Version Control With Git & GitHub

Demitri Muna

AAS 231 • 8 January 2018

What You Want When Writing Code

- Backups
- Ability to see a previous version of your code
- Marking code that works / is stable
- Marking code that ran a particular analysis
- Access to your code from anywhere
- Synchronize changes to code across multiple computers.
- Share your code with people.

Most people try to accomplish some of these things by hand, but often forget to do (or just skip!) one more steps because it isn't easy or is time consuming.

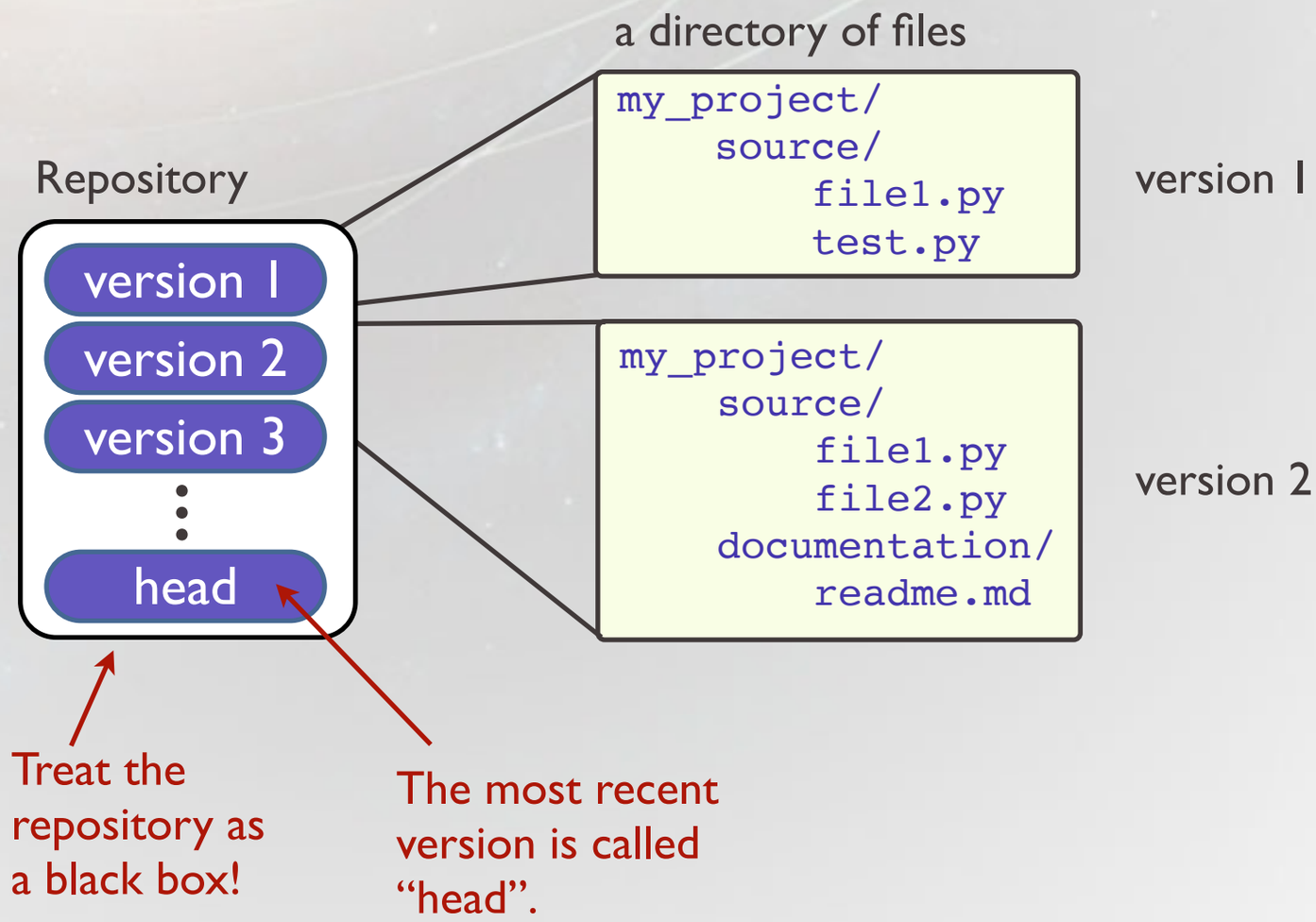
(And really, you want most of these things for *all* your files!)

Integrating Version Control Into Your Workflow

- Many ways to organize a repository; I'll show you one, but feel free to adapt to your needs.
- The most important thing is to *use* it!
- Most any file can be saved into a repository (text, images, mp3s, ... nearly anything).

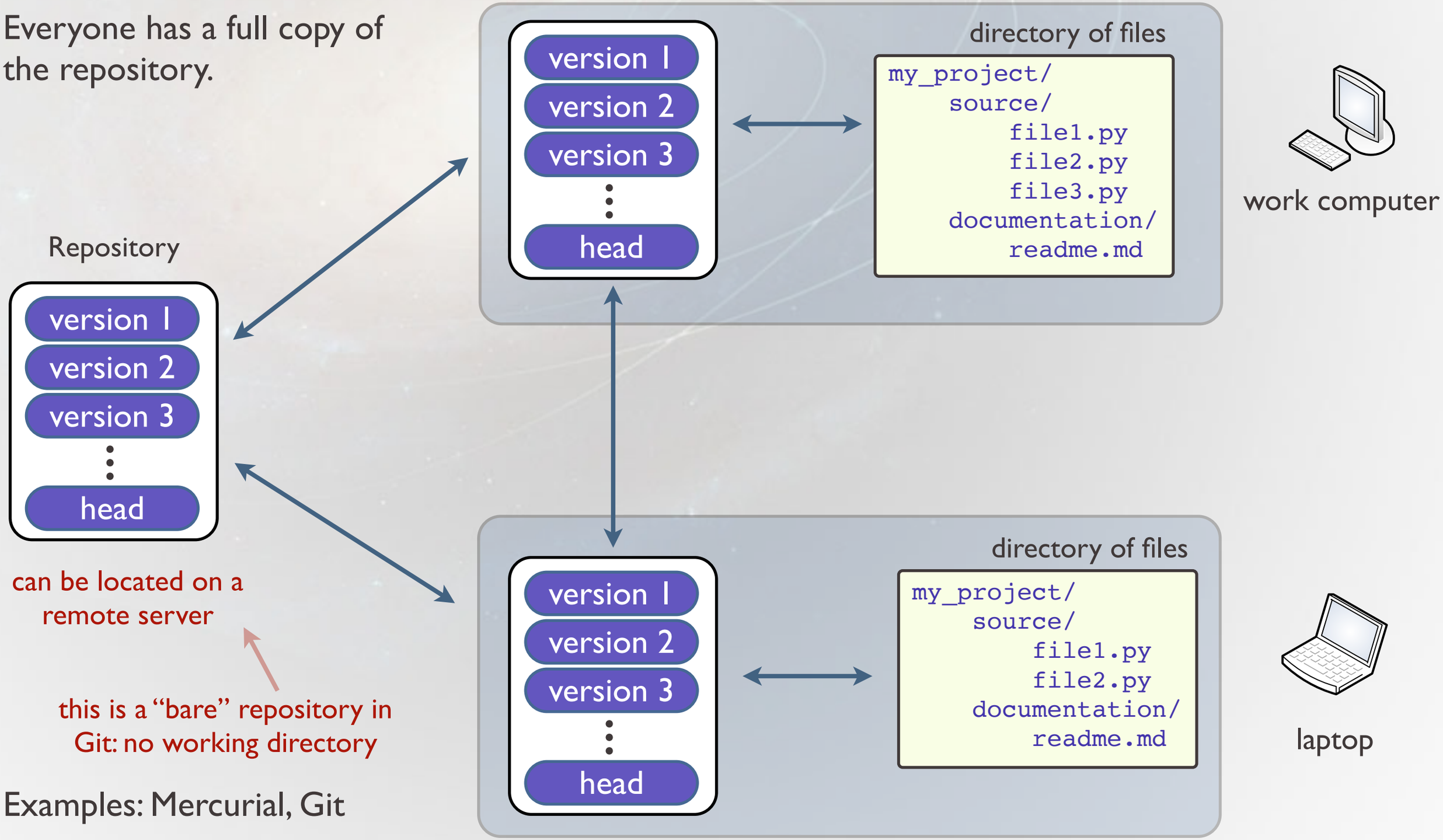
The Repository

A place where all versions of all files are stored. With this, the current version or any prior version of any file in the repository can be recovered. Can be locally or remotely located. If only a local copy (i.e. on your own hard drive) is created, it doesn't provide a backup in case of computer failure.



Distributed Repository

Everyone has a full copy of the repository.



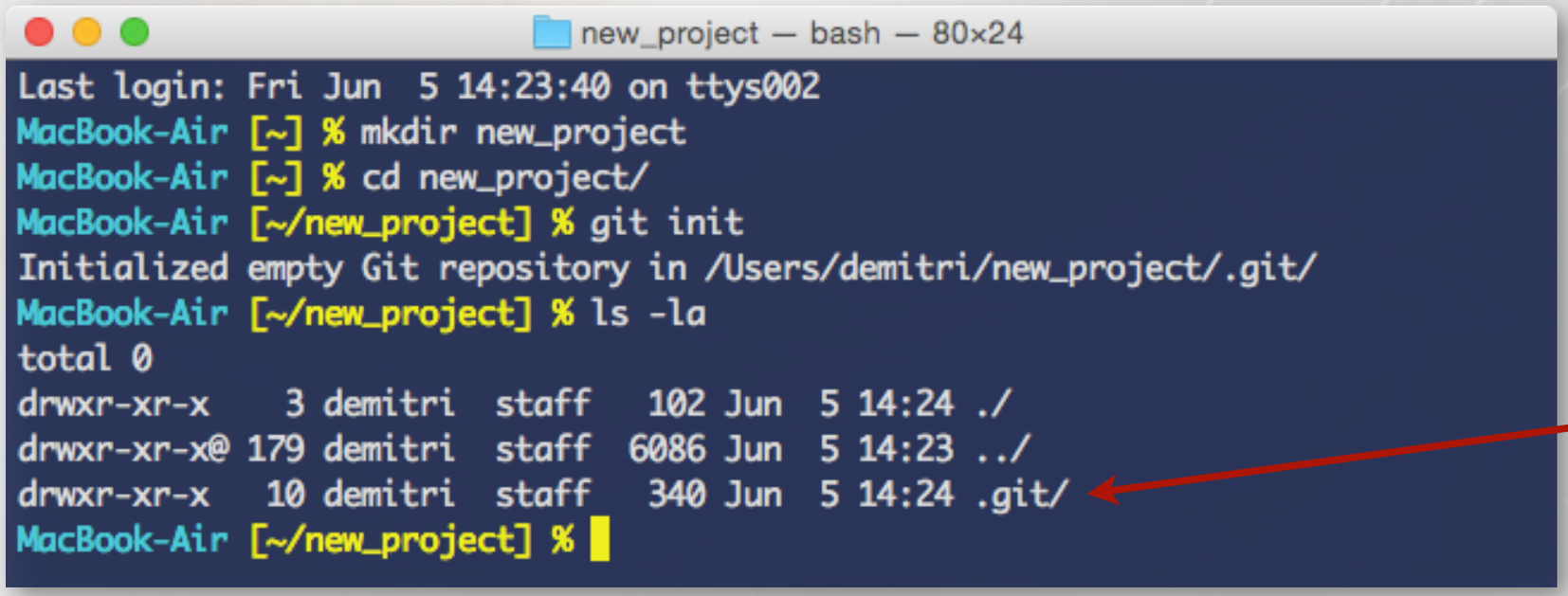
Examples: Mercurial, Git

How Many Repositories?

- Typically, you'll create one repository for every project. This allows you to provide access to others on a project-by-project basis.
- Create your own repository to contain all code you write that is not otherwise contained in another repository.
- Avoid keeping very large data files in your repository. Small data files as appropriate are ok (e.g. data that code depends on).

Creating a New Repository

Creating a new repository:



Similarly, you can "git init" in any existing directory to convert it to a repository. There are tools to then upload it to GitHub (links below). It's easier to just create a new repository on GitHub, clone it, then copy files into the resulting directory.

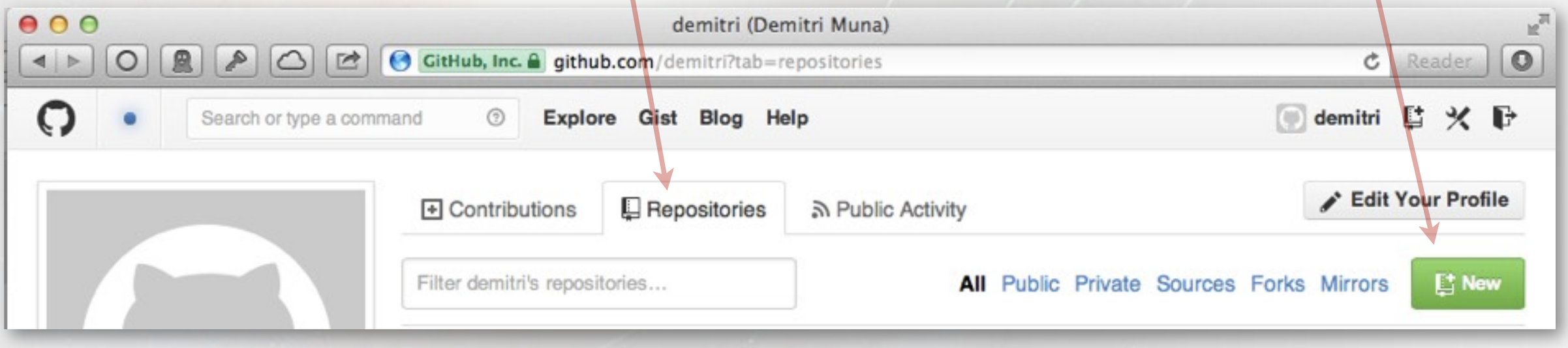
https://import.github.com/new

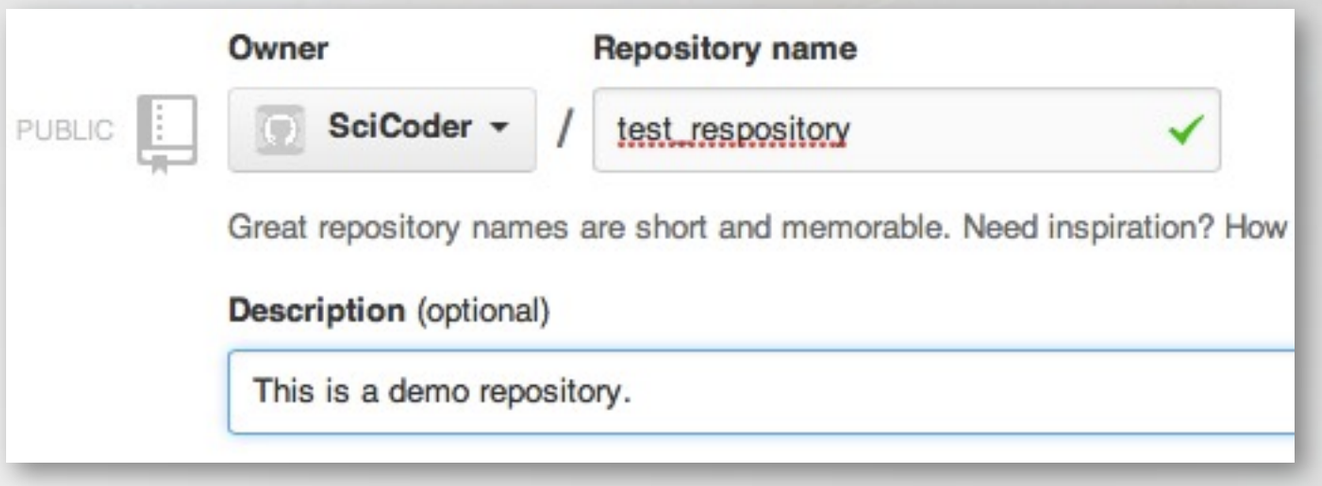
https://help.github.com/articles/importing-a-git-repository-using-the-command-line/

Creating a New Repository on GitHub

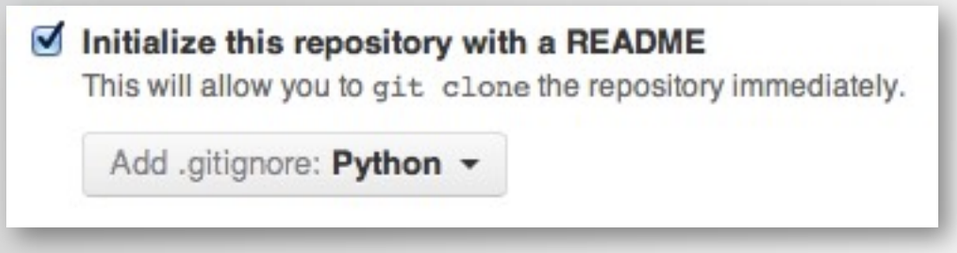
Go to your account on GitHub, select "Repositories".

Create new repository.

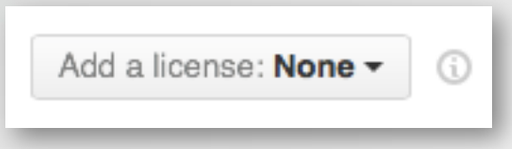




Fill in a name & description.



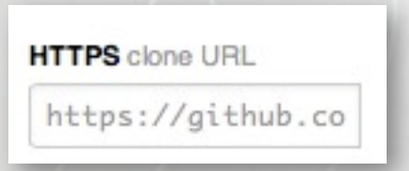
Initialize repository, select primary language to use (more on "ignores" later).



Licenses are a whole other topic…

Cloning the Repository

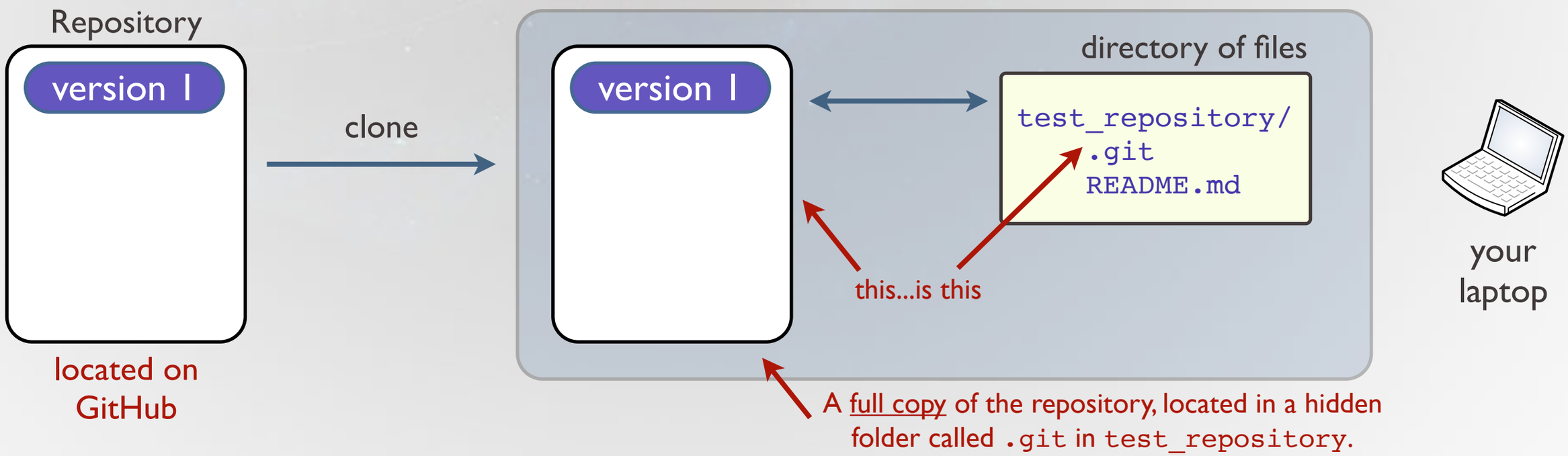
On the lower right on the next page, copy the "clone URL".



In the terminal, enter: `git clone <URL>`

```
blue-meanie [~/Documents/Repositories/tmp] % git clone https://github.com/SciCoder/test_respository.git
Cloning into 'test_respository'...
remote: Counting objects: 4, done.
remote: Compressing objects: 100% (4/4), done.
remote: Total 4 (delta 0), reused 0 (delta 0)
Unpacking objects: 100% (4/4), done.
blue-meanie [~/Documents/Repositories/tmp] %
```

What does this do? You've made a local copy of the repository. Now there are two copies of the repository and one copy of the files (your "working directory").



Cloning the Repository

In git, repositories do not have names. However, we do need to refer to other repositories, e.g. the one on a remote server versus the one on our computer.

The command

```
git clone <URL>
```

will automatically copy the repository at the given URL to your computer and then name the remote repository so you can refer to it. (The name is assigned locally – the remote still doesn't have a name.) The default name it gives is "origin". This command is equivalent to the above:

```
git clone --origin origin <URL>
```

You'll see "origin" a lot – this is what it is referring to.

Adding a File to Your Repository

Create a new file and place it into the repository (`touch newfile.txt` is useful here). It's currently untracked. This means that git won't save or do anything with this file. To see this, type "`git status`".

```
blue-meanie [test_respository] % touch newfile.txt
blue-meanie [test_respository] % git status
# On branch master
# Untracked files:
#   (use "git add <file>..." to include in what will be committed)
#
#       newfile.txt
nothing added to commit but untracked files present (use "git add" to track)
```

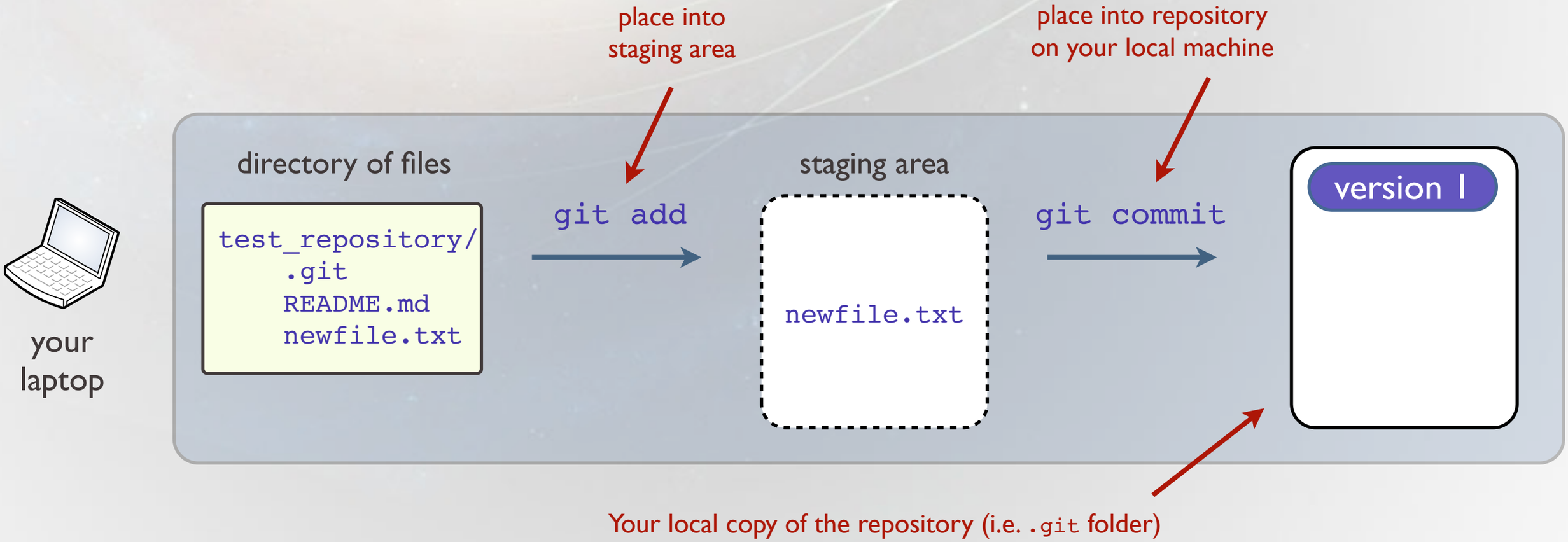
gives you a status of your working directory & local repository - you'll use this command a lot

We want to add this file to the repository, so we say `git add newfile.txt` to do so. From now on, this file is "tracked" by git, but it's not yet in the repository.

```
blue-meanie [test_respository] % git add newfile.txt
blue-meanie [test_respository] % git status
# On branch master
# Changes to be committed:
#   (use "git reset HEAD <file>..." to unstage)
#
#       new file:   newfile.txt
#
blue-meanie [test_respository] %
```

Git Staging

Adding a file puts it into a "staging area", essentially telling git you want to save this version of the file. Later. Not now though. It's like a promise ring. "Get ready git. I might make a commitment. At some point."



The `git commit` command will then actually save the file into the repository.

Committing Files

You need to be roughly aware staging happens. I do not recommend you use this feature. When you are ready to add files, place them into the repository IMMEDIATELY with the `commit` command.

```
blue-meanie [test_respository] % git status
# On branch master
# Changes to be committed:
#   (use "git reset HEAD <file>..." to unstage)
#
#       new file:   newfile.txt
#
blue-meanie [test_respository] % git commit -m "First commit."
[master 9b8c29c] First commit.
 0 files changed
 create mode 100644 newfile.txt
blue-meanie [test_respository] % git status
# On branch master
# Your branch is ahead of 'origin/master' by 1 commit.
#
nothing to commit (working directory clean)
blue-meanie [test_respository] %
```

i.e. in staging area limbo

list of files that will be committed

A description of the changes *must* be specified with every commit, easiest with the "-m" flag.

Yeah, that's helpful. We'll get to this.

This means that the latest version in the repository matches the files in the working directory.

NOTE: Committing files only saves them to your local repository.

Committing Files

If you try to commit without staging, you'll get this error:

```
blue-meanie [~/test_repository] % git commit
On branch master
Changes not staged for commit:
   modified:   newfile.txt

no changes added to commit
blue-meanie [~/test_repository] %
```

Not terribly user-friendly output...

If you commit without the `-m` (message) flag, the default editor on your shell will open to prompt you to enter a message describing the changes.

Avoid committing something before checking to see if there is a remote update. The solution is painful.

Committing Files

Can we just pretend the whole staging thing doesn't exist?! YES!

Staging is annoying; I avoid it whenever possible
Mnemonic: add things for me

```
% git commit -a -m "Fixed all the bugs."
```

```
git add "file1.txt"
git add "file2.txt"
git commit -m "bugs fixed"
```

=

```
git commit -am "bugs fixed"
```

But *only* for files that are being tracked! You have to "add" them yourself at least once.

IF you use staging (don't):

- The typical workflow will be to edit files, '`git add`' them, then immediately commit with a message.
- If you '`git add`', commit immediately. Don't leave files in the staging area.
- If you '`git add`', then modify the file, you will need to '`git add`' again.
- '`git commit`' by itself will open your designated text editor to prompt (force) you to enter a message. Just always use the '`-m`' flag.

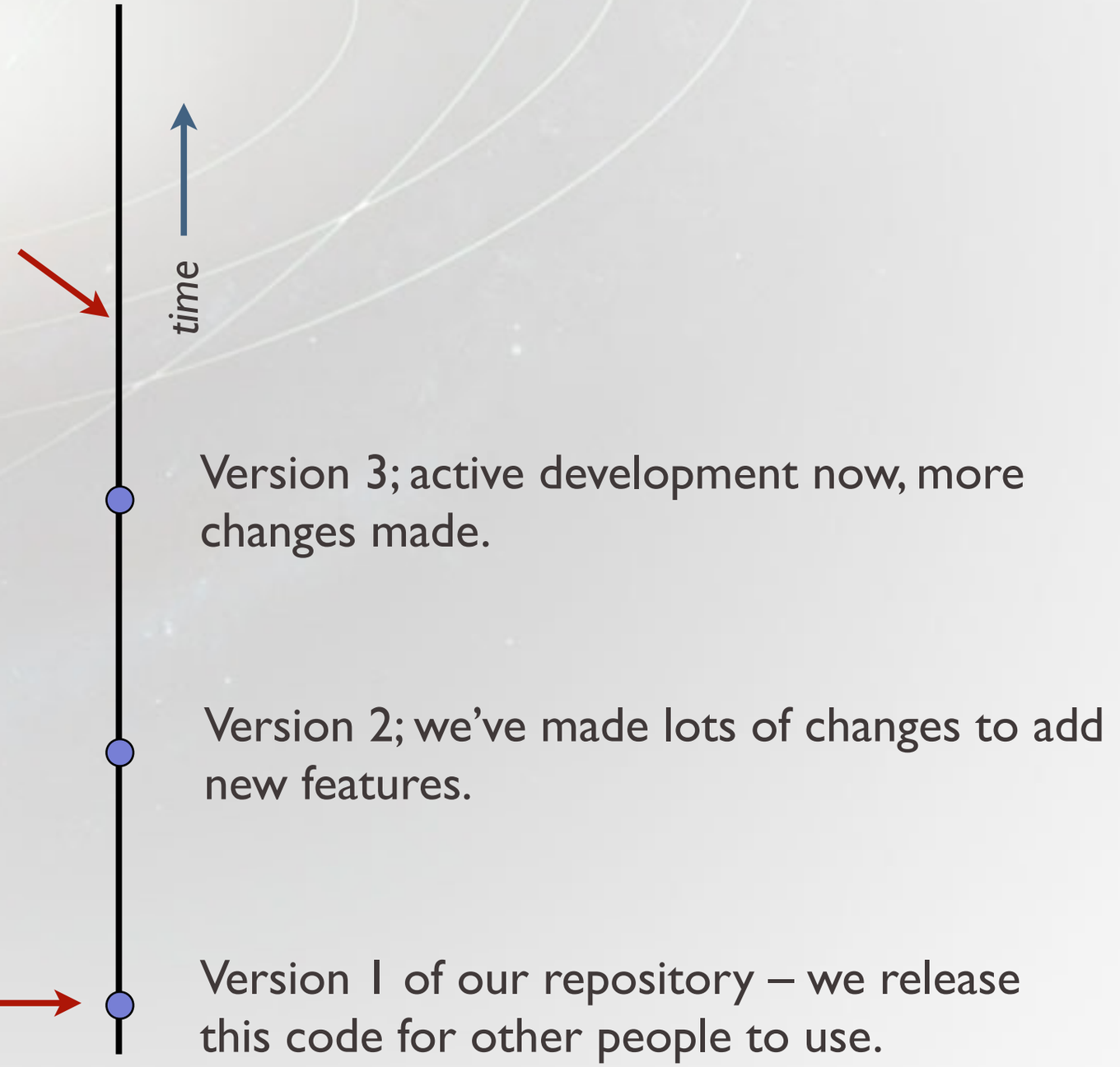
Branching

OK, now it gets complicated.

Someone sends an email about a huge bug in version 1. Oops.

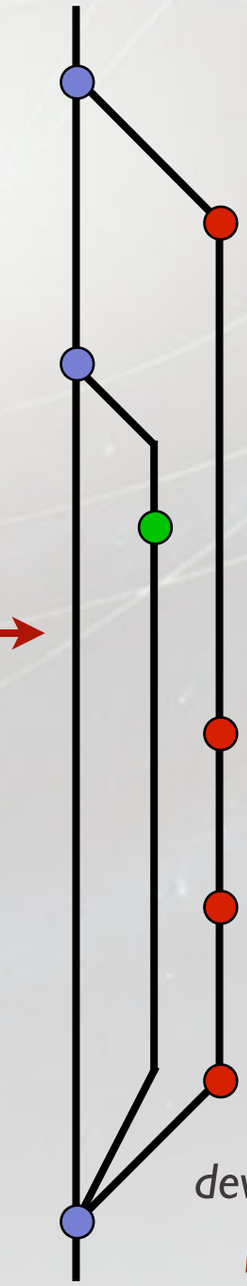
But we've made lots of changes to the code now; we can't simply fix the bug and release a new update.

Well, we can check out version 1, fix the bug, but how do we save the change back? Too many changes have been made since.



Branching

Let's try this again.



Merge development back into *master*, release code.

More development.

Merge fix back into *master*, release this code.

Create a new branch "*bugfix*" based off version 1, not the current code. Fix bug.

Someone sends an email about a huge bug.

Active development now, more changes made.

Lots of changes to add new features.

Start a new *branch* – an independent copy of one version of the repository. This is like having two repositories in one.

Version 1 of our repository – we release this code for other people to use

each branch has its own name

Branching

Your local working directory always represents one branch. To see what branches are in our repository:

first, default branch is automatically named *master*

```
blue-meanie [test_respository] % git branch
* master
blue-meanie [test_respository] %
```

list all branches

the current branch has a * in front of the name

To create a new branch:

`git branch branchname`

This creates a new branch, but your working directory does not change. To change your working directory to the new branch:

`git checkout branchname`

```
git branch branchname
git checkout branchname
```

=

```
git checkout -b branchname
```

Saving To Another Repository

What did this line mean...?

name we call the remote repo

now we know this is the name of the main branch

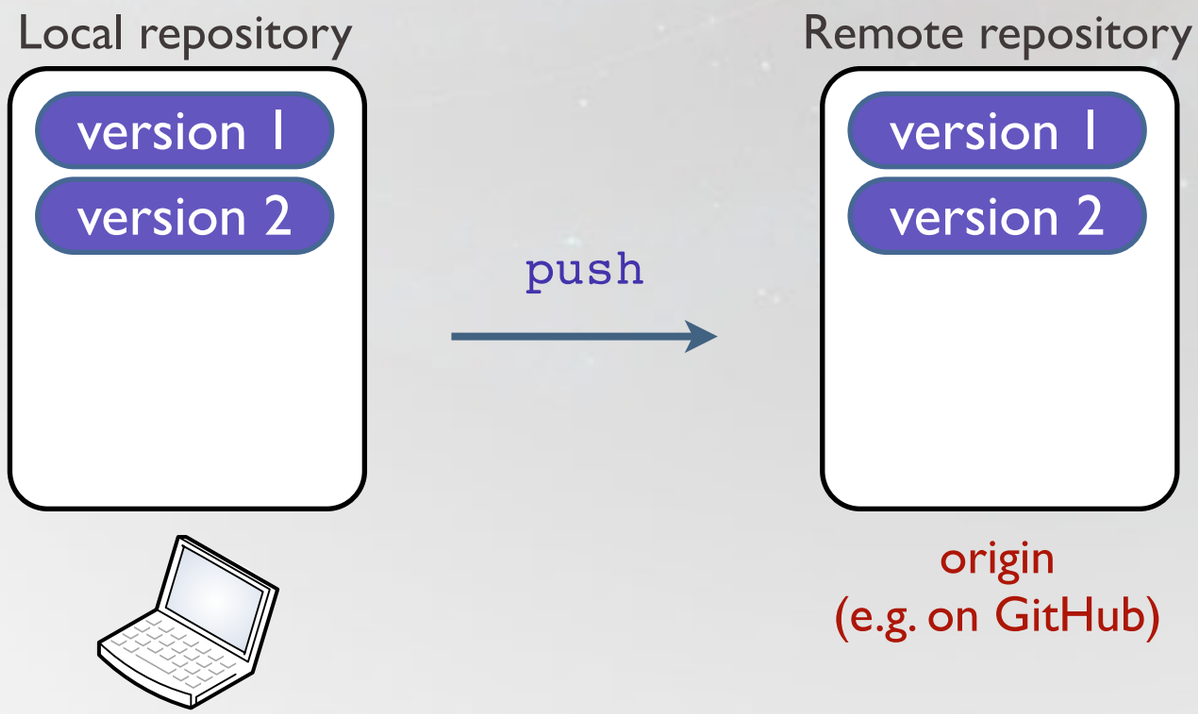
```
# Your branch is ahead of 'origin/master' by 1 commit.
```

The local repository (your computer) has a newer update than what is on the remote server (which we call "`origin`"). The line above means that one commit occurred after the last commit on the master branch on the remote repository `origin`.

We want to send those changes to the remote repository... this is called a *push*:

```
git push <remote repo name> <branch name>
```

note default remote name is "origin" and default branch is "master", defined in .git/config

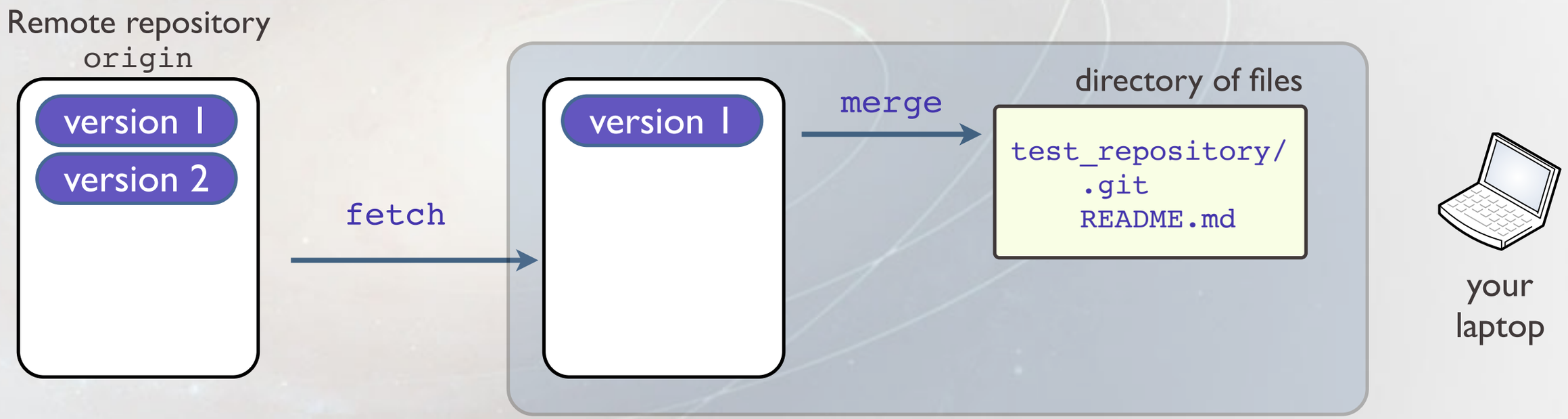


In our example from before, this would be:

```
git push origin master
```

```
blue-meanie [test_respository] % git push
Username for 'https://github.com': demitri
Password for 'https://demitri@github.com':
Counting objects: 9, done.
Delta compression using up to 2 threads.
Compressing objects: 100% (6/6), done.
Writing objects: 100% (8/8), 720 bytes, done.
Total 8 (delta 2), reused 0 (delta 0)
To https://github.com/SciCoder/test_respository.git
   e5aa6ac..2377659  master -> master
```

Getting Changes from the Remote Repository



This command will retrieve changes from the remote repository to your local repository:

```
git fetch
```

This does not update the files in your working directory. To do that, follow the `fetch` with:

```
git merge
```

Or, if you actually have better things to do with your time, use this command:

```
git pull
```

`git pull` = `git fetch` `git merge`

Deleting Files in Git

If a file is in your working directory and you have never added it (with `git add`), you can just delete it.

If your file is being tracked (i.e. you did a `git add` at least once):

```
git rm filename
```

If your file is being tracked and you want git to stop tracking it (remove it from the repository), but to not actually delete it:

```
git rm --cached filename
```

Remember to `git commit` after any of these commands!

Hosting Your Repository

Most commonly used, particularly for open source projects.

Open source repos are free; private repos require paid account. Go to http://github.com/edu to request free upgrade for academic users. Note the academic upgrade expires after two years; your private repos will be deleted unless renewed!!

Unlimited private and public repos. Private repos limited to sharing between five users. Upgraded accounts (automatic with academic address) removes this limit.

Can host Git or Mercurial repositories.

Better for hosting a repo that you don't want to be public (private code, writing a paper with a few people).

It's very common to have an account with both services. These sites provide web access, an "issues" system, wiki, etc. for your repositories. None of these features are built into Git or Mercurial.

AAS 231 Workshop Repository

SciCoder repository:

`https://github.com/demitri/aas231_workshop`

Go ahead and check this out now from the command line:

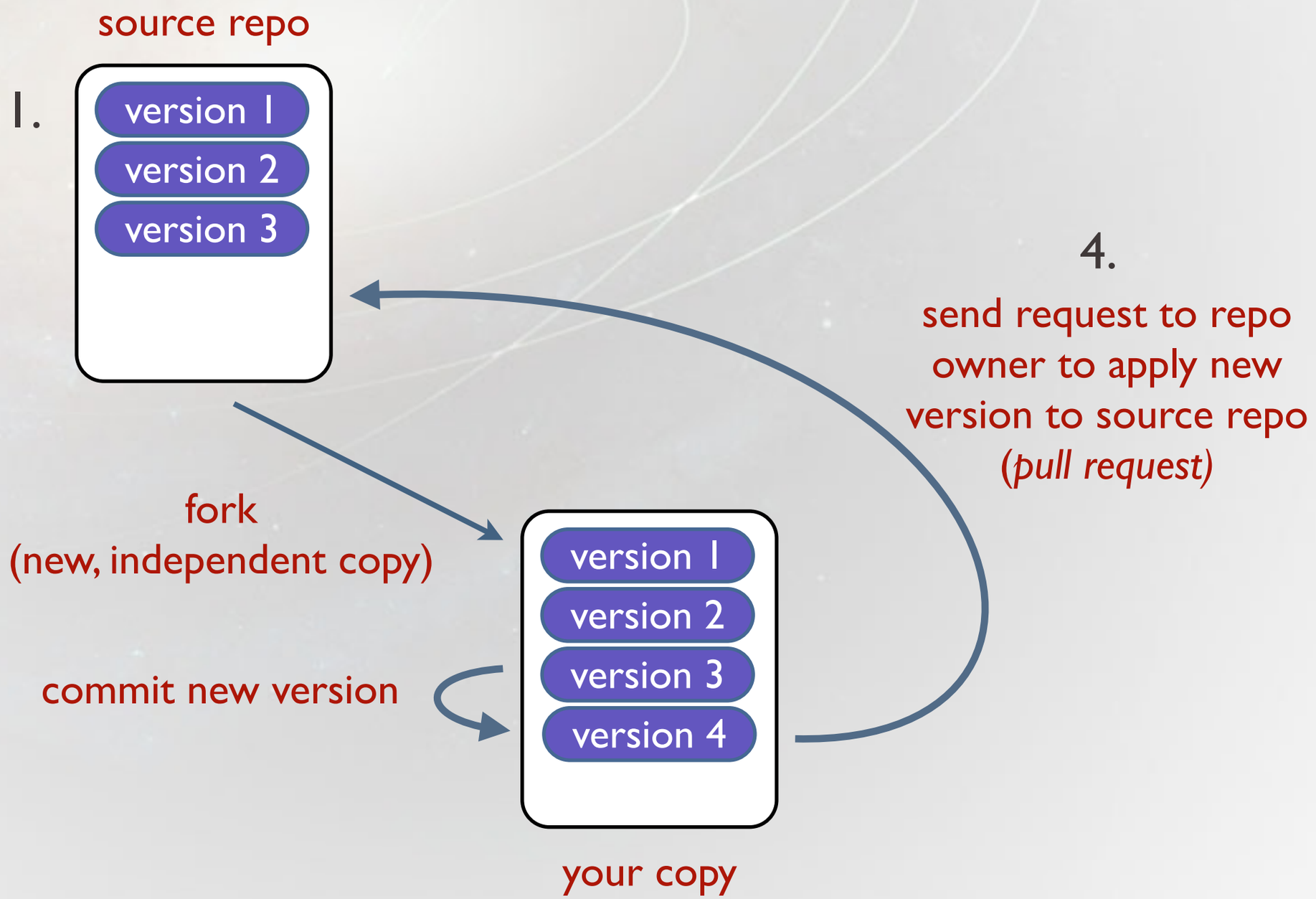
```
% git clone https://github.com/demitri/aas231_workshop
```

Files, code, data, and updates will be distributed to you today through this repository.

Have GitHub (maybe Bitbucket too?) remember your password:

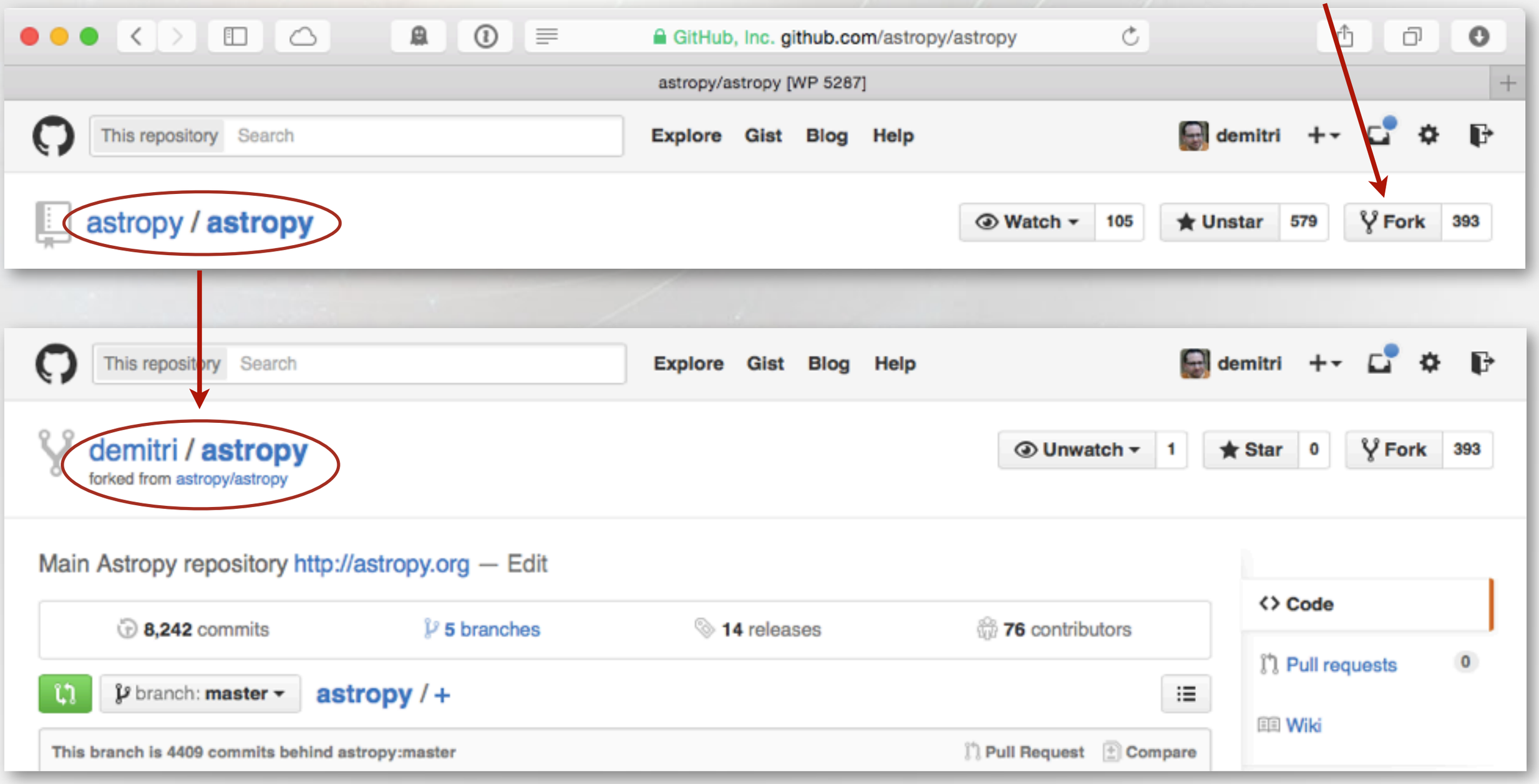
https://help.github.com/articles/caching-your-github-password-in-git/

Contributing to an Existing Repository



Forking on GitHub

Fork an existing repository. This makes a copy of the repository and places it under your account.



Forking on GitHub

The forked repository is a new, independent repo – your own copy. You can also fork a project to use it as a starting point and then develop it in a different direction.

Once forked, clone the copy to your computer as you normally would. I recommend you give it a name that makes it obvious that it's a fork:

```
git clone https://github.com/demitri/astropy.git astropy-demitri
```

source

user name

repo name

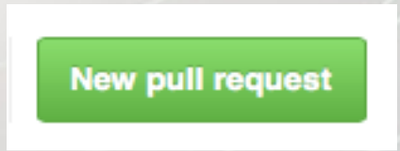
You can now make changes to the files and commit them. The commits stay in your repository (fork) – they will *not* be pushed back to the original repository.

Pull Requests

A *pull request* is a request to take a particular commit that you've made on your fork and merge it back to the source repository. To create a pull request on GitHub:

click here

then here



When you make a pull request, you can include comments. GitHub provides a page for each pull request where anyone can discuss the request before it gets accepted. Only the source repo owner can accept the request.

Updating a Fork

Let's say you fork a project and leave it alone for a while (e.g. Astropy). In that time, many commits have been made to the original project. Your fork is now very out of date. Before working on your fork, you want to bring it up to date.

You can do this directly on GitHub, or you can do it on the command line.

The recipe(s) are here:

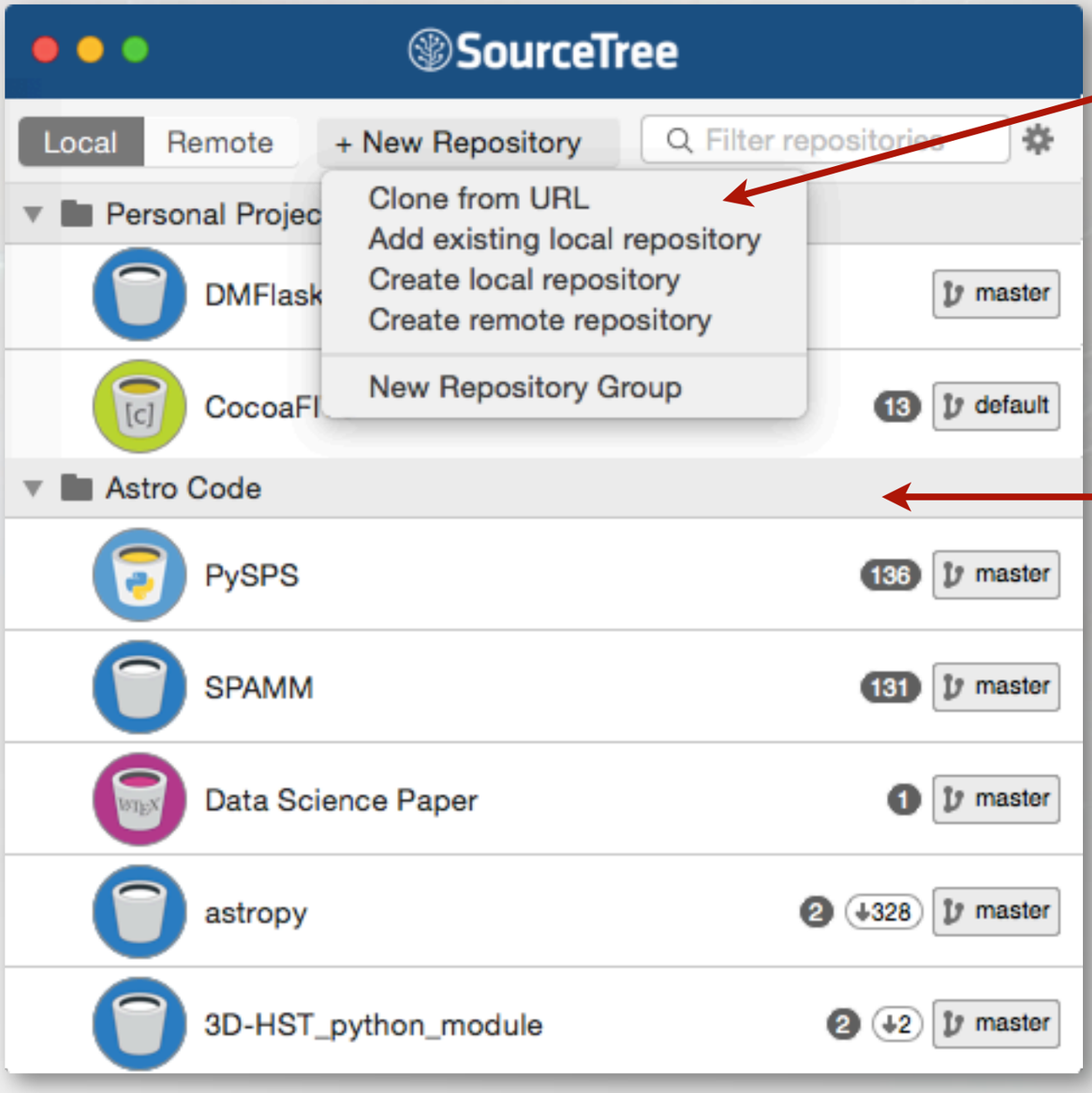
`http://stackoverflow.com/questions/7244321/how-to-update-github-forked-repository`

Graphical Clients

You should (more or less) know how to use Git on the command line, but a graphical tool is much easier to use. Git can get much more complicated beyond what has been presented here, and a GUI can help manage this.

GitHub has their own graphical client. I don't recommend it; it's not very good, and it only works with repositories on GitHub.

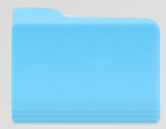
SourceTree (Mac/Windows)



add an already cloned repo or pull one straight from a URL

organize the many repositories you use/follow

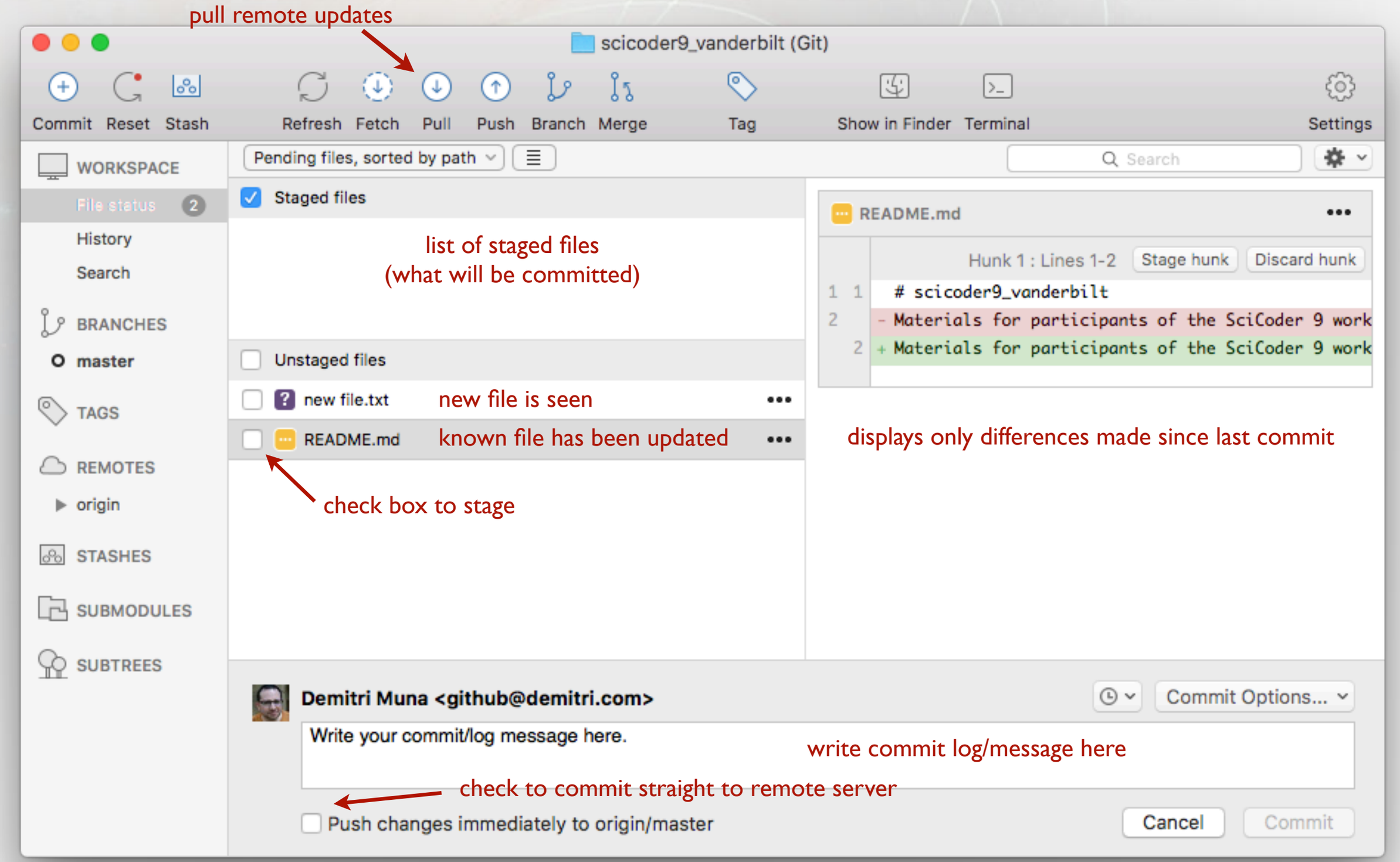
see what repos have updates at a glance



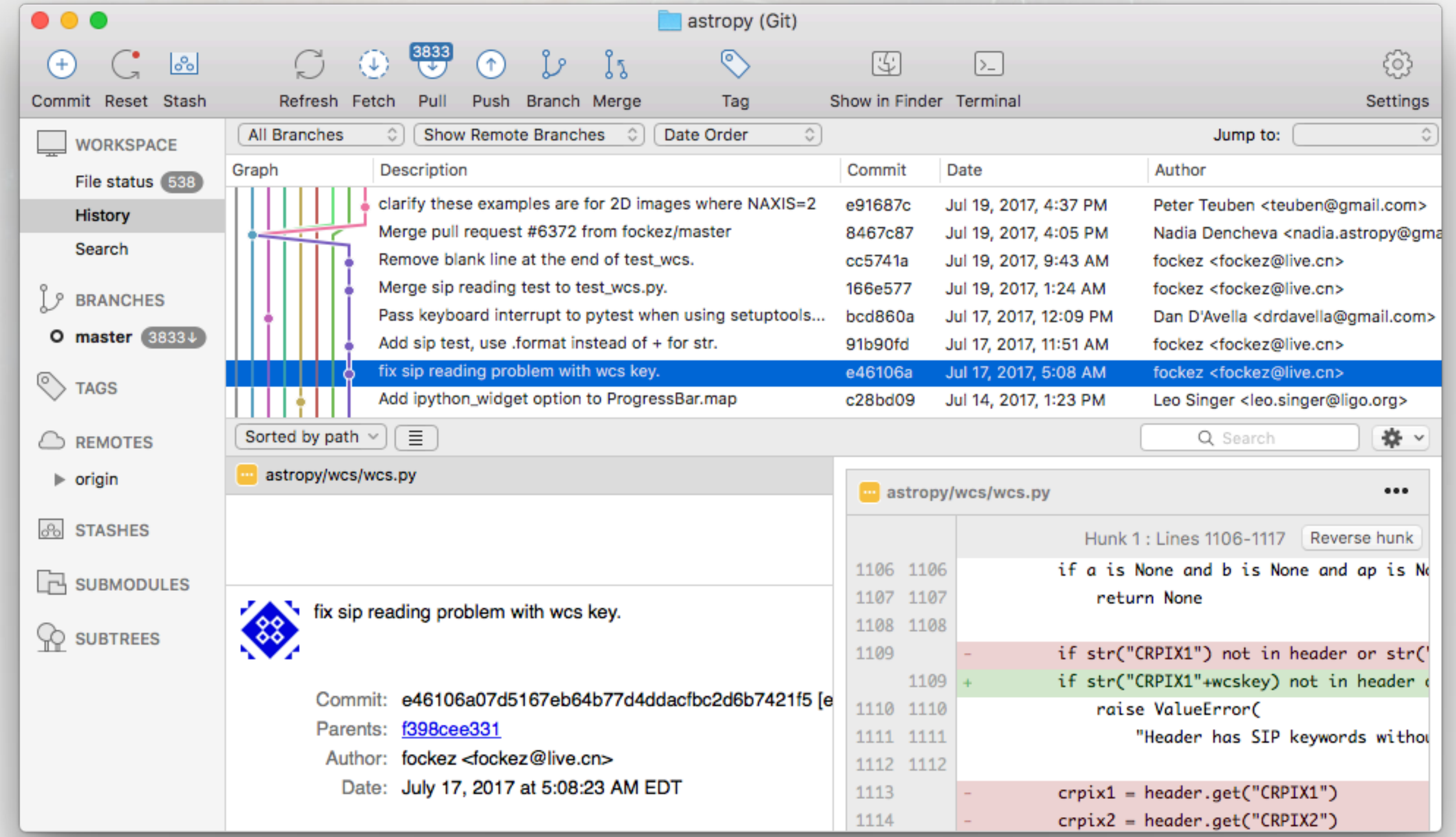
can also drag a folder from your desktop to add to list

list of all your Git or Mercurial repositories on your computer

SourceTree (Mac/Windows)



SourceTree (Mac/Windows)



Linux GUI Tools for Git

I don't use Linux, so you'll have to explore this area on your own!

Here are some places to start:

https://apps.ubuntu.com/cat/applications/gitg/

http://unix.stackexchange.com/questions/144100/is-there-a-usable-gui-front-end-to-git-on-linux