Technological foundations of software development

Manage your source code

ICM – Computer Science Major – Course unit on Technological foundations of computer science
M1 Cyber Physical and Social Systems – Course unit on CPS2 engineering and development, Part 2: Technological foundations of software development
Maxime Lefrançois https://maxime-lefrancois.info
online: https://ci.mines-stetienne.fr/cps2/course/tfsd/

Objectives of the session

Ensure you are familiar with source code management methodologies and tools, in particular the git software, the gitlab platform used at school, and the github platform.

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Manage your source code

Part 1: generalities

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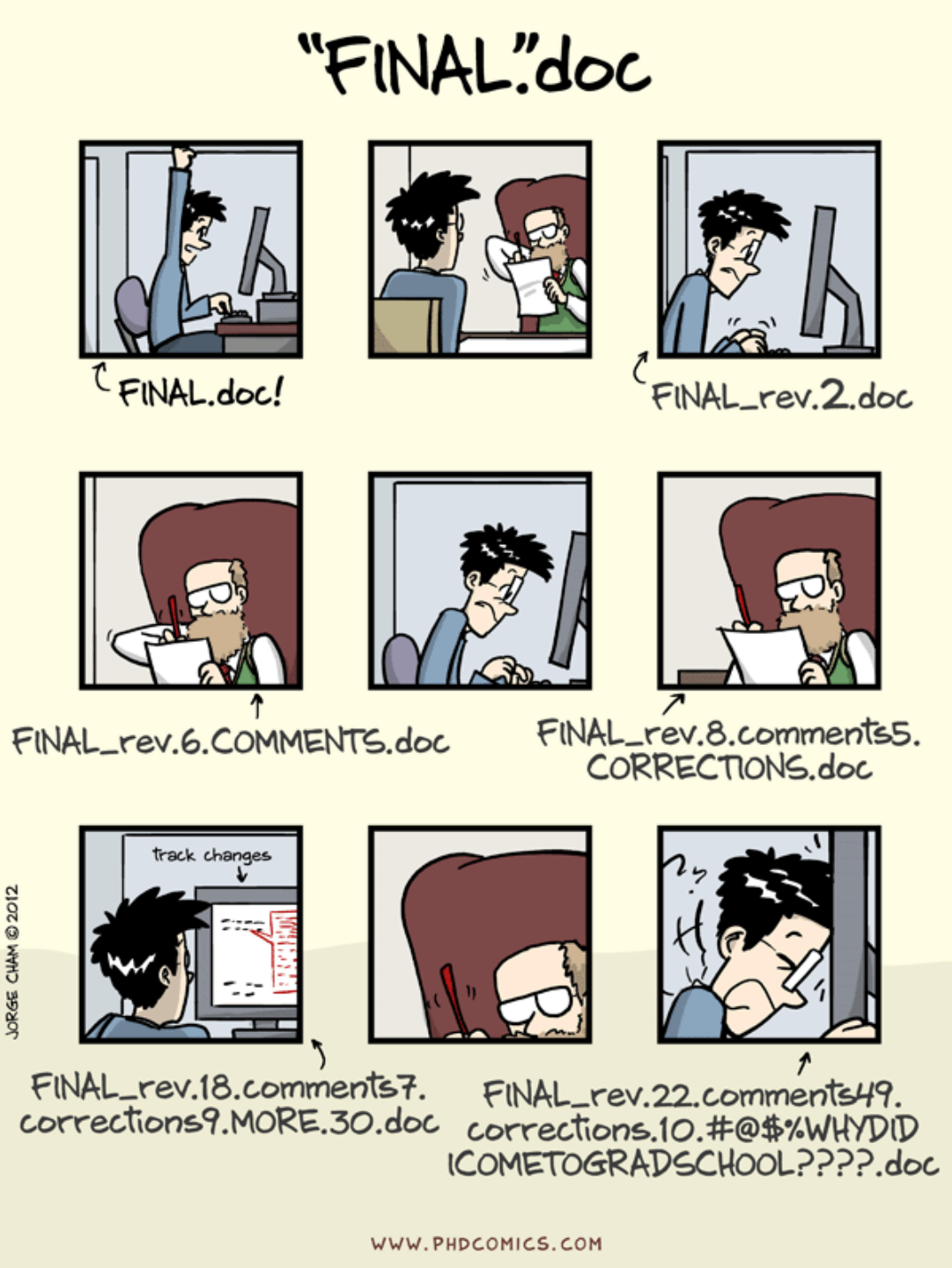
Why track versions ?

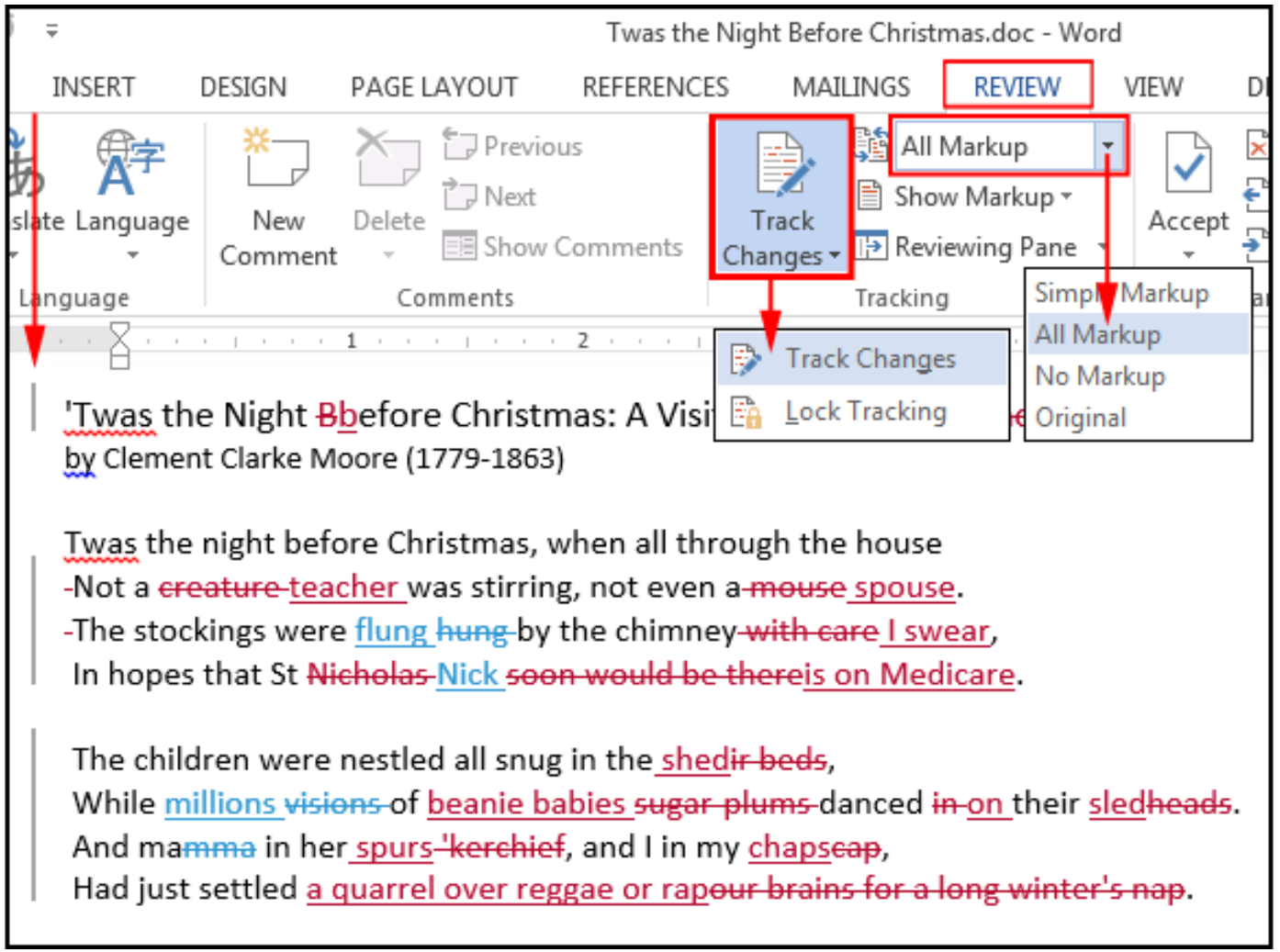
Example: many versions of the same file



http://phdcomics.com/comics/archive.php?comicid=1531

Track changes in a file

Example with Word



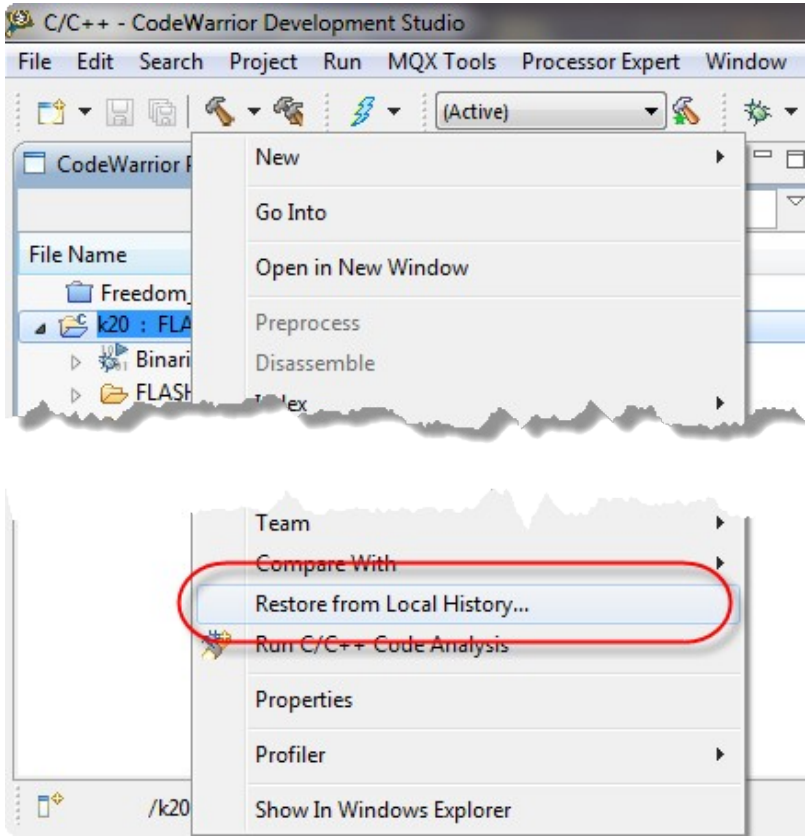
Why save versions ?

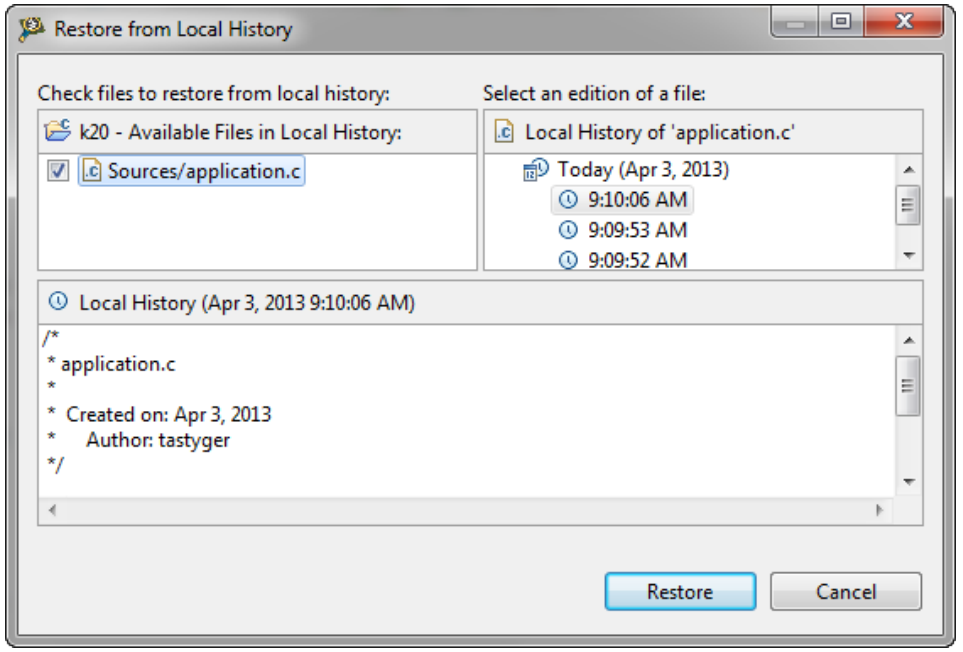
Example: to restore to a previous state

http://library.ucmerced.edu/node/66631

For code ?

Some IDEs have embedded solutions
For example with Eclipse





https://mcuoneclipse.com/2013/04/03/restore-deleted-files-in-eclipse-with-local-history/

For code ?

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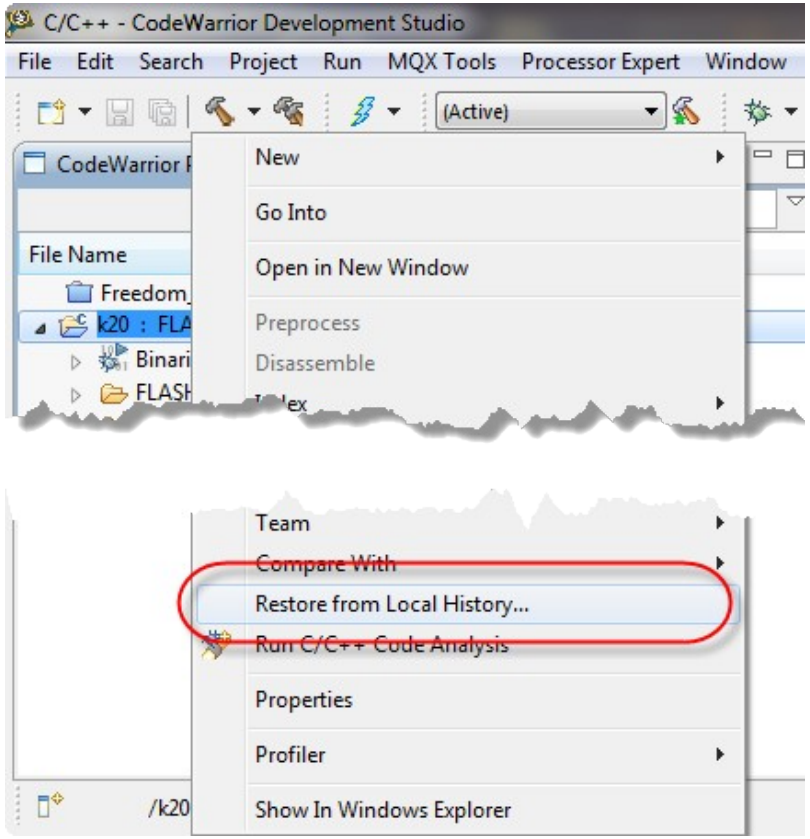
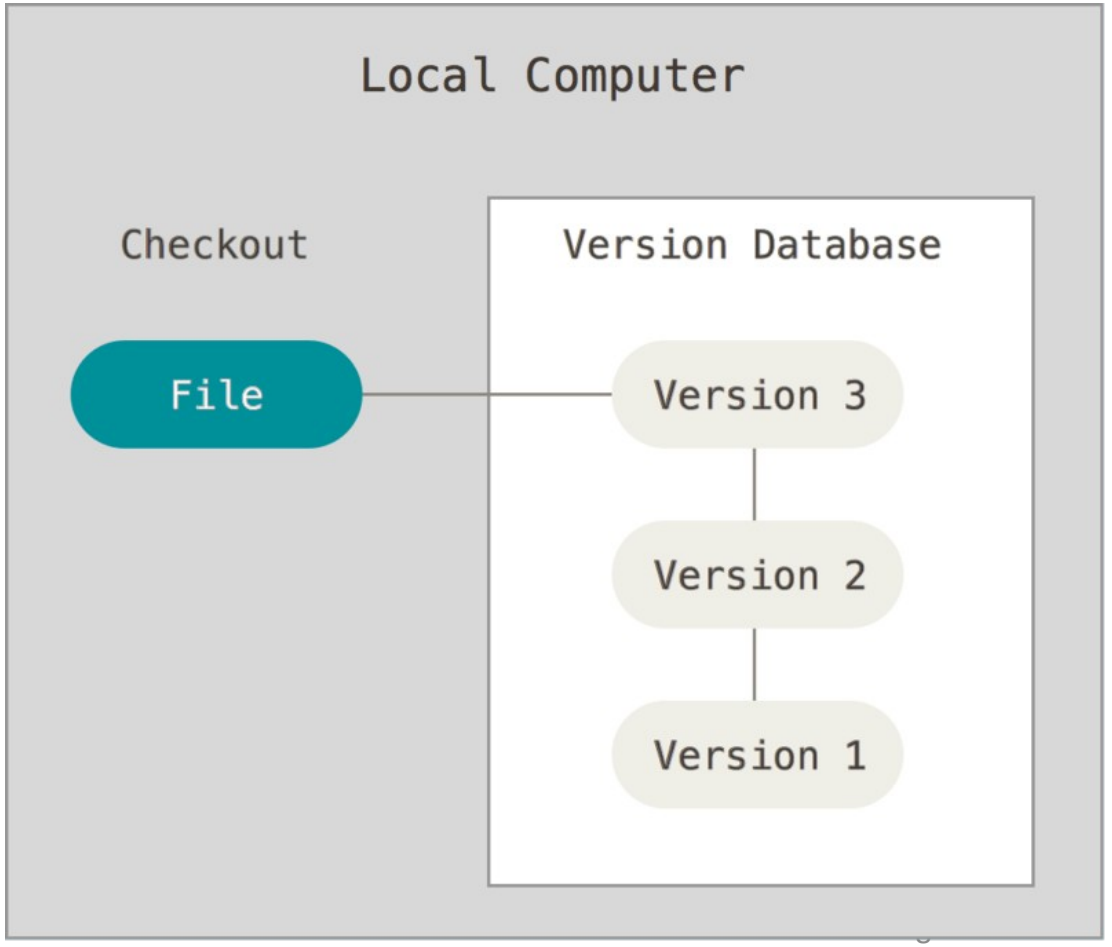


https://mcuoneclipse.com/2013/04/03/restore-deleted-files-in-eclipse-with-local-history/

Local version management



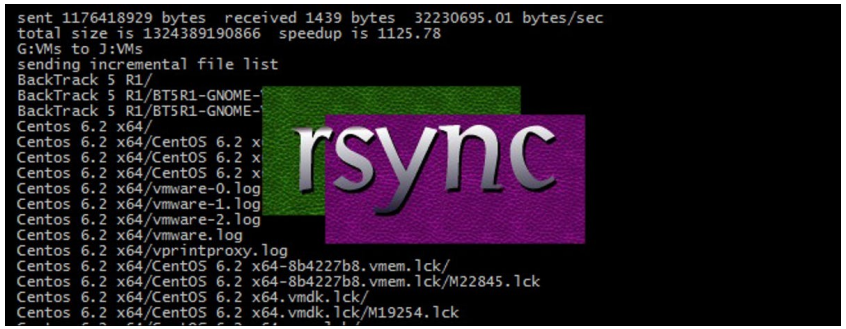
https://git-scm.com/book/en/v2/Getting-Started-About-Version-Control

File synchronization software

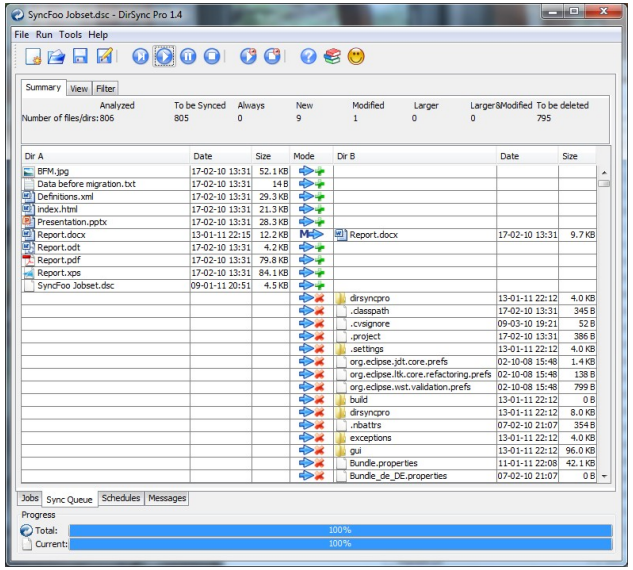
Many solutions exist

https://en.wikipedia.org/wiki/Comparison_of_file_synchronization_software

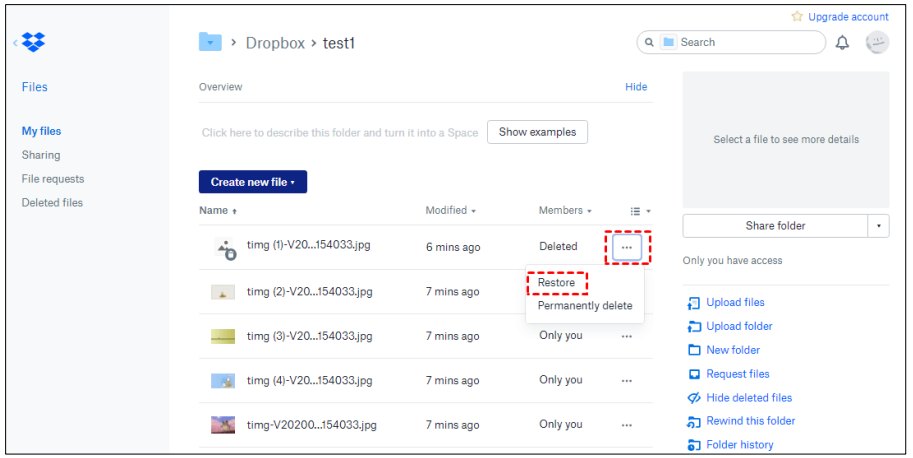
- commercial or open-source
- local, or with server, or with cloud
- personal or collaborative folders



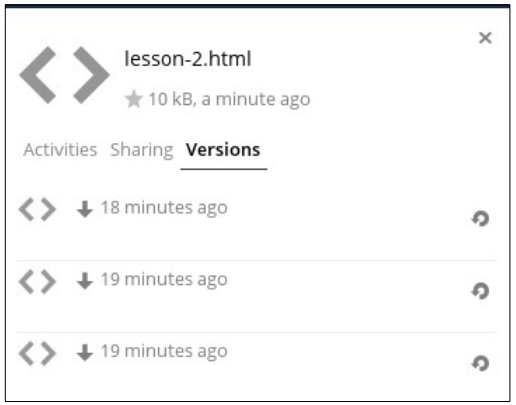
rsync, 1996



dirsyncpro, 2004



dropbox, 2007



ownCloud, 2010

Diff utilities

https://en.wikipedia.org/wiki/Diff

Diff , cmp and comm

- **Diff** command.
  diff command will compare the two files line by line and print out the differences between.
- Syntax : diff [option] files

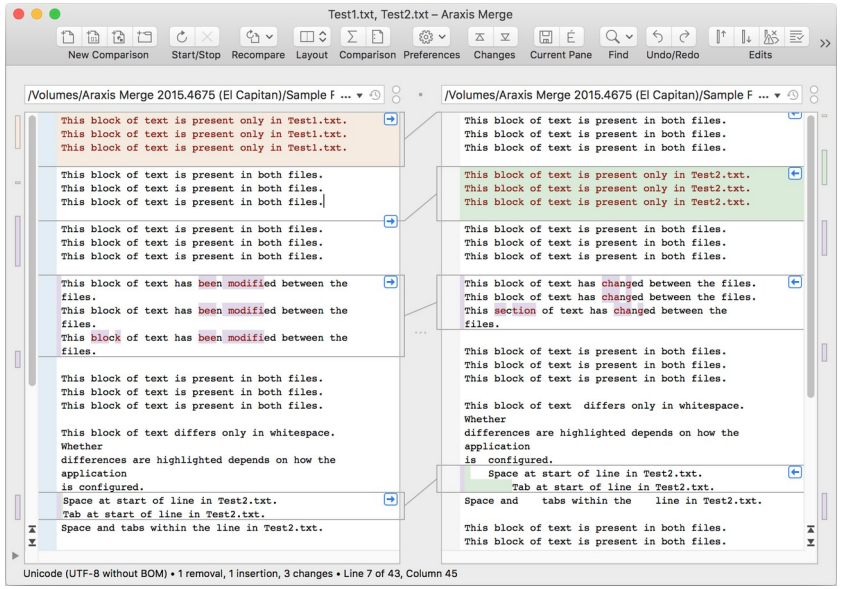
Options are: -b

-w

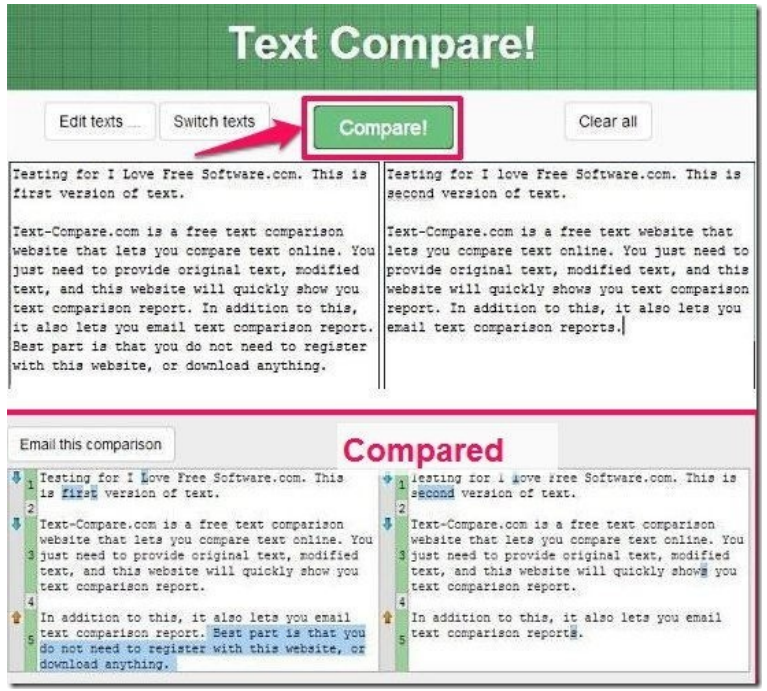
-i

- **cmp** command compares the two files byte by byte with two options : -l , -s
- Comm command finds lines that are identical in two files

linux diff, comp, comm, cli tools



Araxis merge, software

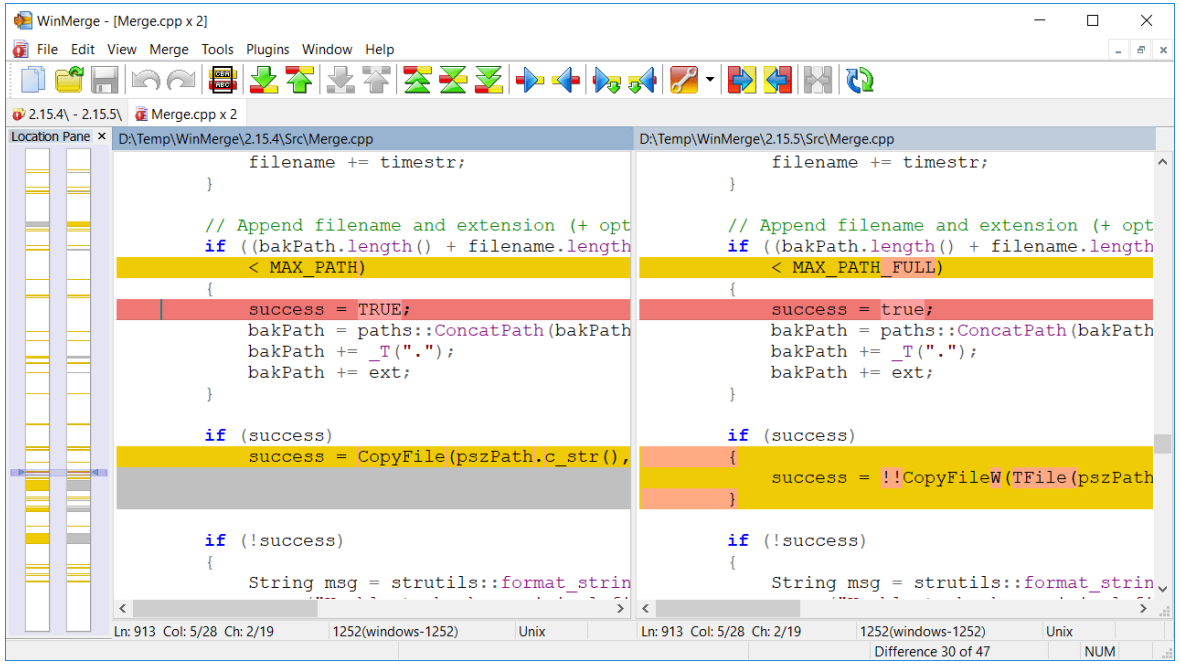


https://text-compare.com/ , online

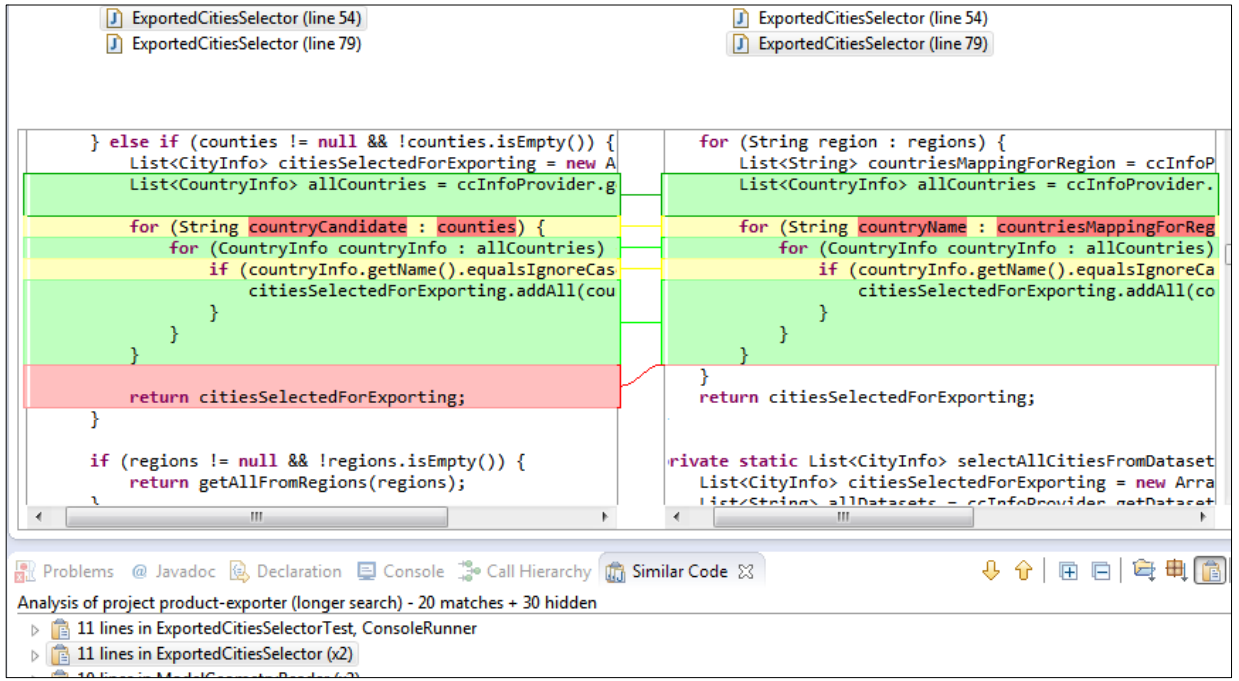
Diff utilities

https://en.wikipedia.org/wiki/Diff

- syntax - semantics



WinMerge

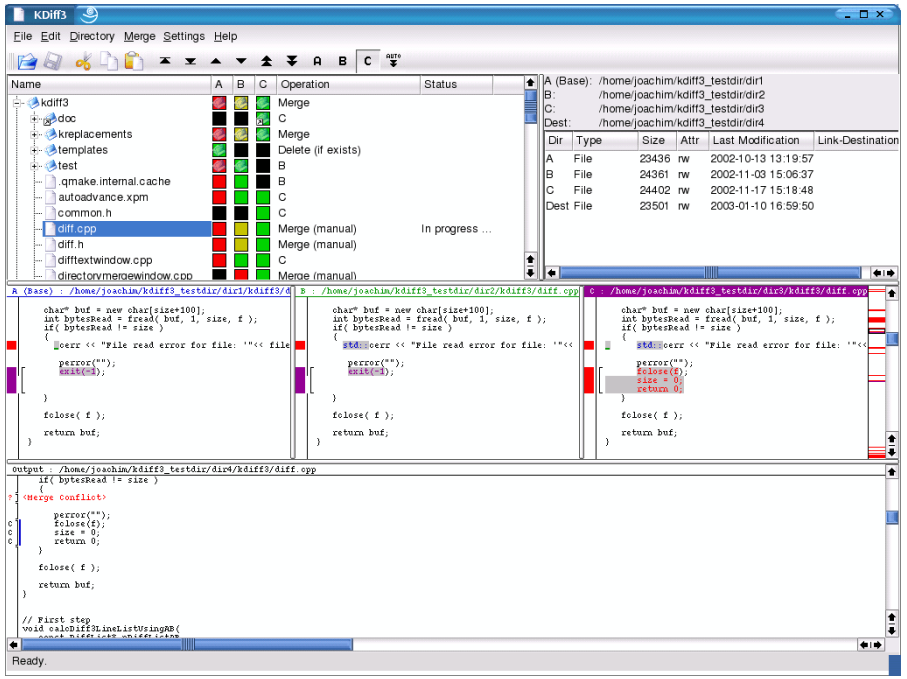


In Eclipse

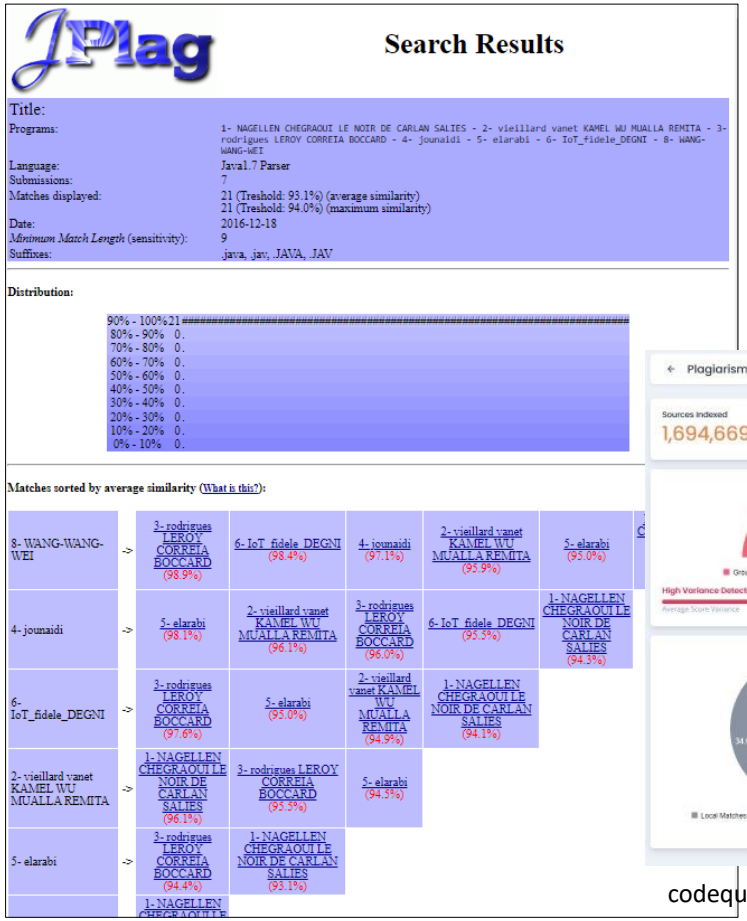
Content comparison utilities

https://en.wikipedia.org/wiki/Content_similarity_detection

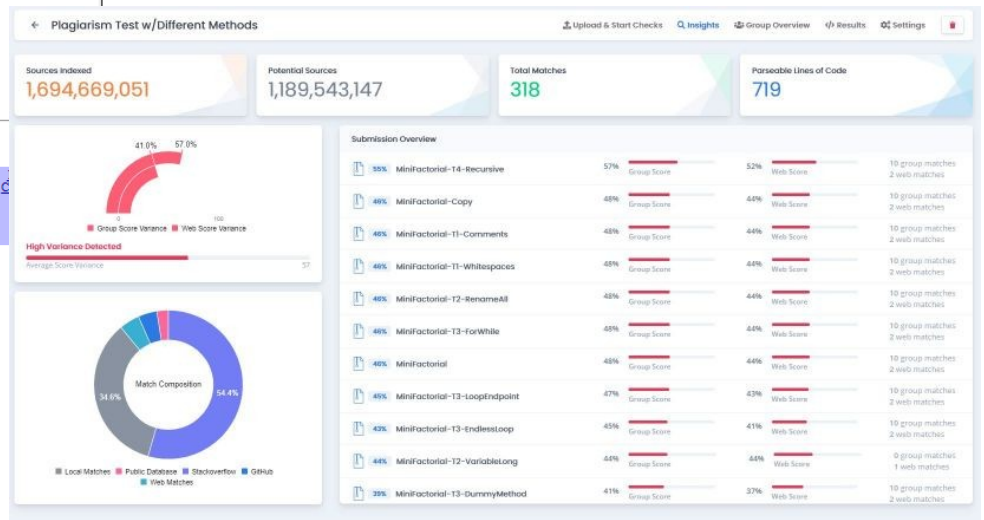
Example: plagiarism detection



KDiff3, open-source



Jplag, freeware

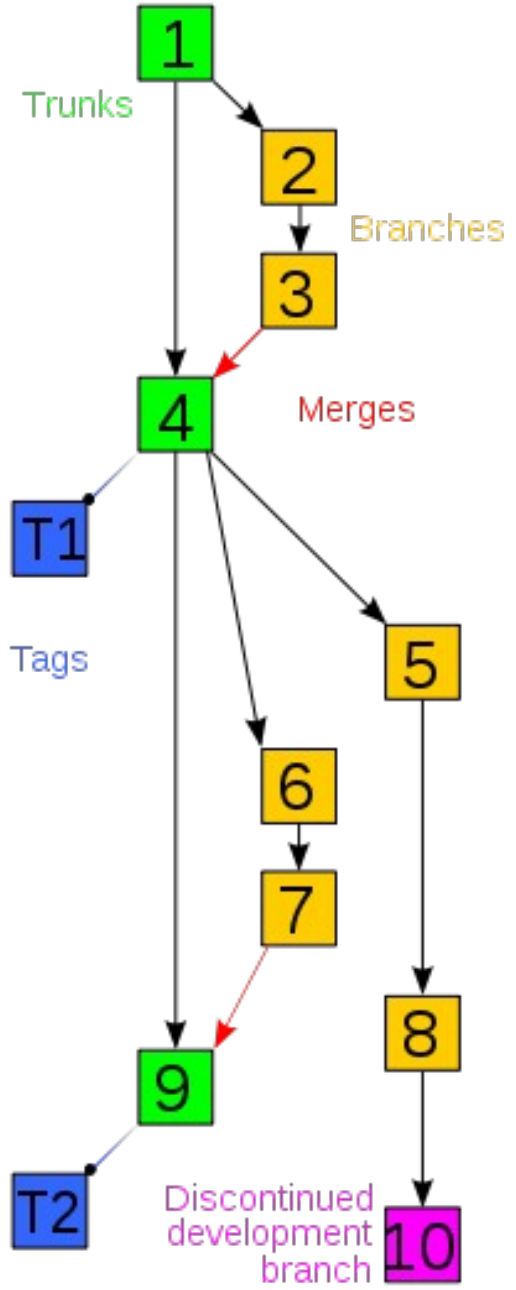


codequiry, shareware

VCS- Version Control System

Definition

A tool that helps developers/programmers solve certain day-to-day problems, such as: tracking code changes, helping with code maintenance, and allowing them to work on the same source code files without affecting each other's workflow.

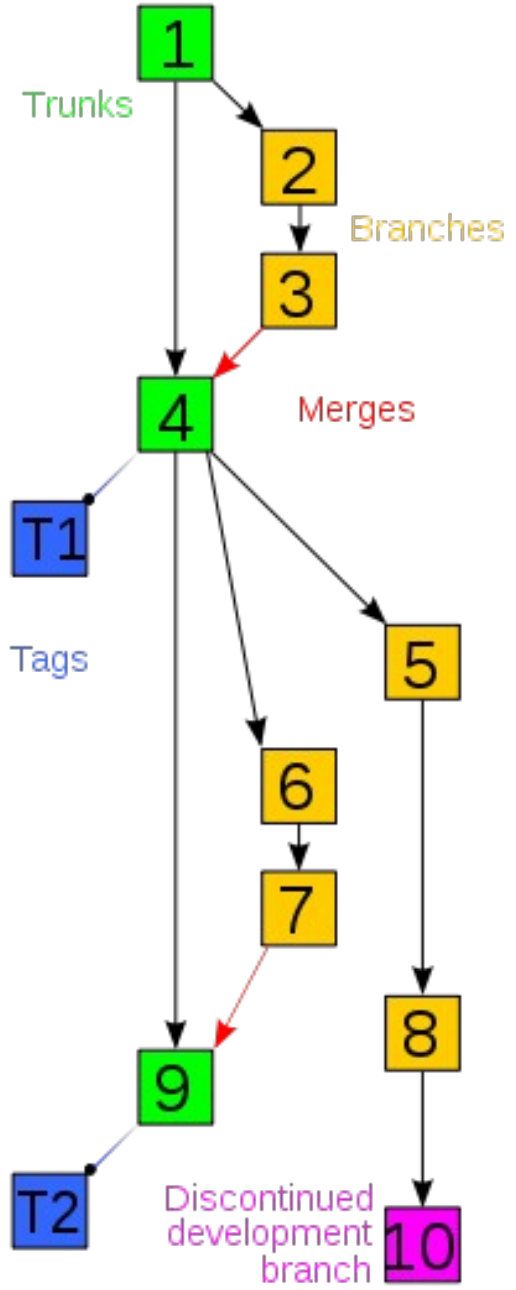


https://en.wikipedia.org/wiki/Version_control

VCS- Version Control System

Objectives

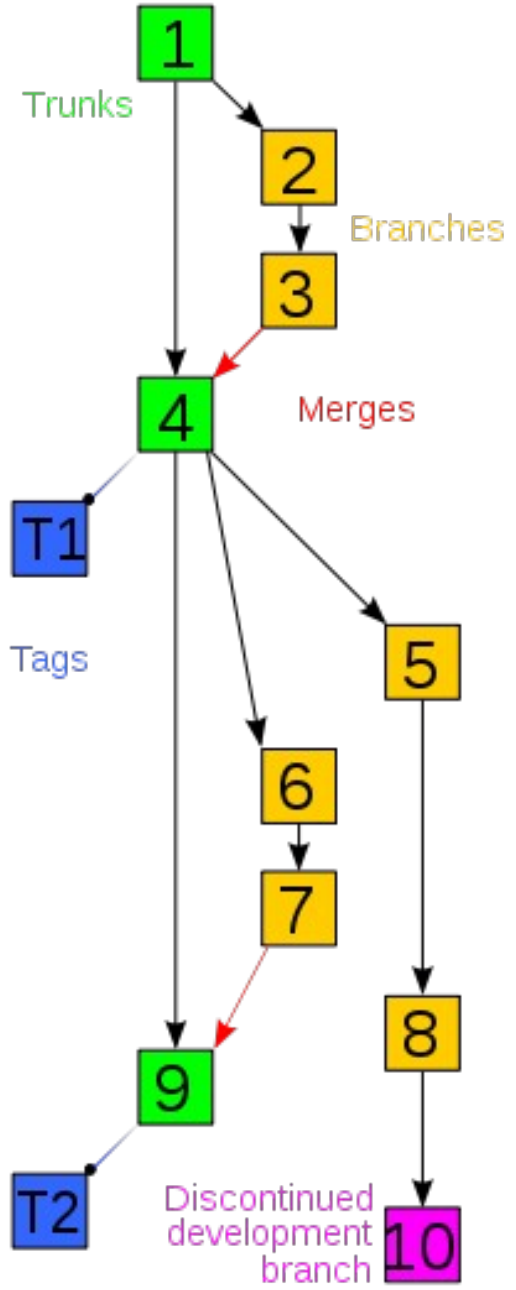
- Generate backups
- Test and experiment
- Keep history and track changes
- Collaborate and contribute remotely



https://en.wikipedia.org/wiki/Version_control

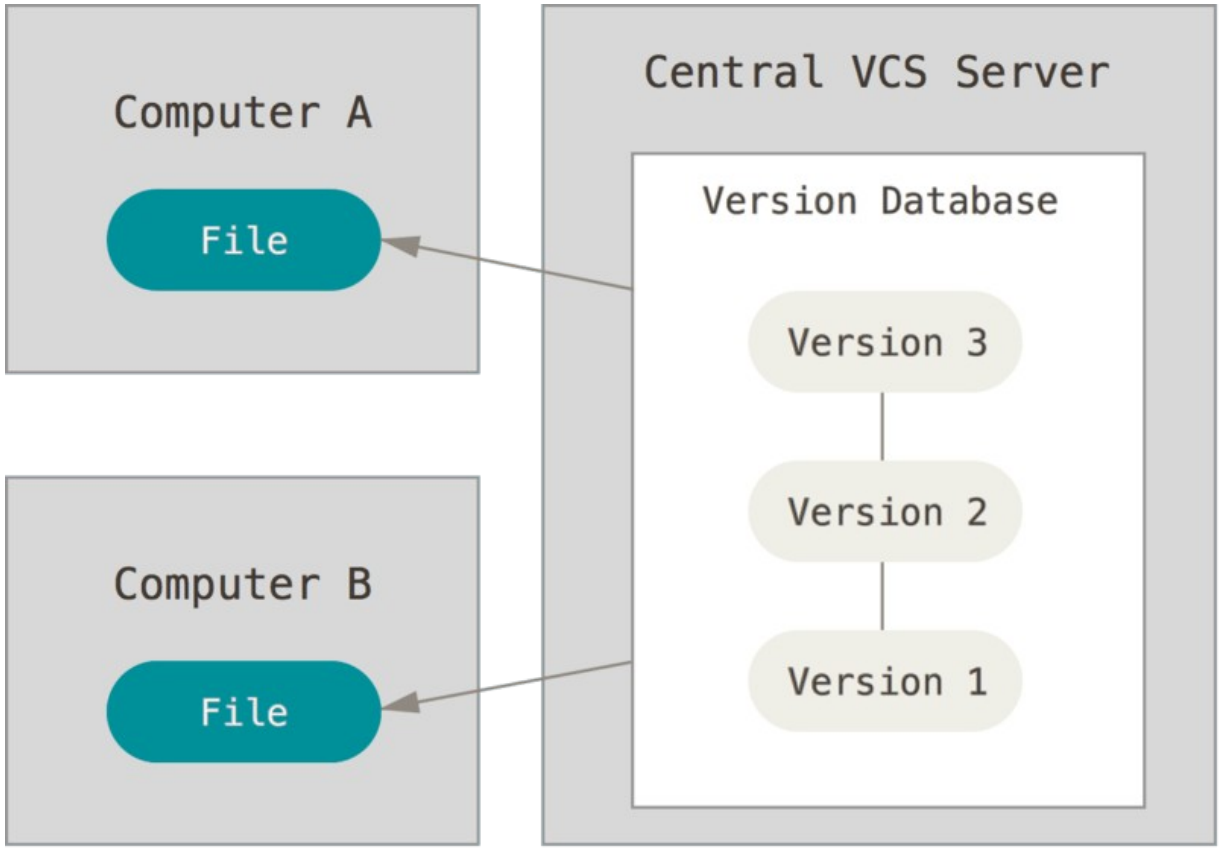
Concepts

- make a **local copy** of a **remote repository**
- make changes, **commit** changes ("submit")
- divergent **branches** containing version sequences
- **merge** branches, with resolution of possible conflicts
- **tag** versions
- propose revisions (PR, **pull request**)



https://en.wikipedia.org/wiki/Version_control

Centralized version management

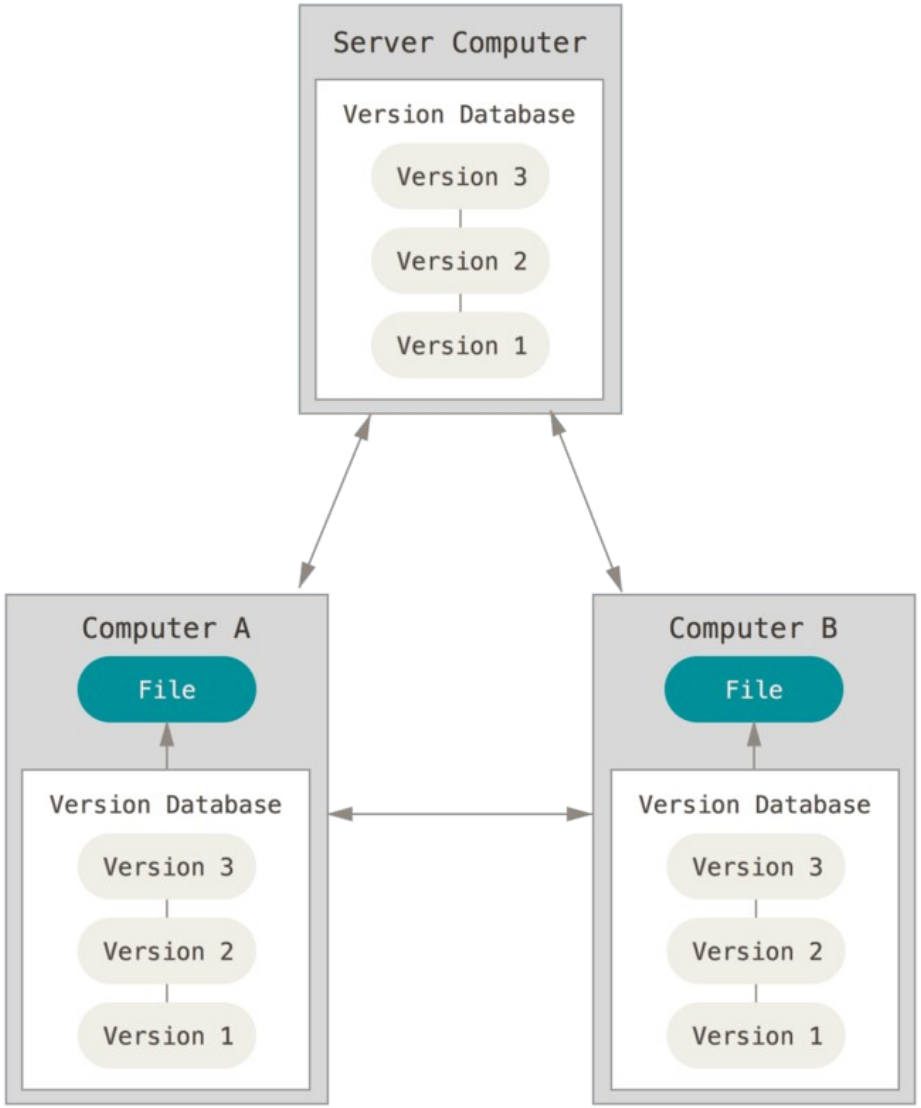


https://git-scm.com/book/en/v2/Getting-Started-About-Version-Control

PERFORCE

Main limitation:
single point of failure

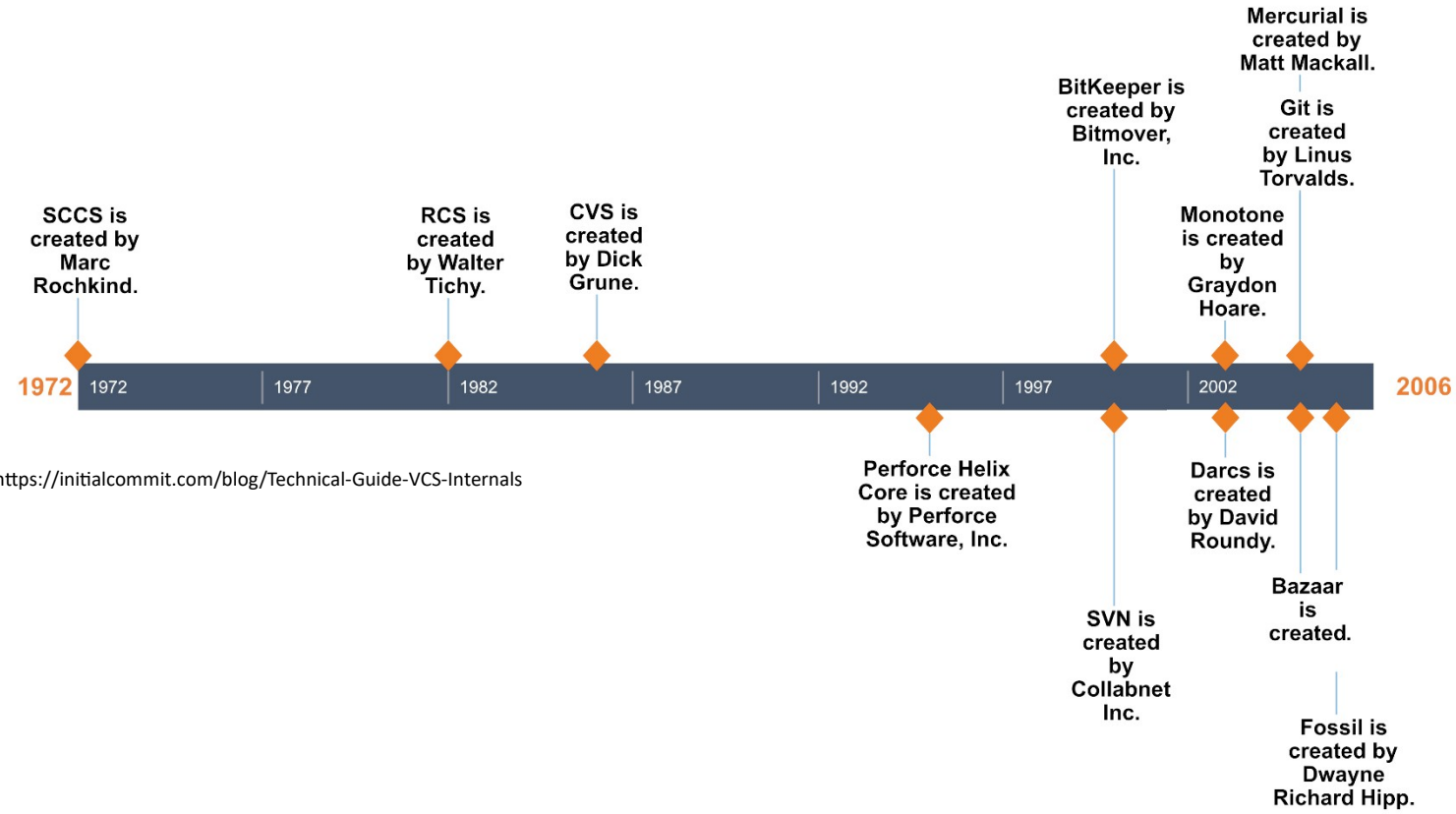
Distributed version management



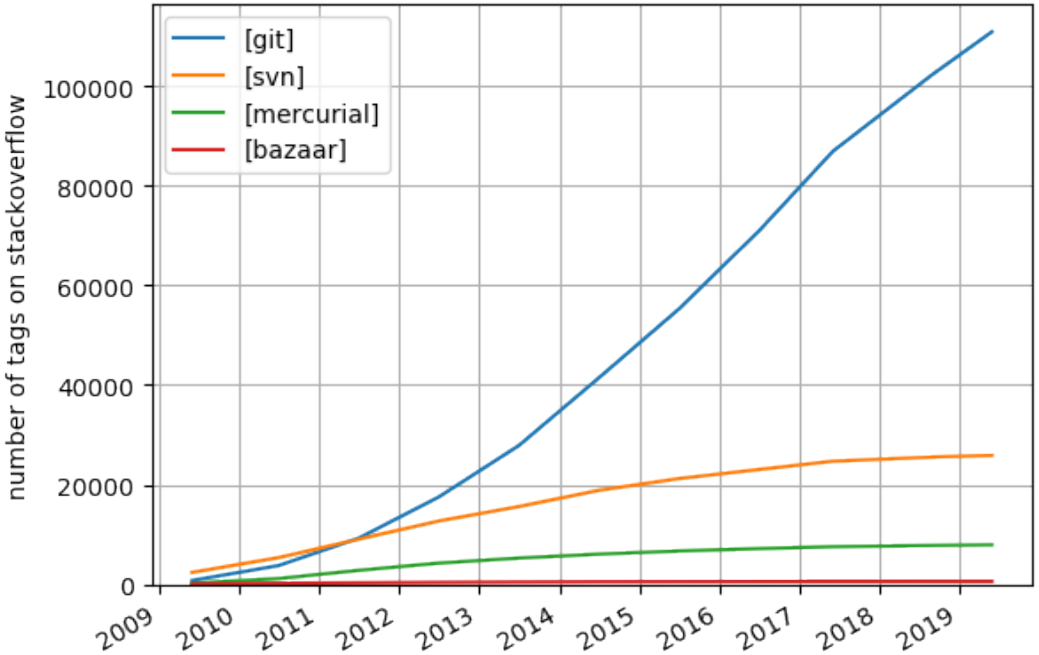
(Bazaar)

https://git-scm.com/book/en/v2/Getting-Started-About-Version-Control

History



https://initialcommit.com/blog/Technical-Guide-VCS-Internals



https://askcodez.com/la-popularite-de-git-mercurial-bazar-vs-qui-a-recommander.html

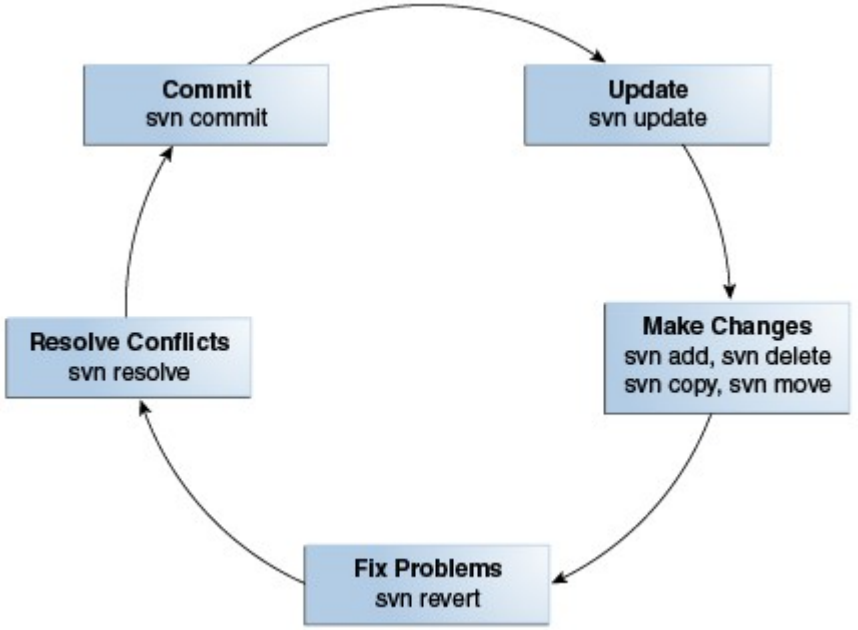
SVN – Apache Subversion

Homepage http://subversion.apache.org/

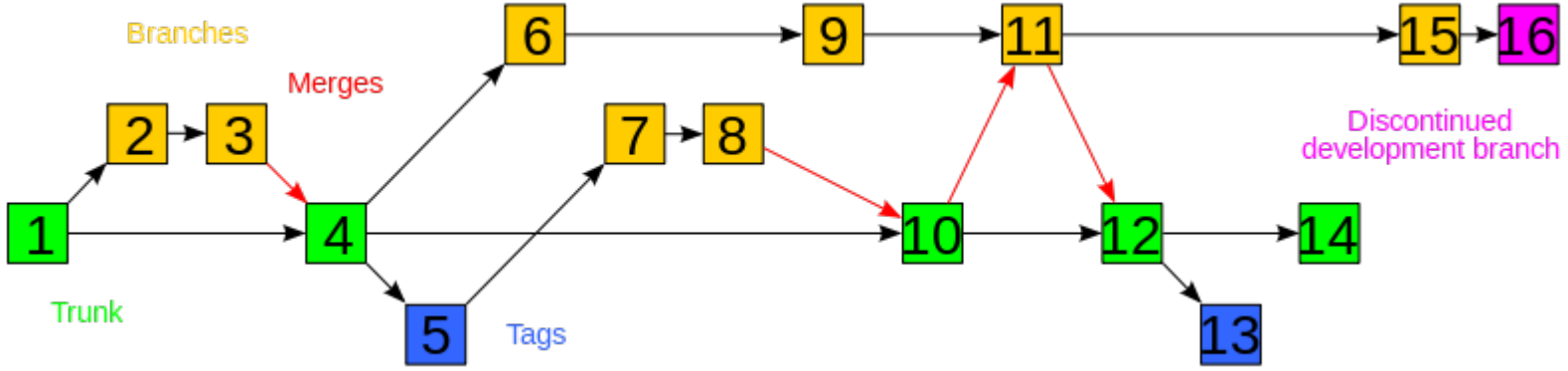
SVN Book http://svnbook.red-bean.com/

Limitations

- centralized system
- no time stamping
- no history management, global version numbering
- network almost always necessary
- poorly managed "move" operation (delete + add)
- no normalization of file names



https://docs.oracle.com/middleware/1221/core/MAVEN/config_svn.htm



https://en.wikipedia.org/wiki/Apache_Subversion

Git

(which means "unpleasant person" in British English slang). : "I'm an egotistical bastard, and I name all my projects after myself. First **'Linux**', now **'git**'." The **man** page describes Git as "the stupid content tracker".

developers initialy Linus Torvalds. Mainly Junio Hamano +1620

to update: https://github.com/git/git/graphs/contributors

first version 2005

current version v2.41.0 to update: https://github.com/git/git/releases

license GPLv2 (free, open-source)

history

- Linux kernel contributions before 2002: patches transmitted and integrated by hand
- Linux kernel development 2002-2005: VCS distributed BitKeeper
- 2005: BitKeeper becomes payware, Linux Torvalds develops git with the following goals:
  - speed ;
  - simple design ;
  - support for non-linear development (thousands of parallel branches) ;
  - fully distributed ;
  - ability to efficiently manage large projects such as the Linux kernel (speed and data compactness)

https://en.wikipedia.org/wiki/Git
https://git-scm.com/book/fr/v2/D%C3%A9marrage-rapide-Une-rapide-histoire-de-Git

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Part 2 – Git basics

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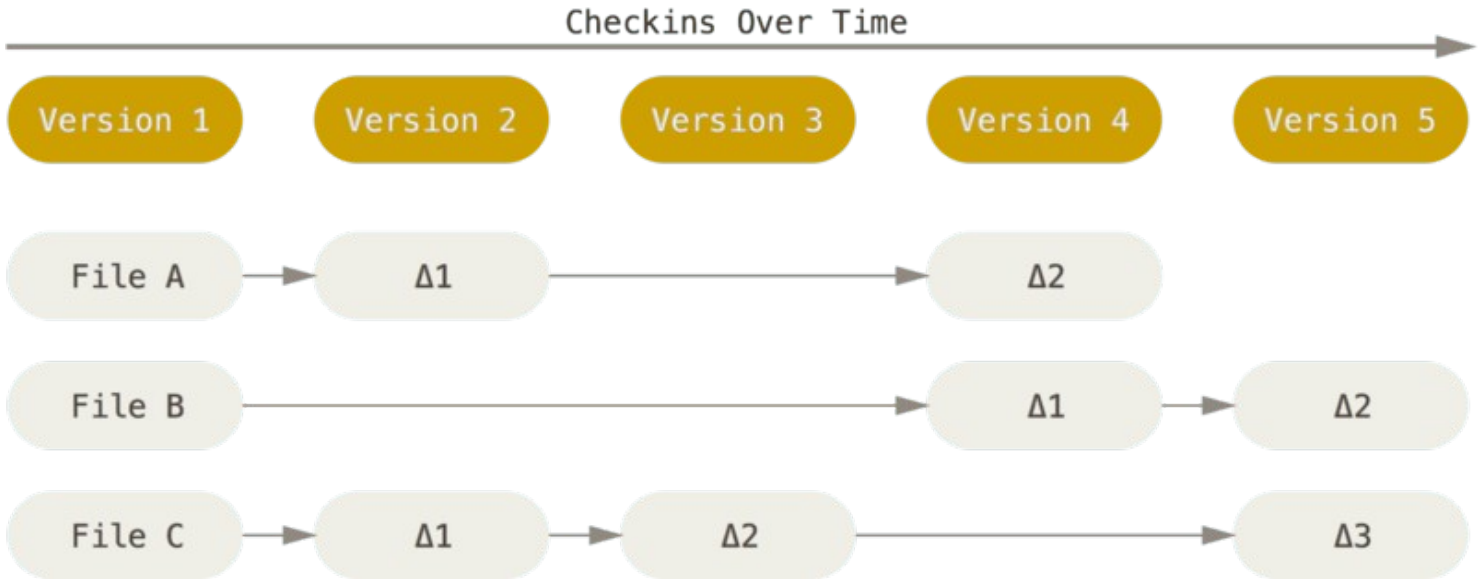
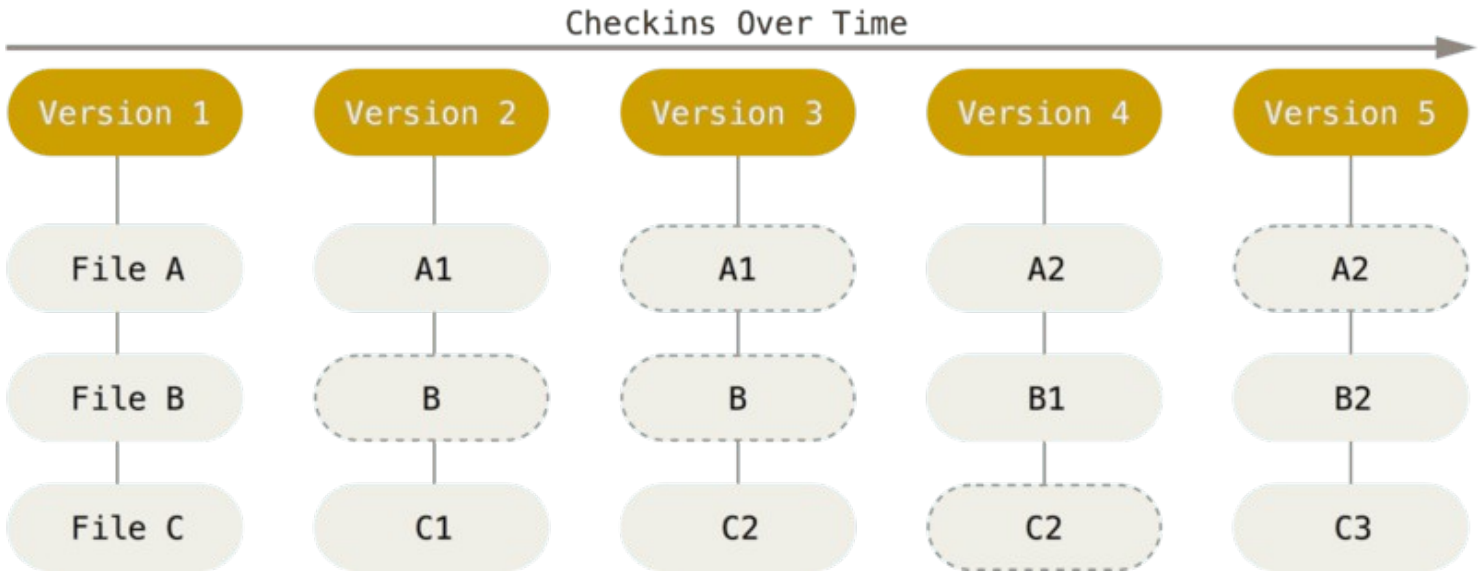
Philosophy

CVS, Subversion, Perforce, Bazaar, etc.
Save information as changes to files



How git works:
Stores data as snapshots of the project over time

(snapshot flow)



https://git-scm.com/book/en/v2/Getting-Started-What-is-Git%3F

Philosophy

Almost all operations are local

- remote repository ≈ local directory
- no need to constantly access the central server

Git manages integrity

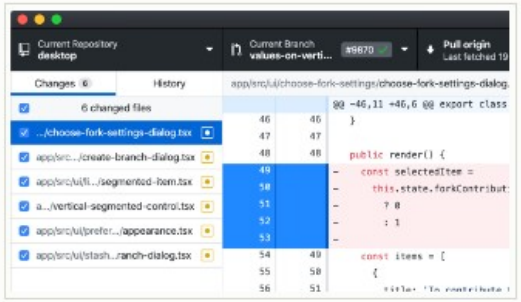
- id of a repo state = checksum(previous id, changes)
- SHA-1 (40 hex characters, example `24b9da6552252987aa493b52f8696cd6d3b00373`)
- git indexes the data by these checksum

Generally, Git only adds data

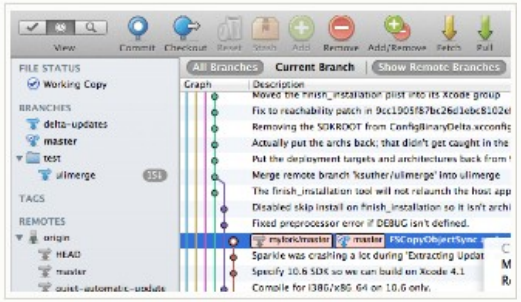
- almost impossible to lose permanently a repo state
- even undo actions are stored as a new change
- gives freedom to experiment safely

https://git-scm.com/book/en/v2/Getting-Started-What-is-Git%3F

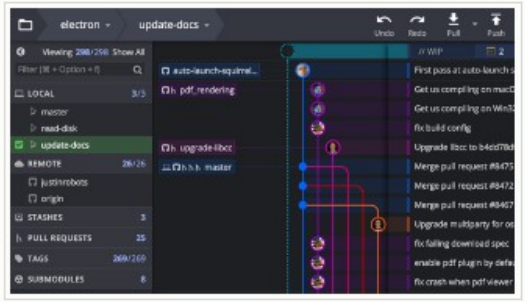
How to use git- softwares



GitHub Desktop
Platforms: Mac, Windows
Price: Free
License: MIT

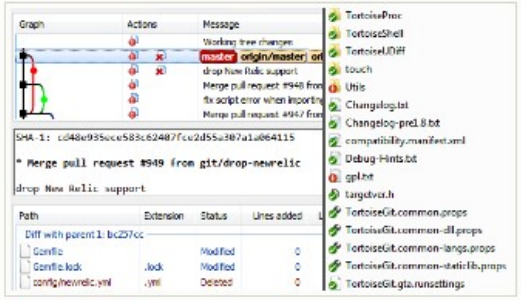


SourceTree
Platforms: Mac, Windows
Price: Free
License: Proprietary

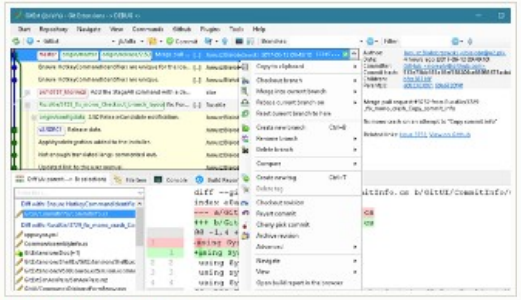


GitKraken
Platforms: Linux, Mac, Windows
Price: Free / $29 / $49
License: Proprietary

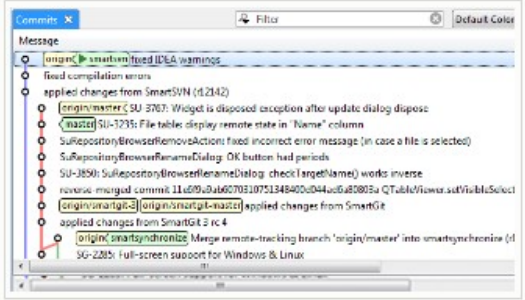
Magit
Platforms: Linux, Mac, Windows
Price: Free
License: GNU GPL



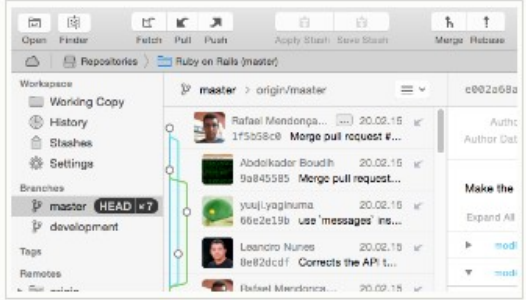
TortoiseGit
Platforms: Windows
Price: Free
License: GNU GPL



Git Extensions
Platforms: Linux, Mac, Windows
Price: Free
License: GNU GPL



SmartGit
Platforms: Linux, Mac, Windows
Price: $79/user / Free for non-commercial use
License: Proprietary



Tower
Platforms: Mac, Windows
Price: $69/user (Free 30 day trial)
License: Proprietary

...

https://git-scm.com/downloads/guis

How to use git- CLI

```
mlefranc@FAYOL-LEFRANCOIS-M: ~
mlefranc@WSL2:~$ git help
usage: git [--version] [--help] [-C <path>] [-c <name>=<value>]
           [--exec-path[=<path>]] [--html-path] [--man-path] [--info-path]
           [-p | --paginate | -P | --no-pager] [--no-replace-objects] [--bare]
           [--git-dir=<path>] [--work-tree=<path>] [--namespace=<name>]
           <command> [<args>]

These are common Git commands used in various situations:

start a working area (see also: git help tutorial)
   clone             Clone a repository into a new directory
   init              Create an empty Git repository or reinitialize an existing one

work on the current change (see also: git help everyday)
   add               Add file contents to the index
   mv                Move or rename a file, a directory, or a symlink
   restore           Restore working tree files
   rm                Remove files from the working tree and from the index
   sparse-checkout   Initialize and modify the sparse-checkout

examine the history and state (see also: git help revisions)
   bisect            Use binary search to find the commit that introduced a bug
   diff              Show changes between commits, commit and working tree, etc
   grep              Print lines matching a pattern
   log               Show commit logs
   show              Show various types of objects
   status            Show the working tree status

grow, mark and tweak your common history
   branch            List, create, or delete branches
```

How to use git- CLI

- Obtain help

```
$ git help <commande>
$ git <commande> --help
$ man git-<commande>
```

- Obtain a concise version of the help

```
$ git <commande> -h
```


https://git-scm.com/book/fr/v2/D%C3%A9marrage-rapide-Obtenir-de-l%E2%80%99aide

Option 1 to start a Git repository:
Initialize a Git repository in a directory

1
```
$ git init
Initialized empty Git repository in .
```

2
```
$ tree -a .
.
└── .git
    ├── HEAD
    ├── branches
    ├── config
    ├── description
    ├── hooks
    │   ├── applypatch-msg.sample
    │   ├── commit-msg.sample
    │   ├── fsmonitor-watchman.sample
    │   ├── post-update.sample
    │   ├── pre-applypatch.sample
    │   ├── pre-commit.sample
    │   ├── pre-merge-commit.sample
    │   ├── pre-push.sample
    │   ├── pre-rebase.sample
    │   ├── pre-receive.sample
    │   ├── prepare-commit-msg.sample
    │   └── update.sample
    ├── info
    │   └── exclude
    ├── objects
    │   ├── info
    │   └── pack
    └── refs
        ├── heads
        └── tag
```

3
```
$ git add *.html
$ git add README.md
$ git commit -m 'first version'
```

https://git-scm.com/book/en/v2/Git-Basics-Getting-a-Git-Repository

Option 2 to start a Git repository:

Clone an existing Git repository

1
```
$ git clone https://github.com/FFmpeg/FFmpeg
Cloning into 'FFmpeg'...
remote: Enumerating objects: 633677, done.
remote: Total 633677 (delta 0), reused 0 (delta 0), pack-reused 633677
Receiving objects: 100% (633677/633677), 263.28 MiB | 11.00 MiB/s, done.
Resolving deltas: 100% (498066/498066), done.
Updating files: 100% (7479/7479), done.
```

2
```
$ cd FFmpeg/
$ git status
On branch master
Your branch is up to date with 'origin/master'.

nothing to commit, working tree clean
```


https://git-scm.com/book/en/v2/Git-Basics-Getting-a-Git-Repository

Three file states: **modified**, **indexed**, **validated**.

modified: file modified but not validated in the DB

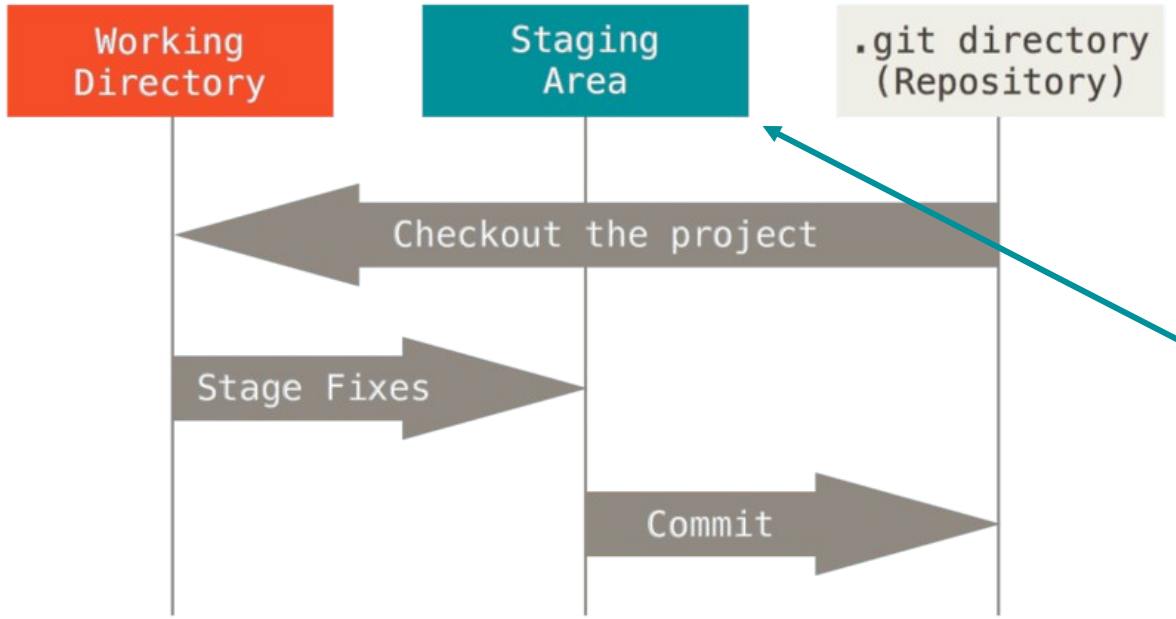
indexed: file marked to be part of the next snapshot

validated: data safely stored in the local database

https://git-scm.com/book/en/v2/Getting-Started-What-is-Git%3F
https://screencasts.delicious-insights.com/courses/git-core-concepts/102205-default-section/305169-zones-and-file-lifecycle

Three repo areas:
working directory, index area, git directory

a unique project extraction



Where metadata, project database, compressed snapshots are stored

copied when cloning from a remote repository

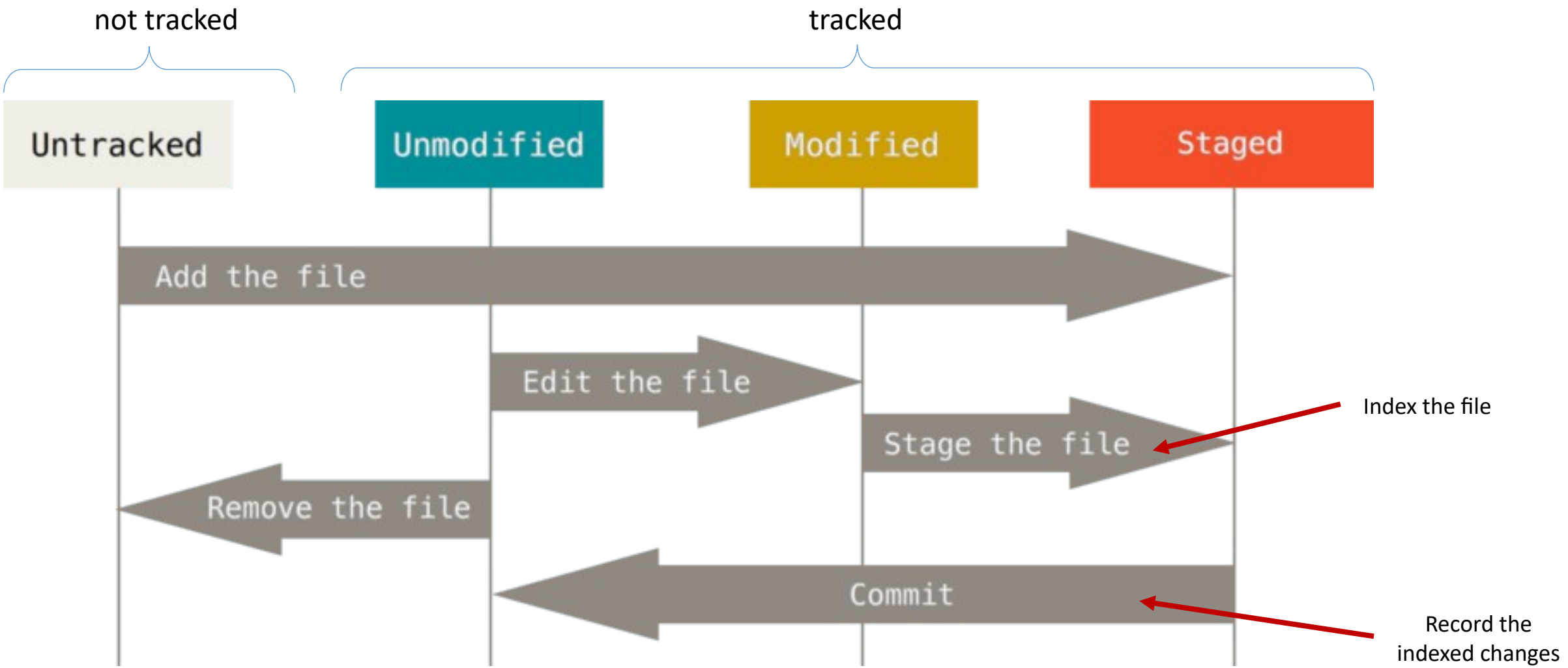
simple file that stores what will be in the next snapshot

Working directory, index area and Git directory

https://git-scm.com/book/fr/v2/D%C3%A9marrage-rapide-Rudiments-de-Git

Record changes to the repository

File states life cycle



https://git-scm.com/book/en/v2/Git-Basics-Recording-Changes-to-the-Repository

Record changes to the repository

Check the files state

```
$ git status
On branch master
Your branch is up to date with 'origin/master'.

nothing to commit, working tree clean
```

- no tracked files have been modified
- no untracked files
- master branch

```
$ echo "My project" > README.md
$ git status
On branch master

No commits yet

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

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

- new untracked file detected

https://git-scm.com/book/en/v2/Git-Basics-Recording-Changes-to-the-Repository

Record changes to the repository

Index changed files

```
$ nano index.html
```

- editing an existing file

```
$ git status
On branch master
Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
        new file:   README.md

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working
directory)
        modified:   index.html
```

- `README.md` file tracked and indexed
- `index.html` file modified

https://git-scm.com/book/en/v2/Git-Basics-Recording-Changes-to-the-Repository

Record changes to the repository

Index changed files

```
$ git add index.html
```

- Index `index.html`

```
$ git status
On branch master
Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
        new file:   README.md
        modified:   index.html
```

- `README.md` tracked and indexed
- `index.html` file tracked and indexed

```
$ nano index.html
```

- modified `index.html`

```
$ git status
On branch master
Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
        new file:   README.md
        modified:   index.html
Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working
directory)
        modified:   index.html
```

?

https://git-scm.com/book/en/v2/Git-Basics-Recording-Changes-to-the-Repository

Record changes to the repository

Index changed files

```
$ git add index.html
```

- Index `index.html`

```
$ git status
On branch master
Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
        new file:   README.md
        modified:   index.html
```

- `README.md` tracked and indexed
- `index.html` file tracked and indexed

```
$ nano index.html
```

- modified `index.html`

```
$ git status
On branch master
Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
        new file:   README.md
        modified:   index.html
Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working
directory)
        modified:   index.html
```

- `index.html` file indexed when running `git add`
- then modified

https://git-scm.com/book/en/v2/Git-Basics-Recording-Changes-to-the-Repository

Record changes to the repository

Commit changes

```
$ git commit –h
usage: git commit [<options>] [--] <pathspec>...

Commit message options
    -F, --file <file>     read message from file
    --author <author>     override author for commit
    --date <date>         override date for commit
    -m, --message <message>
                          commit message
    --status              include status in commit message template
    ...

Commit contents options
    -a, --all             commit all changed files
    -i, --include         add specified files to index for commit
    --dry-run             show what would be committed
    --short               show status concisely
    --branch              show branch information
    --amend               amend previous commit
    ...
```

- `git commit -a`
  skip the indexing step

https://git-scm.com/book/en/v2/Git-Basics-Recording-Changes-to-the-Repository

Technological foundations of software development

Manage your source code

Part 3 – Branching and merging with Git

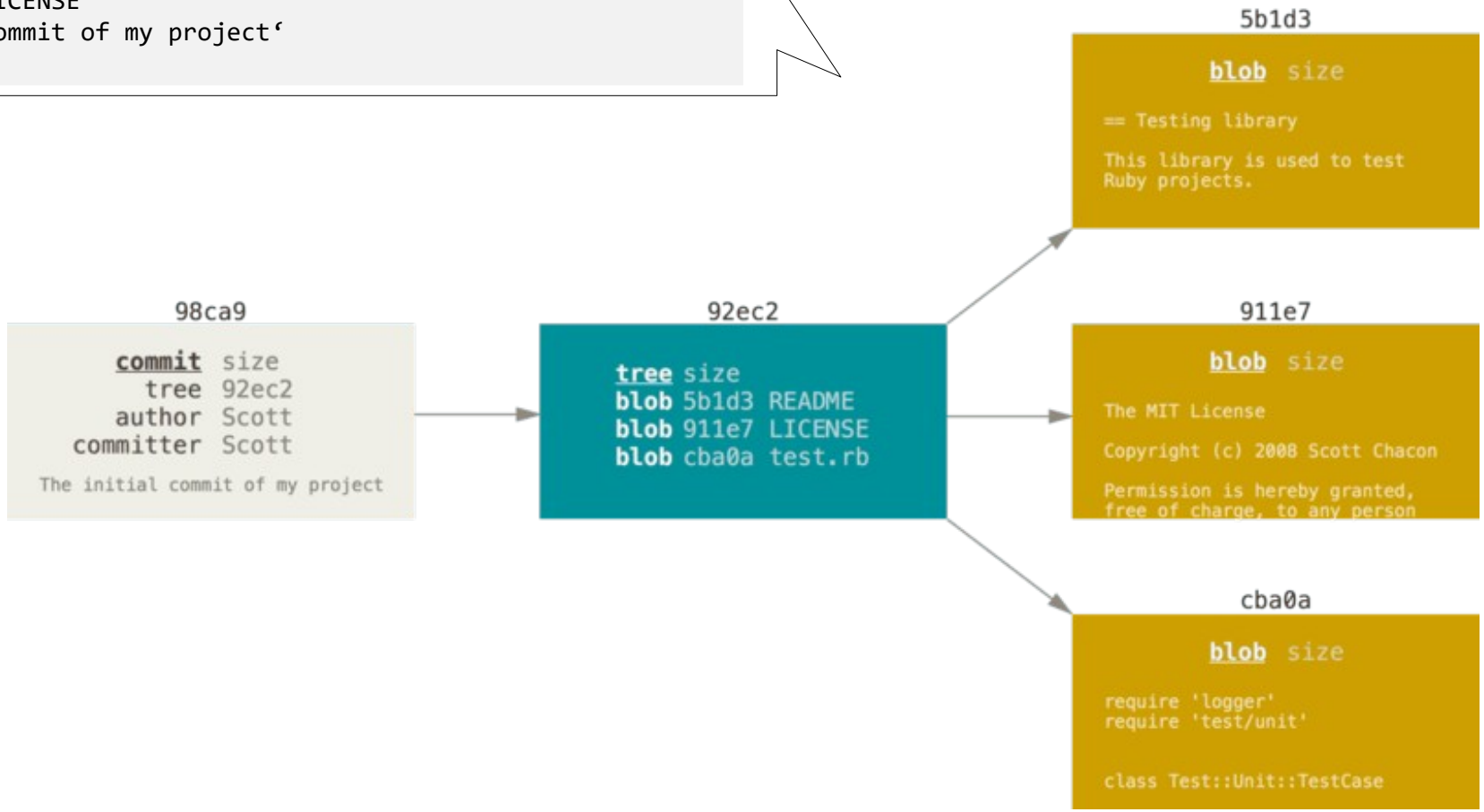
ICM – Computer Science Major – Course unit on Technological foundations of computer science
M1 Cyber Physical and Social Systems – Course unit on CPS2 engineering and development, Part 2: Technological foundations of software development
Maxime Lefrançois https://maxime-lefrancois.info
online: https://ci.mines-stetienne.fr/cps2/course/tfsd/

Branches in a nutshell

A commit and its tree

First commit of a repository with three files indexed, then validated
Calculated checksum: SHA-1

```
$ git init
$ git add README test.rb LICENSE
$ git commit -m 'initial commit of my project‘
$ git tree -a
```

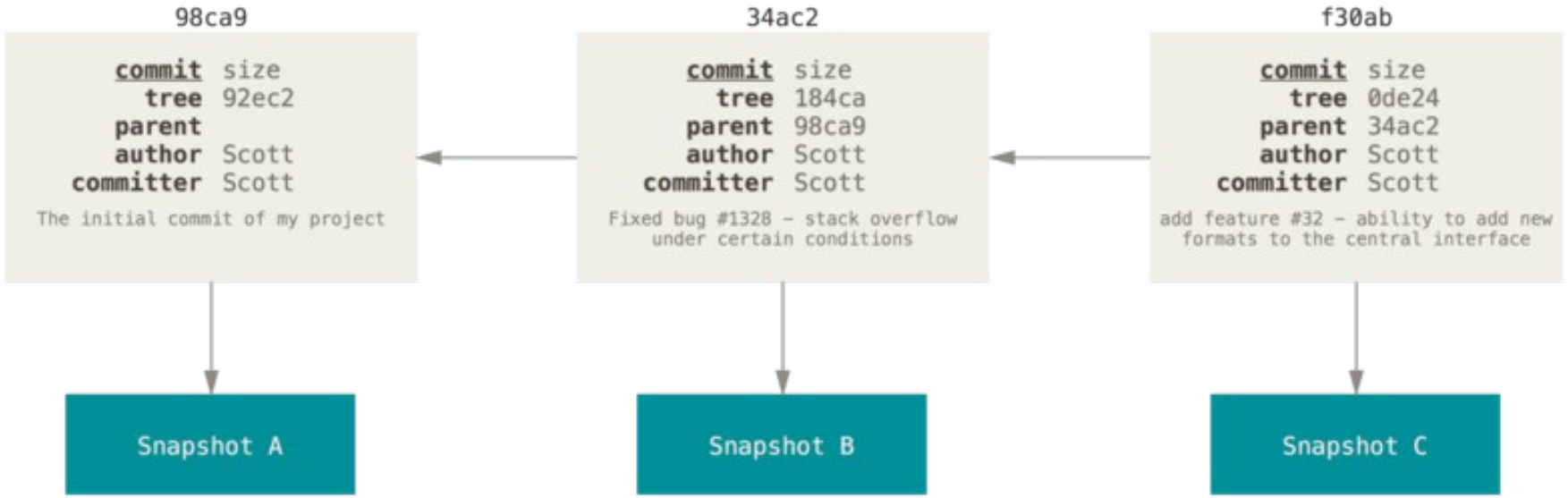


https://git-scm.com/book/en/v2/Git-Branching-Branches-in-a-Nutshell

Branches in a nutshell

Commits and their parents

New changes: each commit stores a pointer to the previous commit(s)



Branch = pointer to the last commit of a sequence.

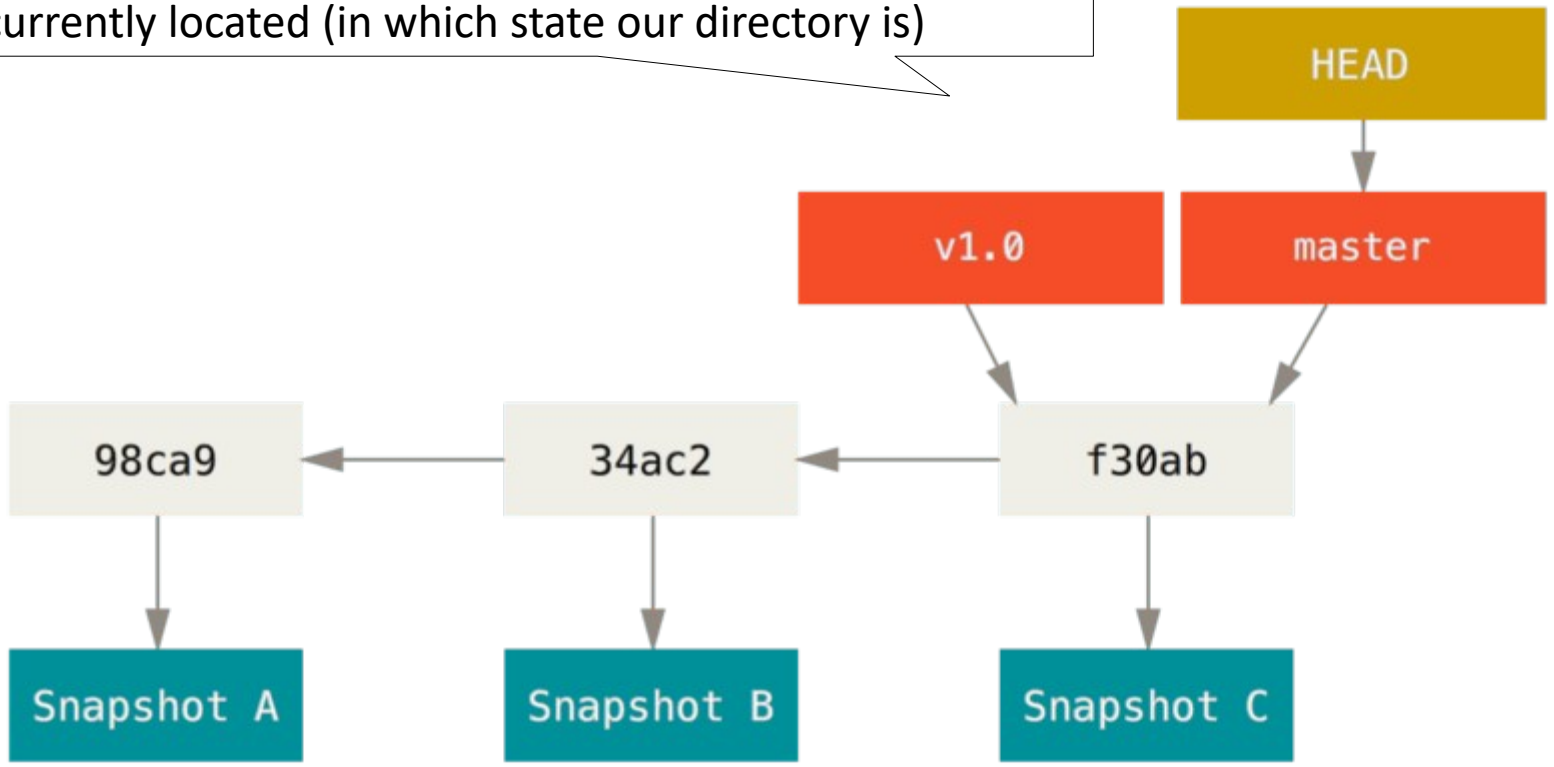
Automatically advances as new commits are made.

https://git-scm.com/book/en/v2/Git-Branching-Branches-in-a-Nutshell

Branches in a nutshell

A branch and its commits history

A sequence of commits,
- A label pointer
- A branch pointer
- The HEAD pointer indicates on which object we are currently located (in which state our directory is)



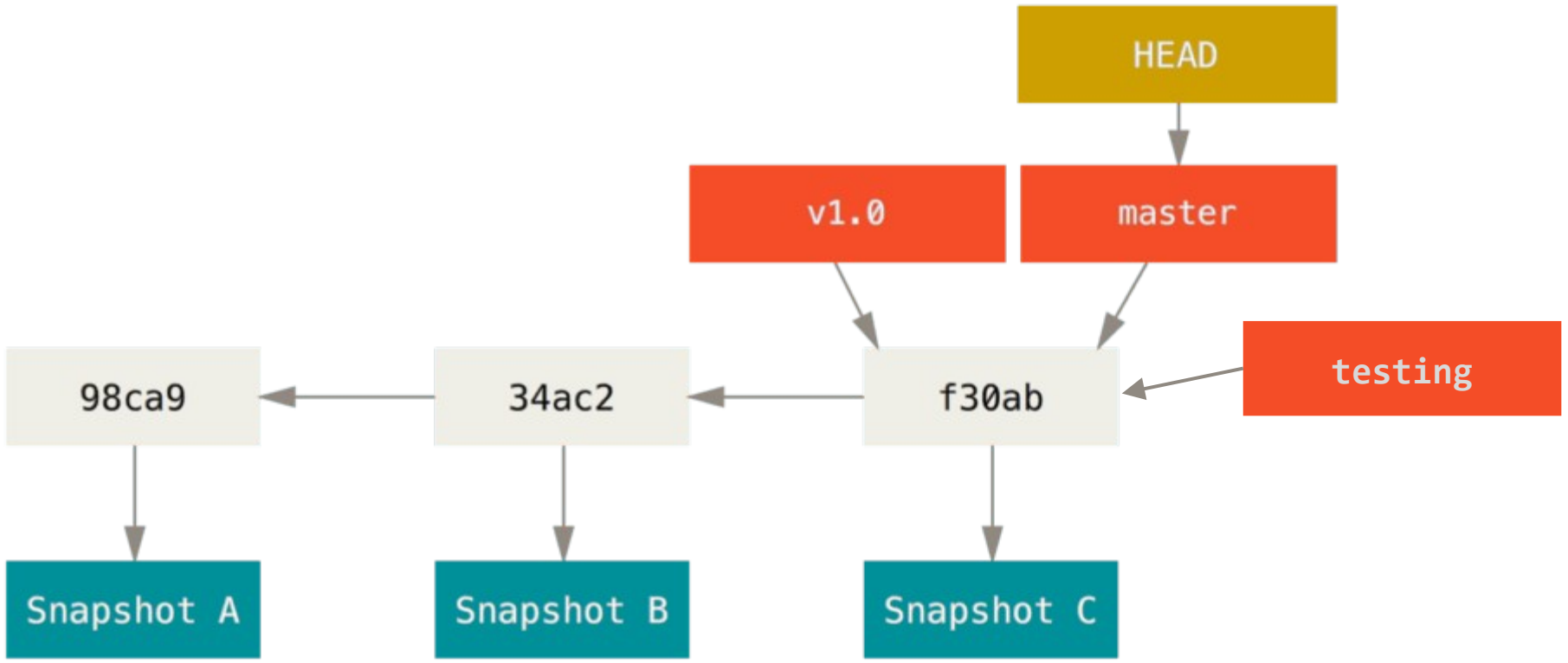
https://git-scm.com/book/en/v2/Git-Branching-Branches-in-a-Nutshell

Branches in a nutshell

Create a new branch

```
$ git branch testing
```

Two branches now point to the same set of *commits*



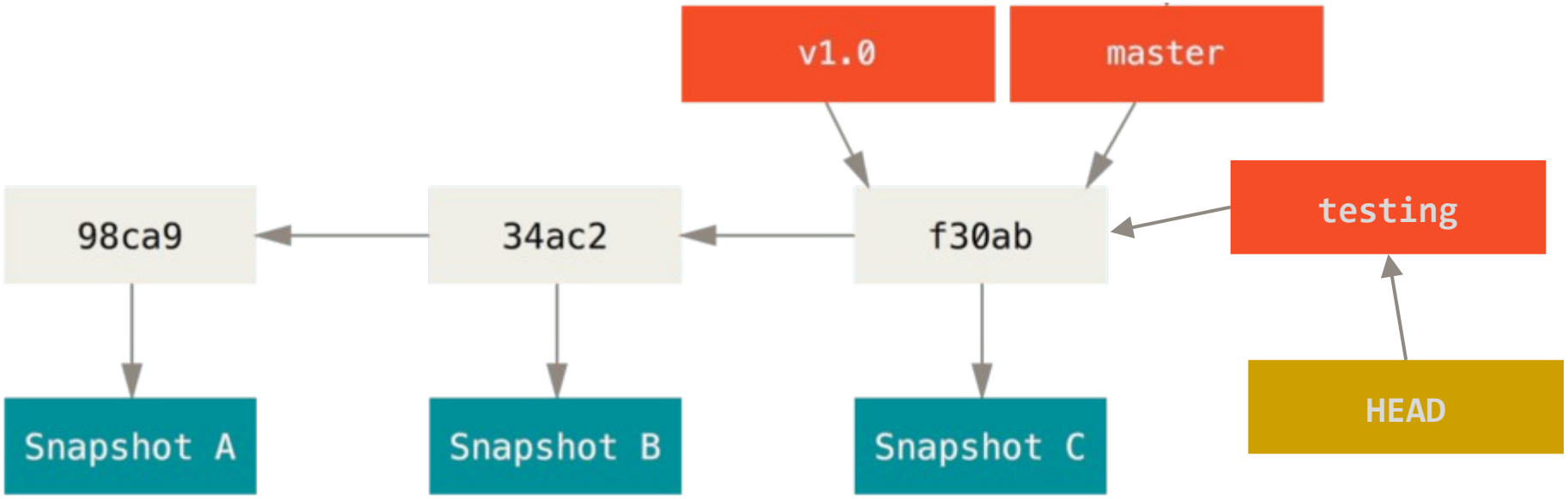
https://git-scm.com/book/en/v2/Git-Branching-Branches-in-a-Nutshell

Branches in a nutshell

Switching between branches

```
$ git checkout testing
```

HEAD now points to the `testing` branch

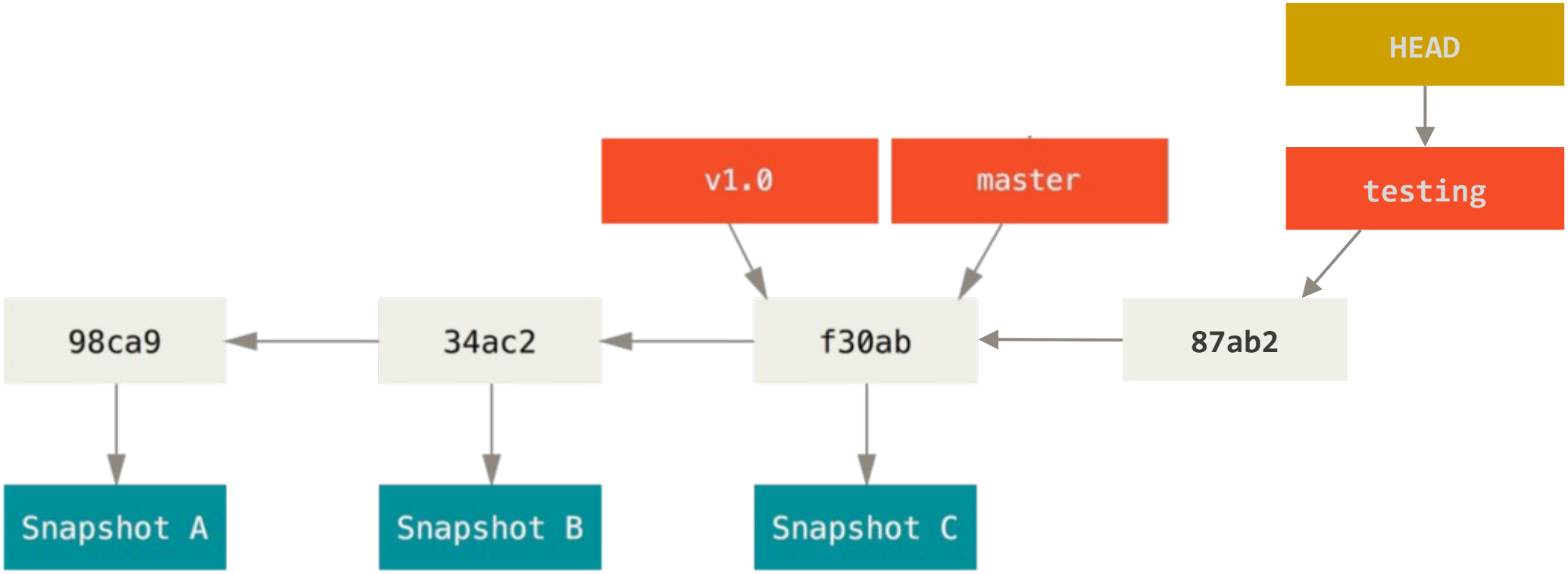


https://git-scm.com/book/en/v2/Git-Branching-Branches-in-a-Nutshell

Branches in a nutshell
Moving the HEAD

```
$ vim test.rb
$ git commit -a -m 'made a change'
```

The testing pointer advances with each commit



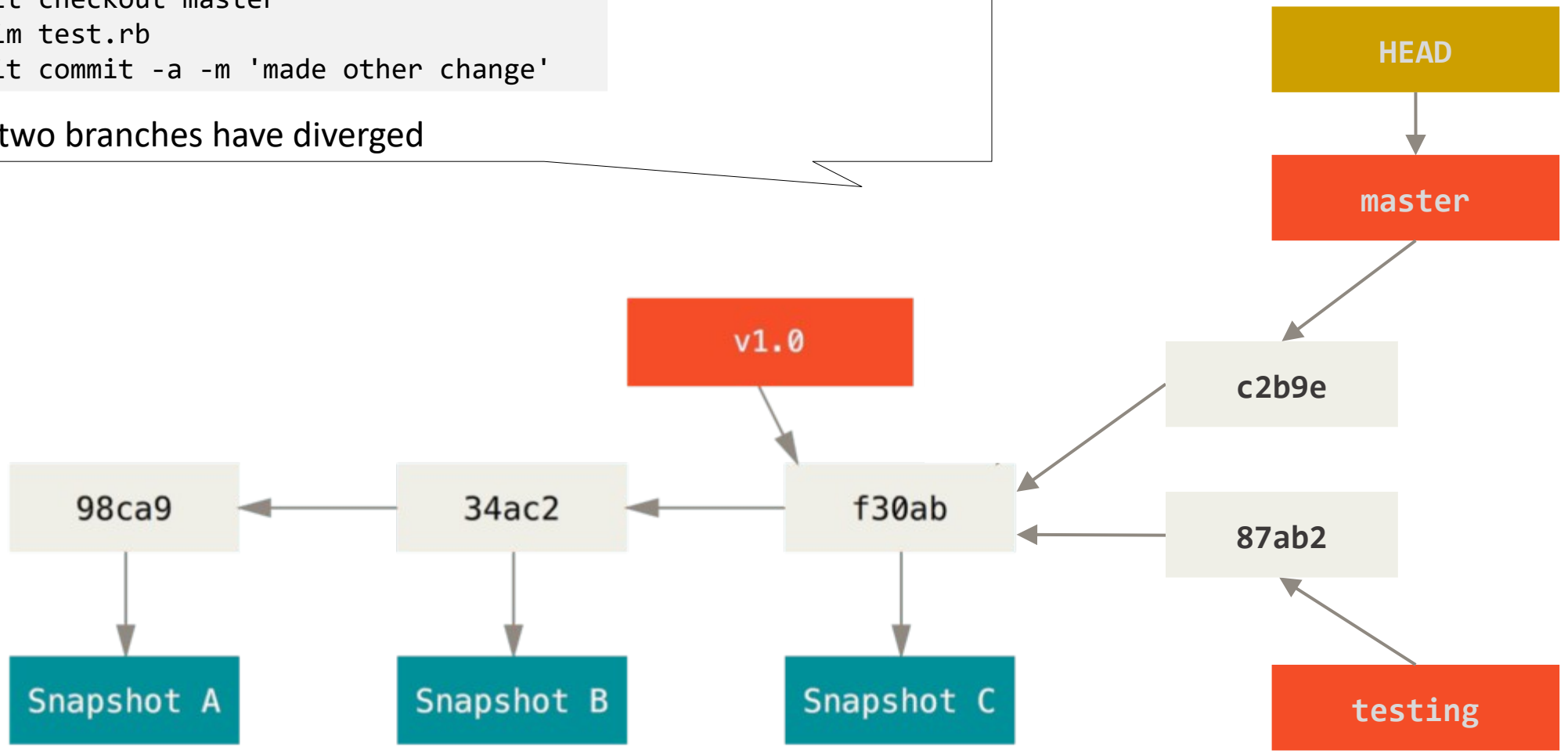
https://git-scm.com/book/en/v2/Git-Branching-Branches-in-a-Nutshell

Branches in a nutshell

Divergent history

```
$ git checkout master
$ vim test.rb
$ git commit -a -m 'made other change'
```

The two branches have diverged

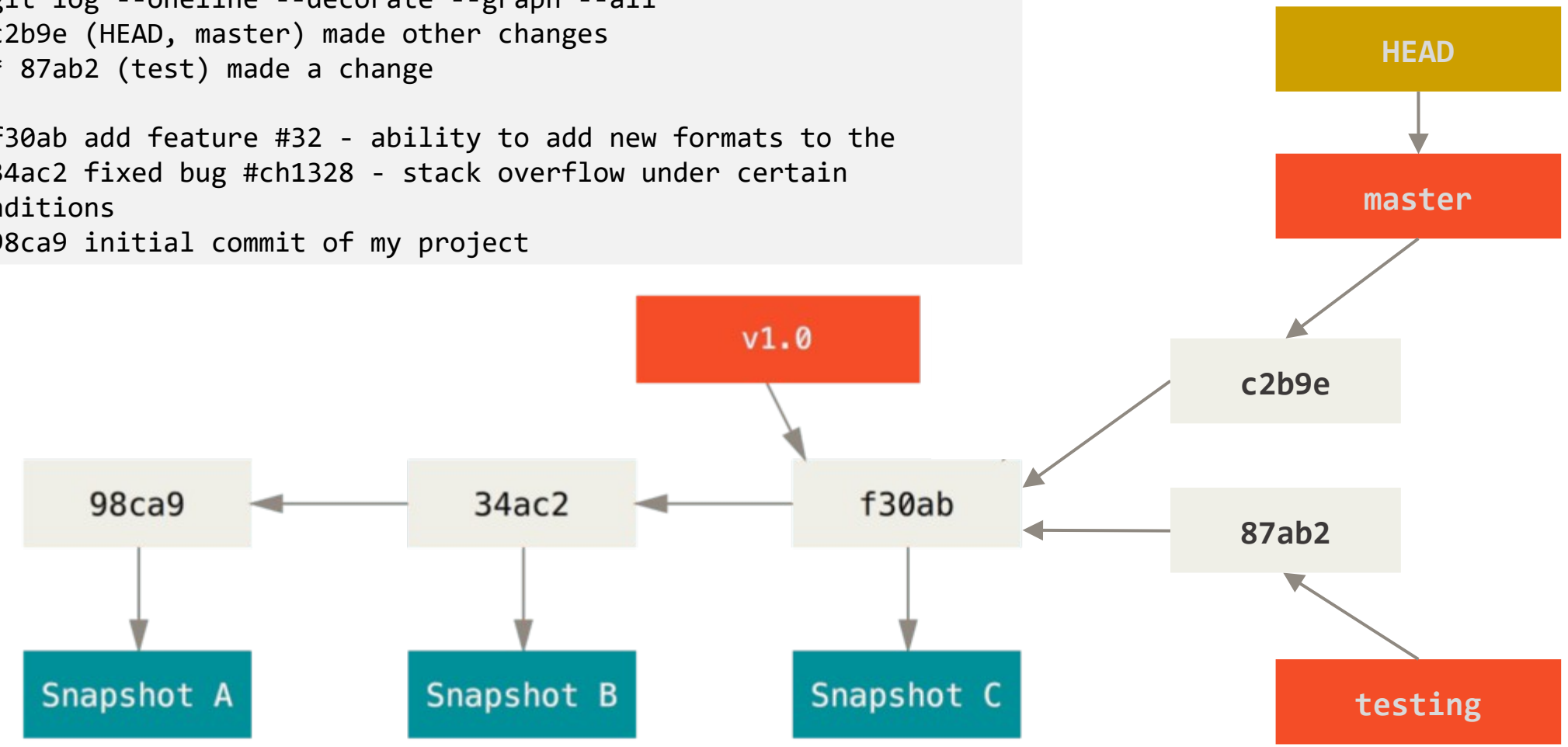


https://git-scm.com/book/en/v2/Git-Branching-Branches-in-a-Nutshell

Branches in a nutshell

Divergent history

```
$ git log --oneline --decorate --graph --all
* c2b9e (HEAD, master) made other changes
| * 87ab2 (test) made a change
|/
* f30ab add feature #32 - ability to add new formats to the
* 34ac2 fixed bug #ch1328 - stack overflow under certain
conditions
* 98ca9 initial commit of my project
```



https://git-scm.com/book/en/v2/Git-Branching-Branches-in-a-Nutshell

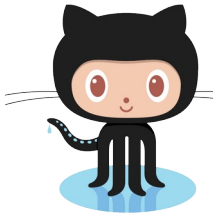
Technological foundations of software development

Manage your source code

Part 4 – Source code management platforms

GitLab

https://gitlab.emse.fr/
https://gitlab.com/



GitHub

https://github.com

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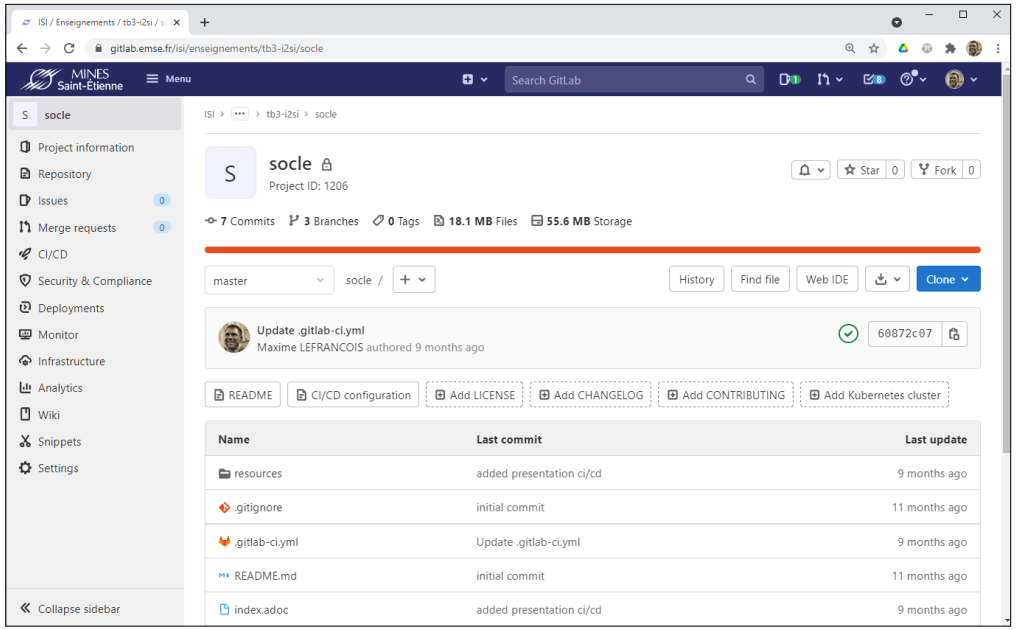
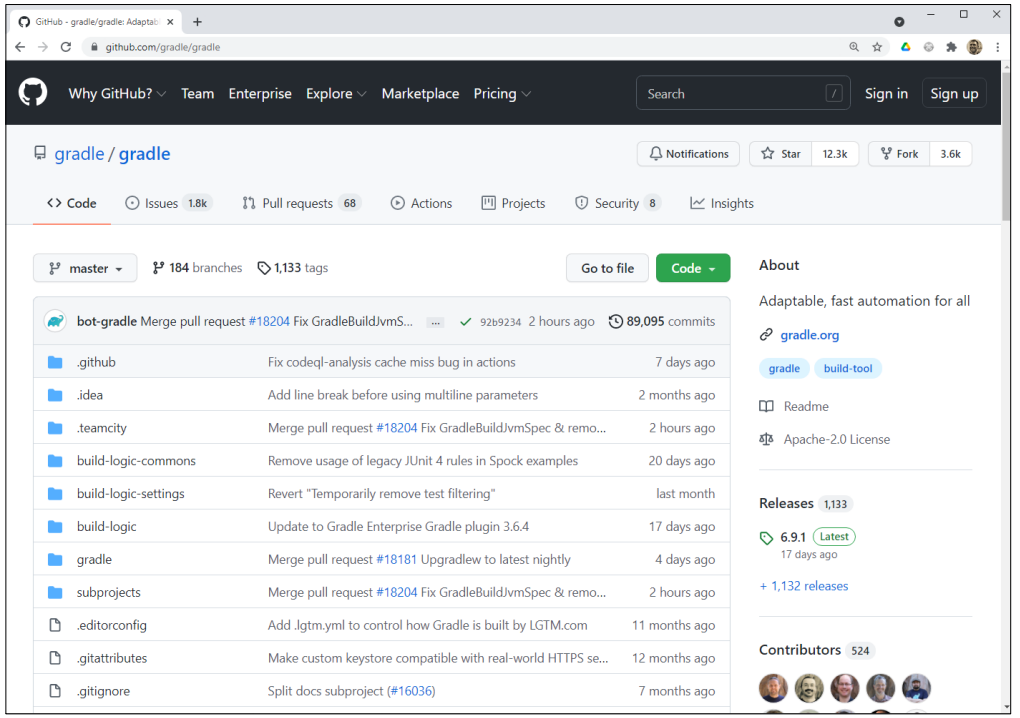
online: https://ci.mines-stetienne.fr/cps2/course/tfsd/

In addition to Git…

- ✓ Rights management
- ✓ Ticket management, Kanban
- ✓ Merge Requests / Pull Requests
- ✓ Integration and continuous deployment (e.g. github pages)
- ✓ Wiki
- ✓ Analytics
- ✓ Integration with other applications,
- ✓ Social network for developers, and opensource resume





https://git-scm.com/book/fr/v2/Les-branches-avec-Git-Branches-et-fusions%C2%A0%3A-les-bases

… References to deepen this course

Pro Git (2e edition), Scott Chacon and Ben Straub, Apress, 2014, 978-1-4842-0076-6
https://git-scm.com/book/en/v2

Git reference documentation https://git-scm.com/docs

Interactive Git cheat sheet http://ndpsoftware.com/git-cheatsheet.html

Gitlab basics: https://docs.gitlab.com/ee/gitlab-basics/
Gitlab docs: https://docs.gitlab.com/ sections *Agile with GitLab* et *Collaboration*

Github guides: https://guides.github.com/introduction/flow/
https://guides.github.com/activities/forking/
https://guides.github.com/activities/socialize/

… your turn

Complete the TODO section:

https://ci.mines-stetienne.fr/cps2/course/tfsd/course-2.html#_todos

Technological foundations of software development

Manage your source code

Part 2 – Git basics – complementary slides

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online: https://ci.mines-stetienne.fr/cps2/course/tfsd/

Record changes to the repository

Ignore files

- Ignore log files, automatically generated files, ...

```
$ cat .gitignore
*.log
*~
target/*
```

- standard shell file patterns (`*, [abc], ?, [0-9], **`)
- applied recursively in the working tree ;
- starts with '/': not recursive ;
- ends with a slash ('/'): directory ;
- starts with '!': include file despite other rules.

```
# pas de fichier .a
*.a

# mais suivre lib.a malgré la règle précédente
!lib.a

# ignorer uniquement le fichier TODO à la racine du projet
/TODO

# ignorer tous les fichiers dans le répertoire build
build/

# ignorer doc/notes.txt, mais pas doc/server/arch.txt
doc/*.txt

# ignorer tous les fichiers .txt sous le répertoire doc/
doc/**/*.txt
```


https://git-scm.com/book/en/v2/Git-Basics-Recording-Changes-to-the-Repository

Record changes to the repository

Inspect indexed and non-indexed changes

```
$ git diff
diff --git a/CONTRIBUTING.md b/CONTRIBUTING.md
index 8ebb991..643e24f 100644
--- a/CONTRIBUTING.md
+++ b/CONTRIBUTING.md
@@ -65,7 +65,8 @@ branch directly, things can get messy.
 Please include a nice description of your changes when you submit your PR;
 if we have to read the whole diff to figure out why you're contributing
 in the first place, you're less likely to get feedback and have your change
-merged in.
+merged in. Also, split your changes into comprehensive chunks if you patch is
+longer than a dozen lines.

 If you are starting to work on a particular area, feel free to submit a PR
 that highlights your work in progress (and note in the PR title that it's
```

- git diff
- git diff --cached
- git difftool --tool-help

https://git-scm.com/book/en/v2/Git-Basics-Recording-Changes-to-the-Repository

Record changes to the repository

Delete files

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

no changes added to commit (use "git add" and/or "git commit -a")
```

deletes the file in the directory only
need `git add index.html`
(or `git rm index.html`)

```
$ git rm index.html
$ git status
On branch master
Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
        deleted:    index.html
```

deletes the file in the directory and in the index

```
$ git rm --cached big_file_should_be_in_gitignore.log
rm 'big_file_should_be_in_gitignore.log'
$ git status
On branch master
Untracked files:
  (use "git add <file>..." to include in what will be committed)
        big_file_should_be_in_gitignore.log

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

deletes a file in the index only

https://git-scm.com/book/en/v2/Git-Basics-Recording-Changes-to-the-Repository

View the history of validations

```
$ git log
commit ca82a6dff817ec66f44342007202690a93763949
Author: Scott Chacon <schacon@gee-mail.com>
Date:   Mon Mar 17 21:52:11 2008 -0700

    changed the version number

commit 085bb3bcb608e1e8451d4b2432f8ecbe6306e7e7
Author: Scott Chacon <schacon@gee-mail.com>
Date:   Sat Mar 15 16:40:33 2008 -0700

    removed unnecessary test

commit a11bef06a3f659402fe7563abf99ad00de2209e6
Author: Scott Chacon <schacon@gee-mail.com>
Date:   Sat Mar 15 10:31:28 2008 -0700

    first commit
```


https://git-scm.com/book/en/v2/Git-Basics-Viewing-the-Commit-History

View the history of validations

```
$ git log
commit ca82a6dff817ec66f44342007202690a93763949
Author: Scott Chacon <schacon@gee-mail.com>
Date:   Mon Mar 17 21:52:11 2008 -0700

    changed the version number

commit 085bb3bcb608e1e8451d4b2432f8ecbe6306e7e7
Author: Scott Chacon <schacon@gee-mail.com>
Date:   Sat Mar 15 16:40:33 2008 -0700

    removed unnecessary test

commit a11bef06a3f659402fe7563abf99ad00de2209e6
Author: Scott Chacon <schacon@gee-mail.com>
Date:   Sat Mar 15 10:31:28 2008 -0700

    first commit
```

```
$ git log --pretty=oneline
ca82a6dff817ec66f44342007202690a93763949 changed the version
number
085bb3bcb608e1e8451d4b2432f8ecbe6306e7e7 removed unnecessary test
a11bef06a3f659402fe7563abf99ad00de2209e6 first commit

$ git log --pretty=format:"%h - %an, %ar : %s"
ca82a6d - Scott Chacon, 6 years ago : changed the version number
085bb3b - Scott Chacon, 6 years ago : removed unnecessary test
a11bef0 - Scott Chacon, 6 years ago : first commit
```

```
$ git log --pretty=format:"%h %s" --graph
* 2d3acf9 ignore errors from SIGCHLD on trap
*  5e3ee11 Merge branch 'master' of git://github.com/dustin/grit
|\
| * 420eac9 Added a method for getting the current branch.
* | 30e367c timeout code and tests
* | 5a09431 add timeout protection to grit
* | e1193f8 support for heads with slashes in them
|/
* d6016bc require time for xmlschema
*  11d191e Merge branch 'defunkt' into local
```

```
$ git log -p -2
commit ca82a6dff817ec66f44342007202690a93763949
Author: Scott Chacon <schacon@gee-mail.com>
Date:   Mon Mar 17 21:52:11 2008 -0700

    changed the version number

diff --git a/Rakefile b/Rakefile
index a874b73..8f94139 100644
--- a/Rakefile
+++ b/Rakefile
@@ -5,7 +5,7 @@ require 'rake/gempackagetask'
 spec = Gem::Specification.new do |s|
     s.platform  =   Gem::Platform::RUBY
     s.name      =   "simplegit"
-    s.version   =   "0.1.0"
+    s.version   =   "0.1.1"
     s.author    =   "Scott Chacon"
     s.email     =   "schacon@gee-mail.com"
     s.summary   =   "A simple gem for using Git in Ruby
code."

commit 085bb3bcb608e1e8451d4b2432f8ecbe6306e7e7
Author: Scott Chacon <schacon@gee-mail.com>
Date:   Sat Mar 15 16:40:33 2008 -0700

    removed unnecessary test

diff --git a/lib/simplegit.rb b/lib/simplegit.rb
index a0a60ae..47c6340 100644
--- a/lib/simplegit.rb
+++ b/lib/simplegit.rb
@@ -18,8 +18,3 @@ class SimpleGit
     end

 end
-
-if $0 == __FILE__
-  git = SimpleGit.new
-  puts git.show
-end
\ No newline at end of file
```

```
$ git log --stat
commit ca82a6dff817ec66f44342007202690a93763949
Author: Scott Chacon <schacon@gee-mail.com>
Date:   Mon Mar 17 21:52:11 2008 -0700

    changed the version number

 Rakefile | 2 +-
 1 file changed, 1 insertion(+), 1 deletion(-)

commit 085bb3bcb608e1e8451d4b2432f8ecbe6306e7e7
Author: Scott Chacon <schacon@gee-mail.com>
Date:   Sat Mar 15 16:40:33 2008 -0700

    removed unnecessary test

 lib/simplegit.rb | 5 -----
 1 file changed, 5 deletions(-)

commit a11bef06a3f659402fe7563abf99ad00de2209e6
Author: Scott Chacon <schacon@gee-mail.com>
Date:   Sat Mar 15 10:31:28 2008 -0700

    first commit

 README           |  6 ++++++
 Rakefile         | 23 +++++++++++++++++++++
 lib/simplegit.rb | 25 +++++++++++++++++++++++++
 3 files changed, 54 insertions(+)
```


https://git-scm.com/book/en/v2/Git-Basics-Viewing-the-Commit-History

View the history of validations

Table 1. Useful options for git log --pretty=format

Option	**Description of formatting**
%H	Commit checksum
%h	Abbreviated commit checksum
%T	Tree checksum
%t	Tree abbreviated checksum
%P	Parent checksums
%p	Abbreviated parent checksums
%an	Author's name
%ae	Author's e-mail
%ad	Author's date (format of -date= <option>)
%ar	Author's relative date
%cn	Validator name
%ce	Validator's e-mail
%cd	Validator date
%cr	Validator relative date
%s	Subject

Table 2. Common git log options

Option	Description
-p	Displays the patch applied by each commit--stat Displays the statistics of each file for each commit
--shortstat	Displays only modified/inserted/deleted lines from the -stat option
--name-only	Displays the list of files modified after the commit information
--name-status	Displays list of affected files with add/change/delete information
--abbrev-commit	Displays only the first few characters of the SHA-1 checksum
--relative-date	Displays the date in relative format (e.g. "2 weeks ago") instead of the full date format
--graph	Displays in ASCII characters the graph of branches and merges opposite the history
--pretty	Displays commits in an alternative format. Formats include oneline, short, full, fuller, and format (where you can specify your own format)
--oneline	Convenience option corresponding to --pretty=oneline --abbrev-commit

Table 3. Options for limiting git log output

Option	Description
-(n)	Displays only the last n commits
--since, --after	Limit the display to commits made after the specified date
--until, --before	Limit the display to commits made before the specified date
--author	Show only commits whose author field matches the string passed as argument
--committer	Show only commits whose validator field matches the string passed as argument
--grep	Show only commits whose validation message contains the string
-S	Show only commits whose add or remove contains the string

https://git-scm.com/book/en/v2/Git-Basics-Viewing-the-Commit-History

Cancel actions

```
$ git commit --amend
```

allows to **replace** the last commit with a new one.

```
$ git commit -m 'validation initiale'
$ git add fichier_oublie
$ git commit --amend
```

```
$ git add index.html
$ git status
On branch master
Changes to be committed:
  (use "git restore --staged <file>..." to unstage)
        modified:   index.html
$ git restore --staged index.html
```

git explains how to **de-index an already indexed file**

```
$ nano index.html
$ git status | grep discard
On branch master
Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working directory)
        modified:   index.html

no changes added to commit (use "git add" and/or "git commit -a")
$ git restore index.html
```

git explains how to **undo changes in the working directory**

https://git-scm.com/book/en/v2/Git-Basics-Undoing-Things

Working with remote repositories

```
$ git clone https://github.com/schacon/ticgit > /dev/null
$ cd ticgit && git remote
origin
$ git remote –v
origin     https://github.com/schacon/ticgit (fetch)
origin     https://github.com/schacon/ticgit (push)
```

when cloning a repository, it is named `origin` by default

we can then pull/push the contributions from this repository

https://git-scm.com/book/en/v2/Git-Basics-Working-with-Remotes

Working with remote repositories

```
$ git clone https://github.com/schacon/ticgit > /dev/null
$ cd ticgit && git remote
origin
$ git remote –v
origin     https://github.com/schacon/ticgit (fetch)
origin     https://github.com/schacon/ticgit (push)
```

when cloning a repository, it is named `origin` by default

we can then pull/push the contributions from this repository

```
$ git remote -h
usage: git remote [-v | --verbose]
   or: git remote add [-t <branch>] [-m <master>] [-f] [--
tags | --no-tags] [--mirror=<fetch|push>] <name> <url>
   or: git remote rename <old> <new>
   or: git remote remove <name>
   or: git remote set-head <name> (-a | --auto | -d | --
delete | <branch>)
   or: git remote [-v | --verbose] show [-n] <name>
   or: git remote prune [-n | --dry-run] <name>
   or: git remote [-v | --verbose] update [-p | --prune]
[(<group> | <remote>)...]
   or: git remote set-branches [--add] <name> <branch>...
   or: git remote get-url [--push] [--all] <name>
   or: git remote set-url [--push] <name> <newurl> [<oldurl>]
   or: git remote set-url --add <name> <newurl>
   or: git remote set-url --delete <name> <url>
```

with `git remote` one can manage remote repositories:

- list remote repositories
- their names, their fetch/push urls,
- the tracked branches
- the default branch of the remote
- …

https://git-scm.com/book/en/v2/Git-Basics-Working-with-Remotes

Working with remote repositories

```
$ git remote add pb https://github.com/paulboone/ticgit
$ git fetch pb
remote: Counting objects: 43, done.
remote: Compressing objects: 100% (36/36), done.
remote: Total 43 (delta 10), reused 31 (delta 5)
Unpacking objects: 100% (43/43), fait.
From https://github.com/paulboone/ticgit
 * [new branch] master     -> pb/master
 * [new branch] ticgit     -> pb/ticgit
```

`git fetch`:

Retrieve all information from a remote repository

- the `master` branch from `pb` is now `pb/master`

✓ **No automatic merge, no local modification!**

```
$ git push pb ticgit
$ # man: git push <remote> <branch>
```

```
$ git push origin branch1:branch2
$ # man: git push <remote> <local-ref>:<remote-ref>
```

```
$ git push
```

`git push`:

Push to the remote repository

- ex 1: push the `ticgit` branch to `pb`
- ex 2: push `branch1` to the `branch2` branch of `origin`
- ex 3: with default values, equivalent to:

```
git push origin master
```

⚠ **There may be conflicts during the merge !** ⚠

https://git-scm.com/book/en/v2/Git-Basics-Working-with-Remotes

Tagging

- git allows you to tag states in the history

```
$ git tag
v0.1
v1.3
```

list tags

```
$ git tag –a v1.4 –m "Version 1.4"
$ git tag
v0.1
v1.3
v1.4
```

tag the current commit, with a tagging message

```
$ git tag -a v1.2 9fceb02
```

tag a specific commit

```
$ git push origin v1.2
```

push a tag

is not done by default during git push, except with the --tags option

```
$ git push origin --tags
```

```
$ git tag –d v1.4
$ git push origin –delete v1.4
```

deleting a tag
and deletion on the remote server

https://git-scm.com/book/en/v2/Git-Basics-Tagging

Tagging

```
$ git checkout v2.29.2
Note : basculement sur 'v2.29.2'.

You are in the "HEAD detached" state. You can visit,
make experimental modifications and and validate them.
You just need to make another switch to
abandon the commits you make in this state without
impacting the other branches

If you want to create a new branch to keep the commits
you create,
you just use the -c option of the switch command like
this:

  git switch -c <name-of-new-branch>

Or undo this operation with :

  git switch -

Disable this advice by setting the advice.detachedHead
configuration variable to false

HEAD is now on 898f80736c Git 2.29.2

$ git checkout v2.29.1
HEAD's previous position was on 898f80736c Git 2.29.2
HEAD is now on b927c80531 Git 2.29.1
```

in the "detached HEAD" state,
a new commit would not belong to any branch
it would be reachable only with its exact footprint
it is better to create a branch
for example:

```
$ git checkout -b v2.29.X
Basculement sur la nouvelle branche 'v2.29.X'
```


https://git-scm.com/book/en/v2/Git-Basics-Tagging

Technological foundations of software development

Manage your source code

Part 3 – Branching and merging with Git – complementary slides

ICM – Computer Science Major – Course unit on Technological foundations of computer science
M1 Cyber Physical and Social Systems – Course unit on CPS2 engineering and development, Part 2: Technological foundations of software development
Maxime Lefrançois https://maxime-lefrancois.info
online: https://ci.mines-stetienne.fr/cps2/course/tfsd/

Branches in a nutshell

Notes

Note	**Creating a new branch and switching to it at the same time** It's typical to create a new branch and want to switch to that new branch at the same time — this can be done in one operation with `git checkout -b <newbranchname>`.
Note	From Git version 2.23 onwards you can use `git switch` instead of `git checkout` to: • Switch to an existing branch: `git switch testing-branch`. • Create a new branch and switch to it: `git switch -c new-branch`. The `-c` flag stands for create, you can also use the full flag: `--create`. • Return to your previously checked out branch: `git switch -`.

https://git-scm.com/book/en/v2/Git-Branching-Branches-in-a-Nutshell

Branching and merging

Scenario

1. you are working on a web site;
2. you create a branch for a new article in progress;
3. you start working on this branch.

At this point, you get a call that a critical problem has been discovered and needs to be addressed as soon as possible.
So you do the following:

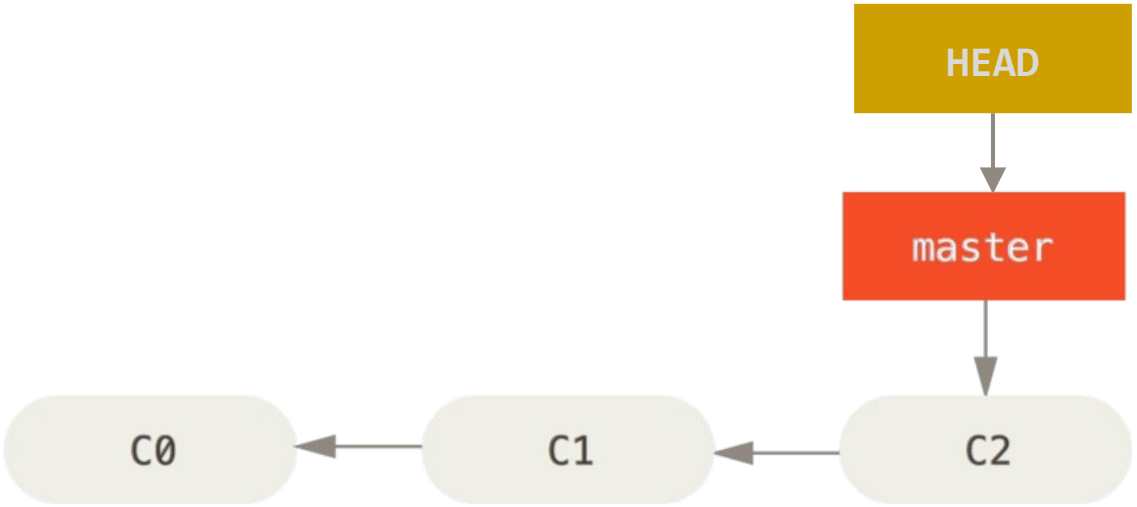
1. you switch to the production branch;
2. you create a branch to add the patch;
3. after testing it, you merge the patch branch and push the result to production;
4. you switch back to the initial branch and continue your work

https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

Branching and merging

Scenario

1. you are working on a web site;

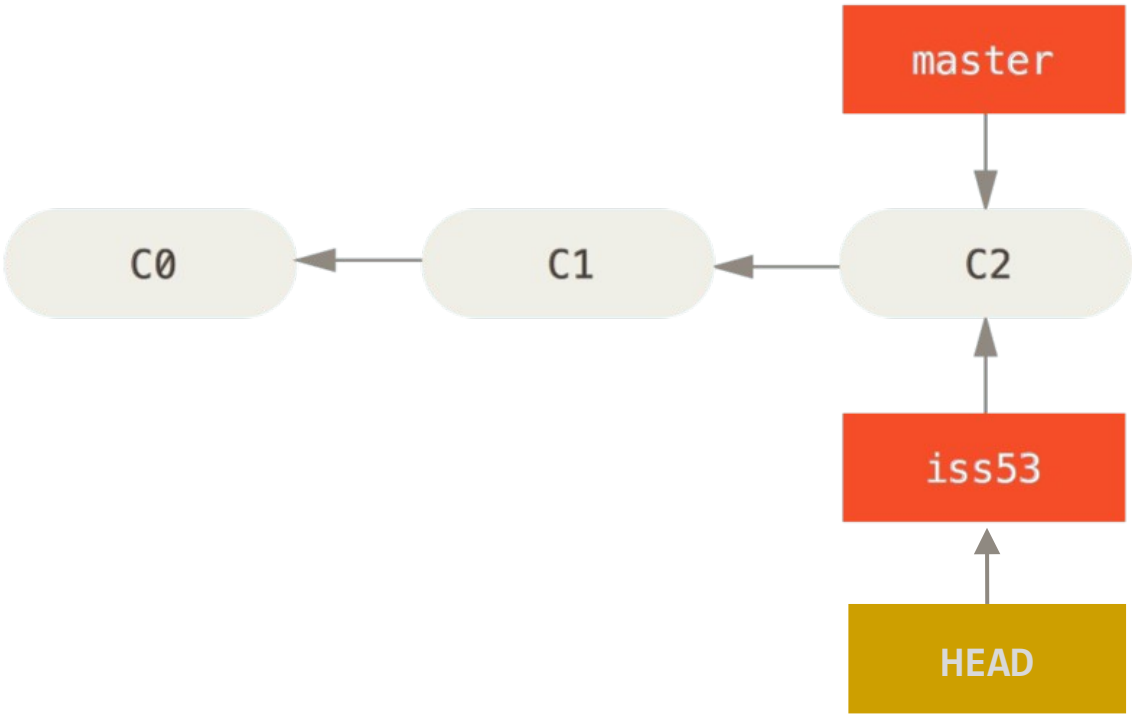


https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

Branching and merging

Scenario

1. you are working on a web site;
2. you create a branch for a new article in progress;



Creation of a new branch `iss53` to work on issue #53

```
$ git checkout -b iss53
Switched to a new branch "iss53"
```

```
$ git branch iss53
$ git checkout iss53
```

https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

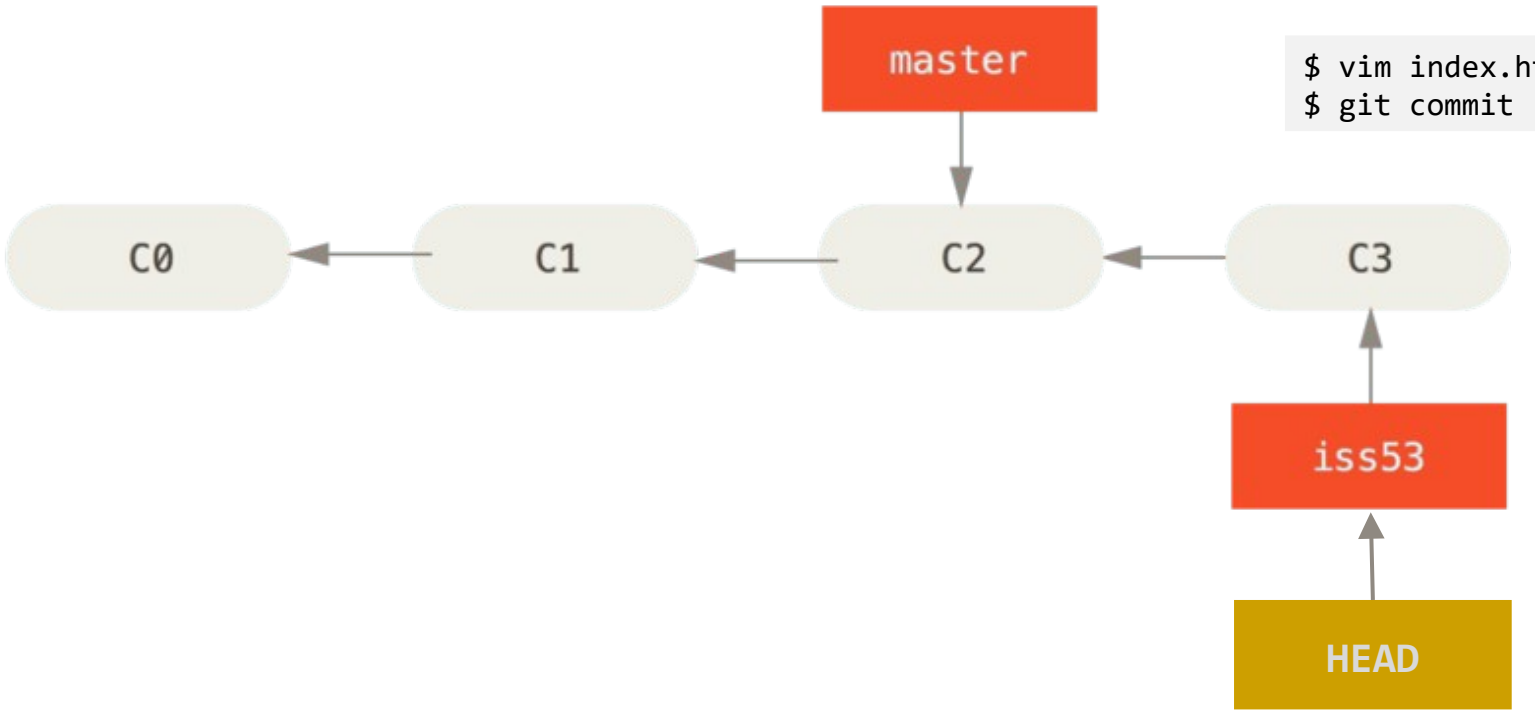
Branching and merging

Scenario

1. you are working on a web site;
2. you create a branch for a new article in progress;
3. you start working on this branch.

Example of a new commit on branch `iss53`

```
$ vim index.html
$ git commit -a -m "add footer [issue 53]"
```

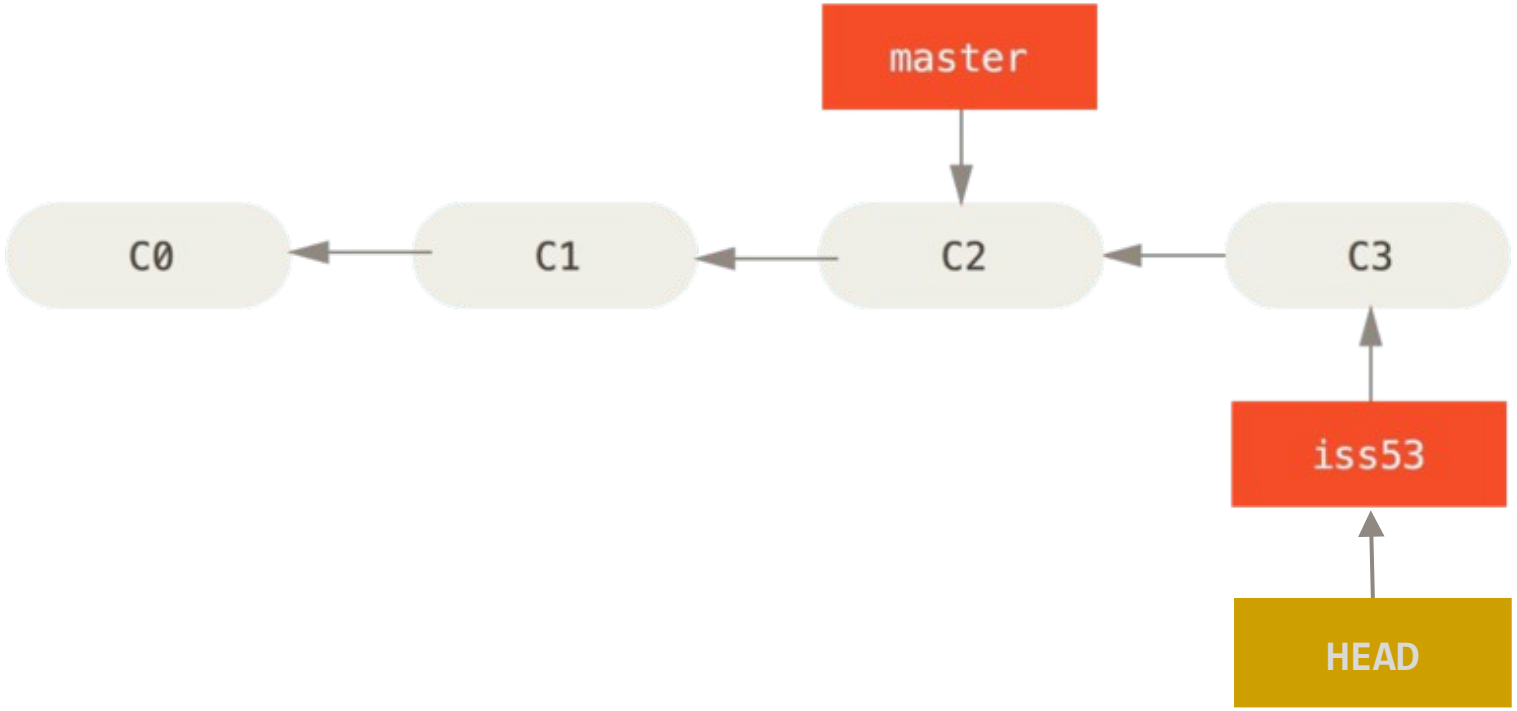


https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

Branching and merging

Scenario

At this point, you get a call that a critical problem has been discovered and needs to be addressed as soon as possible.



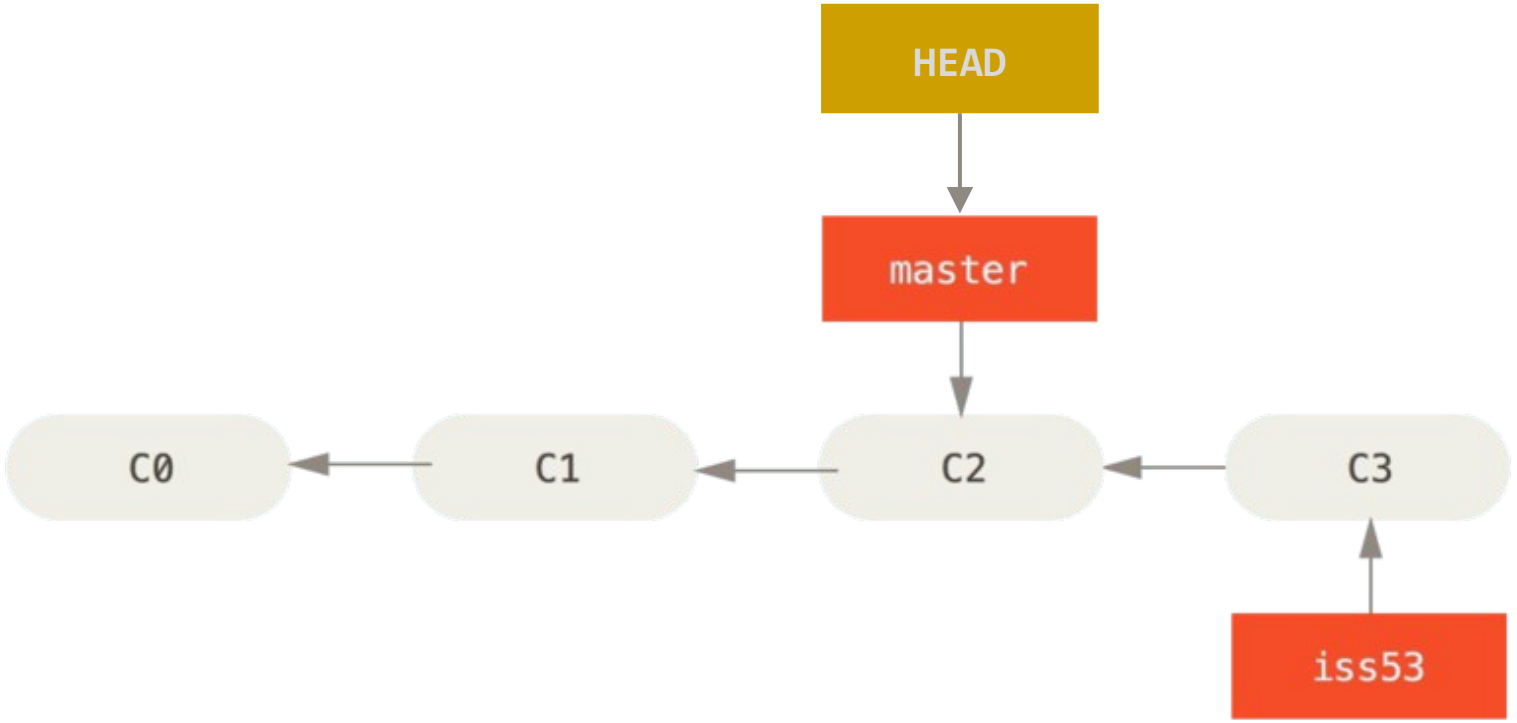
https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

Branching and merging

Scenario

1. you switch to the production branch;

```
$ git checkout master
Switched to branch 'master'
```

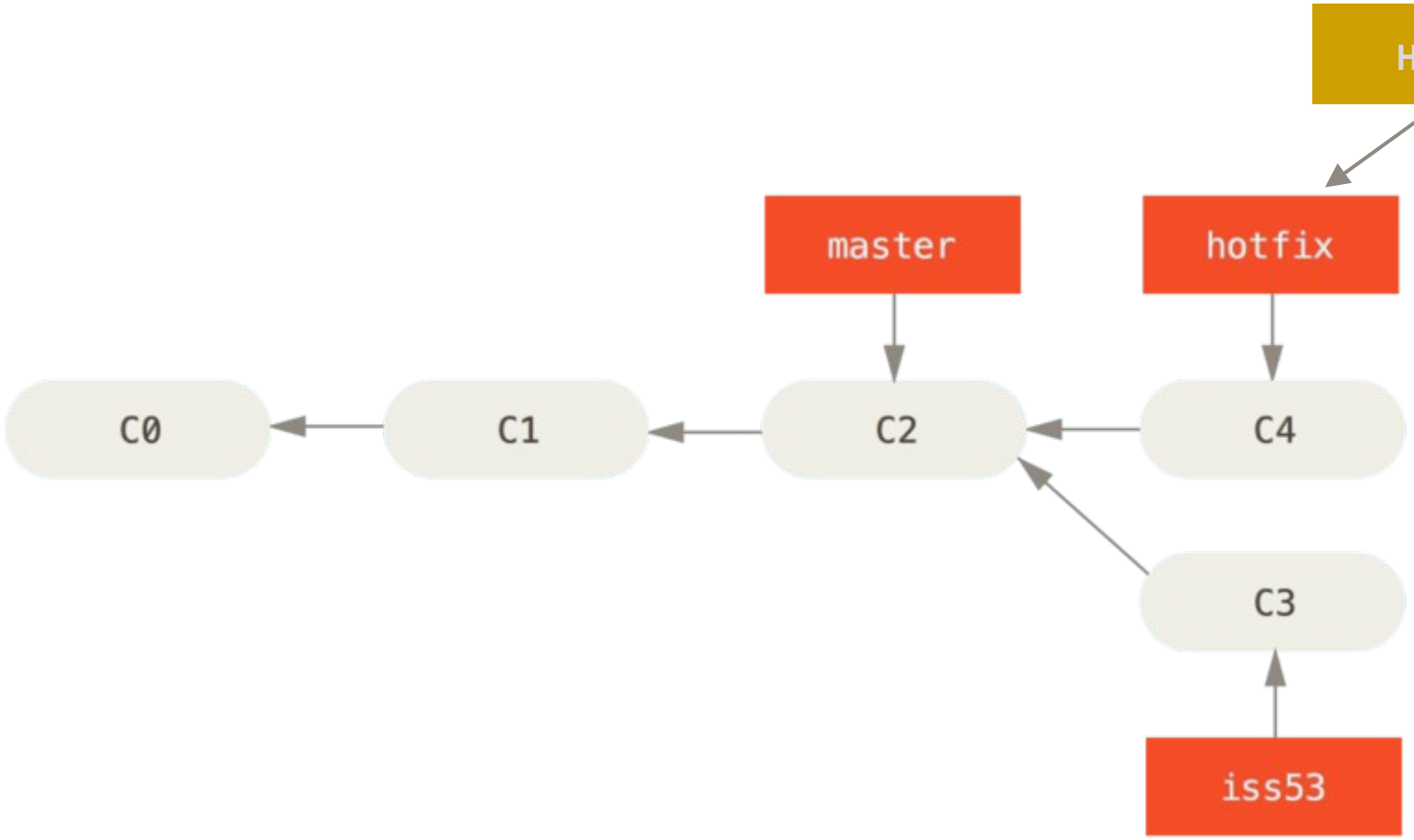


https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

Branching and merging

Scenario

2. you create a branch to add the patch;



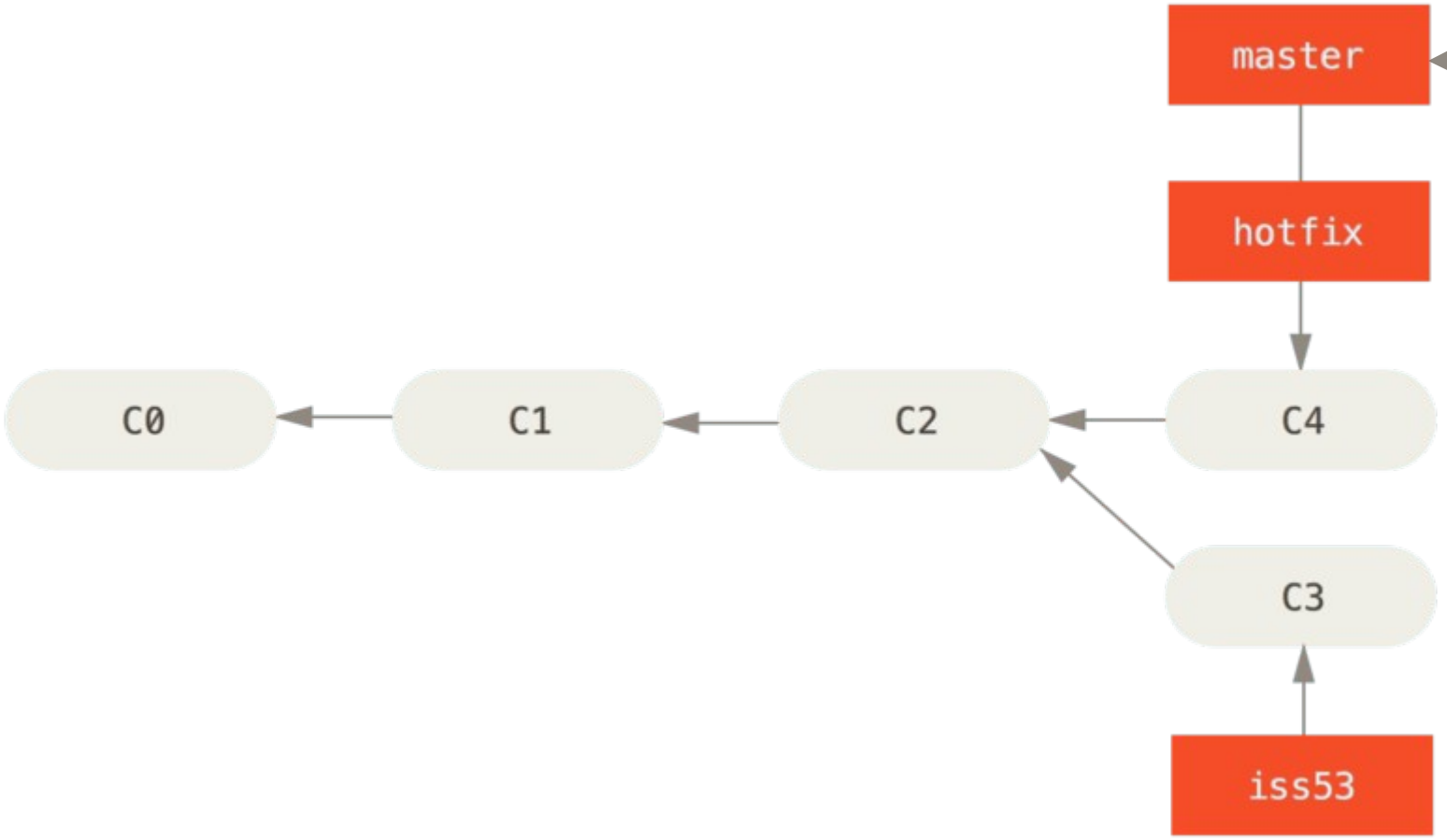

```
$ git checkout -b patch
Switched to a new branch patch'
$ vim index.html
$ git commit -a -m "incorrect email address"
[correctif 1fb7853] "incorrect email address"
 1 file changed, 2 insertions(+)
```


https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

Branching and merging

Scenario

3. after testing it, you merge the patch branch and push the result to production;




```
$ git checkout master
$ git merge patch
Updating f42c576..3a0874c
Fast-forward
 index.html | 2 ++
 1 file changed, 2 insertions(+)
```

Fast-forward: simple déplacement du pointeur vers l'avant

https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

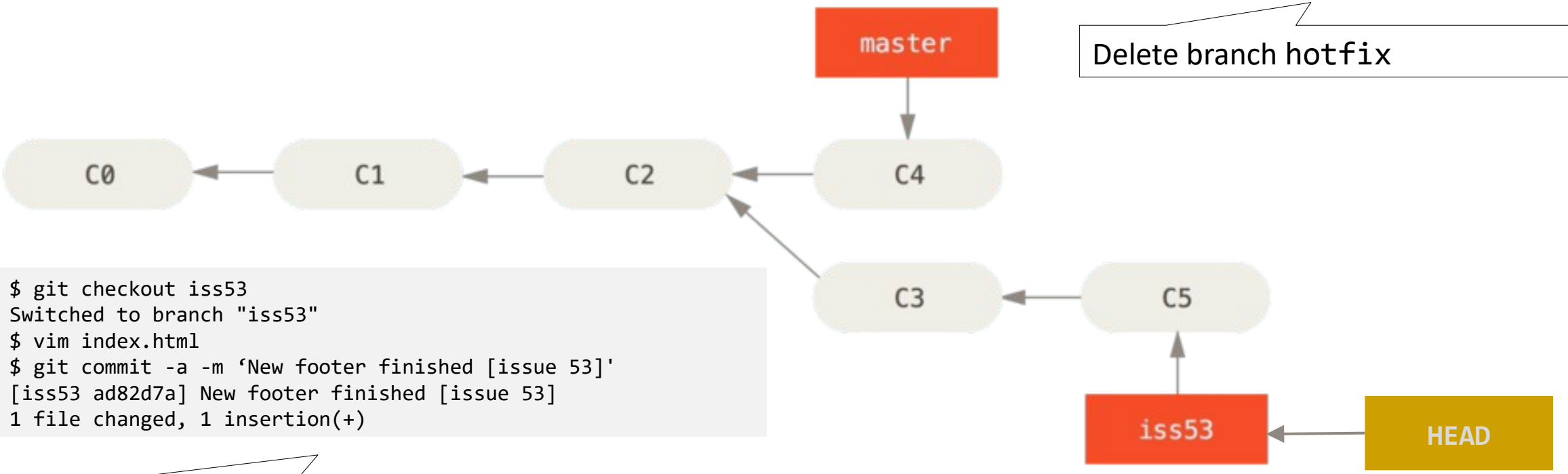
Branching and merging

Scenario

4. you switch back to the initial branch and continue your work

```
$ git branch -d patch
Deleted branch patch (3a0874c).
```

Delete branch hotfix



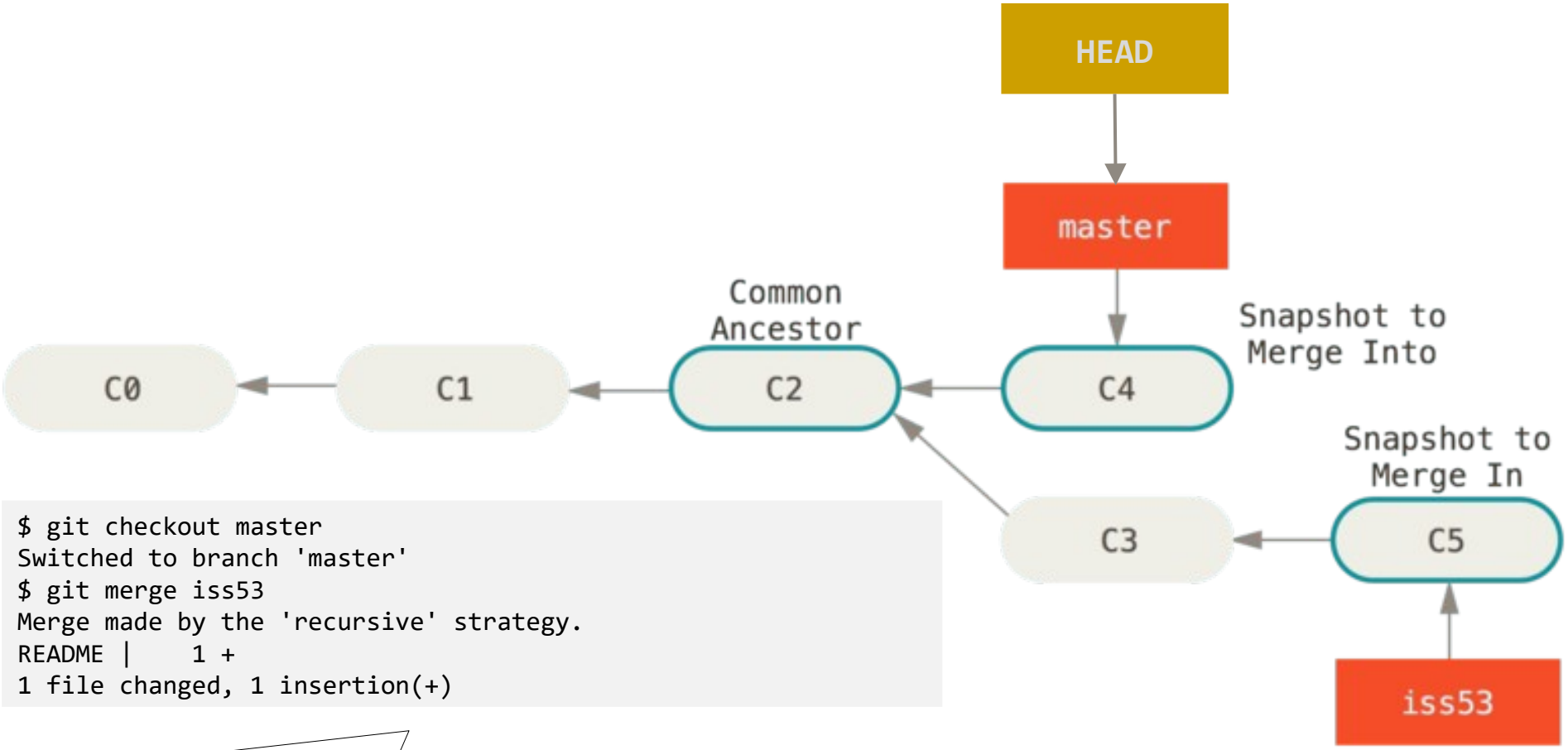

```
$ git checkout iss53
Switched to branch "iss53"
$ vim index.html
$ git commit -a -m ‘New footer finished [issue 53]'
[iss53 ad82d7a] New footer finished [issue 53]
1 file changed, 1 insertion(+)
```

Switch to branch iss53 and create new commits

https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

Branching and merging

Merging



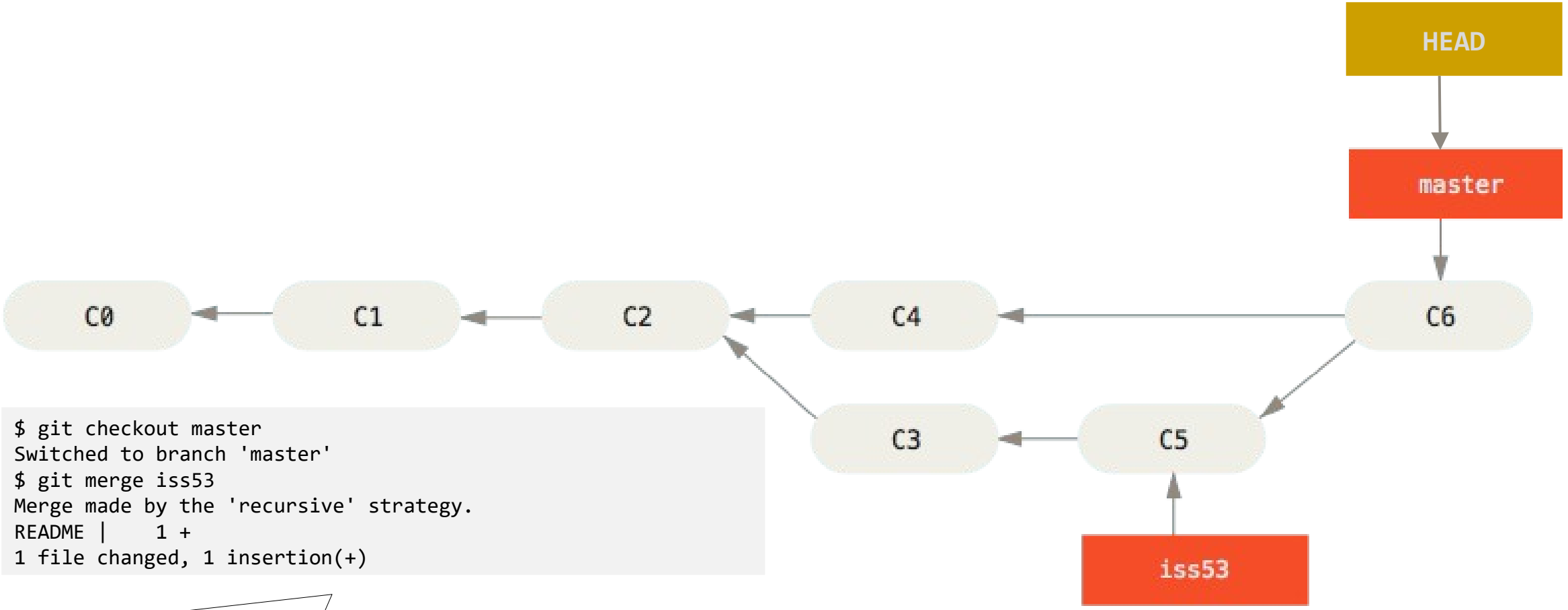

```
$ git checkout master
Switched to branch 'master'
$ git merge iss53
Merge made by the 'recursive' strategy.
README |    1 +
1 file changed, 1 insertion(+)
```

‘recusive’ strategy: Simple 3-sources fusion

https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

Branching and merging

Merging




```
$ git checkout master
Switched to branch 'master'
$ git merge iss53
Merge made by the 'recursive' strategy.
README |    1 +
1 file changed, 1 insertion(+)
```

‘recusive’ strategy: Simple 3-sources fusion

https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

Branching and merging
Merge conflicts

```
$ git merge iss53
Auto-merging index.html
CONFLICT (content): Merge conflict in index.html
Automatic merge failed; fix conflicts and then commit the result.
```

```
$ git status
On branch master
You have unmerged paths.
  (fix conflicts and run "git commit")

Unmerged paths:
  (use "git add <file>..." to mark resolution)

    both modified:      index.html

no changes added to commit (use "git add" and/or "git commit -a")
```

Example of a merger conflict to be resolved

```
<<<<<<< HEAD:index.html
<div id="footer">contact : email.support@github.com</div>
======
<div id="footer">
 please contact us at support@github.com
</div>
>>>>>>> iss53:index.html
```

Contents of the `index.html` file with conflict markers

https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

Branching and merging
Merge conflicts

```
<div id="footer">
please contact us at email.support@github.com
</div>
```

```
<<<<<<< HEAD:index.html
<div id="footer">contact : email.support@github.com</div>
======
<div id="footer">
 please contact us at support@github.com
</div>
>>>>>>> iss53:index.html
```

Example of manual resolution

```
$ git add index.html
```

We mark this conflict "resolved".

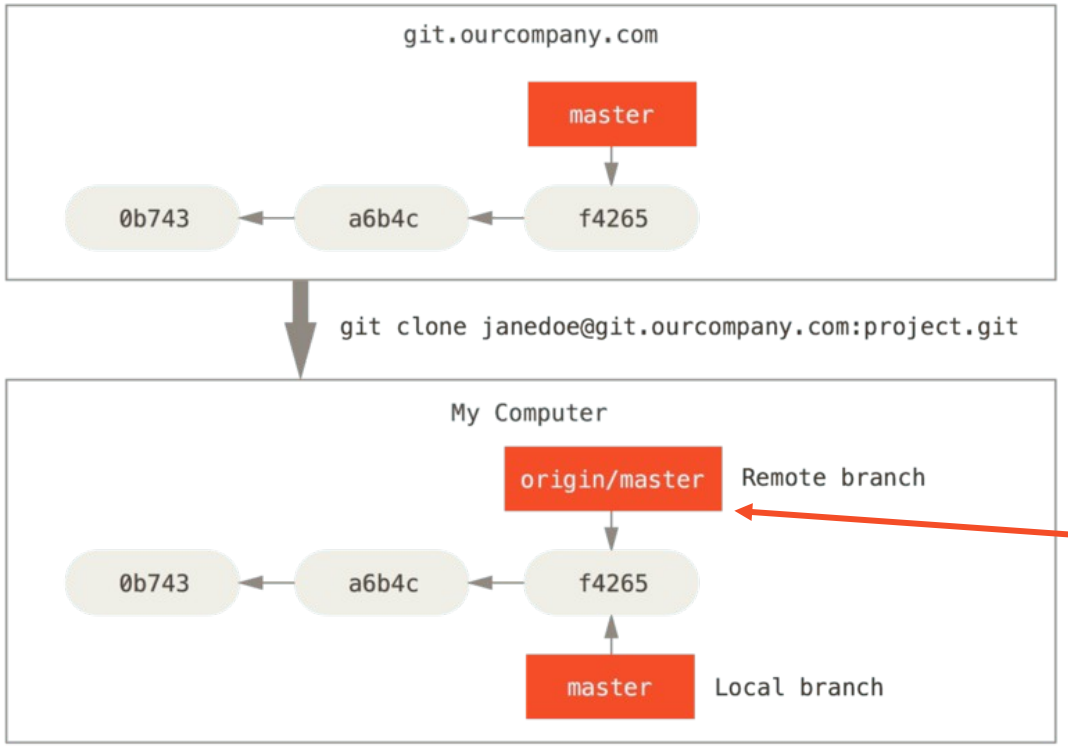
```
$ git status
On branch master
All conflicts fixed but you are still merging.
  (use "git commit" to conclude merge)

Changes to be committed:

    modified:   index.html
```

```
$ git commit
```

We finalize the commit

https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

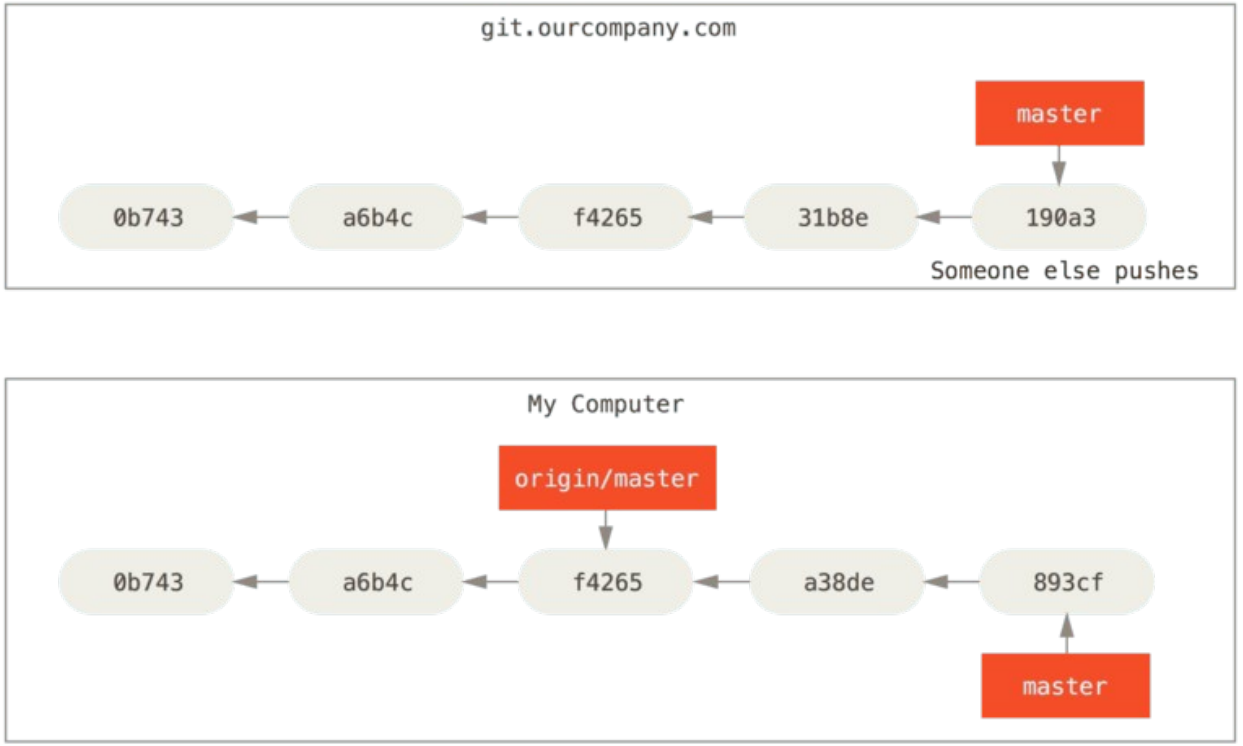
Remote branches



The <remote>/<branch> branch is unmodifiable. It is a bookmark to indicate the state of the remote branch

https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

Remote branches



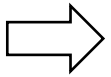
Local and remote work may differ

https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

Remote branches

```
$ git push origin issue-53
Counting objects: 24, done.
Delta compression using up to 8 threads.
Compressing objects: 100% (15/15), done.
Writing objects: 100% (24/24), 1.91 KiB | 0 bytes/s, done.
Total 24 (delta 2), reused 0 (delta 0)
To https://github.com/schacon/simplegit
 * [new branch]      issue-53 -> issue-53
```

I push my changes on the remote server



```
$ git fetch origin
remote: Counting objects: 7, done.
remote: Compressing objects: 100% (2/2), done.
remote: Total 3 (delta 0), reused 3 (delta 0)
Unpacking objects: 100% (3/3), done.
From https://github.com/schacon/simplegit
 * [new branch]      issue-53 -> origin/issue-53
```

My colleague retrieves the changes

```
$ git checkout -b issue-53 origin/issue-53
Branch issue-53 set up to track remote branch issue-53 from origin.
Switched to a new branch 'issue-53'
```

My colleague creates a modifiable local branch issue-53, based on the state of origin/issue-53

https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

Remote branches

```
$ git checkout -b issue-53 origin/issue-53
Branch issue-53 set up to track remote branch issue-53 from origin.
Switched to a new branch 'issue-53'
```

Create issue-53 that "follows" origin/issue-53

Allows you to push and pull from origin/issue-53 by default

```
$ git checkout --track origin/issue-53
Branch issue-53 set up to track remote branch issue-53 from origin.
Switched to a new branch 'issue-53'
```

Shortcut: automatic naming of the created branch

```
$ git checkout issue-53
Branch issue-53 set up to track remote branch issue-53 from origin.
Switched to a new branch 'issue-53'
```

Shortcut: if issue-53 does not exist, and exists on a single remote

https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging

Remote branches

```
$ git branch -vv
  iss53     7e424c3 [origin/iss53: ahead 2] forgot the brackets
  master    1ae2a45 [origin/master] deploying index fix
* correctionserveur f8674d9 [equipe1/correction-serveur-ok: ahead 3, behind 1] this should do it
  test   5ea463a trying something new
```

Visualize the branches and the branches they are configured to follow

```
$ git pull issue-53
```

Shortcut for `git fetch` then `git merge`

https://git-scm.com/book/en/v2/Git-Branching-Basic-Branching-and-Merging