

# Introduction to GIT

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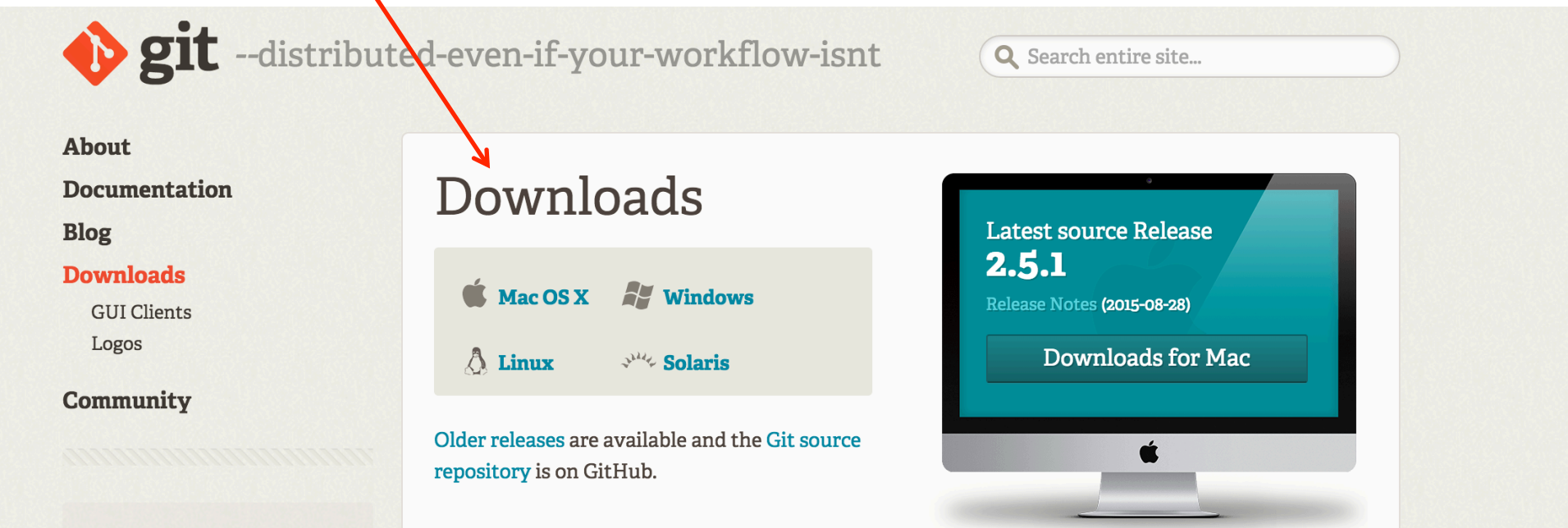
Credits: Jeffrey Leek - Johns Bloomberg School of Public Health



**POLITECNICO**  
MILANO 1863

# First of all...

- Download git from: <http://git-scm.com/downloads>

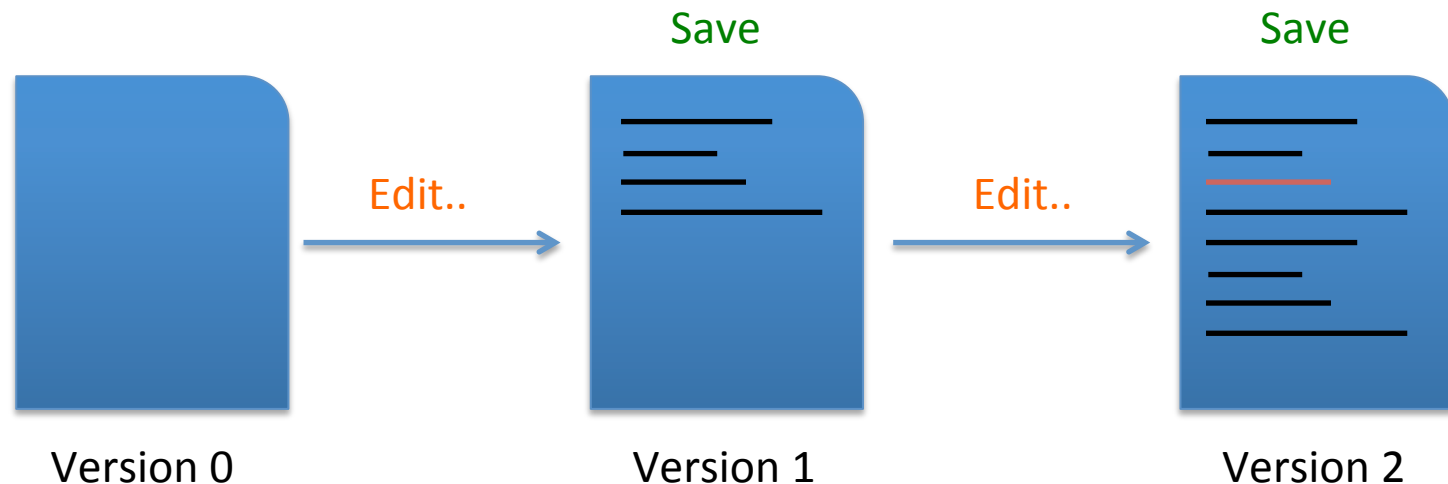


- These slides are available at:  
<https://github.com/marcorabo/brief-git-course.git>

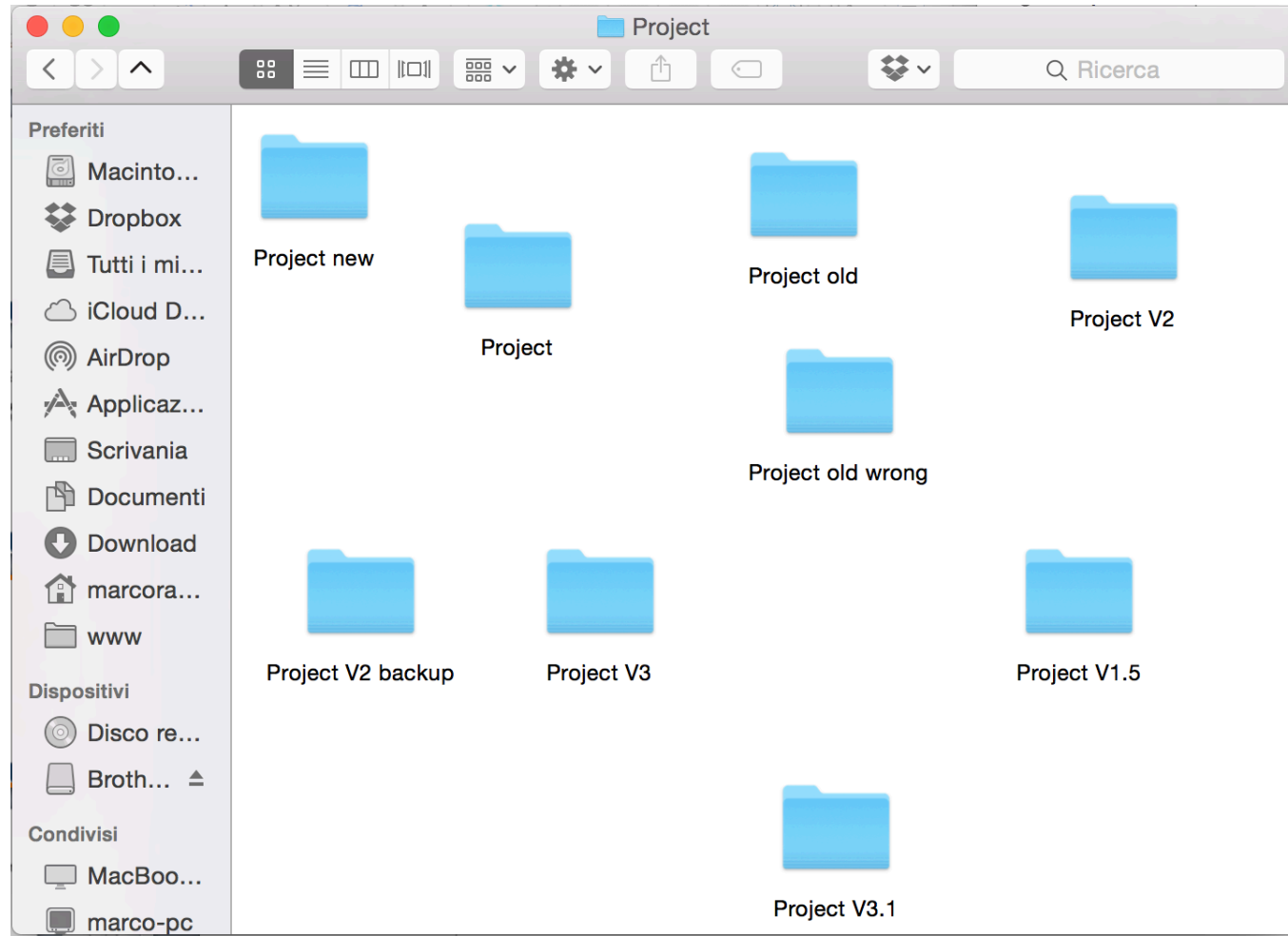


# What is a Version Control System?

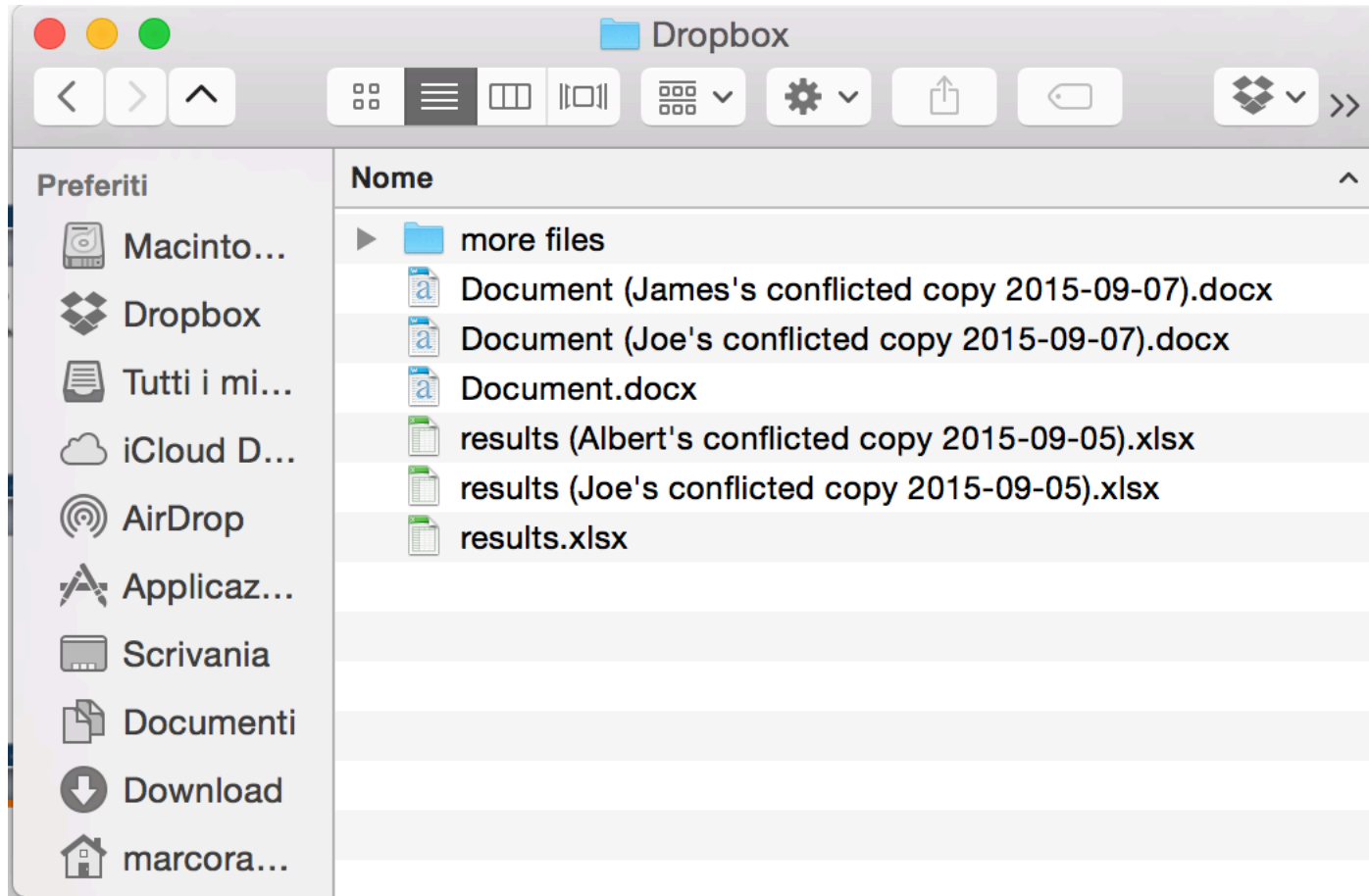
- A Version Control System (VCS) is a software that records changes to a set of files over time so that you can recall specific versions later



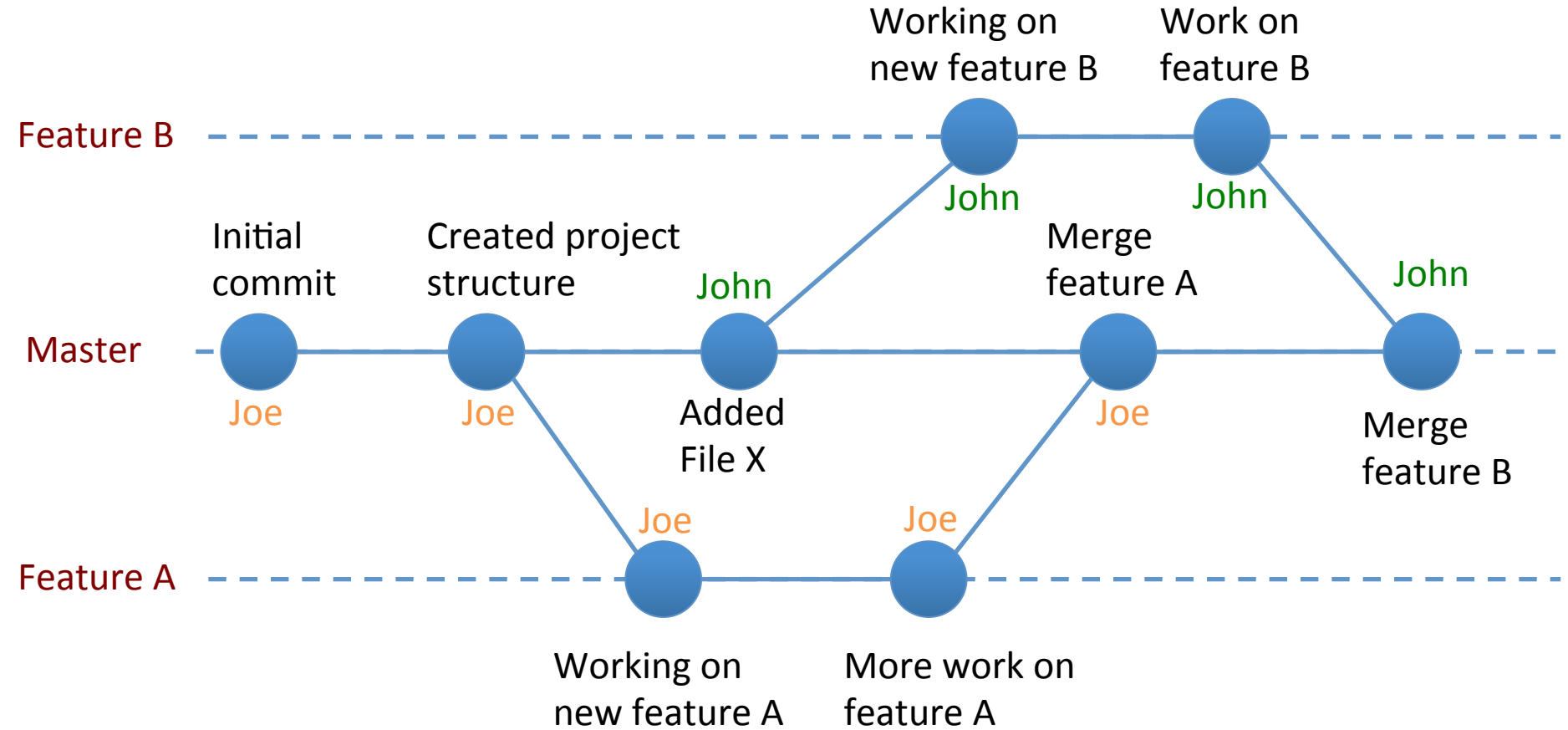
# Why you need a VCS?



# Why you need a VCS?



# Version Control System



# Version Control System

- Allows multiple users to collaborate on a project
- Keeps track of changes made by different users over time
- Example of VCS:
  - GIT
  - SVN
  - Mercurial



# What is GIT?



<http://git-scm.com>

“Git is a free and open source distributed version control system designed to handle everything from small to very large projects with speed and efficiency”





# About GIT

- Created by the same people who developed Linux
- The most popular implementation of version control today
- Everything is stored in local repositories on your computer
- Operated from the command line

<http://git-scm.com/book/en/v2/Getting-Started-A-Short-History-of-Git>



# When to use GIT

- GIT is powerful at versioning text files:
  - C
  - C++
  - MATLAB
  - Latex
  - HTML
  - ...
- Usage scenarios:
  - **Single user:** keep track of the file changes for your own project
  - **Multiple users:** allow a team to share its work for a project
  - **Open source:** allow the world to propose fixes and new features to a project



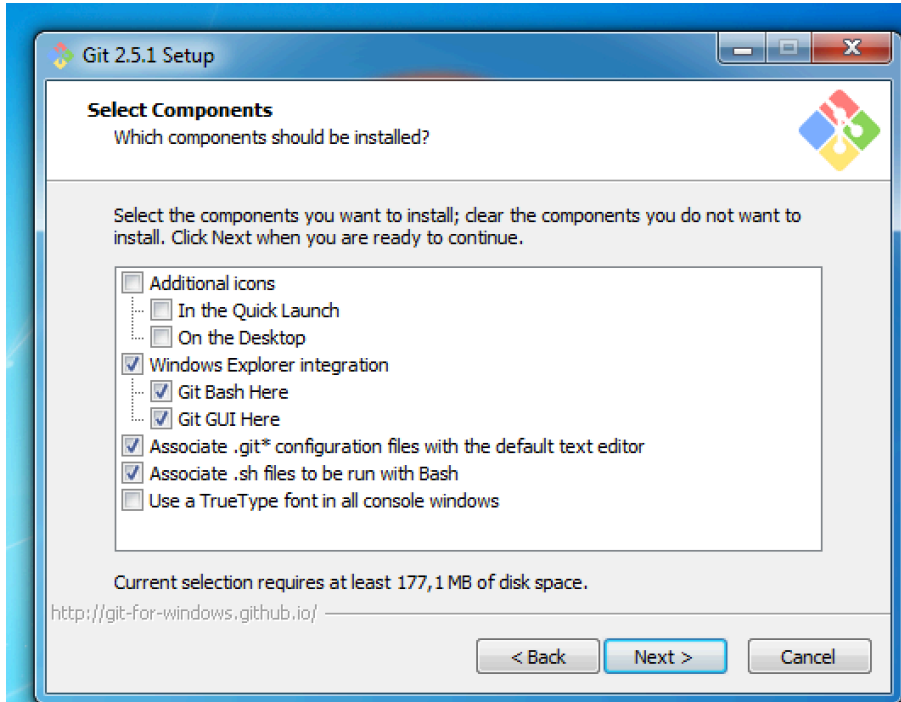
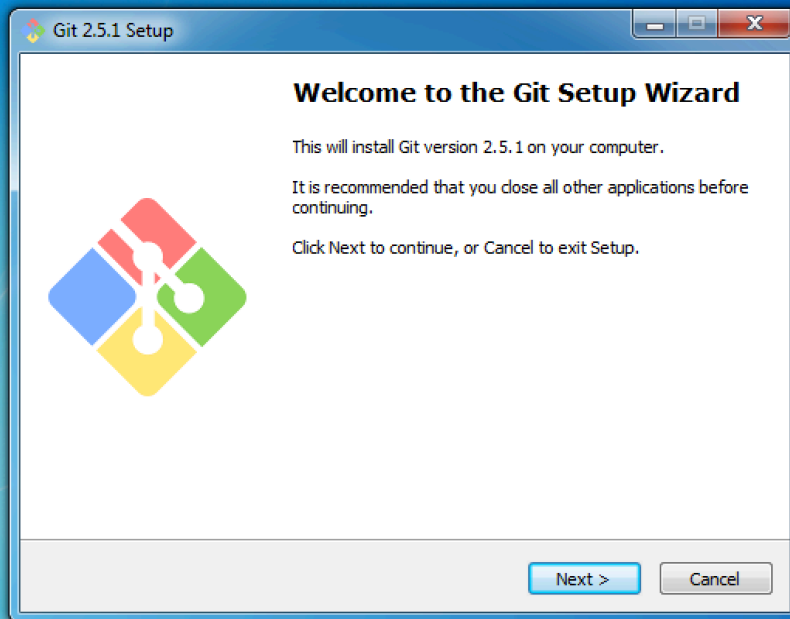
# Getting Started!

- Download git from: <http://git-scm.com/downloads>



# Setup GIT

Leave all the parameters to their default values



(Note: Screenshots for Windows users)



# Verify your setup

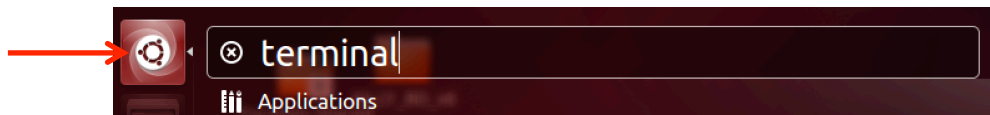
- Open the Command Line Interface (CLI)
  - Windows: search “Git Bash” from the Start Menu



- Mac OS X: search “terminal” from spotlight search

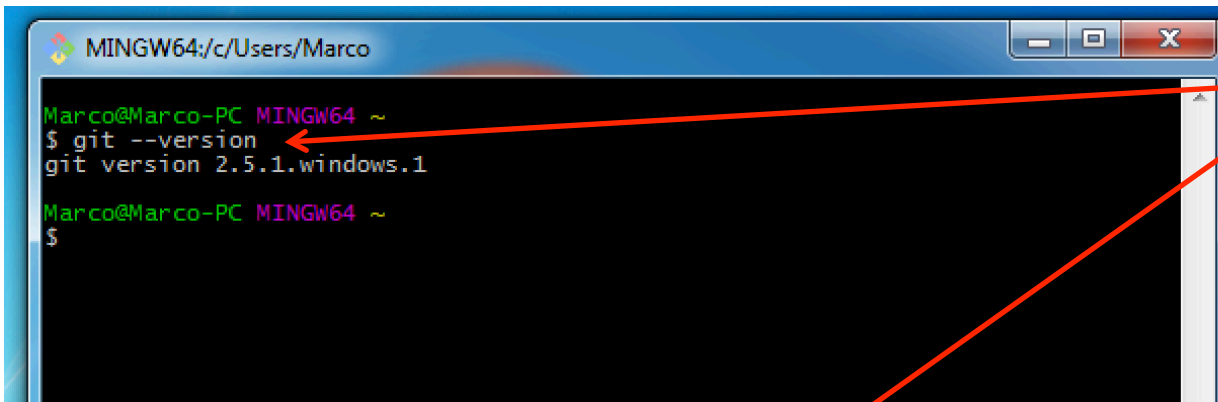


- Linux (Ubuntu): search “terminal” from dash



# Verify your setup

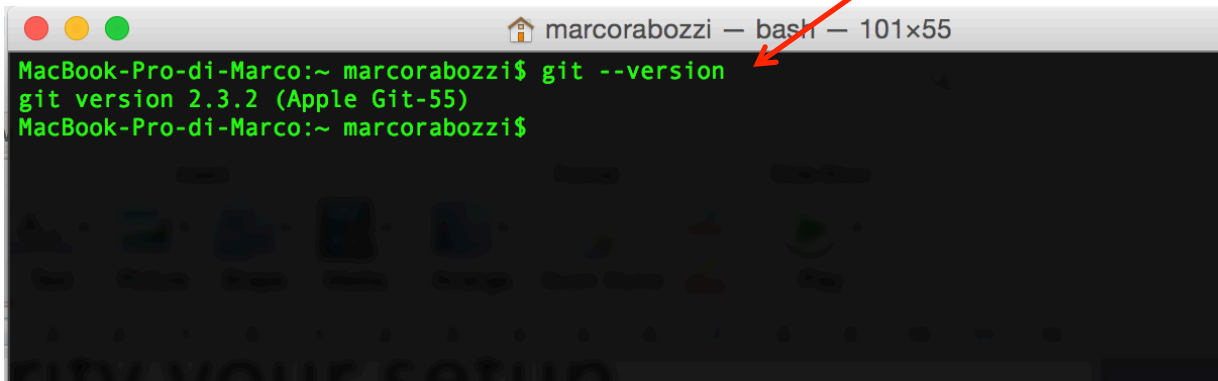
- Check from the CLI that GIT is installed



```
MINGW64; c/Users/Marco
Marco@Marco-PC MINGW64 ~
$ git --version
git version 2.5.1.windows.1
Marco@Marco-PC MINGW64 ~
$
```

Run the command:  
`git --version`

The installed version of  
GIT should be printed



```
marcorabozzi - bash - 101x55
MacBook-Pro-di-Marco:~ marcorabozzi$ git --version
git version 2.3.2 (Apple Git-55)
MacBook-Pro-di-Marco:~ marcorabozzi$
```



# Command line interface (CLI)

- Useful commands
  - pwd
  - cd
  - ls
  - touch
  - mkdir
  - cp
  - rm
  - mv
- Useful tools:
  - vim



# CLI – navigate folders

```
MINGW64:/c/Users/Marco  
  
Marco@Marco-PC MINGW64 ~  
$ pwd  
/c/Users/Marco  
  
Marco@Marco-PC MINGW64 ~  
$ cd Music/  
  
Marco@Marco-PC MINGW64 ~/Music  
$ pwd  
/c/Users/Marco/Music  
  
Marco@Marco-PC MINGW64 ~/Music  
$ ls  
Verdi/  Vivaldi/  
  
Marco@Marco-PC MINGW64 ~/Music  
$ cd Verdi/  
  
Marco@Marco-PC MINGW64 ~/Music/Verdi  
$ pwd  
/c/Users/Marco/Music/Verdi  
  
Marco@Marco-PC MINGW64 ~/Music/Verdi  
$ cd ..  
  
Marco@Marco-PC MINGW64 ~/Music  
$ pwd  
/c/Users/Marco/Music  
  
Marco@Marco-PC MINGW64 ~/Music  
$ cd  
  
Marco@Marco-PC MINGW64 ~  
$ pwd  
/c/Users/Marco
```

Print current directory

Move to folder “Music”

List files/folder in  
current directory

Move to folder “Verdi”

Go UP one level  
(Move to parent folder)

Go to home directory





# CLI – list files

```
MINGW64:/c/Users/Marco/Music

Marco@Marco-PC MINGW64 ~/Music
$ ls
Verdi/  Vivaldi/

Marco@Marco-PC MINGW64 ~/Music
$ ls -a
./  ../  .hidden_file  Verdi/  Vivaldi/

Marco@Marco-PC MINGW64 ~/Music
$ ls -l
total 0
drwxr-xr-x 1 Marco None 0 set  8 00:34 Verdi/
drwxr-xr-x 1 Marco None 0 set  8 00:34 Vivaldi/

Marco@Marco-PC MINGW64 ~/Music
$ ls -la
total 21
drwxr-xr-x 1 Marco None 0 set  8 00:39 ./
drwxr-xr-x 1 Marco None 0 set  8 00:39 ../
-rw-r--r-- 1 Marco None 6 set  8 00:39 .hidden_file
drwxr-xr-x 1 Marco None 0 set  8 00:34 Verdi/
drwxr-xr-x 1 Marco None 0 set  8 00:34 Vivaldi/
```

List files/folders in current directory

List all files/folders including hidden files

List files/folders providing more details

List all files/folder with details including hidden files

NOTE: `ls -la == ls -al`



# CLI – create/delete files and folders

```
MINGW64:/c/Users/Marco/Documents/Test

Marco@Marco-PC MINGW64 ~/Documents/Test
$ ls
file1 file2 folder1/

Marco@Marco-PC MINGW64 ~/Documents/Test
$ mkdir myFolder

Marco@Marco-PC MINGW64 ~/Documents/Test
$ ls
file1 file2 folder1/ myFolder/

Marco@Marco-PC MINGW64 ~/Documents/Test
$ touch TODO.txt

Marco@Marco-PC MINGW64 ~/Documents/Test
$ ls
file1 file2 folder1/ myFolder/ TODO.txt

Marco@Marco-PC MINGW64 ~/Documents/Test
$ rm TODO.txt

Marco@Marco-PC MINGW64 ~/Documents/Test
$ ls
file1 file2 folder1/ myFolder/

Marco@Marco-PC MINGW64 ~/Documents/Test
$ rm -r myFolder

Marco@Marco-PC MINGW64 ~/Documents/Test
$ ls
file1 file2 folder1/
```

Create folder “myFolder”  
in current directory

Create file “TODO.txt” in  
current directory

Remove file “TODO.txt”

Remove folder “myFolder”

**BE CAREFUL** There is no undo for rm!



# CLI – copy/move files and folders

```
Marco@Marco-PC MINGW64 ~/Documents/Test
$ ls
file1 file2 folder1/

Marco@Marco-PC MINGW64 ~/Documents/Test
$ cp file1 file1_copy

Marco@Marco-PC MINGW64 ~/Documents/Test
$ ls
file1 file1_copy file2 folder1/

Marco@Marco-PC MINGW64 ~/Documents/Test
$ cp -r folder1 folder1_copy

Marco@Marco-PC MINGW64 ~/Documents/Test
$ ls
file1 file1_copy file2 folder1/ folder1_copy/

Marco@Marco-PC MINGW64 ~/Documents/Test
$ mv file1_copy test1

Marco@Marco-PC MINGW64 ~/Documents/Test
$ ls
file1 file2 folder1/ folder1_copy/ test1

Marco@Marco-PC MINGW64 ~/Documents/Test
$ mv folder1_copy temp

Marco@Marco-PC MINGW64 ~/Documents/Test
$ ls
file1 file2 folder1/ temp/ test1

Marco@Marco-PC MINGW64 ~/Documents/Test
$ mv test1 temp/

Marco@Marco-PC MINGW64 ~/Documents/Test
$ ls
file1 file2 folder1/ temp/
```

Make a copy of “file1”  
called “file1\_copy”

Make a copy of “folder1”  
called “folder1\_copy”

Rename “file1\_copy” to  
“test1”

Rename “folder1\_copy” to  
“temp”

Move file “test1” in folder  
“temp”



# VIM text editor

```
Marco@Marco-PC MINGW64 ~/Documents/Test
$ ls
file1 file2 folder1/
Marco@Marco-PC MINGW64 ~/Documents/Test
$ vim file1
```

vim <file>  
(enter vim)

“:wq” (quit and save changes)  
“:q!” (quit without saving)

```
file content
text text text...
~
~
~
~
~
~
~
~
~/Documents/Test/file1 [unix] (02:19 08/09/2015)
```

Normal mode

“i”  
ESC

```
file content
text text text...
~
~
~
~
~
~
~
~
~/Documents/Test/file1 [unix] (02:19 08/09/2015)
-- INSERT --
```

Insert mode



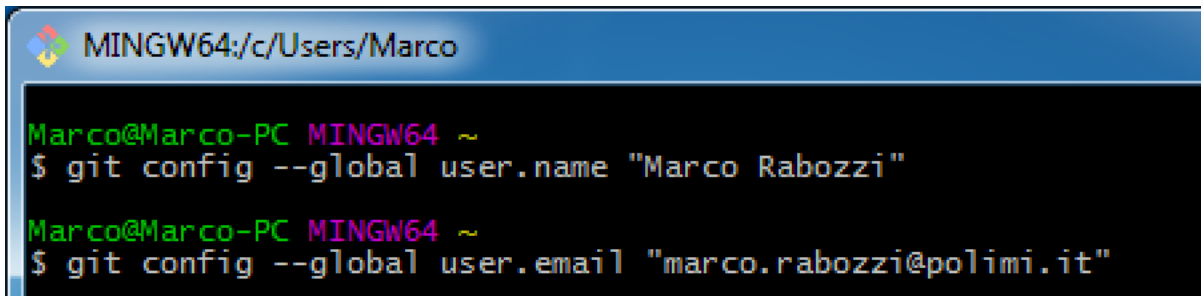
# CLI - recap

- Useful commands
  - `pwd` Print current working directory
  - `cd` Change directory
  - `ls` List files and folders
  - `touch` Create a file
  - `mkdir` Create a folder
  - `cp` Copy file/folder
  - `rm` Remove file/folder
  - `mv` Move file/folder (e.g.: cat and paste)
- Useful tools:
  - `vim` Open a text editor



# GIT configuration

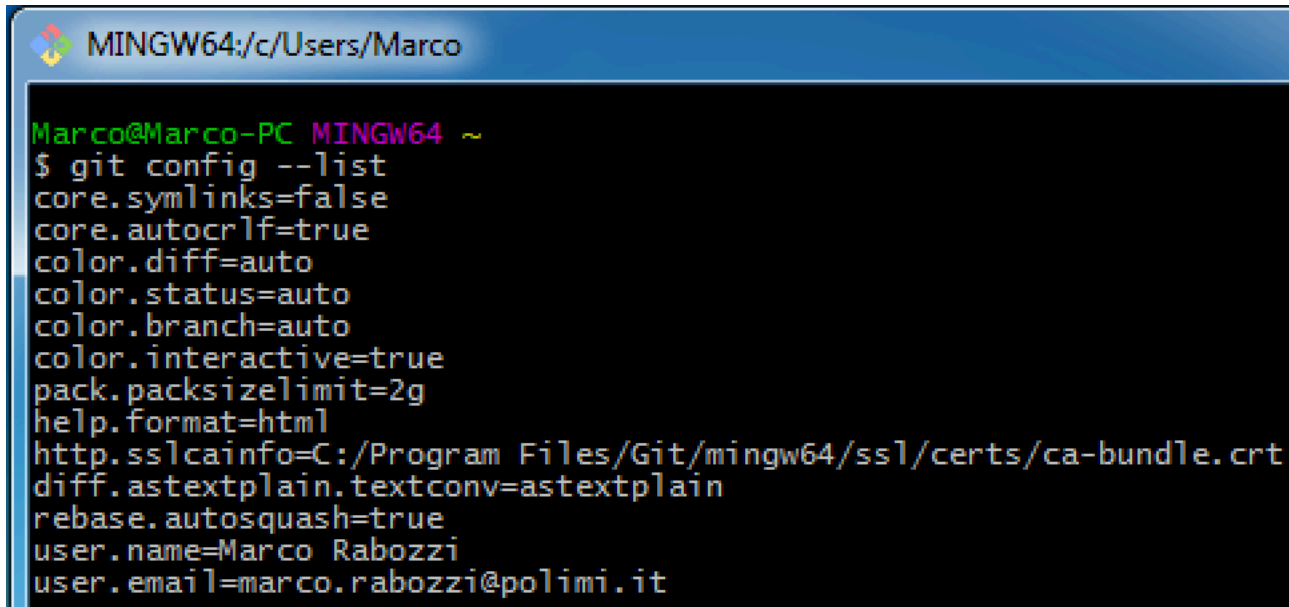
- Each commit to a Git repository will be “tagged” with the name of the person who made the commit
- The following commands set your name and email:



```
MINGW64:/c/Users/Marco  
  
Marco@Marco-PC MINGW64 ~  
$ git config --global user.name "Marco Rabozzi"  
  
Marco@Marco-PC MINGW64 ~  
$ git config --global user.email "marco.rabozzi@polimi.it"
```

# GIT configuration

- Run the command `git config --list` to see your current configuration:



```
MINGW64:/c/Users/Marco

Marco@Marco-PC MINGW64 ~
$ git config --list
core.symlinks=false
core.autocrlf=true
color.diff=auto
color.status=auto
color.branch=auto
color.interactive=true
pack.packsizelimit=2g
help.format=html
http.sslcainfo=C:/Program Files/Git/mingw64/ssl/certs/ca-bundle.crt
diff.astextplain.textconv=astextplain
rebase.autosquash=true
user.name=Marco Rabozzi
user.email=marco.rabozzi@polimi.it
```

# Create a project

- In order to start using GIT, we first need a folder to store our project:

```
Marco@Marco-PC MINGW64 ~  
$ mkdir MyProject
```

- To initialize a GIT **repository** for your project, enter the project folder and run `git init`

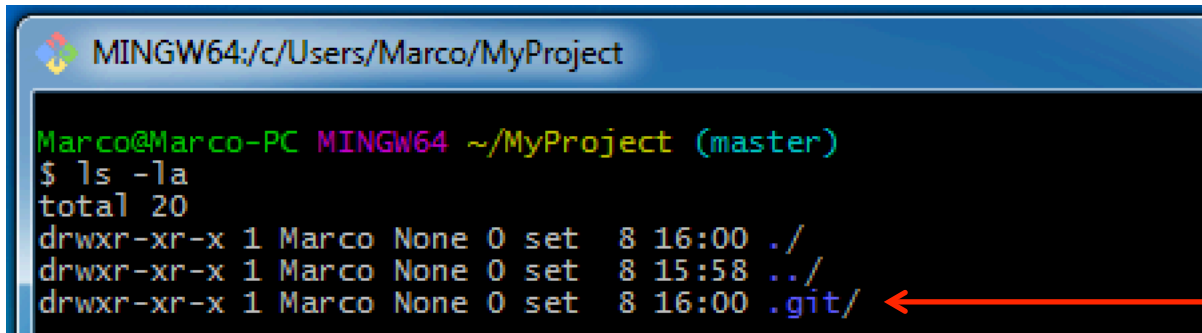
```
Marco@Marco-PC MINGW64 ~  
$ cd MyProject/  
  
Marco@Marco-PC MINGW64 ~/MyProject  
$ git init  
Initialized empty Git repository in C:/Users/Marco/MyProject/.git/  
  
Marco@Marco-PC MINGW64 ~/MyProject (master)  
$ |
```





# Create a project

- The repository is contained within the hidden folder “.git” in your project directory:

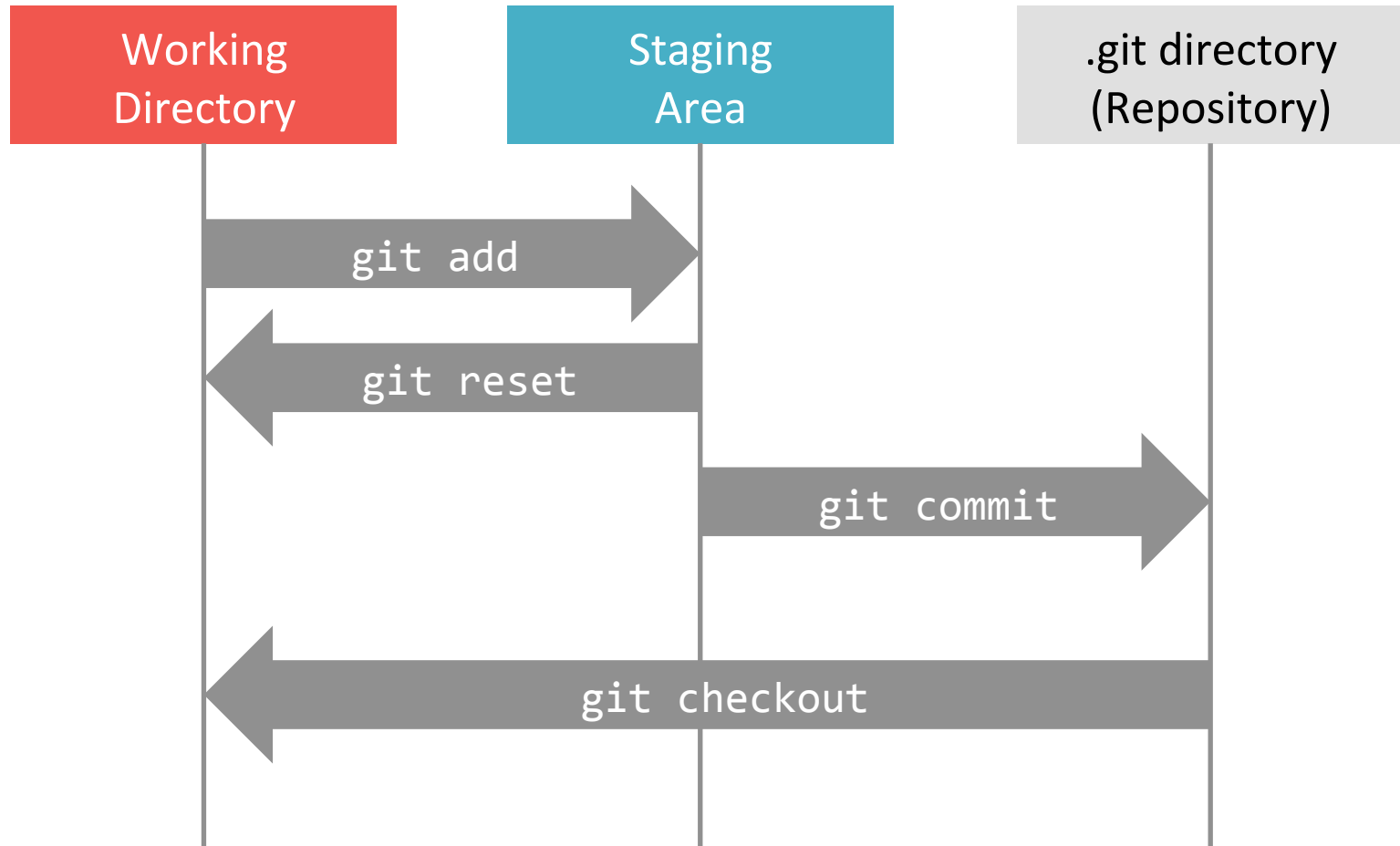
A screenshot of a Windows command prompt window titled "MINGW64:/c/Users/Marco/MyProject". The prompt shows the user "Marco@Marco-PC" in the "MINGW64" environment at the directory "~/MyProject" on the "(master)" branch. The user has entered the command "ls -la", and the output shows the directory contents: "total 20", "drwxr-xr-x 1 Marco None 0 set 8 16:00 ./", "drwxr-xr-x 1 Marco None 0 set 8 15:58 ../", and "drwxr-xr-x 1 Marco None 0 set 8 16:00 .git/". A red arrow points to the ".git/" entry in the output.

```
MINGW64:/c/Users/Marco/MyProject

Marco@Marco-PC MINGW64 ~/MyProject (master)
$ ls -la
total 20
drwxr-xr-x 1 Marco None 0 set 8 16:00 ./
drwxr-xr-x 1 Marco None 0 set 8 15:58 ../
drwxr-xr-x 1 Marco None 0 set 8 16:00 .git/
```

- This folder is used by GIT to manage your repo, it should not be modified manually

# How GIT works (locally)



# Towards the first commit

- Run: `git status`  
to show the current status of your repo  
(i.e.: what changed in your project since the last commit)

```
Marco@Marco-PC MINGW64 ~/MyProject (master)
$ git status
On branch master

Initial commit

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

→ Nothing has changed

# Towards the first commit

- Create a file in your project, you can create/edit the file with the editor of your choice (VIM, notepad, sublime, ...)

```
Marco@Marco-PC MINGW64 ~/MyProject (master)
$ touch contributors.txt

Marco@Marco-PC MINGW64 ~/MyProject (master)
$ ls
contributors.txt
```

- Check the status of your repo:

```
Marco@Marco-PC MINGW64 ~/MyProject (master)
$ git status
On branch master

Initial commit

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

        contributors.txt

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



# Adding files

- Use the command `git add <file>` to add the desired files to the staging area

```
Marco@Marco-PC MINGW64 ~/MyProject (master)
$ git add contributors.txt
```

- Check the status of your repo:

```
Marco@Marco-PC MINGW64 ~/MyProject (master)
$ git status
On branch master

Initial commit

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

    new file:   contributors.txt
```

- NOTE: `git add` can be undone using `git reset`



# The first commit

- The file “contributors.txt” is now in the staging area but has not been committed yet to the repo
- To commit the files in the staging area use:
  - `git commit -m “your commit message”`

```
MINGW64:/c/Users/Marco/MyProject

Marco@Marco-PC MINGW64 ~/MyProject (master)
$ git commit -m "added contributors.txt"
[master (root-commit) c227f58] added contributors.txt
1 file changed, 0 insertions(+), 0 deletions(-)
create mode 100644 contributors.txt
```



# Verify the status of your repo

– git status

```
Marco@Marco-PC MINGW64 ~/MyProject (master)
$ git status
On branch master
nothing to commit, working directory clean
```

– git log (shows the commit history of your repo)

```
Marco@Marco-PC MINGW64 ~/MyProject (master)
$ git log
commit c227f58eda5e1e2be19405b5ccb0ddcef0ca2e0e
Author: Marco Rabozzi <marco.rabozzi@polimi.it>
Date: Tue Sep 8 17:15:12 2015 +0200

    added contributors.txt
```

Commit ID

Message assigned  
to the commit



# GIT history

- Assume that after a few commits `git log --graph` returns:

```
Marco@Marco-PC MINGW64 ~/MyProject (master)
$ git log --graph
* commit 7da1f0e03bf68794db6f4716d7acc6c2c843fe8d
  Author: Marco Rabozzi <marco.rabozzi@polimi.it>
  Date:   Tue Sep 8 19:14:34 2015 +0200

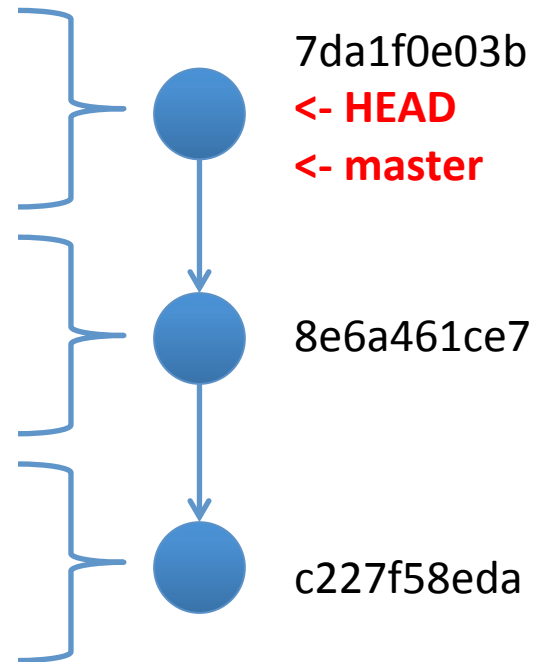
    Added more contributors

* commit 8e6a461ce749bcfad38e2c95c43000ad5dcd4c56
  Author: Marco Rabozzi <marco.rabozzi@polimi.it>
  Date:   Tue Sep 8 19:13:21 2015 +0200

    added Marco Rabozzi to contributors

* commit c227f58eda5e1e2be19405b5ccb0ddcef0ca2e0e
  Author: Marco Rabozzi <marco.rabozzi@polimi.it>
  Date:   Tue Sep 8 17:15:12 2015 +0200

    added contributors.txt
```



- Commits can be identified by the first 10 characters of their ID
- **HEAD** is a pointer to the current commit
- **master** is a pointer to the last commit of the branch “master”





# Checkout a previous commit

- If your working directory is clean you can revert using `git checkout <commit_id>`:

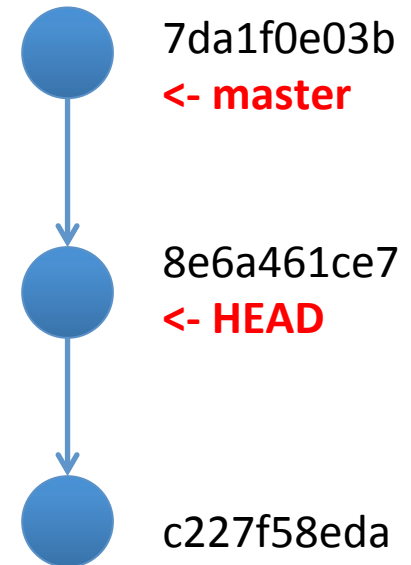
```
Marco@Marco-PC MINGW64 ~/MyProject (master)
$ git checkout 8e6a461ce7
Note: checking out '8e6a461ce7'.

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 8e6a461... added Marco Rabozzi to contributors
```



- The working directory will show the content of the files as they were at the specified commit

# Checkout a previous commit

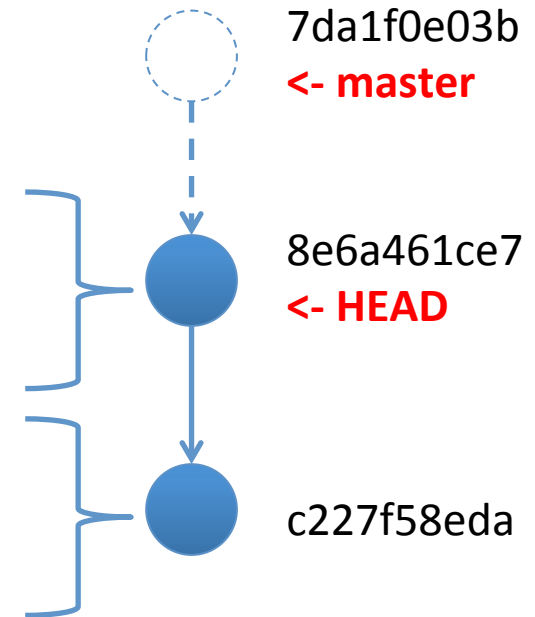
- Running `git log --graph` now shows:

```
Marco@Marco-PC MINGW64 ~/MyProject ((8e6a461...))
$ git log --graph
* commit 8e6a461ce749bcfad38e2c95c43000ad5dcd4c56
  Author: Marco Rabozzi <marco.rabozzi@polimi.it>
  Date:   Tue Sep 8 19:13:21 2015 +0200

      added Marco Rabozzi to contributors

* commit c227f58eda5e1e2be19405b5ccb0ddcef0ca2e0e
  Author: Marco Rabozzi <marco.rabozzi@polimi.it>
  Date:   Tue Sep 8 17:15:12 2015 +0200

      added contributors.txt
```



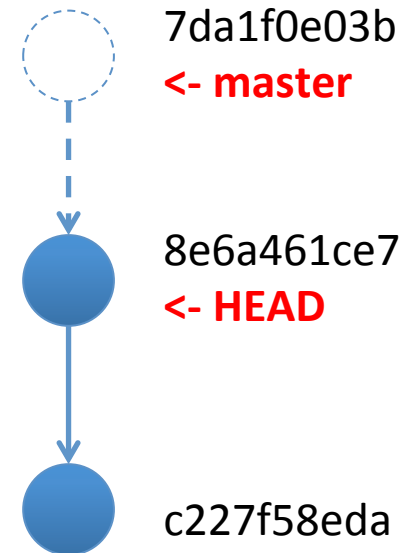
# Checkout a previous commit

- Running `git status` shows:

```
MINGW64:/c/Users/Marco/MyProject

Marco@Marco-PC MINGW64 ~/MyProject ((8e6a461...))
$ git status
HEAD detached at 8e6a461
nothing to commit, working directory clean
```

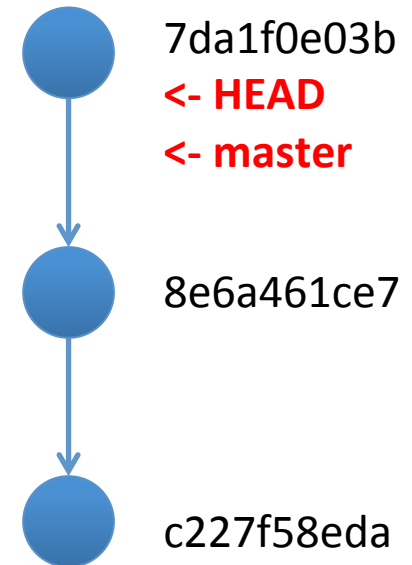
HEAD is not pointing to any referenced commit (e.g. "master")



# Return to the last commit

- To go to the last commit of a branch run:  
`git checkout <branch_name>`

```
Marco@Marco-PC MINGW64 ~/MyProject ((8e6a461...))
$ git checkout master
Previous HEAD position was 8e6a461... added Marco Rabozzi to
contributors
Switched to branch 'master'
```



# How to check last changes

- To show what are the changes not committed yet run:
  - `git diff HEAD`
- To show what are the changes not committed yet for a specific file run:
  - `git diff HEAD -- <file>`



# How to undo things

- To remove a file from the staging (i.e. undo a git add <file>) run:
  - `git reset <file>`
- If you want to discard the changes made to a file since the last commit (or since the last add) run:
  - `git checkout -- <file>`

**WARNING! If undo changes that are not committed yet, these are lost and cannot be recovered**



# GIT introduction recap

- `git --version`
- `git config --global user.name`
- `git config --global user.email`
- `git config --list`
- `git init`
- `git status`
- `git add <file>`
- `git reset <file>`
- `git commit -m "<message>"`
- `git log`
- `git log --graph`
- `git checkout <commit_id>`
- `git checkout <branch_name>`
- `git checkout -- <file>`
- `git diff HEAD`
- `git diff HEAD -- <file>`



# Useful links

- Git Book:
  - <http://git-scm.com/doc>
- Git Tutorial:
  - <https://www.atlassian.com/git/tutorials/>
- Video lectures (check course Week 2):
  - <https://class.coursera.org/datascitoolbox-032/lecture>

