ISTITUTO ITALIANO
DI TECNOLOGIA

Git

Crash Course

Ugo Pattacini

based on course by
D.Domenichelli

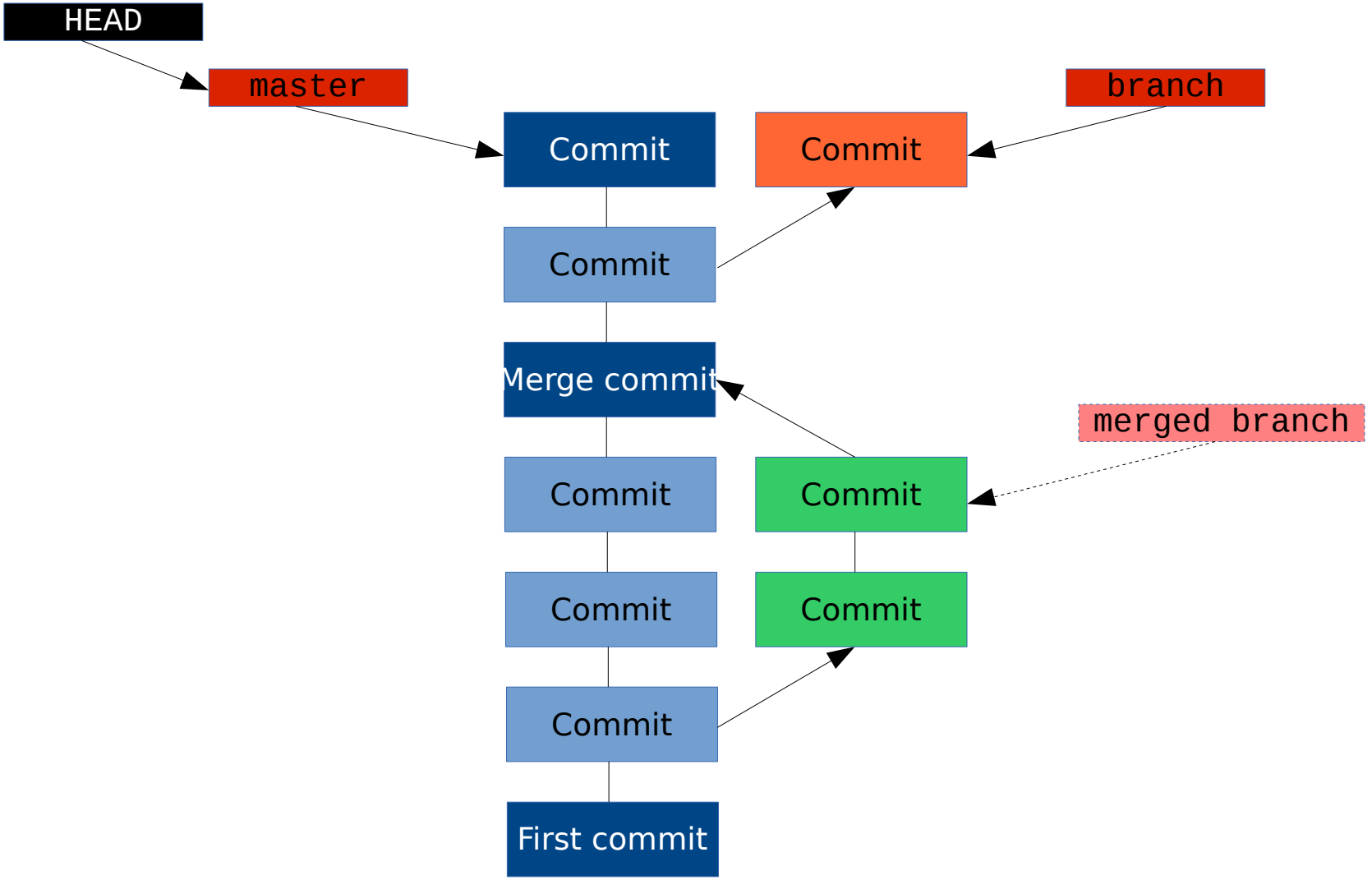
Version Control

- System that records changes to files.
- Allows you to restore a specific versions later.
- A better option than copying files with a different name or into another directory.

Git Design

- Fully distributed
- Fast
- Strong support for non-linear
- development Able to handle large projects
- Saves snapshots, not patches
- Cryptographic authentication of history
- Is not optimized to handle binary files (but there are extensions for this).

Git Repository History Example

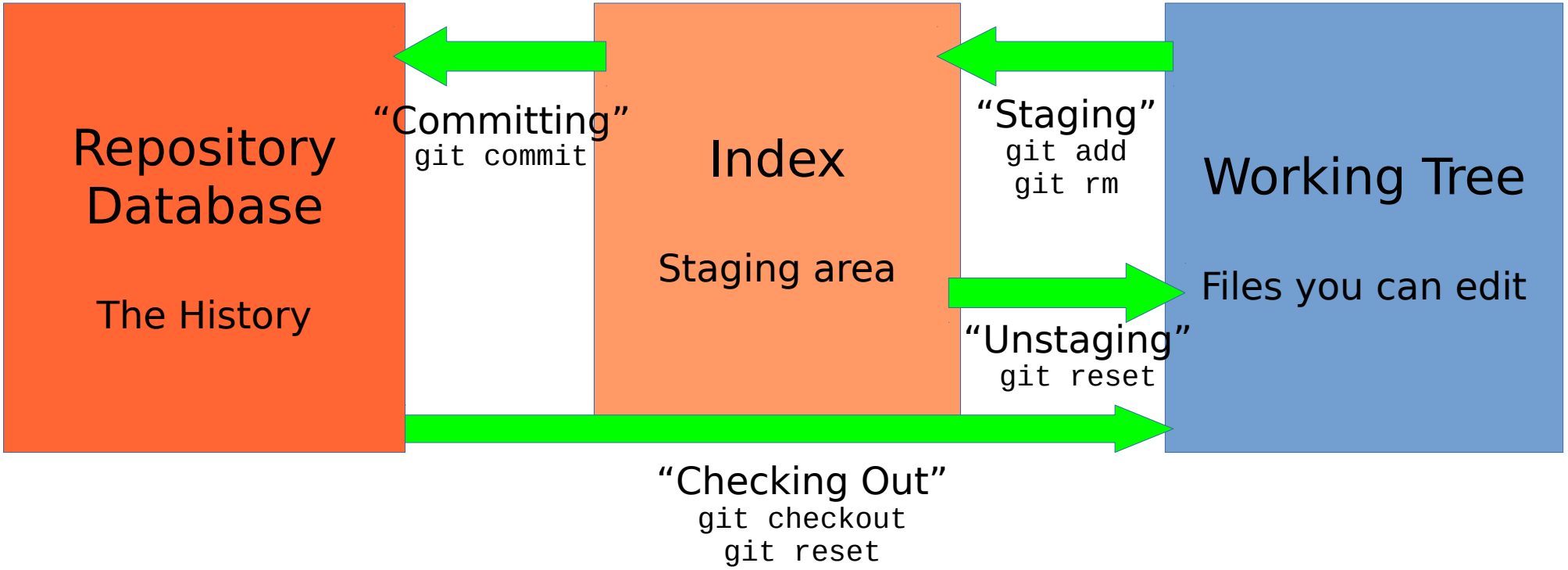


- “HEAD” is a reference to the commit that you checked out in your working tree
- A “merge commit” has two parents, the “first commit” has none.

LOCAL WORKFLOW

Git Repository Structure

Local Workflow



Identity

- The first thing you should do is to set your user name and e-mail address.

```
git config --global user.name "John Doe"
git config --global user.email "john.doe@example.com"
```

Creating a git repository

- `mkdir <folder>`
- `cd <folder>`
- `git init`

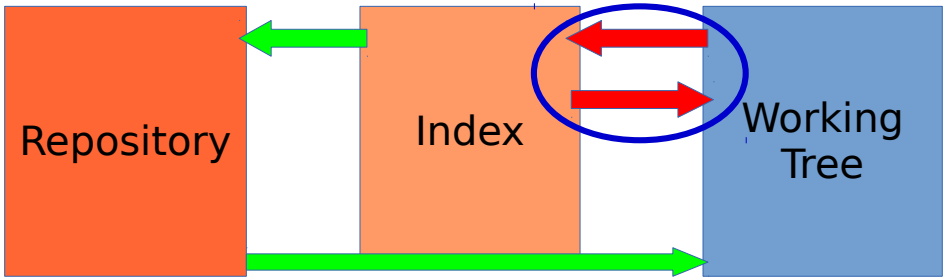
- Now you have a fully working git repository.
- Don't forget that for now it's just on your computer.

Status

- `git status`
  - Shows staged, unstaged and untracked files
  - Do not be afraid to use it after every command
  - Better with colours enabled
- Now try to create a file and see what changes in the output of the command.
  - `touch README.md`
  - `git status`

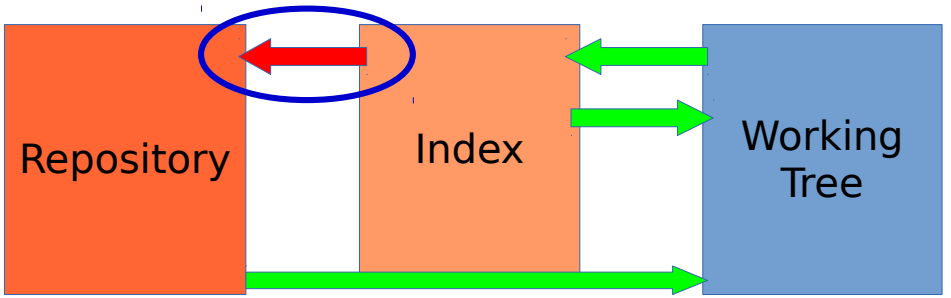
Staging and Unstaging

- `git add <file>`
- `git add .`
- `git reset <file>`
- `git reset`
  - Nothing was committed yet!
  - The “index” is updated
  - Check what changes after each command using “`git status`”
- These commands work on the stage area, but also on the working tree:
  - `git rm <file>`
  - `git mv <old> <new>`



Committing

- Staged files only
  - `git commit -m "Log message"`
- Commit on a shared machine, where your name and email address are not configured
  - `git commit --author="John Doe <john.doe@example.com>"`



Log

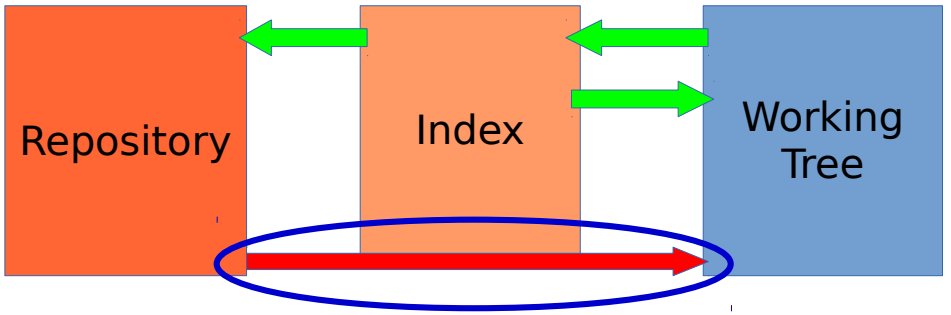
- `git log`
  - Shows the log starting from HEAD
- `git log <revision>`
  - Shows the log starting from <revision>
- `git log [--] path`
  - Limits the log to the changes to a file or a directory

Diff

- `git diff`
  - Shows diff between index and working dir
- `git diff --staged`
  - Shows diff between HEAD and index
- `git diff <object>`
  - Shows diff between object and working dir
- `git diff <object> <object>`
  - Shows diff between two objects

Checking Out a Commit or a Branch

- `git checkout <commit>`
  - If you have some changes to files that would be overwritten when switching branch, the operation fails, and does not try to do anything



Branch

- `git branch (-l)`
  - Shows local branches only
- `git branch -r`
  - Shows remote branches only
- `git branch -a`
  - Shows all branches (local and remote)

Create local branches

- `git branch new-branch <commit>`
  - Create a branch “new-branch” on HEAD or on specified commit. Does not do a checkout of that branch

Merge

- `git merge <branch>`
  - Create a merge commit with multiple parents.
  - If it results in a conflict, user intervention is required

Rebase

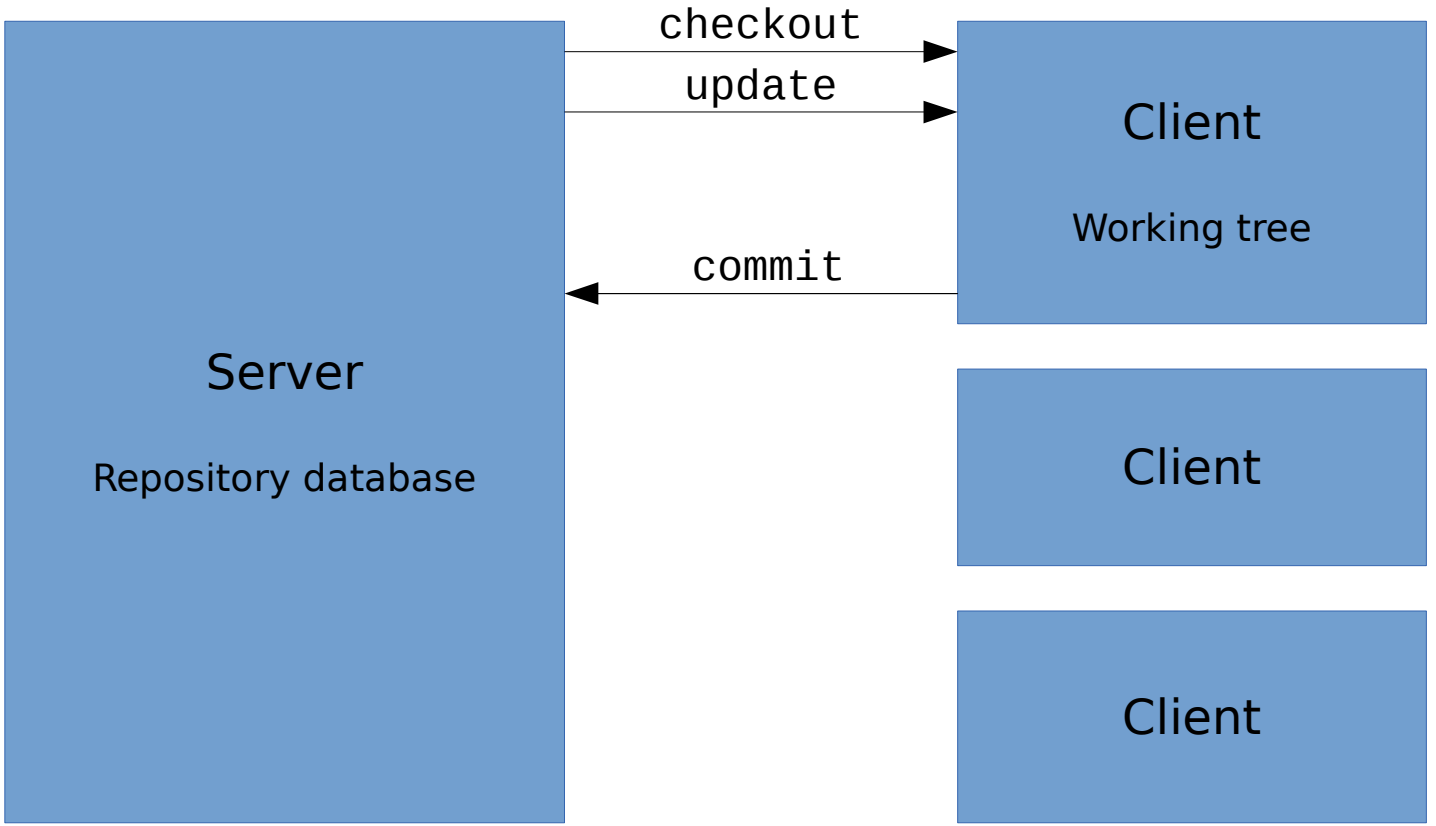
- WARNING: Rewrites the history!
- `git rebase <commit>`
  - Takes all your commits and applies them onto <commit>

Revert

- `git revert <commit>`
  - Applies the reversed patch from <commit> to the repository and creates a new commit

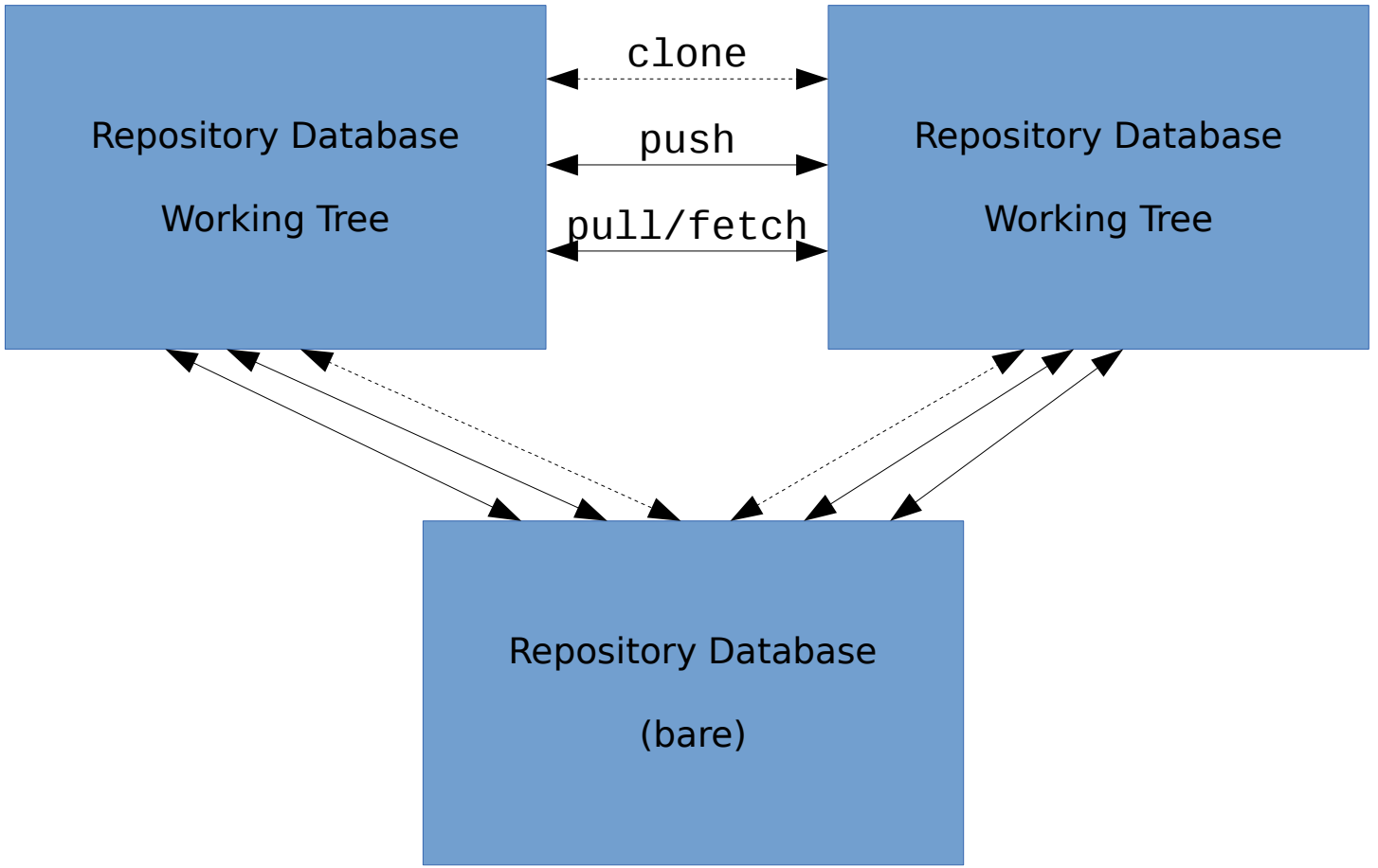
REMOTE WORKFLOW
(with GitHub)

Centralized VCS (Subversion, CVS)



- Most commands require a server, including “informational” commands (log, diff, blame)

Distributed VCS (Git)



- Any “clone” can be a remote, i.e. a server. for another clone.
- Most of the operations are performed locally.
- All the “clones” contain all the history of the repository.

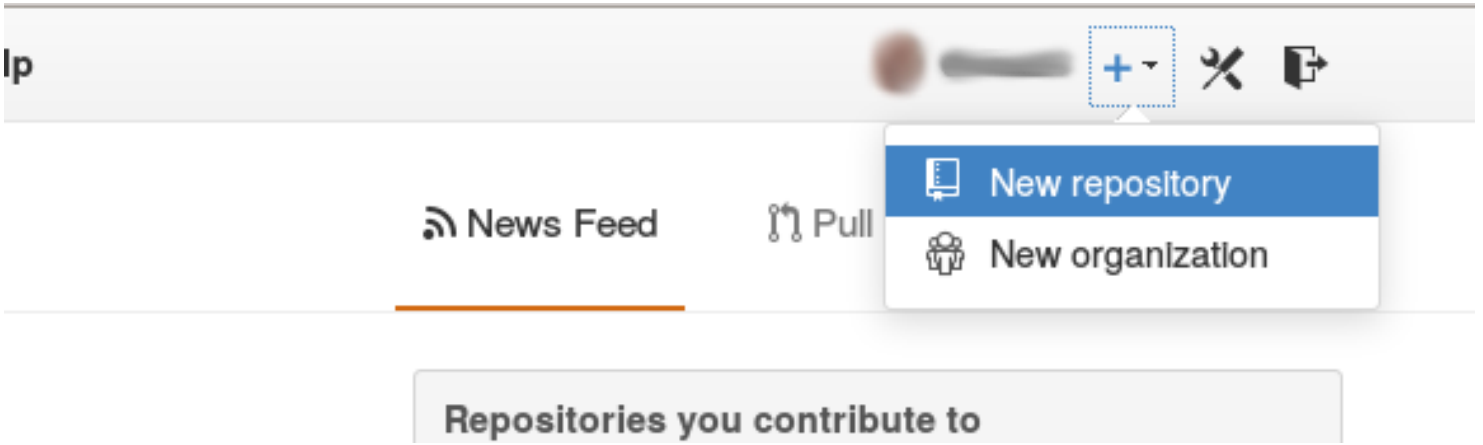
Let's start...

- For now we have just our local repository on our computer.
- Now we'll share this repository with the rest of the world using GitHub as a “central repository”

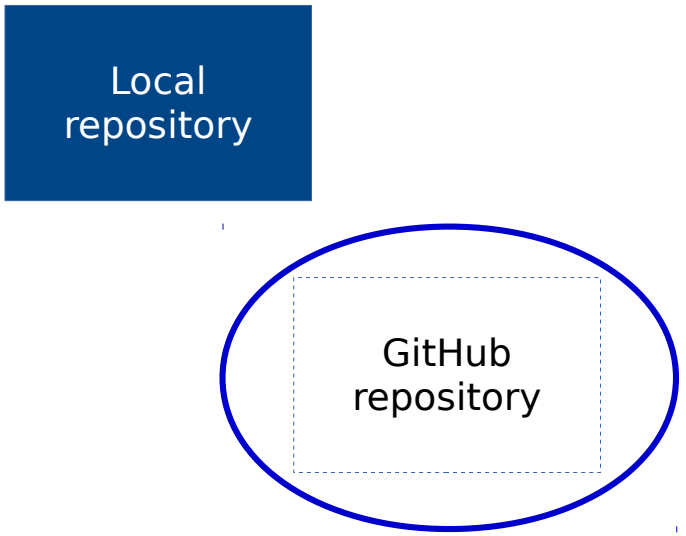
Working with remotes

- All the commands mentioned until now can be used locally, you don't need network or a server
- A remote can be
  - Another local repository
    - `file:///home/user/repo.git`
  - A remote repository (on a server, but also on your friend's computer)
    - `https://github.com/robotology/yarp.git`
    - `ssh://git@github.com:robotology/yarp.git`
    - `git://github.com/robotology/yarp.git`
- Remotes can be read/write or read only

Creating a Git Repository on GitHub

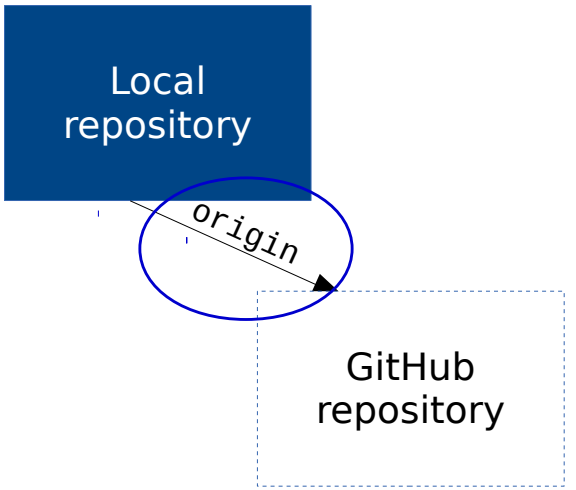


- Get an account if you don't have one
- Log in
- Click on “New repository”
- Follow the instructions
- Congratulations, you just created an empty repository on GitHub



Configure Your Local Repository

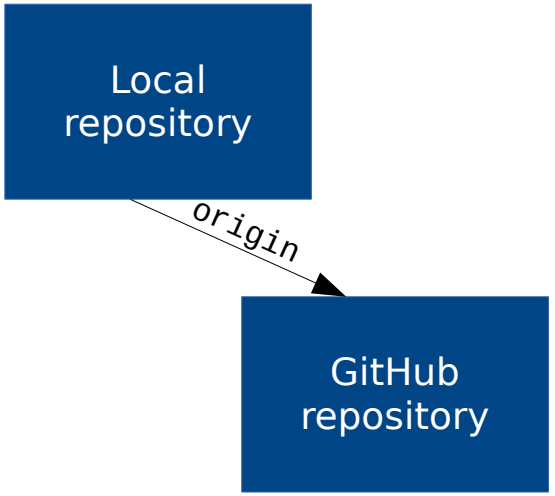
- Our local git repository needs to know that the new “remote” exists
  - `git remote add origin https://github.com/vvv-school/git-training.git`
- Our local git repository now knows “`origin`”.
- This is the name that we assigned to the remote on GitHub, and we can refer to that name from now on.
- The “`origin`” remote is still empty!



Now “Push” our Commits

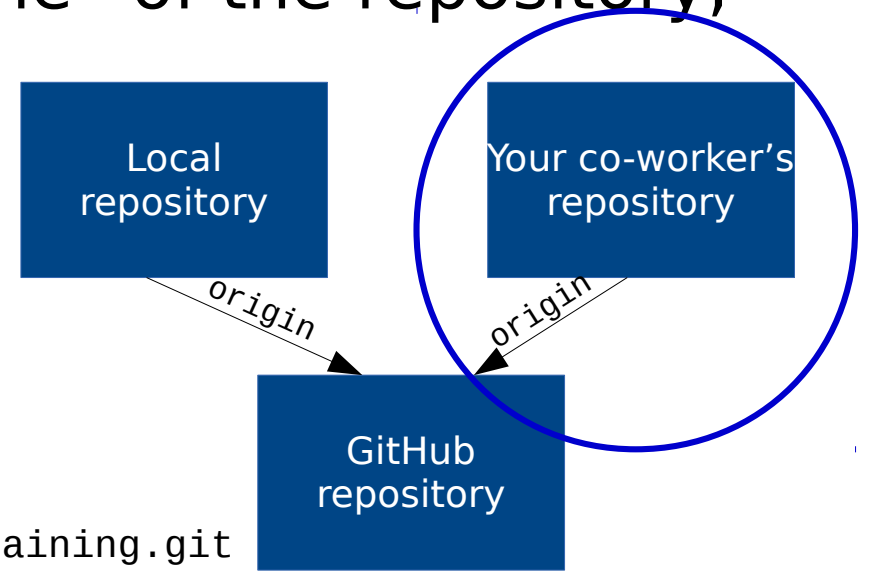
- `git push origin master`

- `origin` is the name of the remote where we want to push our changes.
- `master` is the name of the branch that we want to push.
- The `master` branch on GitHub repository now contains all the commits that we had locally in our local `master` branch.
- Now refresh the page on GitHub and see what happened.
- “`master`” is your local master branch.
- “`origin/master`” is the master branch on the origin remote (it can be different from the local one if you have some commits or if someone else made some commits on the remote)
- The server can reject the push for different reasons.



Let's Do Some Team Work

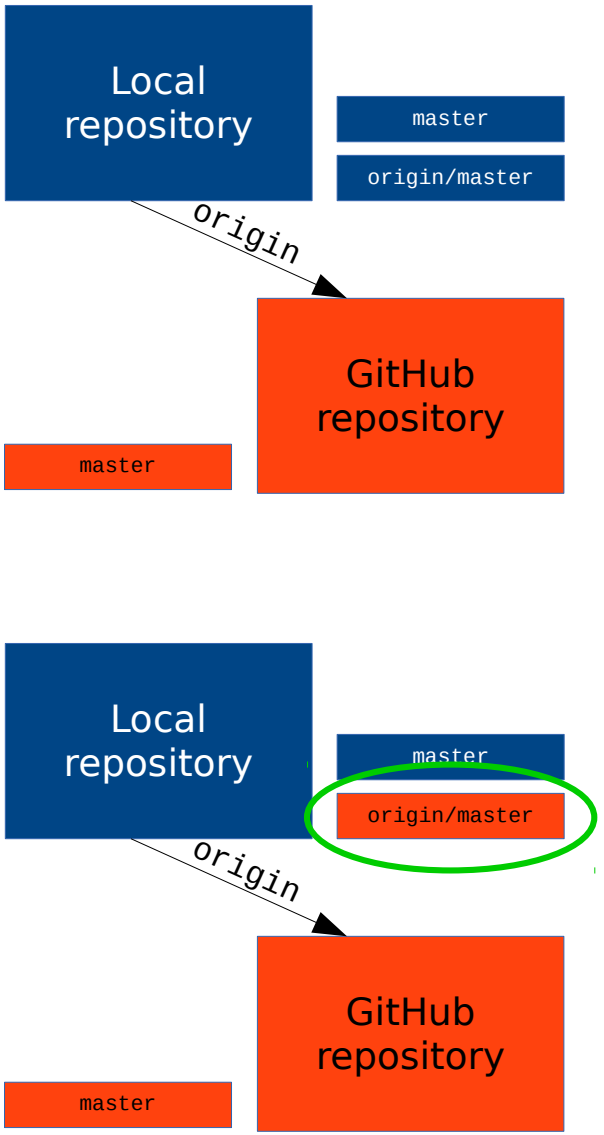
- We are ready to start working in team. Our co-worker wants to grab your files and do some changes
- First of all, he will make a “clone” of the repository, i.e. will download it locally.



- `git clone https://github.com/vvv-school/git-training.git`
- Your co-worker now has a full copy of the repository configured with an “`origin`” remote pointing to the GitHub repository.
- He can now push new commits on this repository.

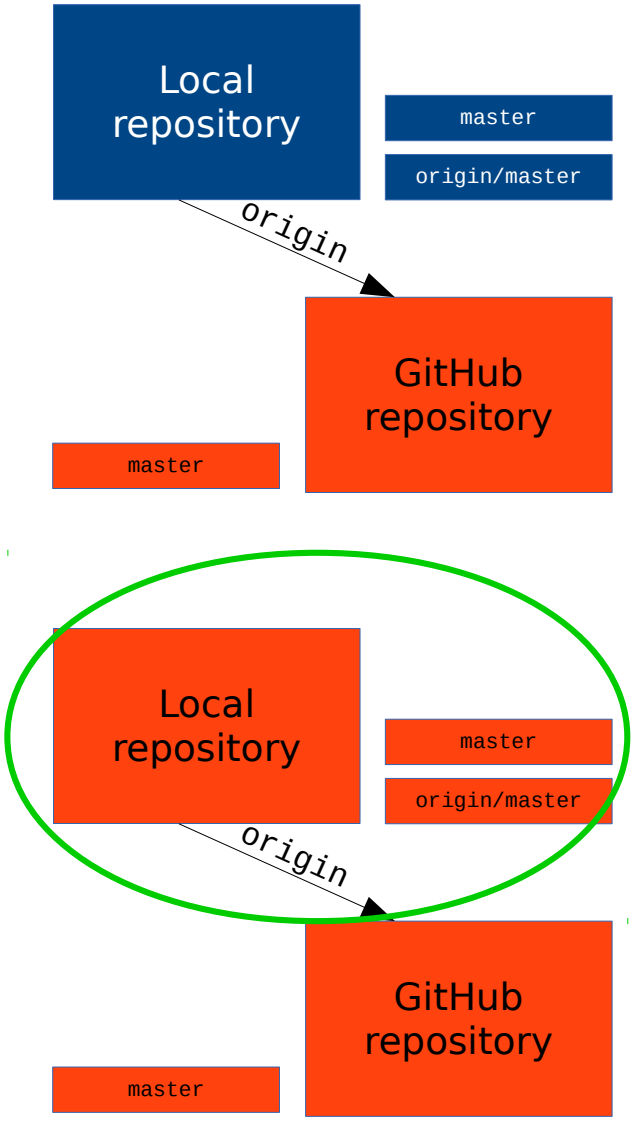
Check Changes on a Remote

- Someone pushed some new commit on the GitHub repository.
- `git fetch origin` (or just `git fetch`)
  - Retrieves all the new objects (commits, branches, tags) in the `origin` remote and saves them in your local repository, but does not apply anything to your working directory.



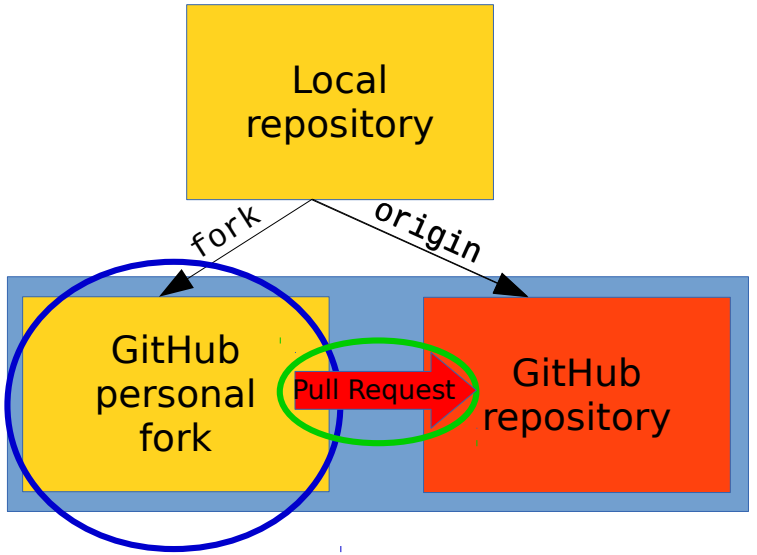
Pull Other People's Changes

- `git pull origin master`
  - Retrieves all the new commits in the `master` branch from the `origin` remote and merge them into your current branch (if you have local commits you get a new local merge commit)
  - Might result in a conflict
- `git pull --rebase origin master`
  - Same as previous command, but does not create an extra merge commit. Instead it rebases your local changes on top of the remote branch. (i.e. applies your local commits on top of `origin/master`)
  - Usually this is the recommended way to do, because the extra merge commits will make the history confused.



Fork & Pull Request on GitHub

- GitHub flow: *https://guides.github.com/introduction/flow*
- **Fork**: copy of a repository that lets you experiment with changes without affecting the original project.
- **Pull Request**: a way to propose to integrate your changes upstream, i.e. in the original project, enabling *code review*.



GOOD PRACTICES

Good Practice 1

- BAD
  - **`git commit -a -m “Fix bug”`**
  - **`git pull`**
  - **`git push origin master`**

- GOOD
  - **`git add`** `<file>` (even better stage the changes one by one using `git add -p <file>`)
  - **`git diff --cached`** (always check what you are pushing)
  - **`git commit`** (enter a proper commit log)
  - **`git pull --rebase origin master`** (rebase your changes over the remote branch instead of creating an useless merge commit)

Now that you are finally really sure about what you are pushing on the server

- **`git push origin master`**

Good Practice 2

- BAD
  - `git commit -a -m “Fix bug”`
- GOOD
  - `git commit`
    (enter a proper commit log in the editor)

```
Summarize changes in around 50 characters or less

More detailed explanatory text, if necessary. Wrap it to about 72
characters or so. In some contexts, the first line is treated as the
subject of the commit and the rest of the text as the body. The
blank line separating the summary from the body is critical (unless
you omit the body entirely); various tools like `log`, `shortlog`
and `rebase` can get confused if you run the two together.

Explain the problem that this commit is solving. Focus on why you
are making this change as opposed to how (the code explains that).
Are there side effects or other unintuitive consequences of this
change? Here's the place to explain them.

Further paragraphs come after blank lines.

 - Bullet points are okay, too

 - Typically a hyphen or asterisk is used for the bullet, preceded
   by a single space, with blank lines in between, but conventions
   vary here

If you use an issue tracker, put references to them at the bottom,
like this:

Resolves: #123
See also: #456, #789
```

http://chris.beams.io/posts/git-commit/

Good practices 3: Work in branches

- Create a branch for each bug you start fixing, or for each new feature you start to work on
- Switching branch with git is very easy and fast
- Merge into master only when you are ready, and you are sure that you will not break the build
- `master` should be always in a stable and releasable state.

Good practices 4: Let someone else review your code

- Nobody writes bug-free code and knows all the best practices for writing code. Having someone else review your code helps reducing them.
- YARP and iCub use GitHub as main repository. GitHub has “pull requests”. If you are writing a non-trivial feature, push you commits in a branch on your private fork and open a “pull request” to ask to someone else to review your code
- Other projects use other web based tools (GitLab, Gerrit, Reviewboard, Phabricator) or a hierarchical access to repositories.

Good practices 5: Never rewrite published history

- There are very few reasons why published history should be rewritten. Some projects enforce fast forward commits only.

- Never `push --force` on a public repository.
- Never ever `push --force` on a public repository.
- If your push fails, and you are tempted to `push --force`, you are doing it wrong. `pull` or `rebase`, and try again.

Interactive Tutorials & Cheat Sheets

- You should try them, even if you already know how to use git, they can teach you some new tricks.

- `try.github.io`
- `learnGitBranching.js.org`
- `education.github.com/git-cheat-sheet-education.pdf`
- `ndpsoftware.com/git-cheatsheet.html`