '.' or end of file:
NOTE: This is NOT the log message!
>> .
initial revision: 1.1
done

$ ls -l
-r--r--r-- 1 olav olav 207 Apr 13 05:24 latest_update.txt,v

$ co -l ./latest_update.txt
./latest_update.txt,v  -->  ./latest_update.txt
revision 1.1 (locked)
done

$ date > latest_update.txt

$ ci ./latest_update.txt
./latest_update.txt,v  <--  ./latest_update.txt
new revision: 1.2; previous revision: 1.1
enter log message, terminated with single '.' or end of file:
```

Version control systems of the past

CVS (Concurrent Versions System)

- First project-level (> 1 file) version-control
- A central server
- Users could checkout project files to work with
- Users needed contact with the server to save work and compare work

Version control systems of the past

Subversion (svn)

- An improvement over CVS
- When a user checks out a project a local reference is maintained
- Development branches are possible (main called trunk)
- Merging branches

Introducing git

- Written by Linus Thorvalds, originally for the Linux kernel
- A distributed VCS
- Several servers have all information
- Any one can be chosen as the reference version
- One of the most popular frameworks today (others: bazaar, mercurial)

When to use

Why

- For source code development
- For manuscripts
- In single-user projects
- In collaborative projects

`Practically always`

Benefits

- No history is lost
- All versions of your documents are preserved
- Easy to backup to other sites

Setup

The first time around

```
$ git config --global user.name "First Last"
$ git config --global user.email "first.last@isp.com"
```

Creates a configuration file `~/.gitconfig`

```
[user]
name = First Last
email = first.last@isp.com
```

Note: You can create and edit the file directly

Initializing a repository

- Use an existing directory or create a new project directory

```
$ mkdir proj
```

- Go to the directory and initialize

```
$ cd proj
$ git init
Initialized empty Git repository in /tmp/proj/.git/
$ ls -a
.  ..  .git
```

- Check repository status

```
$ git status
On branch master

Initial commit

nothing to commit (create/copy files and use "git add" to track)
```

Adding files

- Create a new file

```
$ cat << EOF > hello.py
print "Hello world!"
EOF
$ python hello.py
Hello world!
```

- Recheck status

```
$ git status
On branch master

Initial commit

Untracked files:
  (use "git add <file>..." to include in what will be committed)

    hello.py

nothing added to commit but untracked files present (use "git add" to track)
```

Untracked files

- `git` warns about files in the project directory that Git is not keeping track of
- To tell git to do so

```
$ git add hello.py
$ git status
On branch master

Initial commit

Changes to be committed:
  (use "git rm --cached <file>..." to unstage)

    new file:   hello.py
```

The staging area

- After an add operation a file is in the staging area (cache)
- This is an intermediate level between the work directory and repository

The repository

- Save the latest changes in the local repository (`.git` directory)

```
$ git commit -m "First hello"
[master (root-commit) edf197e] First hello
 1 file changed, 1 insertion(+)
 create mode 100644 hello.py
```

- Check the status again

```
$ git status
On branch master
nothing to commit, working directory clean
```

The work cycle

There are three levels, from "lowest"

- The work directory
- The staging area
- The repository

```
repository (.git)
    ^
    |   commit

staging area (cache)

    ^
    |   add

work directory     <- init
```

A single file may be represented att all levels

The basic work cycle is edit-add-commit

```
    $ vim <file> #edit
    $ git add <file> #adds new file or saves latest changes
    $ git commit -m <message> <file> #save permanently in repository
```

Review history

To see the commit history of the project files

```
    $ git log
    commit edf197e2974f9365abe3a52e6bde5ae0495d5016
    Author: First Last <first.last@isp.com>
    Date:   Thu Oct 16 17:32:45 2014 +0200

    First hello
```

Viewing changes

- Consdier a modified file

```
$ cat << EOF > hello.py
print "Hello there world!"
EOF
```

- git now recognizes this tracked file as modified

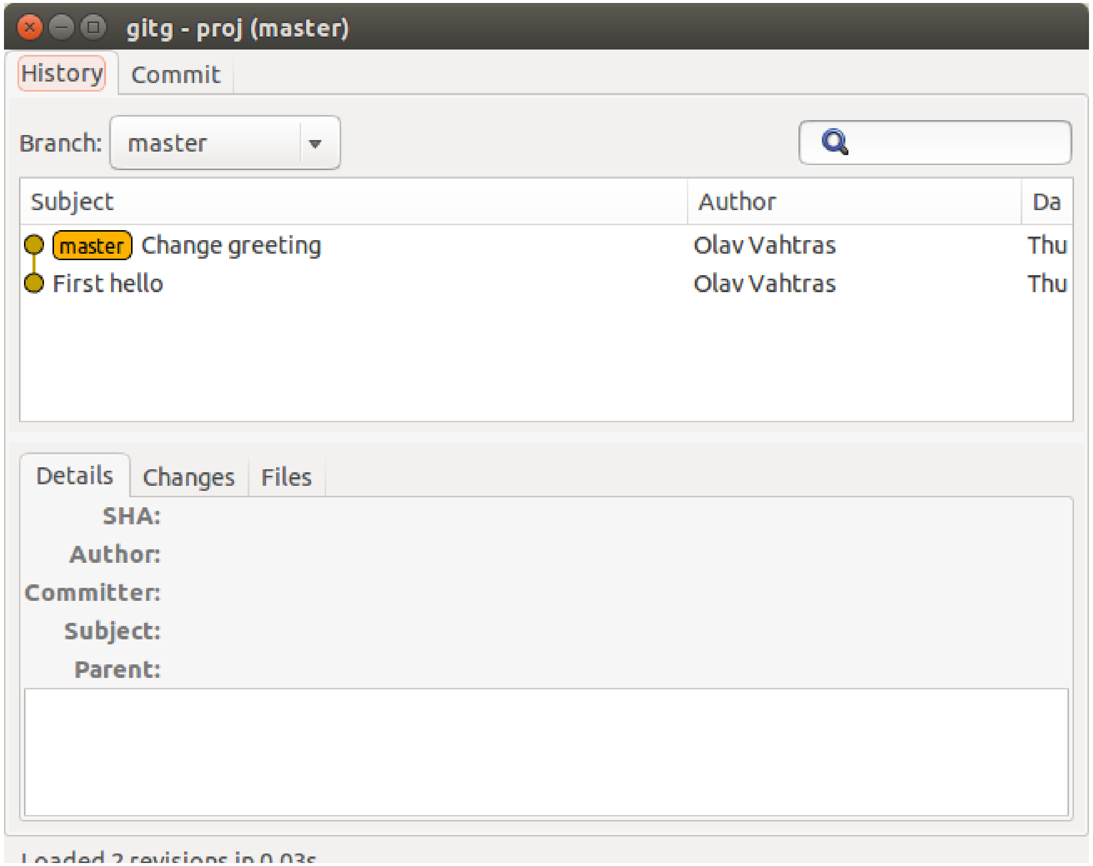
```
$ git status
On branch master
Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working directory)

    modified:   hello.py
```

Update repository

```
$ git add hello.py

$ git commit -m "Change greeting"
[master f7efe62] Change greeting
 1 file changed, 1 insertion(+), 1 deletion(-)

$ git log
commit f7efe62016fcd70fbdbd2232f9086bfd96aaf413
Author: First Last <first.last@isp.com>
Date:   Thu Oct 16 18:32:41 2014 +0200

    Change greeting

commit edf197e2974f9365abe3a52e6bde5ae0495d5016
Author: First Last <first.last@isp.com>
Date:   Thu Oct 16 17:32:45 2014 +0200

    First hello
```

Graphical frontends

```
$ gitg
```



gitg - proj (master)

```
Subject                              Author          Da
master Change greeting               Olav Vahtras    Thu
First hello                          Olav Vahtras    Thu
```

Loaded 2 revisions in 0.03s

Recovering old work

- To retreive old verions, use checkout with the commit string

```
$ git checkout edf197
Note: checking out 'edf197'.

You are in 'detached HEAD' state. You can look around, make experimental
changes and commit them, and you can discard any commits you make in this
state without impacting any branches by performing another checkout.

If you want to create a new branch to retain commits you create, you may
do so (now or later) by using -b with the checkout command again. Example:

  git checkout -b new_branch_name

HEAD is now at edf197e... First hello
$ cat hello.py
print "Hello world!"
```

Switch back to latest version

```
$ git status
HEAD detached at edf197e
nothing to commit, working directory clean
```

```
$ git checkout master
Previous HEAD position was edf197e... First hello
Switched to branch 'master'
```

```
$ git status
On branch master
nothing to commit, working directory clean
```

```
$ cat hello.py
print "Hello there world!"
```

Remote repositories

- Necessary for collaborative projects
- Useful for single-user projects
- Web-services, github, bitbucket
- A shared directory (NFS, AFS, Dropbox....)
- git pull from remote
- git push to remote

```
repository (.git)  <->   remote
                pull,push

    ^
    |   commit

staging area (cache)

    ^
    |   add

work directory     <- init, clone
```

A shared directory repository

- Create an empty remote repository

```
$ git init --bare ~/Dropbox/proj.git
Initialized empty Git repository in /home/olav/Dropbox/proj.git/
```

A shared directory repository

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```
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```

- Create an alias for the remote repository

```
$ git remote add origin ~/Dropbox/hello.git
$ git remote -v
origin    /home/olav/Dropbox/proj.git (fetch)
origin    /home/olav/Dropbox/proj.git (push)
```

A shared directory repository

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```
$ git init --bare ~/Dropbox/proj.git
Initialized empty Git repository in /home/olav/Dropbox/proj.git/
```

- Create an alias for the remote repository

```
$ git remote add origin ~/Dropbox/hello.git
$ git remote -v
origin    /home/olav/Dropbox/proj.git (fetch)
origin    /home/olav/Dropbox/proj.git (push)
```

- Let the local branch track the remote repository

```
$ git push -u origin master
Counting objects: 6, done.
Delta compression using up to 4 threads.
Compressing objects: 100% (2/2), done.
Writing objects: 100% (6/6), 473 bytes | 0 bytes/s, done.
Total 6 (delta 0), reused 0 (delta 0)
To /home/olav/Dropbox/proj.git
 * [new branch]      master -> master
Branch master set up to track remote branch master from origin.
```

- Now your local is in sync with your remote
- Make another local change

```
$ cat << EOF > hello.py
print "HELLO THERE WORLD!"
EOF
```

```
$ git add hello.py
```

```
$ git commit -m "Capitalize"
[master cb05b3f] Capitalize
 1 file changed, 1 insertion(+), 1 deletion(-)
```

Backup to remote

- View local changes

```
$ git status
On branch master
Your branch is ahead of 'origin/master' by 1 commit.
  (use "git push" to publish your local commits)

nothing to commit, working directory clean
```

- Backup to remote repository

```
$ git push
Counting objects: 5, done.
Writing objects: 100% (3/3), 269 bytes | 0 bytes/s, done.
Total 3 (delta 0), reused 0 (delta 0)
To /home/olav/Dropbox/proj.git
   f7efe62..cb05b3f  master -> master
```

Continue work on another computer

- With access to the same shared file system

```
|Other> git clone ~/Dropbox/proj.git
Cloning into 'proj'...
done.
|Other> cd proj
```

- work on remote
    - edit -> add -> commit -> push

Back on local

- Retrieve changes that was made on another system
- By you or another developer

```
$ git pull
remote: Counting objects: 5, done.
remote: Total 3 (delta 0), reused 0 (delta 0)
Unpacking objects: 100% (3/3), done.
From /home/olav/Dropbox/proj
   cb05b3f..d5fe073  master     -> origin/master
Updating cb05b3f..d5fe073
Fast-forward
 hello.py | 2 +-
 1 file changed, 1 insertion(+), 1 deletion(-)
```

Summary of work cycle

- Start a new project

```
$ git init
```

- Get a copy of existing project

```
$ git clone
```

- Locally: edit-add-commit

```
$ vim ...
$ git add...
$ git commit...
```

- Sync with remote: pull-push

```
$ git pull
$ git push
```

Use a remote server (service)

- github.com (free for public projects)
- gitlab.com (free for public and private projects)

Links

- http://git-scm.com/book
- http://software-carpentry.org/v5/novice/git/index.html
- http://www.linux.com/news/featured-blogs/185-jennifer-cloer/821541-10-years-of-git-an-interview-with-git-creator-linus-torvalds
- https://gun.io/blog/how-to-github-fork-branch-and-pull-request/
- http://christoph.ruegg.name/blog/git-howto-revert-a-commit-already-pushed-to-a-remote-reposit.html
- http://git-man-page-generator.lokaltog.net/