

Git_{Hub,Lab}

-- “everything is local”

— A beginner’s guide —

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Corrections and suggestions are welcome and should be consigned in the *Issues* section of the https://www.github.com/Cbhihe/quickstart_git repo.

Foreword

Writing this document began as an expanded version of another quick-start document, authored by Jordi Torres and [available on Github](#). It has undergone several full rewrites and has grown to become a 23 page long manual in the form of a step by step tutorial.

As the original document put together by Jordi Torres, it is meant as a hands-on introduction to both GitHub and GitLab for beginners. It should get you started and operational from scratch under two or three hours. It deals with the most salient aspects of how to get on and about with git version control. If you would rather have a lengthier, more detailed description of git’s concepts and general philosophy, I can refer you to *Pro git* by Scott Chacon and Ben Straub, a freely available 514 page long [digital reference](#). This Quickstart tutorial was not written with *Pro git* in hand and is not a summary of that book. In fact I have not read *Pro git* (yet) even though I occasionally do consult it.

Corrections and suggestions are welcome and should be consigned in the Issues section of [this repo](#).

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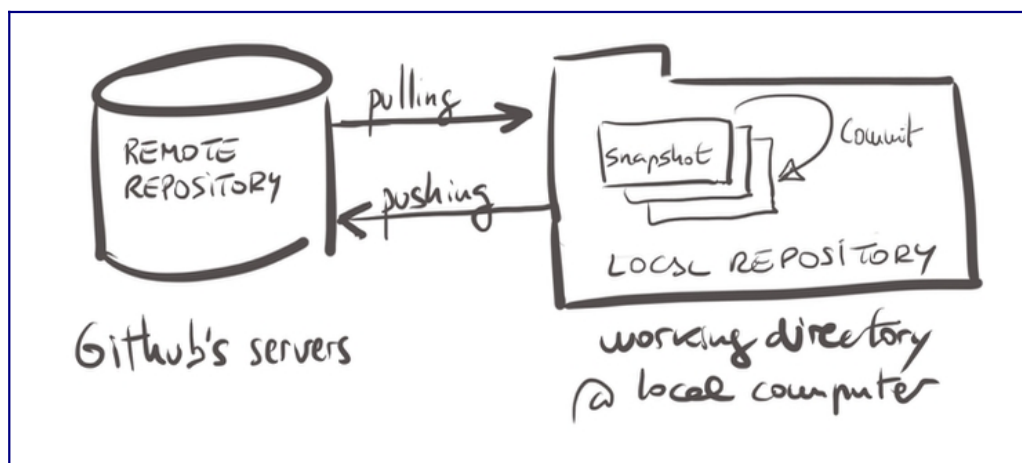
This hands-on tutorial is a beginner's guide to one of the best known distributed version-control system (dVCS): Git. It provides a step-by-step introduction to its basic characteristics. It is intended for an audience either with no prior knowledge, or who needs a refresher due to insufficient practice. Its main objective is to bring all to the required knowledge level necessary to use `git` at a passing level. This document was originally written and later edited and expanded based on the belief that hands-on practice is paramount when acquiring new technical knowledge. To benefit from this tutorial, follow instructions preferably on a computer running Linux and connected to the internet. You should have `sudo` privileges to be able to install packages on your local host.

1. Getting Started

`git` is a free and open-source dVCS, launched in 2005 by Linus Torvald. It is designed to handle everything from small to very large code projects. With `git`, **users keep entire code files on their location machines**. `git` also keeps a historical record of the files in your codebase. It manage workflows, in such a way that teams of programmers may work together and revert any changes by rolling back their code to a previous version. To achieve that `git` stores files into a repository typically hosted on GitHub ([G+](#)) or on GitLab.

Clarifying some vocabulary and key concepts:

- **Snapshot** is the way `git` keeps track of code history, recording what files look like at a given point in time. We can decide when to take a snapshot and go back to visit any previous snapshot.
- **Commit** refers to the act of creating a snapshot. Essentially, a project in GitHub is made up of a bunch of commits. Basically a commit contain 3 pieces of information: information about how the files changed from previous snapshot, a reference to the commit that came before it (called the *parent commit*) and a hash code name to identify the commit.
- **Repo** refers the collection of all the files, the history of those files and all the commits. A repo can live in our local machine, referred to as a our **local repository**, or be located on GitHub's servers. In this case we talk about a **remote repository**.
- The action of downloading commits that don't exist on our local repository from a remote repository is called **pulling** changes. The process of adding our local changes to the remote repository is called **pushing** changes.
- In `git`, a **branch** is a copy of all the files in your codebase. Think of the birth as a snapshot of the supporting branch, i.e. the branch from which . Each branch has an identifying name and its own set of version or commit history. When you create a new repository, the default branch is called 'main' (previously called 'master'). Even if you do not create any additional branches, you can performing all `git` commands on that default branch.



2. Getting started with **git**

2.1. Installing **git**

In order to install **git** you can visit the [git download page](#) and run the installer for your operating system.

You can verify that **git** is working from the command line:

```
$ git --version
git version 2.37.0
```

The installed version may be behind the latest one in your case, in particular if your installation is made from a Linux distro's official repository. Official repositories usually harbor stable but older versions.

In this hands-on we will be using the command line to interact with git repositories. There are also graphical user interface, or GUI, applications available for viewing and maintaining your repositories from Windows, Linux or OS X.

2.2. **git init**

To start, let's create a new **local** directory called **localRepo** in **/srv/git/** and add a few files to it.

```
$ mkdir -p /srv/git/localRepo
$ cd /srv/git/localRepo
```

Create files **Readme.md** and **License.md**. Note that both are included in the root directory of many open source projects. These particular files use the [markdown](#) format. Markdown formatting on GitHub permits the production of ultra light-weight flat files for your prose (and perhaps also for your code) with a very simple syntax. See *Appendix A* for a quick overview on markdown.

```
localRepo $ echo '# README #' > Readme.md
localRepo $ echo '# LICENSE #' > License.md
```

Once inside **/srv/git/localRepo**, create a local repository with the following command. Commands will be followed by the output shown:

```
localRepo $ git init
Initialized empty Git repository in /srv/git/localRepo/
```

Internally a **.git** directory was added to local directory as you can check with:

```
localRepo $ ls -a
.      ..      .git      License.md  Readme.md
```

That turns that directory into a git repository. This **.git hidden** directory will contain all of the configuration and metadata necessary for git to keep track of our files and the changes that we make to them.

Store your **identity information**. It tells all git repositories in our system our name/email, which will be applied to each commit. Type the following into the command line, replacing the fake identity with your own:

```
localRepo $ git config --global user.name "Cbhihe"
localRepo $ git config --global user.email insert-your-email-here
```

Additionally, you need to configure the **default push behavior**. There are two possibilities:

```
localRepo $ git config --global push.default matching
or
localRepo $ git config --global push.default simple
```

When `push.default` is set to 'matching', git will push local branches to the existing remote ones with the same name. In Git 2.0, git will default to the more conservative 'simple' behavior, which only pushes the current branch to the corresponding remote branch that 'git pull' uses to update the current branch.

After we initialize a directory as a git repository, we can then start issuing other git commands.

Warning: *Never (even try to) nest repositories. It will fail ... sometimes in unpredictable ways. You have been warned.*

2.3. Add & commit

Our local repository consists of three "trees" maintained by git:

- **Working Directory** which holds the actual files: `localRepo`
- **index** which acts as a *staging area*, inside the working directory.
- **HEAD** which points to the last commit we have made, inside the working directory.

The first step in the basic git workflow is to propose changes (add them to *index*):

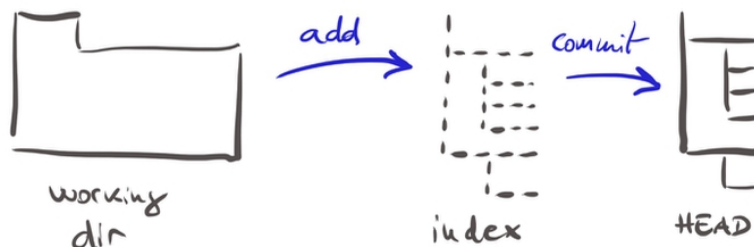
```
$ git add <filename>
or
$ git add *
$ git add -n *
```

The last command above will perform a dry run and may spare you unpleasant surprises.

To commit changes, do:

```
$ git commit -m "Type a short meaningful commit message here"
```

Now the file is committed and HEAD will reflect that fact, in the local working directory (but not in the remote repository yet).



In our case we can execute:

```
localRepo $ git add Readme.md
localRepo $ git commit -m "My first commit... blah blah"
```

We do not add `License.md` file intentionally, in order to illustrate differences. The reason is sometimes git repositories will have private data that you do not want shared (unintentionally added for instance). That is what for the `.gitignore` file is. This file is a list of files and/or directories that you do not want included in a repository. Git will not allow you to add any of the files referenced in the file `.gitignore` to a given repository.

You can also create a global **.gitignore** file, which is a list of rules for ignoring files in *every* Git repository on your computer. For example, you might want to create the file at `~/ .gitignore_global` and add some rules to it.

1. Open a terminal window

2. Run the following command in your terminal

```
$ git config --global core.excludesfile ~/.gitignore_global
```

Some good rules to add to this file are included in *Appendix B*.

To list all the commits done so far between the last (local) *main* commit and the last (remote) *origin/main* commit:

```
localRepo $ git log [--oneline] [main origin/main]
...
commit 1e5307f4d089ef9089775f671dd8cc48d29b2dcb
Author: Cedric Bhihe <Cbhihe@users.noreply.github.com>
Date:   Fri Apr 21 13:51:05 2017 +0200
Update of Readme.md with emails
...
```

To see the **working tree status** (here on the *main* branch):

```
localRepo $ git status
On branch main      Your branch is up-to-date with 'origin/main'.
nothing to commit, working directory clean
```

Sometimes, you may need to **delete files**. After doing so locally, issue:

```
localRepo $ git add *
localRepo $ git commit -m "commit-message"
On branch branch-name
Changes not staged for commit:
deleted: ...
deleted: ...
...
```

This is expected behavior as otherwise any staged (local) changes including deletes would be committed automatically and subsequently pushed. To prevent spurious deletions of files on *origin* (i.e. on the the remote repo), *git* actually requires a special command to stage the deletion of files, i.e. to add those deletions to the index.

```
localRepo $ git add -u
localRepo $ git commit -m "commit-message"
localRepo $ git push
```

From *git* docs (git-scm.com/docs/git-add):

Options for ‘git add’: **-u** , **--update** will updates the index just where it already has an entry matching <pathspec>. This removes as well as modifies index entries to match the working tree, but adds no new files. If no <pathspec> is given when -u option is used, all tracked files in the entire working tree are updated...

Only matches against already tracked files in the index rather than the working tree. That means that it will never stage new files, but that it will stage modified new contents of tracked files and that it will remove files from the index if the corresponding files in the working tree have been removed.

The above is strictly equivalent to the bash cmds:

```
localRepo $ git status | sed -n '/^# *deleted:/s///p' | xargs git rm
or
localRepo $ git ls-files --deleted | xargs git rm
```

2.4 Files' status and stage

- The states in which any file might find itself are:
Untracked - when you first create the file, it is *untracked*. This happens specifically when newly created files have never been staged before and do not appear in the local git repo's previous snapshot (as part of the *index*). Files become tracked with both ``$ git add .`` and ``$ git add -A``
- **Staged / indexed** - when you use git add command on the file, it goes in this area
- **Committed** - when you use the git commit on the file, it goes in this area
- **Modified** - the file is committed but has local changes, which are neither staged nor committed yet.

2.5 Removing already staged or committed files

Sometimes a file may accidentally be staged, committed to your local git repo, or even mistakenly pushed to remote. How you deal with that depends on the context.

2.5.1 – Remove from staging area

To remove a file from the staging or cached area, issue:

```
localRepo $ git rm --cached file_name
```

For whole directories and contents, use the `-r|--recursive` additional option:

```
localRepo $ git rm -r --cached directory-name
```

2.5.2 – Remove single file from committed area

The following applies to the latest *commit*, not to any *commit* already pushed to a remote repo. Recall that local commits are stored in *HEAD*. Three cmds are required in succession:

```
localRepo $ git reset --soft HEAD^1
```

to undo the latest commit(s) not already pushed to *origin*. At this point

```
localRepo $ git status
```

will reveal files in the staging area (*index*). Remove them from the staging area with:

```
localRepo $ git rm --cached file-name
```

or, for whole directories (and contents):

```
localRepo $ git rm -r --cached directory-name
```

By running the above command, the file will appear in the untracked files' section.

After having removed one or several file, go ahead and re-commit the remaining indexed files.

```
localRepo $ git commit -m "commit-message"
```

2.5.3 – Correct mistakes on commits and / or pushes

If a mistake is made after a commit but before a push, you may rectify the last commit, prior to pushing, with:

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

On the other hand if a commit mistake was made AND pushed, then you might need to **force-push** a second commit to clobber the first one:

```
localRepo $ git push origin/<remote-branch> <local-branch> --force
```

Warning:

- Force-pushing will overwrite any changes on the remote repo with the current local repo's state.
- The replaced commit will be effectively overwritten with a different SHA identification. This may have adverse consequences if collaborators in the remote repo's project have already either pulled the material erroneously pushed by you, or merged their own contributions to the project on the remote repo. In such cases, in order to be aligned with the new remote, others might want to reset their history locally.

There are three ways for other contributors (i.e. all but the author of the force-push) to do that:

a) A *hard reset* will reset the index and working tree. Any changes to tracked files in other contributors' local working trees (staged files) since your forceful push will be lost.

```
localRepo $ git reset origin/main --hard
```

b) A *soft reset* will preserve others' staging areas, while updating their commit history with the content of your forceful push. It will also afford them the possibility to re-commit their changes to remote.

```
localRepo $ git reset origin/main --soft
```

c) However it is generally preferable to proceed with a much safer interactive *rebase*. "Rebasing" consists for other contributors in replaying their local commits on top of any other pushed commits, with:

```
localRepo $ git rebase -i origin/main
```

This will invoke *rebase* in interactive mode where users can choose how to apply each individual commit not in the remote's commit history on top of which they are rebasing.

If the remote's commits removed (with ` \$ git push -f `) have already been pulled into the local history of any contributor about to conduct a rebase, then those commits would be listed as valid rebase commits, and would be reapplied. To prevent this, i.e. in order for those commits not to simply be re-included into the history for the branch, they would need to be deleted as part of the rebase, lest one wishes to see them reappear in the remote history on the next push.

Users can limit their interactive rebase scope, with:

```
localRepo $ git rebase -i HEAD~X
```

where X is the number of commit log entries before the force push. Git will "collect" all the commits in the last X log entries and if there was a merge somewhere in between, that range will see all those merges' commits as well, so the outcome will really be X+ commits to manually approve / edit.

To better understand what your options are in complicated situations where the project time-line includes one or more *merges*, between the correction and the original commit and push, consult the help with `'$ git <cmd> --help'`, see related posts on StackOverflow, or visit:

- [git-commit\(1\) man page](#)
- [git-rebase\(1\) man page](#)
- [git-push\(1\) man page](#)

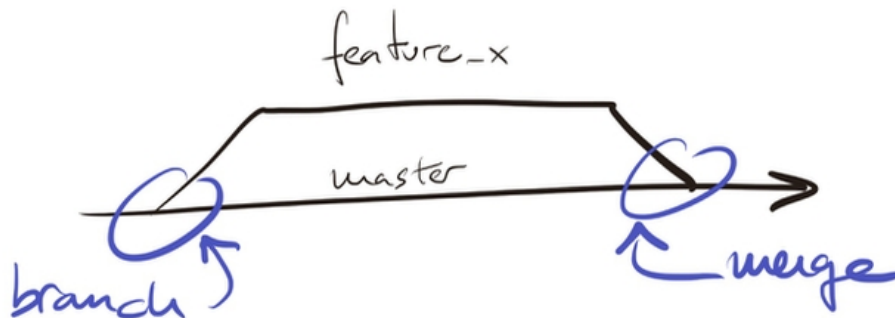
also available from your Linux console as `'$ man git-commit'`, etc.

2.6. Branching

Branching is a powerful mechanism in any repository tool that allows developers to veer off into a tangential or experimental direction, without affecting the main codebase.

To create a branch, we **fork** it from another existing branch, likely from 'main'. In this tutorial we choose to call the branch from which a new branch is forked, the *supporting branch*. Then we switch to the newly forked branch and start working inside it. The new "feature-x" branch will contain all the historical changes accumulated in the supporting branch up to the point of the fork. It means that the two branches do not stay in sync automatically when applying subsequent changes as one goes ahead with development work or any other modification it may undergo.

In case an forked branch must be discarded, simply delete it. On the other hand, if we want to keep the code we can **merge** commits from any branch into our main branch.



To **create a new branch locally**, name it "feature_x" and switch to it, issue:

```
$ git checkout -b feature_x
```

To **switch back to main locally**, do:

```
$ git checkout main
```

To **visualize difference locally** between the new branch and its source (here the "main" branch), do:

```
$ git diff main feature_x
```

To **visualize differences remotely** between a branch and its upstream-source (here the "origin/main" branch), do:

```
$ git diff origin/main origin/branch
```

or `$ git diff ...origin/branch`

where the default name “origin” points to the repo on GitHub. (We will see that that default can be changed.)

To **delete a branch locally**, do, from another branch, possibly from main:

```
$ git branch -d <branch>
```

Replace ‘-d’ with ‘-D’ above to force deletion.

One can also delete a branch on GitHub via the GUI, or from your local console, with:

```
$ git push origin :<branch>
```

where ‘:’ above indicates deletion of the named branch.

2.7. Remote branches: fetch, merge and pull

From any local repo, you can:

- **list** all the remote connections that current repo has to other repositories:

```
localRepo $ git remote [-v]
```

The -v flag (verbose) includes the URL of each connection. For instance:

```
origin https://github.com/Cbhihe/CLC_cloud-computing.git (fetch)
origin https://github.com/Cbhihe/CLC_cloud-computing.git (push)
```

- **create** a new connection to a remote repository specified by its <url>:

```
localRepo $ git remote add <name> <url>
```

After adding a remote, you’ll be able to use <name> as a convenient shortcut for <url> in subsequent git commands.

In this case however, the term “origin”, previously meant to denote the remote repo, is no longer functional. It is replaced by the new name. For instance:

```
localRepo $ git remote add <name> <url>
<name> https://github.com/Cbhihe/CLC_cloud-computing/tree/lab2 (fetch)
<name> https://github.com/Cbhihe/CLC_cloud-computing/tree/lab2 (push)
```

Where https://github.com/Cbhihe/CLC_cloud-computing/tree/lab2 would be the <url> part in this case

Note that you can also access and manually edit that info with your terminal session’s default editor, by issuing:

```
localRepo $ git config -e
```

The config file is at: localRepo/.git/config

- **remove** the connection to the remote repository called <name>:

```
localRepo $ git remote rm <name>
```

This will not remove the remote repo, just its local shortcut, <name>, previously created to alias its url.

- **rename** a remote connection from <old-name> to <new-name>:

```
localRepo $ git remote rename <old-name> <new-name>
```

- **fetch** will import commits (download objects and refs) from the remote repo in the local repo:

```
localRepo $ git fetch <remote_repo> [<remote_repo_branch>]
```

Example 1:

```
localRepo $ git fetch origin
```

will fetch all branches at origin (remote repo) and will display their commits up to the time the fetch cmd was issued.

Example 2:

```
localRepo $ git checkout 2nd-branch
localRepo $ git fetch https://github.com/Cbhihe/syncThat.git 2nd-branch
or localRepo $ git fetch origin 2nd-branch
```

The resulting commits are locally stored as *remote branches* instead of the normal local branches. This gives the user a chance to review changes before integrating them into his/her copy of the project.

Note that specifying a **<branch>** has the effect of only downloading info specific to said branch of the remote repo.

Remote branches are just like local branches, except they represent commits from somebody else's repository. You can check out a remote branch just like a local one, but this puts you in a detached **HEAD** state (similar to checking an old commit). You can think of them as read-only branches.

Caution: You cannot fetch a remote branch if locally you already have an identically named branch.

To **view existing branches**, simply issue the cmds:

```
localRepo $ git branch -r      (← for remote branches)
origin/feature_x              (← example)
origin/2nd-branch              (← example)
origin/main                    (← always present)

localRepo $ git branch         (← for local branches)
feature_x
2nd-branch
main
remote

localRepo $ git branch -a      (← for all branches)
feature_x
2nd-branch
main
remote
remotes/origin/feature_x
remotes/origin/2nd-branch
remotes/origin/main
```

Remote branches can be inspected with the usual *git checkout* and *git log* commands:

```
$ git log -r
or $ git log origin/main
```

Further, all local repos can be updated with one command by issuing:

```
$ git remote update
or equivalently
$ git fetch --all
```

Both will import commits (download objects and refs) from all remotes, not just one as with *'git fetch origin'* from within a specific local repo...

To **merge <branch>** into the active branch (e.g. main) locally:

Once a branch's commits are fetched and approved, you can merge it with:

```
localRepo $ git checkout branch
localRepo/branch $ git merge [<other_local_branch>]
```

where `localRepo/branch` can be the local main or any branch to which `<other_local_branch>` is being merged. The above command must be issued from *outside the branch* (`<local_branchname>`) to be merged.

Git tries to auto-merge changes. It is not always possible and may result in *conflicts*. You are responsible to resolve those conflicts manually by editing the files shown by `git`. After manual changes are made to resolve conflicts in a file, mark the file `<filename>` as staged with:

```
localRepo/branch $ git add <filename>
```

Again, before merging changes, you can also preview them by using:

```
localRepo $ git diff <source_branch> <target_branch>
```

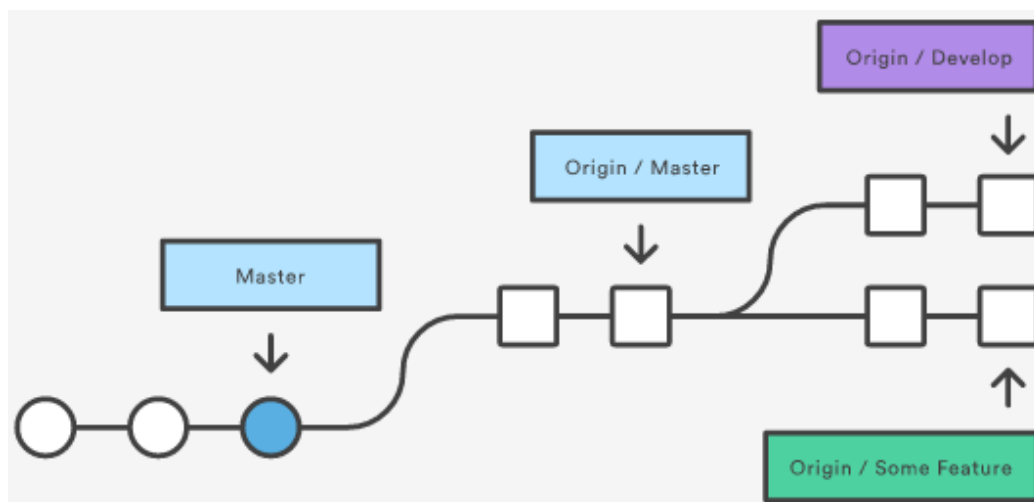
So, unlike SVNⁱ, synchronizing your local repository with a remote repository is actually a two-step process: `fetch` → `merge`. The `git pull` command is a convenient shortcut for this process.

Imagine the situation illustrated by the figure below. To see what commits have been added to the upstream main, run `git log` using `origin/main` as a filter:

```
$ git log --oneline main origin/main
```

To approve the changes and merge them into your local main branch with the following commands:

```
$ git checkout main
$ git log origin/main
```



Then we can use `git merge origin/main`:

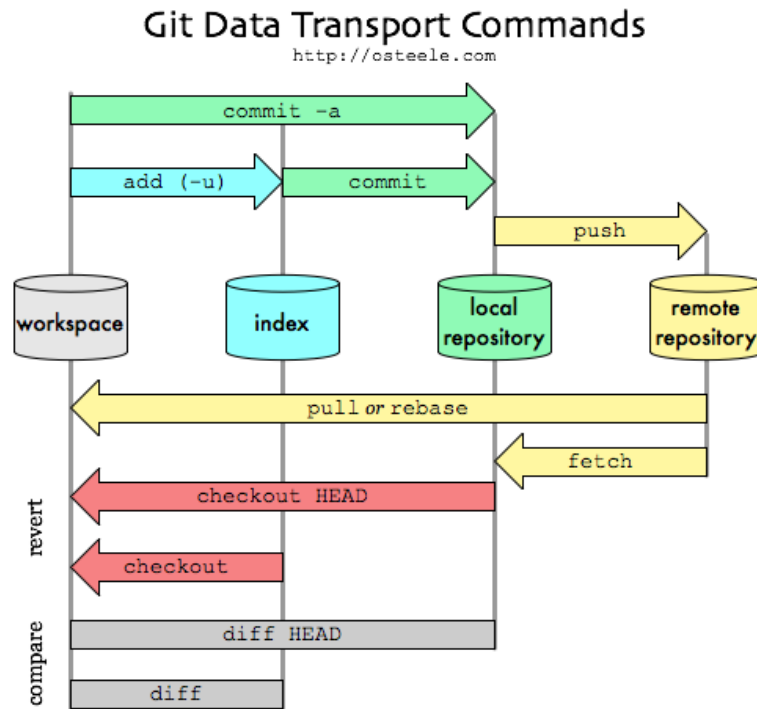
```
$ git merge origin/main
```

The `origin/main` and `main` branches now point to the same commit, and you are synchronized with the upstream developments.

Imagine that you would like to merge a remote branch called `test` with the `origin/main`:

```
localRepo $ git checkout main  (← go to your local main)
localRepo (main) $ git pull origin main(← update your local main )
localRepo (main) $ git merge test          (← merge local branch test with local main )
localRepo (main) $ git push origin main(← pushed local main to remote main )
```

ⁱ SVN: short for subversion, which is a type of [version control](http://aymanh.com/subversion-a-quick-tutorial) system. More at <http://aymanh.com/subversion-a-quick-tutorial>



Source: <http://blog.osteele.com/2008/05/my-git-workflow/>

2.8. Renaming branches

2.8.1 – On the remote repo (at “origin”)

On <https://www.github.com:>

- navigate to the main page of the repository.
- above the list of files, click **Branches** and select the branch to be renamed from the displayed list.
- to the right of the branch you want to rename (e.g. “main”), click on the small pencil-shaped icon to edit.
- type in the new branch name (e.g. “main”) and click the “Rename” button.

2.8.2 – On the locally cloned repo

- Update it with the changed branch name(s) by running the following commands:

```
localRepo $ git branch -m main main
localRepo $ git fetch origin
localRepo $ git branch -u origin/main main
localRepo $ git remote set-head origin -a
```

2.9. Renaming repos

“Renaming” a Git repo may mean renaming the local repo’s directory name, or the remote repo’s name. Each requires different steps.

2.9.1 – Renaming the remote repo (“origin”)

- Follow the host's instructions to rename the project (start at Settings), and note the new URL,
- Open a terminal, and navigate to your local repository directory,
- Set the new URL:

```
localRepo $ git remote set-url origin git@github.com:<user>/<new_name.git>
```

or, if you use a public key to access your remote repo:

```
localRepo $ git remote set-url origin git@HOSTNAME:<user>/<new_name.git>
```

where HOSTNAME is referenced in `.ssh/config`.

2.9.2 – Renaming the local repo

- rename the corresponding directory, using `mv` from the CLI.
- in case submodules are present, an additional corrective step is mandatory:

AS Git uses an absolute path to index submodules (when they exist), only renaming the local repo directory will impede further access to submodules. Each submodule configuration file, located at `.git/modules/config`, has the form:

```
[submodule "old/path/to/submodule"]
  path = old/path/to/submodule
  url = https://github.com/user/projectName.git
```

To fix that issue, it is necessary to edit each submodule's path information manually with:

```
localRepo $ find . -type f \( -name ".git" -o \( -path "*.git/modules/*" -name
config \) \) -print0 | xargs -0 grep --colour "old/path"
```

followed by:

```
localRepo $ find . -type f \( -name ".git" -o \( -path "*.git/modules/*" -name
config \) \) -print0 | xargs -0 sed -i -e "s#old/path#new/path#g"
```

2.10. Removing / deleting branches

Git branches reflect the state of a project with a commit history line that diverges from the branch from which it forked. Typically when a branch is merged with the branch from which it was forked, commit histories are reconciled and the merged branches stay behind, while the codebase moves on with later developments and modifications. Ultimately merged branches may clutter the project. For that reason it may be useful to delete certain branches after merging them.

To list local, remote and all branches, the commands are respectively:

```
localRepo $ git branch          # local
localRepo $ git branch -r       # remote
localRepo $ git branch -a       # all (local + remote)
```

2.10.1 – Deleting a local branch

This can only be done from outside the branch to be deleted.

After that branch's commits were fully merged, do:

```
localRepo $ git branch -d local_branch_name
```

If you want to disard that branch's commits, and force-delete it, simply do:

```
localRepo $ git branch -D local_branch_name
```

2.10.2 – Deleting a remote branch

From your local cloned repo, do:

```
localRepo $ git push origin -d remote_branch_name
```

in case your remote repo's name defaults to "origin".

2.11. Fetching remote branches

New Git branches may appear on the remote repo, "origin". That may be explained by contributors pushing new branches to the remote repo in order to push commits to it. You in turn may be interested in fetching such a remote branch, say "new_rem_branch", on your local repo. One of the ways to do this is:

```
localRepo $ git fetch
```

```
localRepo $ git checkout -b new_rem_branch --track origin/new_rem_branch
```

In the above "-b new_rem_branch" can be omitted, in which case the new local branch name will default to the new remote branch name.

3. Getting started with GitHub

3.1. Creating a GitHub account

[Github](#) offers free accounts for users and organizations working on public and open source projects, as well as paid accounts that offer unlimited private repositories.

- Set up your GitHub account. Within the next half hour, you will know how to use it.

Whenever you are logged in to the GitHub website, you will see a plus icon in the upper right corner. When you click on that, you will see a menu that includes a *New Repository* link. Click on that link. Choosing a repository name comes next (if we have spaces in our repo name, GitHub will automatically replace them with hyphens).

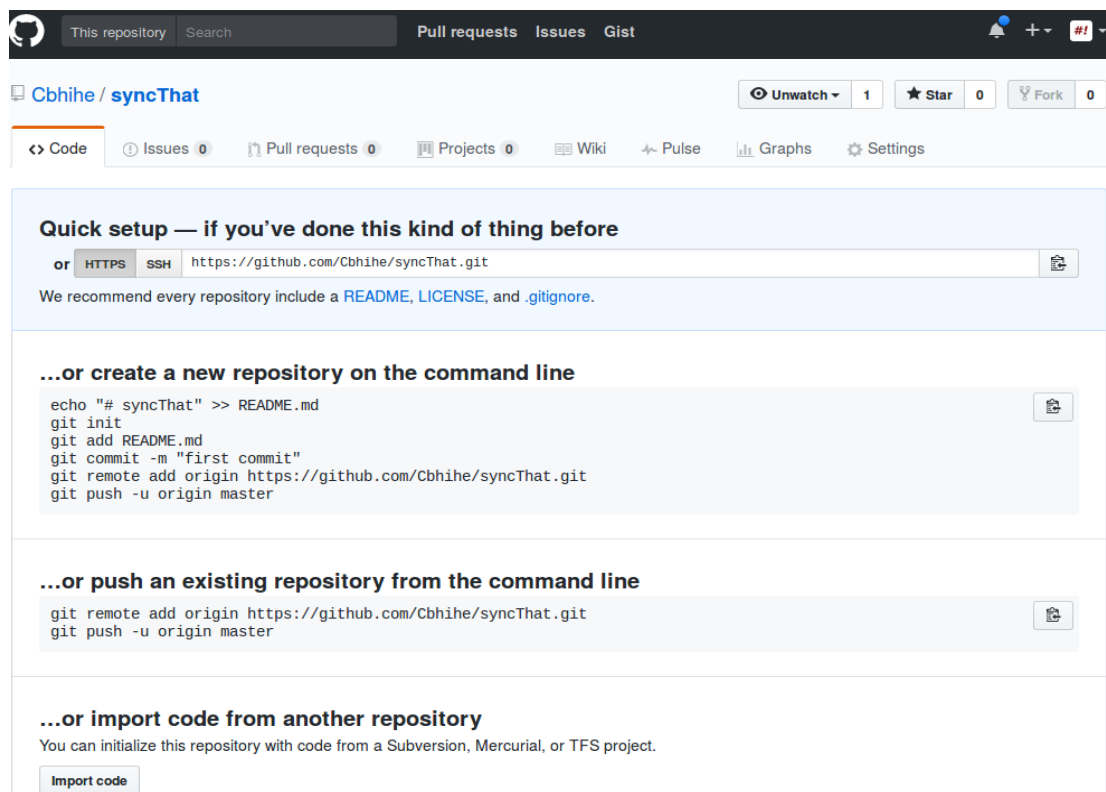
In this hands-on, we are going to create a remote repository on GitHub where we can push the local repository that we created previously (our local and remote repos do not have to have the same name). We can decide if our repo is public or private.

The next important thing we need to look at is the *Initialize this repository with a README* checkbox. This is a very important step in creating our remote repo. If we check the box, it will automatically create and commit a *README* file in our remote repo. We will usually create our local repo first, so we will not check this box in this case (this is the case of our example in this hands-on).

What you get is the screen shot below.

3.2. Connecting a local repo to a Github repository

Now you should see instructions (similar to the following screenshot) on how to connect your local repository in your computer to the remote one you just created on GitHub.



Looking at just the first option, the set of git commands should look very familiar, we have already done the first four commands. We only need to perform the last two commands in order to link our local repository with the remote one.

Remember that your changes are in the HEAD of your local working copy. To send those changes to your remote repository, your local repo must know about the remote repo on GitHub.

For that add a reference to that remote repo with `git remote add origin <server>` from your local repo. Only now can changes be pushed to the selected remote server:

```
LocalRepo $ git remote add origin https://github.com/Cbhihe/clc.git
```

In the above *origin* is an alias or place-holder for the remote repo.

Before we move on, let's take a look at the command we just executed. The primary git command we issued is `git remote` to work with remote repositories.

```
LocalRepo $ git remote -v
```

By itself the above would list all remote repositories known to the local repo. If we pass additional sub-commands to the `git remote` command, we can further add, remove, and modify the remote GitHub repository that your local repository is linked to.

Parameters:

```
origin
https://github.com/Cbhihe/clc.git
```

refer to the remote repository. In particular *origin* is an alias that we will use locally to interact with this remote repository and `https://github.com/Cbhihe/localRepo.git` indicates the remote repository's URL.

You can open `.git/config` with a text editor to see how git stores the information you just added.

You are now ready to **push** our code to GitHub with:

```
$ git push -u origin main
```

origin is an alias or place-holder for the remote repo and *main* indicates the remote repository branch. (It could be any branch beside *main*) The `-u` option shows untracked files (it includes in particular files that were removed from the local repo from the console shell).

If we have never pushed to GitHub before, we will now be seeing a login prompt, and we are required to introduce our GitHub username and password. SSH secure login can also be arranged as is detailed hereafter in Section 3.5. But if you follow this tutorial and come from the previous sections, your output should as follows:

```
Username for 'https://github.com': Cbhihe
Password for 'https://Cbhihe@github.com':
Counting objects: 3, done.
Writing objects: 100% (3/3), 236 bytes | 0 bytes/s, done.
Total 3 (delta 0), reused 0 (delta 0)
To https://github.com/Cbhihe/clcLab.git
 * [new branch]      main -> main
Branch main set up to track remote branch main from origin.
```

After a successfully login, a message appears to the effect that a number of objects have been written. We will also see a message saying that a local main branch was set up to track the remote main branch (thanks to the `-u` flag). As a result the remote GitHub account now holds files previously added with `git add` in the local repo: `Readme.md`

Sometimes the code in our remote repository will contain commits we do not have in your local repository (for example because we work on a team or we made a change to a file directly on GitHub.com). In those situations, we will need to **pull** the commits from the remote repository into our local repository with the command:

```
localRepo $ git pull origin main
```

3.3. Branching

It is important to be aware that branches can exist both locally and on remote repositories. A local branch is not available to others unless it is pushed to the remote repository with:

```
$ git push <remote> [<branch-name>]
```

You can omit to specify the branch name, if you are in that branch as you issue the command. However you must specify the branch name if you specifically need not to push other branches to the origin.

If pushing everything on the local repo to the remote repo (e.g. *origin*) is ok, then do:

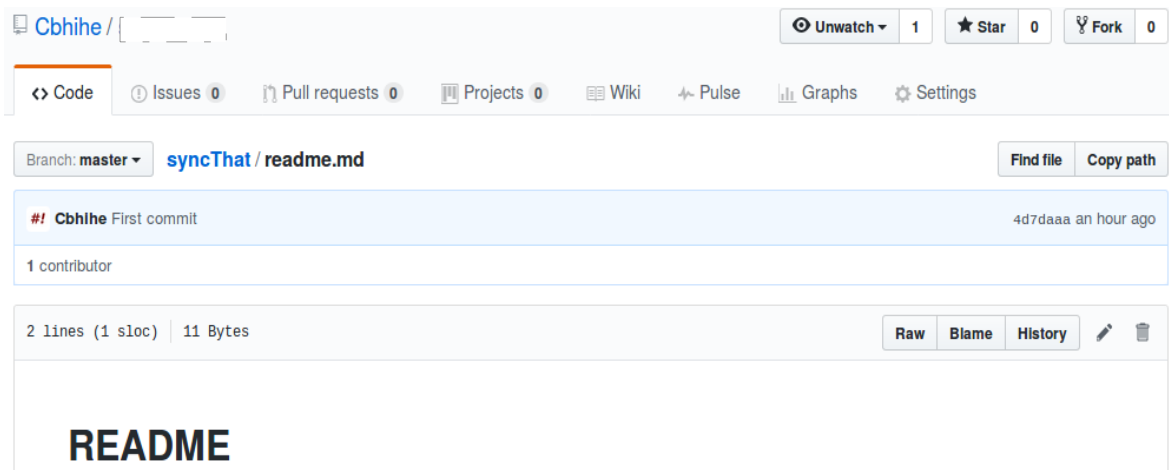
```
$ git checkout main ; git push <remote> --all
```

To update the local repo to the newest commit, go to the local repo's working directory. *Fetch* and *merge* remote changes with:

```
$ git pull
```

To merge another branch into your active branch (e.g. *main*), use:

```
$ git checkout main ; git merge <branch>
```

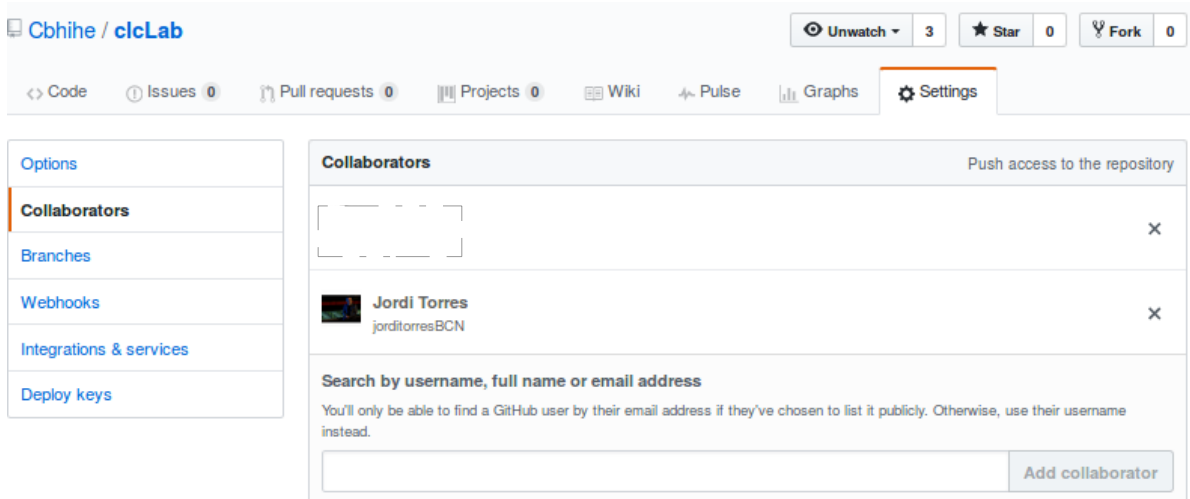


3.4. Inviting collaborators to a project

Hopefully you will not work on your own on all your project. Chances are that you will eventually want to invite outsiders (also with a GitHub account) to share your project. In that case “sharing” means that the invitee will acquire the capacity to act on your project's content and flow, much in the way that you would.

In order to do so, log onto GitHub and go to the concerned project's repo.

- go to Settings inside your project's repo
(Settings are located on the right hand side of the horizontal menu above the repos contents)
- on the left (vertical menu) click on “Collaborators”
- add collaborators to your project, by filling in their full names or their GitHub's nicknames.
- an invitation will be automatically sent to them.



In the case depicted in the previous figure, two collaborators have accepted GitHub-user Cbhihe's invitation and are featured.

3.5. Securing an SSH connection to your GitHub account

You can use either SSH private and public keys or GPG keys to connect to a GitHub account without entering a username and password everytime you push something from the local repo. What follows is a step by step guide to achieve that. (Also see <https://help.github.com/articles/connecting-to-github-with-ssh/>)

Open Terminal:

```
$ ls -al ~/.ssh      # Lists all files in the .ssh directory
id_rsa
id_rsa.pub
...
```

Check the directory listing to see if as shown above, you already have a public SSH key. By default, public keys filenames are `id_rsa` and `id_rsa.pub`.

3.5.1 Creating an SSH key

If you already have a public key you would like to use, skip to Section 3.5.2 to directly add that key to the ssh-agent.

If you don't have an existing public and private key pair, or don't wish to use any that are available to connect to GitHub, then generate a new SSH key.

```
$ ssh-keygen -t rsa -b 4096 -C "your_email@example.com"
```

The above creates a new ssh 4096 bit key, using the provided email as a label. You are then prompted to "Enter a file in which to save the key". Pressing 'Enter' accepts the default file location. At the following prompt, type a secure passphrase. The passphrase can be empty, although it is not a secure practice. The newly created key consists in reality of two files. One contains the public key and ends with the suffix `".pub"` and is called `"id_rsa.pub"` by default. The other file, called `"id_rsa"` by default, contains the SSH private key.

3.5.2 Adding an SSH key to the SSH-agent

If you see an existing public and private key pair listed (for example `id_rsa.pub` and `id_rsa`) that you would like to use to connect to GitHub, you can add that SSH key to the ssh-agent.

Start the ssh-agent in the background.

```
$ eval "$(ssh-agent -s)"
Agent pid 59566
```

Add the SSH private key to the ssh-agent. If you created a key with a different name, or if you are adding an existing key that has a different name, replace `id_rsa` in the command with the name of the desired private key file.

```
$ ssh-add ~/.ssh/id_rsa
```

Optionally you can check that the key was correctly added to the SSH-agent:

```
$ ssh-add -L    # for full key
or $ ssh-add -l  # for fingerprint
...
```

The result of the command above will show you either the full key (with ‘-L’), or a fingerprint (with ‘-l’) you should check for correctness. If everything checks, you are now ready to add the SSH key to the GitHub account.

3.5.3 Adding an SSH key to a GitHub account

To configure your GitHub account to use your new (or existing) SSH key, you must first add it to your GitHub account.

- copy the SSH public key to your clipboard:
- locate the `~/.ssh` folder
- open the public key file whose default name is “`id_rsa.pub`” (if you have not called it something else),
- paste its contents, including the starting tag (“`ssh-rsa`”) at the beginning, but not the end tag, separated from the key by a single space. Do not add any newlines or whitespace. Do not modify the contents of that file in any way.
- in the upper-right corner of any GitHub page in the account of interest, click the profile photo, then:
 - click **[Settings]**
 - select **[GPG and SSH keys]**
 - click **[New SSH key]** or **[Add SSH key]**
 - add a descriptive label for the new key in the “Title” field
 - e.g., if your host is called **Mozart**, you might call this key “Mozart SSH key”.
 - paste your key into the “Key” field
 - click **[Add SSH key]**
 - if prompted, confirm your GitHub password.

3.5.4 Test the SSH connection

To test the SSH connection, do in terminal:

```
$ ssh -T [-v[v[v]]] git@github.com
.... (message from GitHub)
```

Similarly for GitLab, you would do:

```
$ ssh -T [-v[v[v]]] git@gitlab.com
.... (message from GitLab)
```

Verify that the fingerprint in the message you see matches one of the messages in step 2, then type “yes”.

Verify that the resulting message contains your username.

3.5.5 Troubleshooting

After generating a SSH key-pair and adding the public-key to GitHub, pushing any change may result in GitHub still demanding the username/password combination. Git Hub does so probably because the `origin` (on GitHub) point to the https url rather than to the ssh url. To reveal that, do in terminal:

```
$ git remote -v
$ git remote set-url origin git@github.com:<Username>/<Project>.git
```

The first time a push is made, GitHub will normally request the corresponding passphrase.

4. Git clone

So far, we have been talking about connecting an existing remote repository with an existing local repository. But what if we don't have an existing local repository, and just want to pull down all the contents of a remote repository? In this case we can issue `git clone` to clone the contents of an existing remote repo in our local repo. That cmd has several options, but most of the time we will only consider its basic usage `git clone`.

`git clone` is used mainly when we need to work with a remote repo, and do not yet have a local repo created. This is the case of many of the hands-on suggested in this course. For that reason `git clone` is used in almost every lab's hands-on session. For instance, assume that the documentation of today hands-on is at `https://github.com/Cbhihe/localRepo.git`. Here's what it looks like in action:

```
~ $ pwd
/home/Cbhihe
~ $ git clone https://github.com/Cbhihe/clcLab.git hands-on_lab
Cloning into 'hands-on_lab'...
remote: Counting objects: 3, done.
remote: Total 3 (delta 0), reused 3 (delta 0), pack-reused 0
Unpacking objects: 100% (3/3), done.
Checking connectivity... done.
~ $ ls
hands-on_lab
~ $ cd hands-on_lab/
hands-on_lab $ ls -a
.      ..      .git      README.md
hands-on_lab $
```

As you can see a new local git repository was created in a directory called `hands-on_lab`. The full content of the remote repository `https://github.com/Cbhihe/localRepo.git` was downloaded into the newly created local repo.

Finally, indicate that a remote repo was added to the local repo's config, pointing to the remote repo URL, aliased as `origin`. This is the same thing as issuing:

```
$ git remote add origin https://github.com/Cbhihe/clcLab.git
```

from within the local repo's directory.

5. To go into more detail

An excellent book is the [Pro Git](#) book, written by Scott Chacon and Ben Straub and published by Apress. It is available [here](#) (pdf, epub, mobi, html). Its contents are licensed under the Creative Commons Attribution Non Commercial Share Alike 3.0 license. A dead-tree printed version of the book is also available (for a price) on amazon.com.

Now, we are ready to start a [new hands-on](#).

Appendix A

Markdown format

- ◆ To create a heading, add one to six # symbols before your heading text. The size of the heading is set in inverse proportion to the number of # used.
- ◆ To indicate emphasis with bold use ****** before and after the selected text.
- ◆ To indicate emphasis with italic use *** before and after the selected text.
- ◆ You can quote text with a >.
- ◆ You can call out code or a command within a sentence with single backticks ```. The text within the backticks will not be formatted.
- ◆ To format code or text into its own distinct block, use triple backticks.
- ◆ We can create an inline link by wrapping link text in brackets [], and then wrapping the URL in parentheses ().
- ◆ We can make a list by preceding one or more lines of text with - or * . To order the list, precede each line with a number.
- ◆ We can create a new paragraph by leaving a blank line between lines of text.

For more information, see Daring Fireball's ["Markdown Syntax"](#).

Appendix B

.gitignore

```
# Compiled source #
#####
*.com
*.class
*.dll
*.exe
*.o
*.so

# Packages #
#####
# it's better to unpack these files and commit the raw source
# git has its own built in compression methods
*.7z
*.dmg
*.gz
*.iso
*.jar
*.rar
*.tar
*.zip

# Logs and databases #
#####
*.log
*.sql
*.sqlite

# OS generated files #
#####
.DS_Store
.DS_Store?
.*
.Spotlight-V100
.Trashes
ehthumbs.db
Thumbs.db
```