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CENTRE DE RECHERCHE

01
Chapiter

Version Control with Git

2I1AC3 : Génie logiciel et Patrons de conception

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“Git signifie ne jamais avoir à dire que vous êtes désolé.”
M. J. Dominus

Outline

1
Why
Version Control?

Why Version Control?

1) For tracking and managing changes to files

- Change log : what is new from the previous version (addition, modification, deletion)
- Rollback to a previous version (undo/redo)

Why Version Control?

1) For tracking and managing changes to files
2) **For managing multiple versions of the same project**
    - eg. Microsoft OS: Windows 11, Windows 10 Home, Windows 10 Pro, ...

Why Version Control?

1) For tracking and managing changes to files
2) For managing multiple versions of the same project
3) **For sharing files**
    - Integrate developer's contributions to build a common version of the software
    - Identify and resolve conflicts when two developers modify the same file

Why Version Control?

1) For tracking and managing changes to files
2) For managing multiple versions of the same project
3) For sharing files
4) **For organizing collaborative work: workflow**
   - Organize how to develop software with multiple contributors
     - eg. Linux with its 1,500 contributors!

Course Outline

1) Lecture 1
    1) For tracking and managing changes to files
    2) For managing multiple versions of the same project
2) Lecture 2
    3) For sharing files
    4) For organizing collaborative work: workflow

Outline

1
Why
Version Control?

2
The Git
tool

Git

- History
  - 2005 Linus Torvalds (creator of Linux)
- Alternatives
  - Mercurial
  - Perforce (video game)
  - Subversion
- Most popular
  - Free, open-source, super fast, scalable
  - *Should be mentioned in your resume*

Git

- Execution
  - CLI (Command Line Interface): all commands start with keyword ‘git’:

```
$ git <command> [--<parameter>]* [<args>]
```

  - UI: Interfaced by most of IDE (Intellij, VS Code) and multiple dedicated software tools

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3
Local Repository
for tracking and managing changes to files (1)

Create Local Repository

- Create git repository

```
$ mkdir <project>
$ cd <project>
$ git init
```

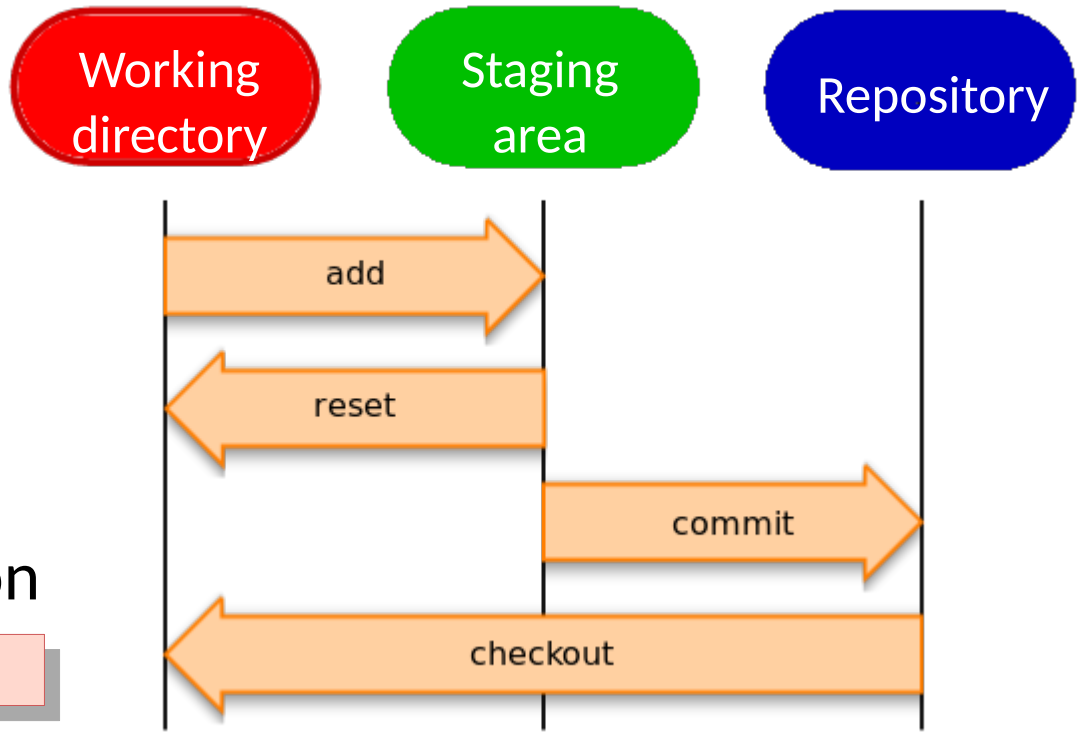
Local Repository

- File lifecycle: 3 sections
  1) Working directory

     files edition
  2) Staging area (*aka Index*)

     file selection for the next version (copy)
  3) Repository

     next version



- **Hint**: get the state of each section

```
$ git status
```

  - Short version

```
$ git status -s
```

Working Area → Staging Area

- Add files to the staging area
  - Note: the files in the staging area are fresh copies of those in the working area

```
$ git add <filename>
$ git add -A # stages all changes (creation, modification, deletion)
             # in the entire project directory
$ git add .  # stages all changes (creation, modification, deletion)
             # from the current directory and subdirectories
```

- Remove files from the staging area

```
$ git reset <filename>
```

- Show the contents of the staging area

```
$ git ls-files
```

Working Area → Staging Area

- File `.gitignore`
  - Text file
  - Lists the files and folders that you do not want to store in the repository
  - Operates on the directory and subdirectories
  - The `git add` command becomes inoperative on the listed files

```
# example of a .gitignore file
local.properties      # a single file
*.bak                 # many files
etc/                  # folder
app/build/            # folder
```

Staging Area → Repository

- Move the files from the staging area to the local repository

```
$ git commit -m "<Message justifying the commit>"

For example:
$ git commit -m "Added User table in the database"
```

  - Without the *-m* argument, git opens the default editor
- **Caution**:
  - avoid (ie, add + commit in one command)

```
$ git commit -am "<Message justifying the commit>"
```

  - since it does not take into account new files
- Message relevance is important because it is the only clue to understand the history and therefore to find into it

History of commits

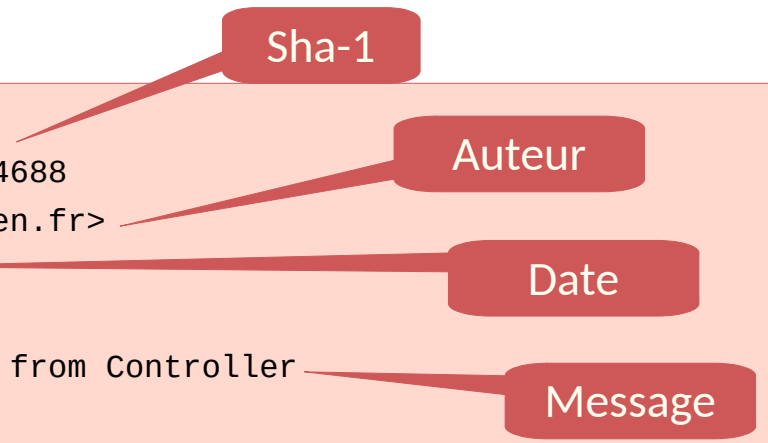
- Commit messages
  - Log:

```
$ git log
commit 1fdbb470a9ac440eb1015227fb912f40163d4688
Author: Régis Clouard <regis.clouard@ensicaen.fr>
Date:   Tue Jul 8 14:20:41 2025 +0200

    refactor(control): extract CsvGenerator from Controller

commit dca4c78cd83d883c1aa1a727c15f395a9a25a85d
Author: Régis Clouard <regis.clouard@ensicaen.fr>
Date:   Tue Jul 8 10:39:49 2025 +0200

    feat(global setting): prevent using distribution directory as working directory
```



  - Rollback to old version

```
$ git checkout <sha-1>
```

```
$ git checkout dca4c78cd83d883c1aa1a727c15f395a9a25a85d
```

Staging Area → Repository

- Remove the file from the working directory and the Git repository

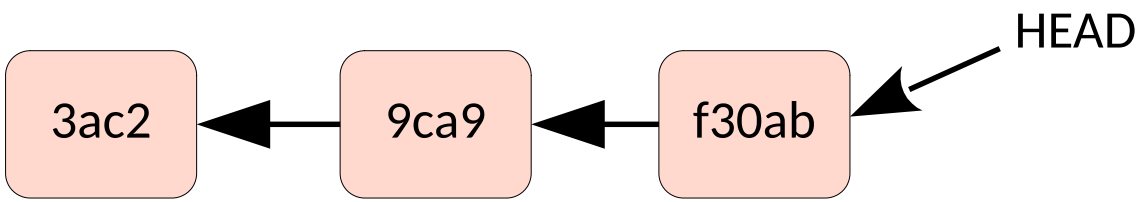
```
$ git rm <file>
```

- Remove the file from the Git repository, but not from the working directory

```
$ git rm --cached <file>
```

Commit

- Repository is organized as a linked list of commits



- HEAD points to the current commit in the repository
- The list allows you to go back and forth in the linked commits

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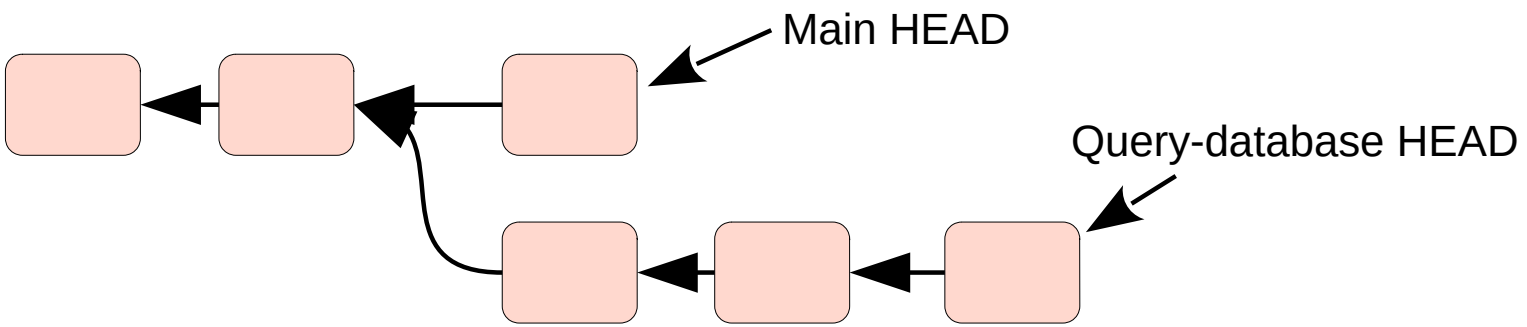
4
Branches
for managing multiple versions of the same project (2)

Branch

- A branch holds a version of the repository
  - We can reference several versions in a same repository like so many branches



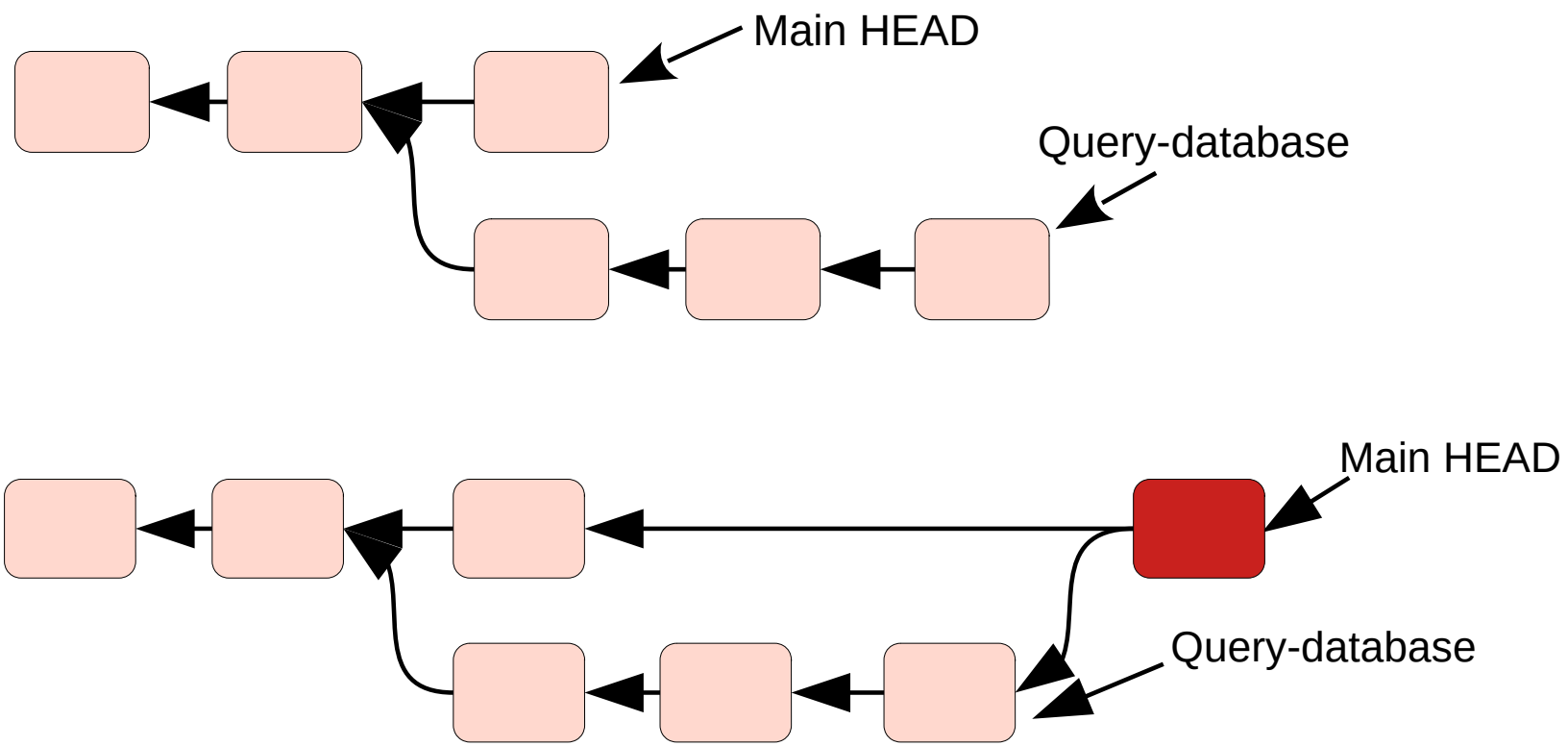
- By default, there is a branch named “*main*” or “*master*”
- Git commands:

```
$ git branch query-database    # Create a branch as a copy the current branch
$ git branch                   # List of branches
$ git checkout query-database  # Install a branch on the working directory
$ git checkout main
$ git branch -d query-database # Remove the branch
```

Merging branch

- Merge one branch into another:

```
$ git checkout main
$ git merge query-database
```



Conflicts

- A conflict appears when two branches are merged and some common files have been modified in both branches
- Conflict resolution must be done by hand!

Conflict Resolution

- Edit the conflicting file and delete the conflict markers: <<<<, ====, >>>> and make the changes you want in the final merge

Before

```
#include <stdio.h>
#include <stlib.h>
<<<<<<< OURS
void do_something_else() {
=======
void do_something() {
>>>>>>> THEIRS
    // code non modifié
}
```

Version of the current contributor named OURS

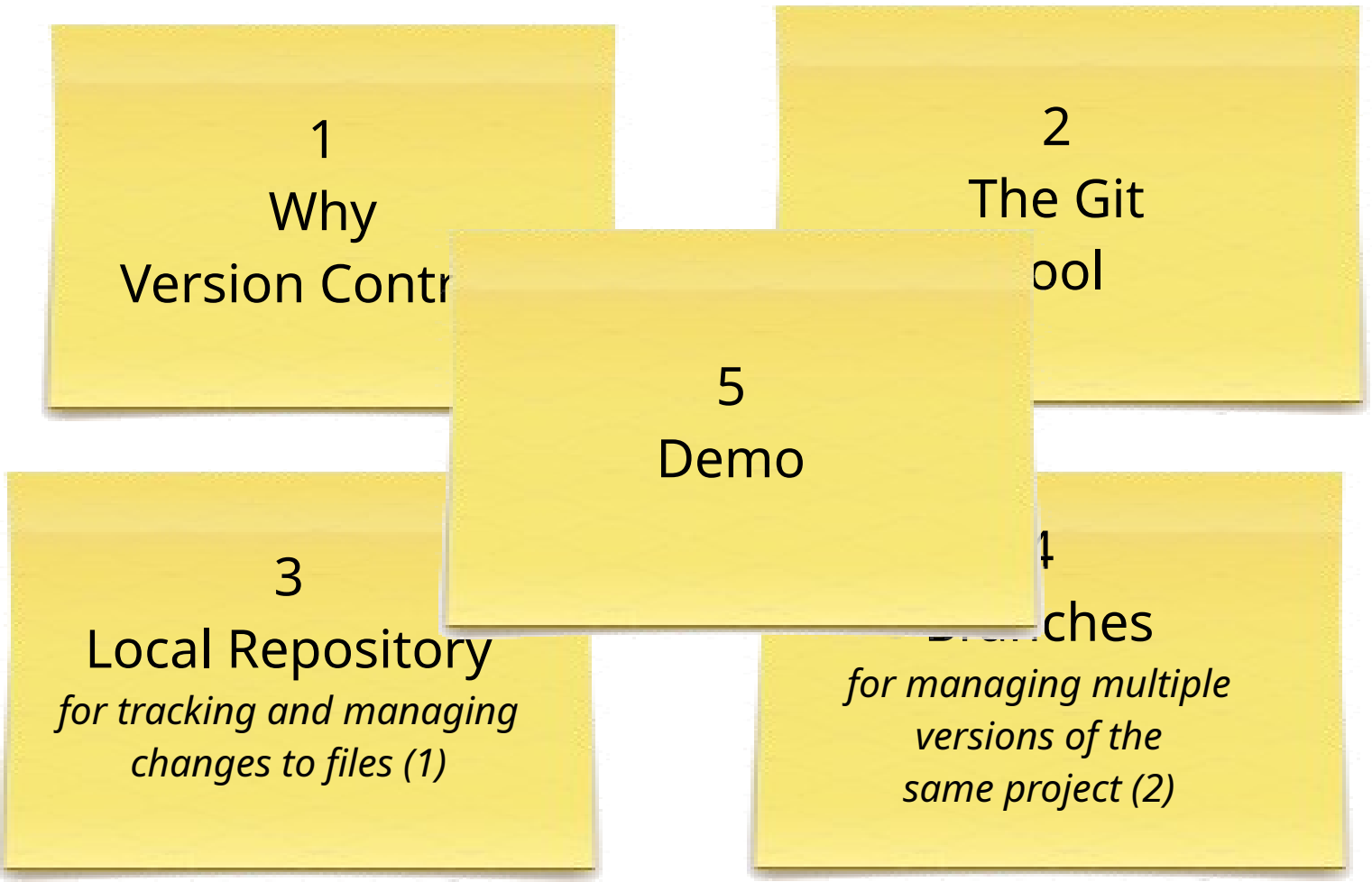
Version of the merge request contributor named THEIRS

After

```
#include <stdio.h>
#include <stlib.h>
void do_something() {
    // code non modifié
}
```

New version without conflict after keeping the "theirs" version

Outline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