

# GIT - advanced tutorial

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## Contents

<b>1</b>	<b>Preamble</b>	<b>2</b>
1.1	Checking your <code>git</code> configuration . . . . .	2
1.2	Setup . . . . .	2
<b>2</b>	<b>Toying with git and some of its concepts and tools</b>	<b>2</b>
2.1	Introduction . . . . .	2
2.2	Detached HEAD, Remote-Tracking Branches and Upstreams . . . . .	3
2.3	Patching and Cherry-Picking . . . . .	5
2.4	Bisect, Stash and "Partial Commits" . . . . .	6
<b>3</b>	<b>Rewriting and correcting your history</b>	<b>9</b>
3.1	Introduction . . . . .	9
3.2	Amend and rebase -i – an appetizer . . . . .	9
3.3	Rewrite history – difficult stuff . . . . .	12
3.4	History and undoing . . . . .	13
3.4.1	First use case . . . . .	14
3.4.2	Second use case . . . . .	14
3.5	Cleaning up your mess before pushing . . . . .	15
<b>4</b>	<b>Git and Pull-Request contributions</b>	<b>15</b>
4.1	Introduction . . . . .	15
4.2	Pull request mode . . . . .	16
4.3	Patch mode . . . . .	16
<b>5</b>	<b>Conclusion</b>	<b>17</b>
<b>A</b>	<b>One Solution for rewriting history</b>	<b>17</b>

# 1 Preamble

## 1.1 Checking your git configuration

Before using **git**, check that your **git** configuration is set correctly (at least you should have told **git** your committer name and email address).

```
$ git config -l
```

## 1.2 Setup

For this practical work, you will need :

- to retrieve **git** repository from [github.com](https://github.com)
- to retrieve archive files from <https://sed.inrialpes.fr/advancedgit-tuto/> Web page, when needed.
- and eventually a GitHub account: see <http://github.com> Web site.

# 2 Toying with git and some of its concepts and tools

## 2.1 Introduction

The aim of this section is double:

- To experiment various tools from **git** such as patches, cherry picking, stash and bisect
- To better grasp the concepts of **DETACHED** head, remote-tracking branches and upstream branches

For this section you need to retrieve (clone) a public project on **GitHub**, following these instructions:

```
$ # Create system aliases for git and gitk
$ alias g=git
$ alias gk="gitk --all"
$ # Clone project
$ g clone https://github.com/david-parsons/tpgitsedra-completed.git git-adv-section1
$ cd git-adv-section1
$ # Look around
$ gk&
```

You can notice that there is one local branch (master) and 2 remote tracking branches (master and serialization).

Another way of seeing that is by running:

```
$ # Create shorthand for branch
$ g config --global alias.br branch
$ g br -a
* master
  remotes/origin/HEAD -> origin/master
  remotes/origin/master
  remotes/origin/serialization
```

This also tells you that the "default branch" on the remote is 'master'.

## 2.2 Detached HEAD, Remote-Tracking Branches and Upstreams

Since you've just cloned a repository, you "are on" the "default branch" (master). You can convince yourself that's true *e.g.* by launching **gitk** (master is in bold) or with one of the following commands:

```
$ cat .git/HEAD
ref: refs/heads/master
$ # Create shorthand for status
$ g config --global alias.s status
$ g s
On branch master
[...]
```

Let's checkout some other commit:

```
$ # Create shorthand for checkout
$ g config --global alias.co checkout
$ g co 9550
Note: checking out '9550'.

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 9550cf9... Add function loadSphere
```

OK, **git** is pretty clear that we are in 'detached HEAD' state... Let's check how this shows with the same 2 commands we've already tried:

```
$ cat .git/HEAD
9550cf915497227e25a51aff23afb1bf7d18dbc5
$ g s
HEAD detached at 9550cf9
[...]
```

As **git** prompts us, we can "make experimental changes and commit them", let's do that:

```
$ echo "Hi there!" > foo
$ g add foo
$ # Create shorthand for commit
$ g config --global alias.ci commit
$ g ci -m "experimental change"
[detached HEAD 398c0ec] experimental change
[...]
```

```
* (HEAD detached from 9550cf9)
  master
```

Notice (*e.g.* using **gitk**) that you have created a commit, that you are "on" it but no branch references it, even indirectly ?

This is what detached HEAD means. If it remains unreferenced, it will eventually be garbage-collected.

**git** has also suggested us to create a branch:

```
$ g co -b serialization
Switched to a new branch 'serialization'
$ # We now have 2 local branches (and still 2 remote-tracking branches:
$ g br
  master
* serialization
```

We are no longer in 'detached HEAD' state, our commit won't get lost.

Now, if you run **git branch** again, but this time with option **-vv**, you can see that **master** has an upstream, namely **origin/master**, but **serialization** has none:

```
$ g br -vv
  master          e444c1e [origin/master] Merge branch 'use_math_constants'
* serialization  398c0ec experimental change
```

One of the situations where having an upstream branch set is nice, is when you want to push your branch (**git** knows **where** to push to).

Here a **push** will fail unless you tell **git** onto which branch of which remote you want to push your changes:

```
$ g push
fatal: The current branch serialization has no upstream branch.
To push the current branch and set the remote as upstream, use

    git push --set-upstream origin serialization
```

Here, **git** prompts us to set our branch's upstream **while pushing**.

We can also just set the upstream (without pushing) with the following command:

```
$ g branch -u origin/serialization
Branch serialization set up to track remote branch serialization from origin.
$ # Now we have an upstream on both master and serialization:
$ g br -vv
  master          e444c1e [origin/master] Merge branch 'use_math_constants'
* serialization  398c0ec [origin/serialization: ahead 1] experimental change
```

## 2.3 Patching and Cherry-Picking

There are basically 2 ways of creating a patch: using `git diff` or `git format-patch`. Let's do both and compare the results.

```
$ # Create shorthand for diff
$ g config --global alias.d diff
$ g d HEAD~ > exp-change.patch
$ g format-patch HEAD~
0001-experimental-change.patch
$ meld exp-change.patch 0001-experimental-change.patch
```

You can see that the (automatically named) patch generated by `format-patch` contains the exact same information as the other one, plus some additional data (committer, commit date, commit message, ...)

We can now apply each of these patches on 2 dedicated branches:

```
$ g co master -b patching-1
Switched to a new branch 'patching-1'
$ g apply exp-change.patch
$ # Applied the patch but did not commit (nor even stage the changes)
$ g add foo
$ g ci -m "exp-change"
```

```
$ g co master -b patching-2
Switched to a new branch 'patching-2'
$ g am 0001-experimental-change.patch
Applying: experimental change
```

Since the diff-generated patch does not contain any more information than the changeset, `git` can not commit the changes automatically. It lacks the additional information contained by the patch generated by `format-patch`.

`git format-patch` and `git am` also allow you to create and apply series of patches:

```
$ g format-patch -o patches f5d6..serialization
patches/0001-Add-method-dump.patch
patches/0002-Add-function-loadSphere.patch
patches/0003-experimental-change.patch
$ g co master -b patching-3
$ g am patches/*
Applying: Add method dump
Applying: Add function loadSphere
Applying: experimental change
```

Actually, generating a patch from a [series of] commit[s] somewhere in the revision graph to apply it [them] somewhere else is so common that there is a dedicated command for that: `git cherry-pick`

```
$ g co master -b cherry-picking-1
Switched to a new branch 'cherry-picking-1'
$ # Create shorthand for cherry-pick
```

```

$ g config --global alias.cp cherry-pick
$ # Cherry-pick a single commit:
$ g cp serialization
[cherry-picking-1 6958add] experimental change
[...]
$ g co master -b cherry-picking-2
Switched to a new branch 'cherry-picking-2'
$ # Cherry-pick a series of commits:
$ g cp f5d6..serialization
[cherry-picking-2 777bda5] Add method dump
[...]
[cherry-picking-2 59b9706] Add function loadSphere
[...]
[cherry-picking-2 977301c] experimental change
[...]

```

You may have noticed that the commits generated by either `git am` or `git cherry-pick` can have their committer distinct from their author

## 2.4 Bisect, Stash and "Partial Commits"

For this section, we will create a repository from a series of patches.

Run the following commands to get started:

```

$ # Create dir and cd into it
$ mkdir section_2.4 && cd section_2.4
$ # Init empty repository
$ g init
$ # Download and extract the archive
$ wget http://sed.inrialpes.fr/advancedgit-tuto/section_2.4.tgz
$ tar xzf section_2.4.tgz
$ # Apply a series of patches (will create commits)
$ g am patches/*
$ # Apply another patch without committing, this is work in progress.
$ g apply WIP.patch

```

You are in the middle of something (your working directory is 'dirty') when your boss tells you there is a bug in the app which needs to be fixed **\*\*right now\*\***.

You have no choice but to stop what you're doing on the spot and address the bug, but you don't want to lose the work you were doing...

```

$ # Keep your work in progress safe by stashing it:
$ g stash
Saved working directory and index state WIP on master:
  a00081e Add missing new lines at eof
HEAD is now at a00081e Add missing new lines at eof
$ # View stashed changesets:
$ g stash list
stash@0: WIP on master: 02f1c61 Add missing new lines at eof
$ # Check that our working directory is clean:
$ g s

```

```
On branch master
nothing to commit, working tree clean
```

OK, you've saved your work for later. Now... the bug...  
Before even trying to correct it, you should file it and try to reproduce it.  
Boss tells you there's an error when running the program with no argument. Indeed, when you run it:

```
$ mkdir build && cd build
$ cmake ..
$ make
$ ./2_4
terminate called after throwing an instance of 'std::logic_error'
  what():  basic_string::_M_construct null not valid
Aborted
```

OK, you can reproduce the bug. But to file it properly you should tell when it was introduced (and you have no idea!).

To find it with ease, we will use git bisect.

Git bisect needs to be run from the toplevel of the working tree. To make things easier, we will open a new terminal and cd into that directory.

In a new terminal:

```
$ g bisect start
$ # We've just tested HEAD and know it has the bug, i.e. is 'bad'
$ g bisect bad
```

We need to mark an earlier revision as 'good' for bisect to start bisecting. Yet, we have no idea where the error may have been introduced.

Let's checkout the very first commit and check if the bug existed then:

In the first terminal:

```
$ g co HEAD~7
[...]
$ # Test the revision
$ make && ./2_4
[...]
Hello, World!
```

This revision does not present the bug, we can mark it as 'good':

In the second terminal:

```
$ g bisect good
Bisecting: 3 revisions left to test after this (roughly 2 steps)
[c3bc7b5d7ace4b45a943affbac2d11b04f1367ad] Extract function hello_text()
```

Keep checking revisions and mark them either 'good' or 'bad' until you find the "first bad commit". You can now file the bug (e.g. in your gitlab's issue tracker).

We won't actually file the bug today but here's what it could contain the following information:

```
Title: std::logic_error when program lauched with no argument
```

```
Full message:
```

```
terminate called after throwing an instance of 'std::logic_error'
```

```
  what():  basic_string::_M_construct null not valid
```

```
Aborted
```

```
Introduce by commit 626f0ec0f7046c564bbbabf60f29157b6364195f
```

Let's consider our issue tracker has given our new issue the number #13. We can now create a branch dedicated to fixing this bug:

```
$ # Create a branch to fix the bug:
$ g co -b fix#13
Switched to a new branch 'fix#13'
```

This is where you would work on fixing the bug. But before we do that let's see how we can retrieve our stashed changes:

```
$ # checkout the branch where your stashed feature belongs to:
$ g co master #Note: working on master is [very] bad habit!
$ g stash pop
On branch master
Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git checkout -- <file>..." to discard changes in working directory)

    modified:   hello_text.cpp

no changes added to commit (use "git add" and/or "git commit -a")
Dropped refs/stash@0 (e9713d83ef2abeb94092f4edaf4e91d2a90a4360)
$ g stash list
```

OK, let's stash our work again and, this time, actually work on the bug:

```
$ g stash
Saved working directory and index state WIP on master:
  a00081e Add missing new lines at eof
HEAD is now at a00081e Add missing new lines at eof
$ g co -b fix#13
Switched to branch 'fix#13'
```

While correcting the bug, you can't resist the temptation, you correct the typo "Bonjour le monde" => "Bonjour le monde" and some other stuff. After completing the fix (apply fix#13.patch to see what you've done), you end up trying to write a commit message like: "Fix bug, add default value to param lang of fn hello\_text and fix a typo"

Well, I have bad news, being tempted to write "X **and** Y" in a commit message could be referred to as a "git smell".

Here you've made 3 changes and should hence split your changeset into 3 different commits.

Plus, your fixing a typo or adding a default value to a function parameter has nothing to do in branch 'fix#13'

So, now we will try to build a "partial commit" containing the bugfix and only the bugfix:

To do that, open `git gui` and add to your staging area only those modifications that should be part of the bugfix (remember you will have 2 more commits to do: typo and default param value).

Once you are satisfied with your modifications, you realize you are not comfortable committing them because you couldn't test them independently from the other changes you've made.

Here's another situation where `git stash` can be handy.

```
$ # Stash using -k option to keep (i.e. not stash) the staging area
$ g stash -k
$ # Got an error? Unstash and try again (you may need to edit files)
$ g stash pop
$ # ...
$ # Eventually, commit bugfix
$ git commit
$ # Place yourself where you want to apply the other 2 commits, then:
$ g stash pop
$ # Break the remainder of your changeset into 2 commits
```

## 3 Rewriting and correcting your history

### 3.1 Introduction

The aim of this section is to take you through `git`'s history rewriting process on a local repository.

The first exercise presents a simple use case where you use `--amend` and start experimenting with `rebase -i`.

The second exercise is a little trickier because you will be less guided on how to do things and you will be faced with a more extensive use of `rebase -i`.

### 3.2 Amend and rebase -i – an appetizer

Keep in mind that all the actions to be performed here concern a local repository.

- First, create and initialize a new `git` repository locally.

```
$ mkdir MyNewDirectory
$ cd MyNewDirectory
$ git init
```

- Then, create a `readme.txt` file and add it to you `git` repository

```
$ touch readme.txt
$ git add readme.txt
$ git commit
[master (root-commit) c66c567] add new file
1 file changed, 0 insertions(+), 0 deletions(-)
create mode 100644 readme.txt
```

- You realize you forgot the `license.txt` file. Yet you want a single commit containing both files. For this, you can take advantage of `git --amend`

```
$ touch license.txt
$ git add license.txt
$ git commit --amend
[master 2c3df5a] add new files
Date: Mon Feb 5 22:50:02 2018 +0100
2 files changed, 0 insertions(+), 0 deletions(-)
create mode 100644 license.txt
create mode 100644 readme.txt
```

You can check using `gitk` that the top of your local repository includes both files in a single commit.

- Now you need a configuration file, `config.ini`, containing a login and password in plain text. This can be a file that would be necessary during your development and you think you'll add it as a template for other developers. So, you create this file and update your repository.

```
$ echo "login=admin" > config.ini
$ echo "passwd=12345" >> config.ini
$ git add config.ini; git commit
[master 0ae90a7] Add config information
1 file changed, 2 insertions(+)
create mode 100644 config.ini
```

- Then, you create a `howto.txt` and update your repository.

```
$ touch howto.txt
$ git add howto.txt; git commit
[master 051a221] Add template file for faq
1 file changed, 0 insertions(+), 0 deletions(-)
create mode 100644 howto.txt
```

- Oh no! You eventually realize you have added sensitive information (login and password in plain text, remember!) in a previous commit. Since it is not the last one, `git commit --amend` won't work! Thankfully, you have not pushed the faulty commit yet. You can hence use the interactive rebase feature to get rid of the commit adding sensitive data.

Your goal here is to delete the commit that added this file. First retrieve the commit reference corresponding to the commit you want to rebase from, *i.e.* the one before adding `config.ini`.

```
$ git log
commit 051a2216f0bc9c2410e672e2cf29ccf918c1d289
Author: yourname <youremail.address>
Date:   Mon Feb 5 23:06:39 2018 +0100

Add template file for faq

commit 0ae90a7fc940afdc0bf96d69a390519d38605c8b
Author: yourname <youremail.address>
Date:   Mon Feb 5 23:05:19 2018 +0100

Add config information

commit 2c3df5a55e698b4e3c556dcd853bf9e728422e91
Author: yourname <youremail.address>
Date:   Mon Feb 5 22:50:02 2018 +0100

add new files
```

According to the logs above, the commit we need to reference is `2c3df5a55e69`. Then we run the `rebase -i` command with the suitable commit reference.

```
$ git rebase -i COMMIT_REFERENCE_FOR_REBASE
```

Your favorite text editor (see `EDITOR` environment variable) should pop up with the following instructions (or similar):

```
pick 4b0462d Add config information
pick b5bb052 Add template file for faq

# Rebase b941f67..b5bb052 onto b941f67 (2 command(s))
#
# Commands:
# p, pick = use commit
# r, reword = use commit, but edit the commit message
# e, edit = use commit, but stop for amending
# s, squash = use commit, but meld into previous commit
# f, fixup = like "squash", but discard this commit's log message
# x, exec = run command (the rest of the line) using shell
# d, drop = remove commit
#
# These lines can be re-ordered; they are executed from top to bottom.
#
# If you remove a line here THAT COMMIT WILL BE LOST.
#
# However, if you remove everything, the rebase will be aborted.
#
# Note that empty commits are commented out
~
~
~
```

As we want to get rid of the commit that added the configuration file altogether (because it included sensitive information we do not want to share), we can **drop** the commit related to the configuration file. But we want to keep the commit related to adding `howto.txt`. So the rebase instructions can be such as:

```
drop 4b0462d Add config information
pick b5bb052 Add template file for faq

# Rebase b941f67..b5bb052 onto b941f67 (2 command(s))
#
# Commands:
# p, pick = use commit
# r, reword = use commit, but edit the commit message
# e, edit = use commit, but stop for amending
# s, squash = use commit, but meld into previous commit
# f, fixup = like "squash", but discard this commit's log message
# x, exec = run command (the rest of the line) using shell
# d, drop = remove commit
#
# These lines can be re-ordered; they are executed from top to bottom.
#
# If you remove a line here THAT COMMIT WILL BE LOST.
#
# However, if you remove everything, the rebase will be aborted.
#
# Note that empty commits are commented out
~
~
```

Save the file for the rebase process to run. Once done you should get the following message:

```
Successfully rebased and updated refs/heads/master.
```

You can check with `gitk` that the commit list does not include adding `config.ini` file. But beware, if you **drop** the commit, `config.ini` file has also been deleted.

Note that deleting the line with instruction **drop** would have had the exact same effect.

Finally, you can execute `git gc --prune` in order to remove the remaining objects of the deleted commit in the local repository.

### 3.3 Rewrite history – difficult stuff

For this use case, you will be less guided.

1. First you need to work on a **new directory**.
2. Then you need to retrieve and uncompress the following archive file:
  - <https://sed.inrialpes.fr/advancedgit-tuto/rewriteHistory.tgz>This archive contains a local **git** repository, not yet associated to a remote.
3. Take a look at the commit history of this repository:

```
$ git log --graph
```

You might also use **gitk** to better understand the different succession of commits.

You can state from this history that some commit messages are misspelled, some commits should have been performed differently to ensure atomic commit, etc.

Therefore, this history needs a good cleanup: `git rebase -i` is now your best friend.

4. So we ask you to rewrite this history keeping in mind that you need to:

- ensure commits are atomic
- smarten commits that are related
- fix spelling for commit messages

To start rewriting this history, we recommend you use `git rebase -i --root`. This way, you begin at the origin commit (**root**) of the repository.

Instead, you can use the reference to a commit, i.e. `git rebase -i COMMIT_REFERENCE_FOR_REBASE`.

### Some hints

- Sometimes trying to do everything at once is not the best way to go...
- Look at the commit messages, they describe what you might want to do during the rebase operation
- If you want to split a commit, you have to mark it as "edit" when using `git rebase -i`. Once you are editing this commit, run `git reset HEAD~` to go back to the state right before this commit. After having committed your changes run `git rebase --continue`.
- Use `git status` often: it will tell you the current state of the repository and give you advice on what to run next.
- You may need to perform partial commits, see `git add -p` and `git diff --cached`.
- After resolving merge issues, run `git rebase --continue` instead of `git commit`.
- Use **gitk** to ensure your progress is correct.

For a solution to this problem, see section A.

## 3.4 History and undoing

In this subsection you will be less guided regarding the commands needed to complete the required task.

Here we focus on how to undo committed modifications both locally and on a remote repository.

We propose two very similar use cases but that require two different sets of **git** commands to be solved, so be smart/cautious. We do give you some hints :-) !

### Hints

- Check the help for `git revert` and `git checkout`
- You will be asked to undo things when commits have been pushed (to a remote repository). To that end, you can emulate a remote repository by creating a local "bare" repository. Here are the commands you will need to create and link to a "bare" repository (don't do it just now):

```
$ mkdir ../pseudo-remote.git
$ cd ../pseudo-remote.git
$ git init --bare
$ cd -
$ git remote add origin ../pseudo-remote.git
$ git push origin master
```

### 3.4.1 First use case

1. First you need to work on a **new directory**.
2. Retrieve the archive you can find at:  
`http://sed.inrialpes.fr/advancedgit-tuto/undoHistoryCase1.tgz`.
3. Untar this archive and check the status of this local repository:

```
$ tar xvfz undoHistoryCase1.tgz
$ cd undoHistoryCase1
$ git log --graph, or
$ gitk
```

You should identify the following situation:

- Four successive commits have been made.
  - Some files added in the first commit have been removed in the second one.
4. We ask you to:
    - **”Undelete” the deleted files** (they should be present at the tip of master after your intervention). How can you do this?
    - Consider both cases:
      - none of the commits have been pushed to a remote repository yet,
      - all commits have already been pushed (see Hint paragraph above for the use of ”bare” repo).

### 3.4.2 Second use case

1. First you need to work on a **new directory**.
2. Retrieve the archive you can find at:  
`http://sed.inrialpes.fr/advancedgit-tuto/undoHistoryCase2.tgz`.
3. Untar this archive and check the status of this local repository.

```
$ tar xvfz undoHistoryCase2.tgz
$ cd undoHistoryCase2
$ git log --graph, or
$ gitk
```

You should identify the following situation:

- Four successive commits have been made.
  - Only a single line within file `readme.txt` has been modified by the second commit.
4. We ask you to:
    - **Remove the update** made in `readme.txt` within the second commit. How can you do this?
    - Consider both cases:
      - none of the commits have been pushed to a remote repository yet,
      - all commits have already been pushed (see Hint paragraph above for the use of ”bare” repo).

## 3.5 Cleaning up your mess before pushing

This exercise aims at illustrating how to use the `git reset` functionality within 3 independent use cases but based on the same local `git` repository.

1. First you need to work on a **new directory**.
2. Retrieve the archive you can find in:  
`https://sed.inrialpes.fr/advancedgit-tuto/cleanBeforePushing.tgz`.
3. Untar this archive and check the status of the following working tree.

```
$ tar xvfz cleanBeforePushing.tgz
$ cd cleanBeforePushing
$ git log --graph, or
$ gitk
```

4. Each of the following use cases is independent from the other 2. You need to restart from the original contents of `cleanBeforePushing.tgz` archive for each case.

**Case 1** You realize your last changes on `license.txt` are unnecessary and you want to go back to a previous version:

```
$ git checkout COMMIT_REFERENCE_WITH_PREVIOUS_LICENSE -- license.txt
```

**Case 2** You have added `license.txt` to the index but realize the changes made to it should not be included to the next commit. How can you go back without deleting `license.txt` file?

```
$ git reset --mixed # Resets the whole index, or
$ git reset -- license.txt # Removes license.txt from the index
```

**Case 3** You have modified files and added some of them in the index, but you realize everything you did there was wrong. Therefore, you want to get back to the state of the latest commit and discard the changes you had made.

```
$ git reset --hard # Resets the index AND the working dir (be careful)
```

## 4 Git and Pull-Request contributions

### 4.1 Introduction

The aim of this section is to take you through the "pull-request" mode when contributing to a `git` project.

For this exercise, we provide a project on `http://github.com` that you need to fork.

Why forking this project and not cloning it directly ? Because in "pull-request" mode, you are not allowed to push directly your commit to the upstream repository as you are not one of the "owners" of the repository.

Forking is actually copying the content of the repository into your own remote repository (a new project entry on your account page). Then you can clone it on your computer.

Here are summarized the prerequisites for this exercise:

1. Check you can sign in on GitHub.com (otherwise you need to sign up).
2. The base project you will build upon is located at `https://github.com/sedinriara/tpseditpr`. Fork the project by clicking on the *fork* button in the upper right corner of the project page.

3. Go back to your profile page, and check that a `tpsedgitpr` project is listed.
4. Finally, *clone* the forked repository. You will find the url of your git repository by clicking on *Clone or download* → *Clone with SSH*.

## 4.2 Pull request mode

We ask you to:

- Take a look at the repository files. The files of interest are `runsphere` and `sphere/sphere.py`. The last Python file computes sphere related attributes such as its surface, volume, diameter given a radius.
- Run `runsphere` with option `-svd` and check if the results are correct. For instance, if radius is set to 2.0, you should get:
  - sphere surface: 50.265
  - sphere volume: 33.51
  - sphere diameter: 4.0
- Correct the `sphere/sphere.py` (if needed :-)) and commit locally.
- Push your changes in your own GitHub fork repository.

```
$ git push
```

- To contribute to the original repository `sedinriara/tpsedgitpr` with your changes, you need to perform a *merge request*.  
Go to the GitHub Web page corresponding to your forked project, find the `Code` tab, check your push has been done. Then click on `New pull request` button and follow the instructions to create the request.

**Note** If you want to retrieve in your own repository changes made on original/upstream repository `sedinriara/tpsedgitpr`, you can use:

```
$ git remote add source https://github.com/sedinriara/tpsedgitpr
$ git fetch
$ git branch -a # to check the branches
$ git rebase # to merge modification from source original repo to your local repo
```

## 4.3 Patch mode

Another way to perform a "pull/request" contribution is to send a patch containing your modifications.<sup>1</sup>

To do so:

- From the current state of your local repository, create a patch between the original/upstream repository version and your current repository state:

```
$ git format-patch REFERENCE_TO_THE_ROOT_REPO_BASE_COMMIT
```

- You should get a file `.patch` per commit. These files include the commit author name and email.
- You can e-mail the files to the owners of the root repository.
- See `git am --help` to understand how to apply this kind of patch sent by mail.

<sup>1</sup>If you are using Inria Gitlab, <http://gitlab.inria.fr>, it is one of the methods recommended to perform "pull-requests". See Inria Gitlab FAQ for more information.

## 5 Conclusion

You should now have performed a lot of reasonably advanced `git` operations, locally and using a remote `git` repository.

### A One Solution for rewriting history

We start rebasing interactively the local repository from `root`.

```
$ git rebase -i --root
```

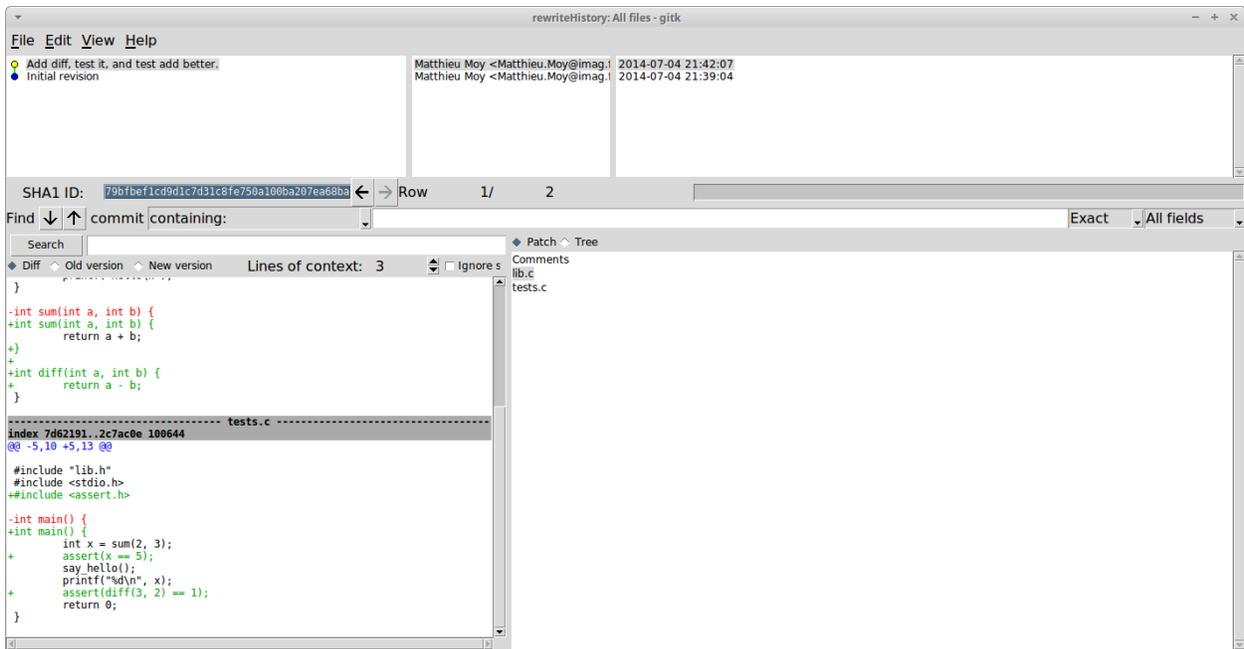
We want to edit the second commit to add first the sum method, then in a another commit the adding and testing of diff method.

```
pick c5603bc Initial revision
e bd28b12 Add diff, test it, and test add better.
pick 1c5ca4c Rename diff to sub
pick 2976e39 Rename diff to sub in tests too
pick 495c6a0 add fnuctino f

# Rebase 495c6a0 onto 260caa8 (5 command(s))
#
# Commands:
# p, pick = use commit
# r, reword = use commit, but edit the commit message
# e, edit = use commit, but stop for amending
# s, squash = use commit, but meld into previous commit
# f, fixup = like "squash", but discard this commit's log message
# x, exec = run command (the rest of the line) using shell
# d, drop = remove commit
#
# These lines can be re-ordered; they are executed from top to bottom.
#
# If you remove a line here THAT COMMIT WILL BE LOST.
#
# However, if you remove everything, the rebase will be aborted.
#
-- INSERT --                                     4,1                               Top
```

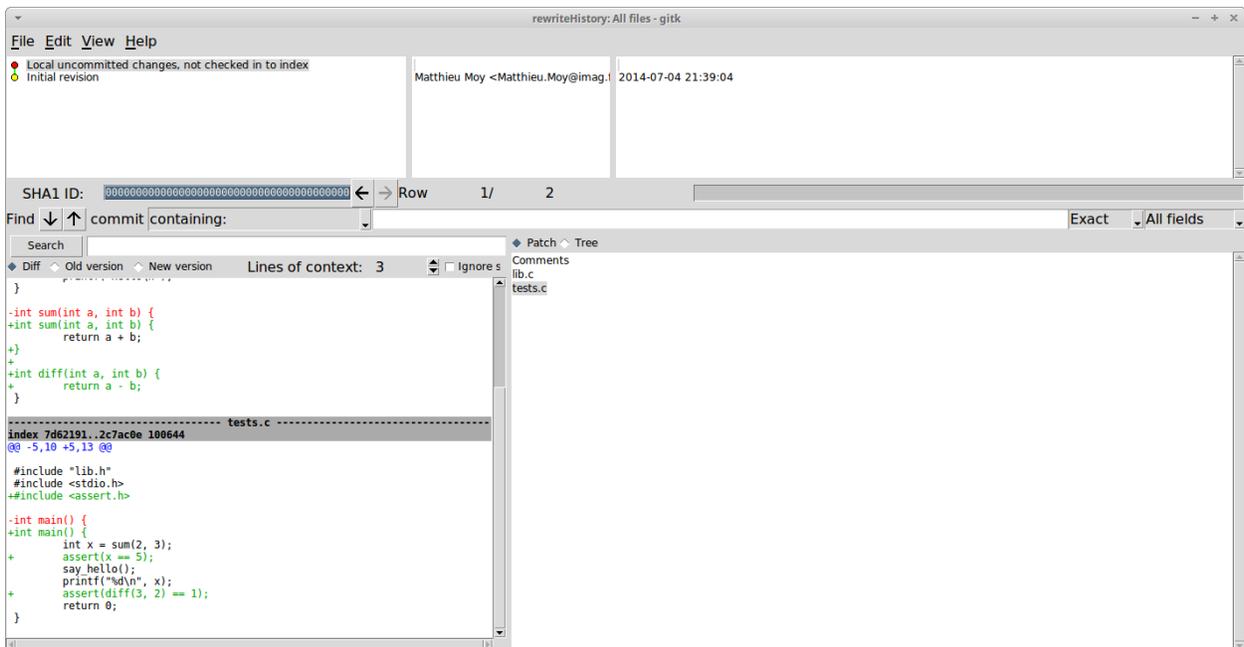
```
$ git status
interactive rebase in progress; onto 46ee46e
Last commands done (2 commands done):
  pick c5603bc Initial revision
  e bd28b12 Add diff, test it, and test add better.
Next commands to do (3 remaining commands):
  pick 1c5ca4c Rename diff to sub
  pick 2976e39 Rename diff to sub in tests too
  (use "git rebase --edit-todo" to view and edit)
You are currently editing a commit while rebasing branch 'master' on '46ee46e'.
  (use "git commit --amend" to amend the current commit)
  (use "git rebase --continue" once you are satisfied with your changes)

nothing to commit, working directory clean
$ gitk
```



As we want to reconsider the current commit (the one concerning adding diff and test add better) in order to split it into one commit for testing add and another to add and test diff, we need to change the HEAD of the current repository to be able modify this commit

```
$ git reset HEAD~
$ gitk
```



Then, we can modify tests.c to take into account only the test on add method. But we do not want to lose the modifications about the diff method, so we perform a *partial* commit modification.

```
$ git add -p tests.c
```

```

# Manual hunk edit mode -- see bottom for a quick guide
@@ -5,10 +5,13 @@

#include "lib.h"
#include <stdio.h>
+#include <assert.h>

-int main() {
    int x = sum(2, 3);
+   assert(x == 5);
    say_hello();
    printf("%d\n", x);
    return 0;
}
# ---
# To remove '-' lines, make them ' ' lines (context).
# To remove '+' lines, delete them.
# Lines starting with # will be removed.
#
# If the patch applies cleanly, the edited hunk will immediately be
# marked for staging. If it does not apply cleanly, you will be given
# an opportunity to edit again. If all lines of the hunk are removed,
# then the edit is aborted and the hunk is left unchanged.
~

```

```

$ git status
interactive rebase in progress; onto 46ee46e
Last commands done (2 commands done):
  pick c5603bc Initial revision
  e bd28b12 Add diff, test it, and test add better.
Next commands to do (3 remaining commands):
  pick 1c5ca4c Rename diff to sub
  pick 2976e39 Rename diff to sub in tests too
  (use "git rebase --edit-todo" to view and edit)
You are currently splitting a commit while rebasing branch 'master' on '46ee46e'.
  (Once your working directory is clean, run "git rebase --continue")

Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

        modified:   tests.c

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

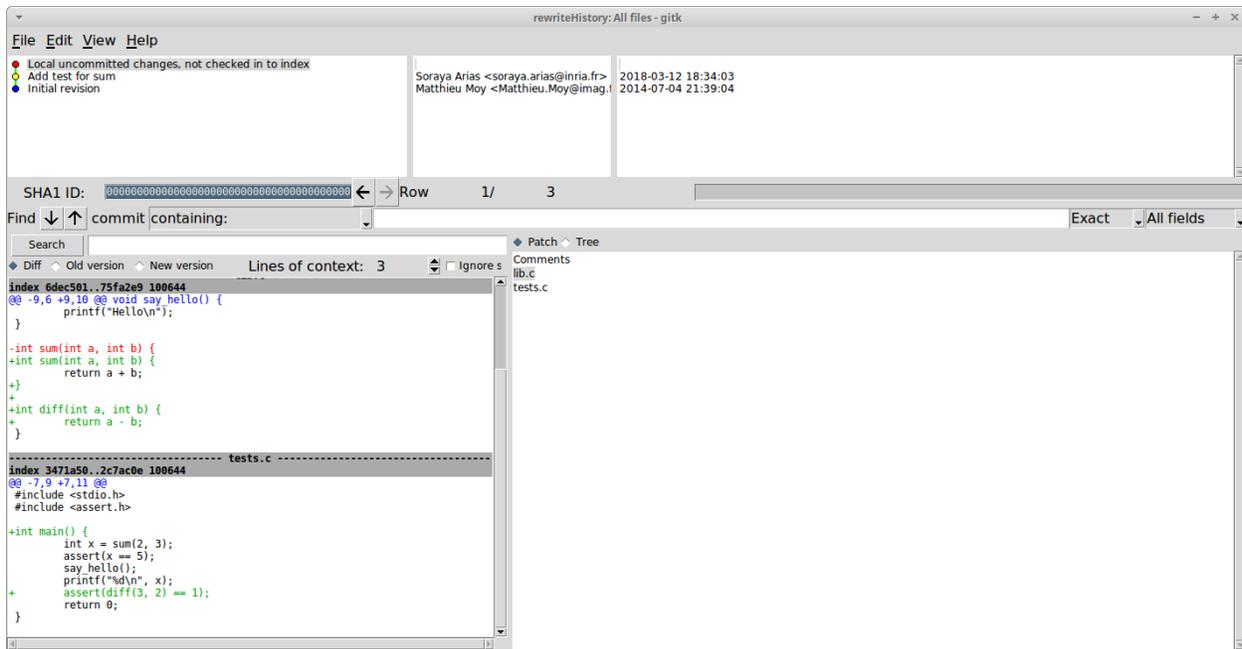
        modified:   lib.c
        modified:   tests.c

```

```

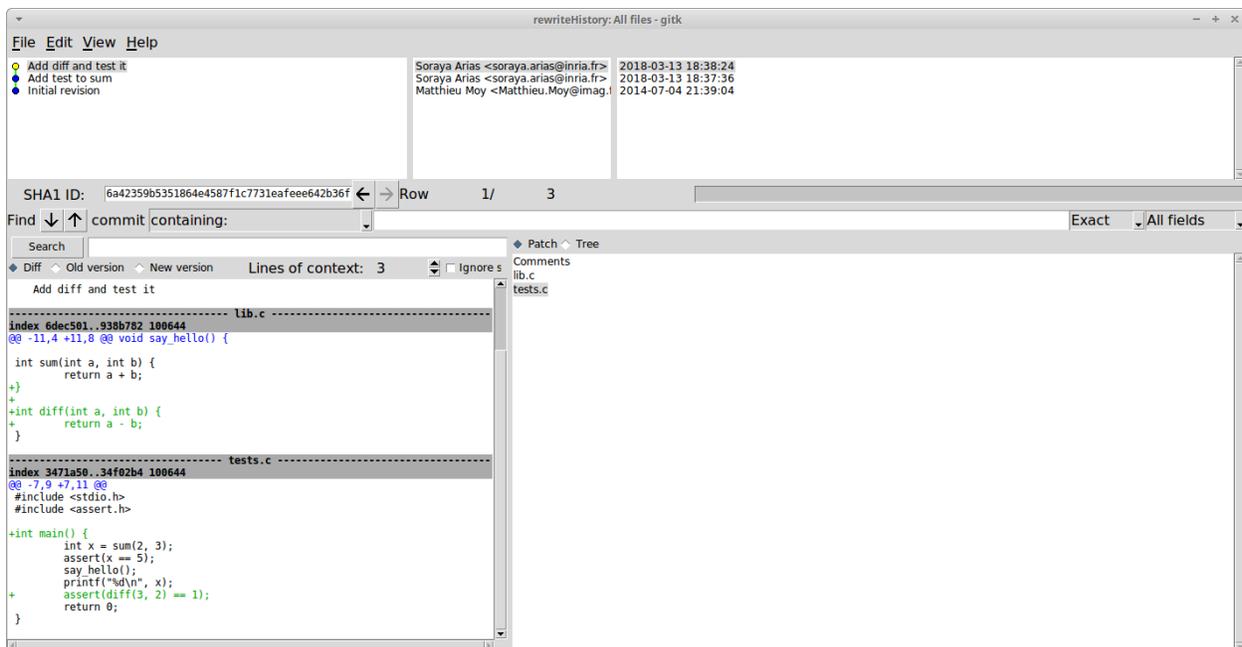
$ git commit -m "Add test for sum"
$ gitk

```



Now you can edit `lib.c` and `tests.c` and delete unnecessary spaces after `main()` and `sum()` definitions. Then, you can add and commit these modifications.

```
$ git stage lib.c tests.c ; git commit -m "Add diff and test it"
$ gitk
```



If we take a look to what `git status` tells us and as we are satisfied with previous changes, we can continue rebasing:

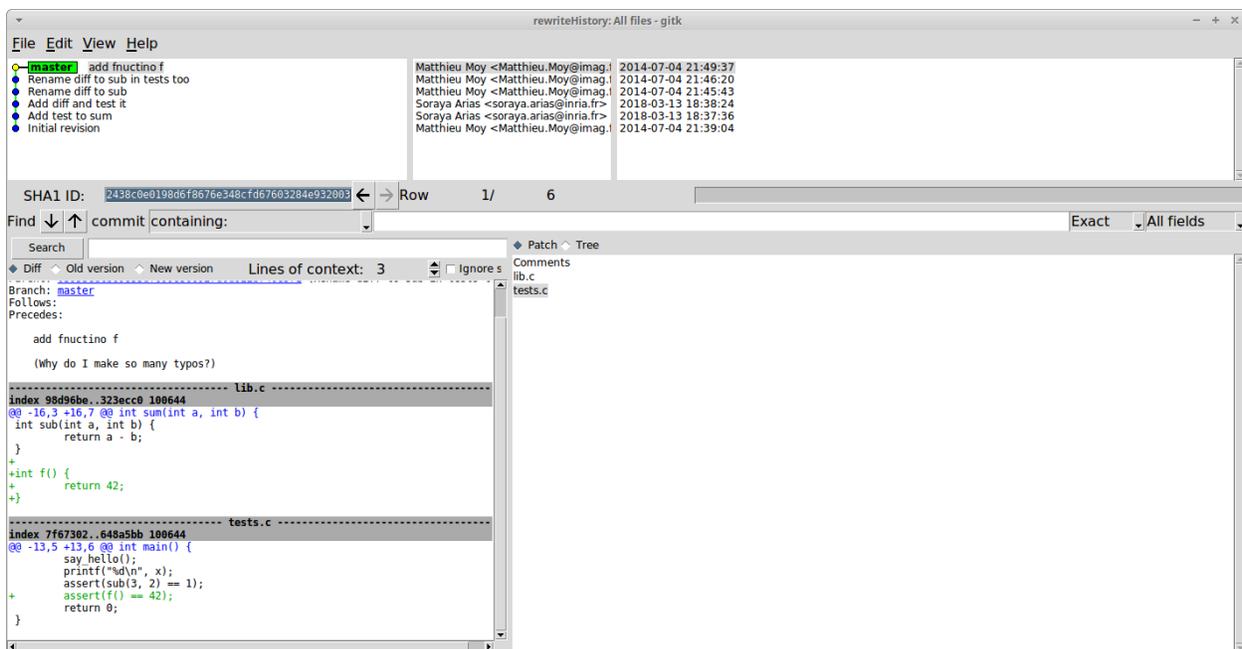
```
$ git status
interactive rebase in progress; onto f76f6a5
```

```

Last commands done (2 commands done):
  pick c5603bc Initial revision
  e bd28b12 Add diff, test it, and test add better.
Next commands to do (3 remaining commands):
  pick 1c5ca4c Rename diff to sub
  pick 2976e39 Rename diff to sub in tests too
  (use "git rebase --edit-todo" to view and edit)
You are currently editing a commit while rebasing branch 'master' on 'f76f6a5'.
  (use "git commit --amend" to amend the current commit)
  (use "git rebase --continue" once you are satisfied with your changes)

nothing to commit, working directory clean
$ git rebase --continue
Successfully rebased and updated refs/heads/master.
$ gitk

```



We can continue rewriting the history to squash or fix diff related commits and correct misspelled comment. So we can use `git rebase -i` to perform these modifications on history.

```
$ git rebase -i --root
```

```

pick 7818ele Initial revision
pick 97f61a1 Add test for sum
pick 4fc133c Add diff and test it
pick 9708dbc Rename diff to sub
f 0aa493f Rename diff to sub in tests too
r 171a8a6 add fnuctino f

# Rebase 171a8a6 onto e8f0d6b (6 command(s))
#
# Commands:
# p, pick = use commit
# r, reword = use commit, but edit the commit message
# e, edit = use commit, but stop for amending
# s, squash = use commit, but meld into previous commit
# f, fixup = like "squash", but discard this commit's log message
# x, exec = run command (the rest of the line) using shell
# d, drop = remove commit
#
# These lines can be re-ordered; they are executed from top to bottom.
#
# If you remove a line here THAT COMMIT WILL BE LOST.
#
# However, if you remove everything, the rebase will be aborted.
#
# Note that empty commits are commented out
~

```

Here is the editor to reword the misspelled comment:

```

add function| f
(Why do I make so many typos?)
# Please enter the commit message for your changes. Lines starting
# with '#' will be ignored, and an empty message aborts the commit.
#
# Author:      Matthieu Moy <Matthieu.Moy@imag.fr>
# Date:       Fri Jul 4 21:49:37 2014 +0200
#
# interactive rebase in progress; onto e8f0d6b
# Last commands done (6 commands done):
#   f 0aa493f Rename diff to sub in tests too
#   r 171a8a6 add fnuctino f
# No commands remaining.
# You are currently editing a commit while rebasing branch 'master' on 'e8f0d6b'.
#
# Changes to be committed:
#   modified:   lib.c
#   modified:   tests.c
#
~

```

You should get an output message telling you the rebase is successful:

```

$ git rebase -i --root
[detached HEAD cccb2d9] Rename diff to sub
Author: Matthieu Moy <Matthieu.Moy@imag.fr>
Date: Fri Jul 4 21:45:43 2014 +0200

```

```
2 files changed, 2 insertions(+), 2 deletions(-)
[detached HEAD 6c0acf5] add function f
Author: Matthieu Moy <Matthieu.Moy@imag.fr>
Date: Fri Jul 4 21:49:37 2014 +0200
2 files changed, 5 insertions(+)
```

Successfully rebased and updated refs/heads/master.

And finally you should retrieve a more coherent history !

```
$ gitk
```

The screenshot shows the gitk graphical user interface. At the top, there is a commit history table with columns for commit hash, author, and date. The current commit is highlighted in green. Below the table, there is a search bar and a dropdown menu for 'commit containing:'. The main area shows a diff view for the current commit, with a tree view on the right showing the files 'lib.c' and 'tests.c'. The diff view shows the changes made in the current commit, including the addition of a function 'f' and the modification of 'tests.c'.

```
rewriteHistory: All files - gitk
File Edit View Help
- master add function f
- Rename diff to sub
- Add diff and test it
- Add test to sum
- Initial revision
Matthieu Moy <Matthieu.Moy@imag.i 2014-07-04 21:49:37
Matthieu Moy <Matthieu.Moy@imag.i 2014-07-04 21:45:43
Soraya Arias <soraya.arias@inria.fr> 2018-03-13 18:38:24
Soraya Arias <soraya.arias@inria.fr> 2018-03-13 18:37:36
Matthieu Moy <Matthieu.Moy@imag.i 2014-07-04 21:39:04
SHA1 ID: 6c0acf5c59f3a33b8c9bc975cd978d3ac485e691 Row 1/ 5
Find commit containing: Exact All fields
Search Patch Tree
Diff Old version New version Lines of context: 3 Ignore s Comments
Branch: master
Follows:
Precedes:
add function f
(Why do I make so many typos?)
----- lib.c -----
index 98d96be..323ecc0 100644
@@ -16,3 +16,7 @@ int sub(int a, int b) {
int sub(int a, int b) {
return a - b;
}
+
+int f() {
+return 42;
+}
----- tests.c -----
index 7f67302..648a5bb 100644
@@ -13,5 +13,6 @@ int main() {
say_hello();
printf("%d\n", x);
assert(sub(3, 2) == 1);
+assert(f() == 42);
return 0;
}
```