LEIDEN UNIVERSITY MEDICAL CENTER

Working with branches in Git

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The Git commit graph

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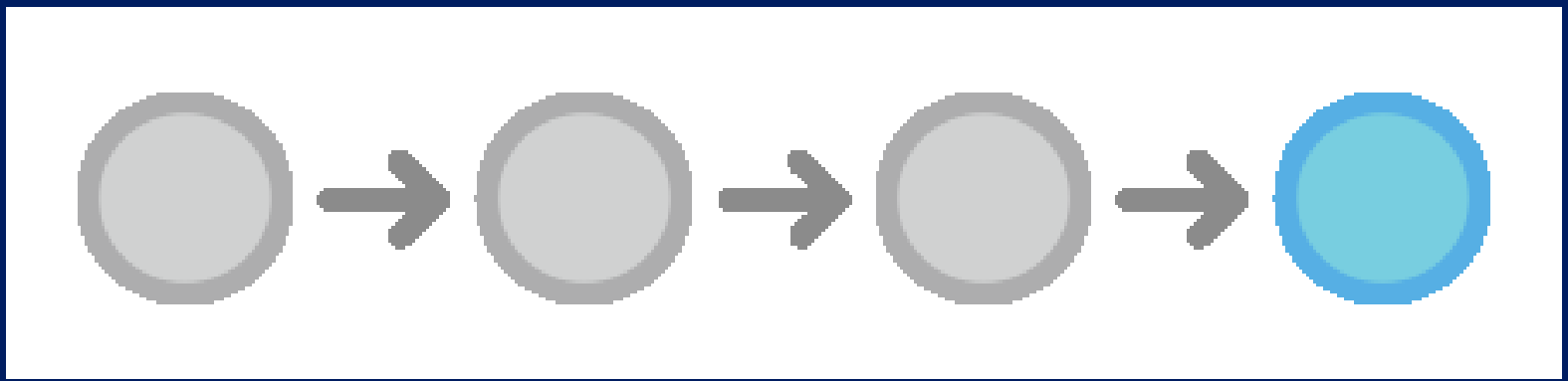
The Git commit graph

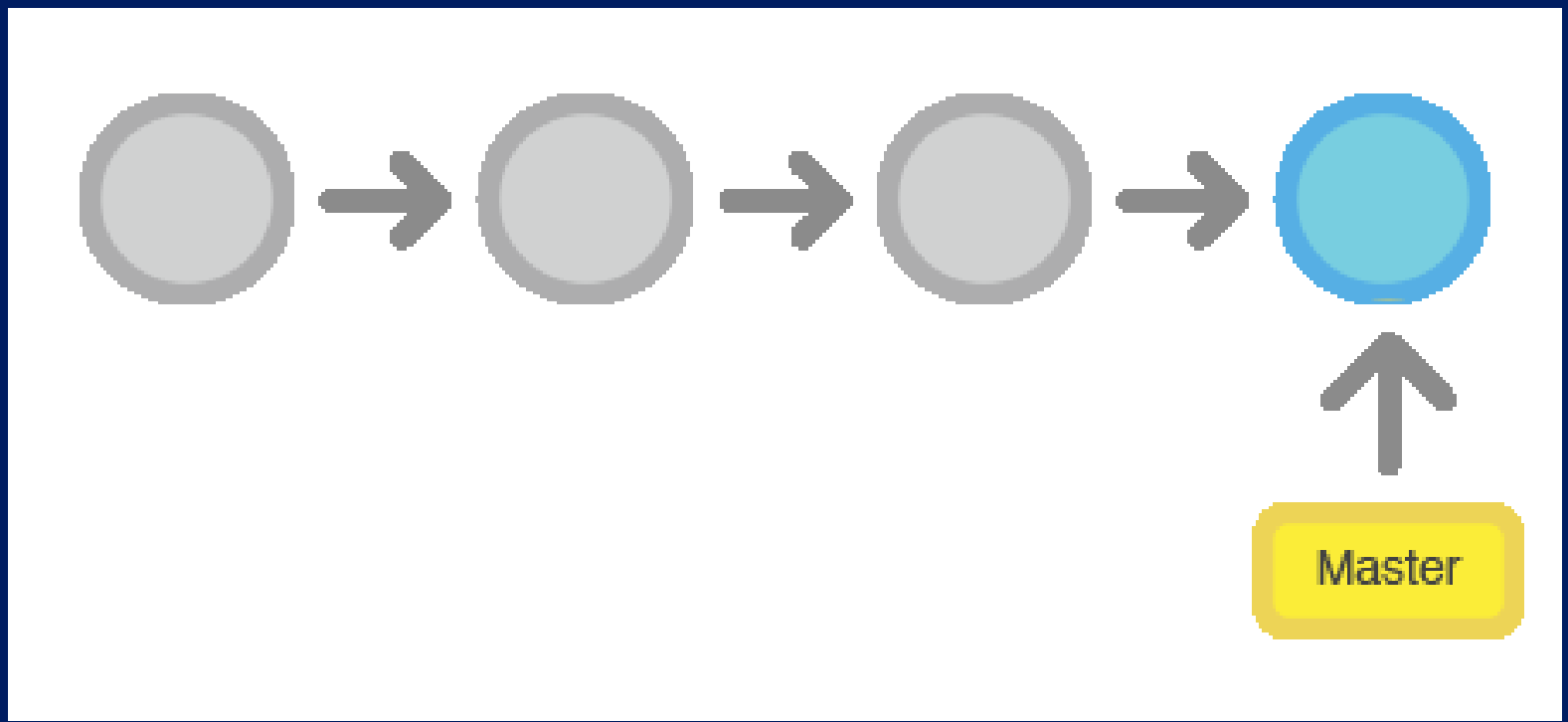
A linear history



- Every commit has a parent.
- *Committing* creates a new commit on top of the current one.

The Git commit graph

The default `master` branch

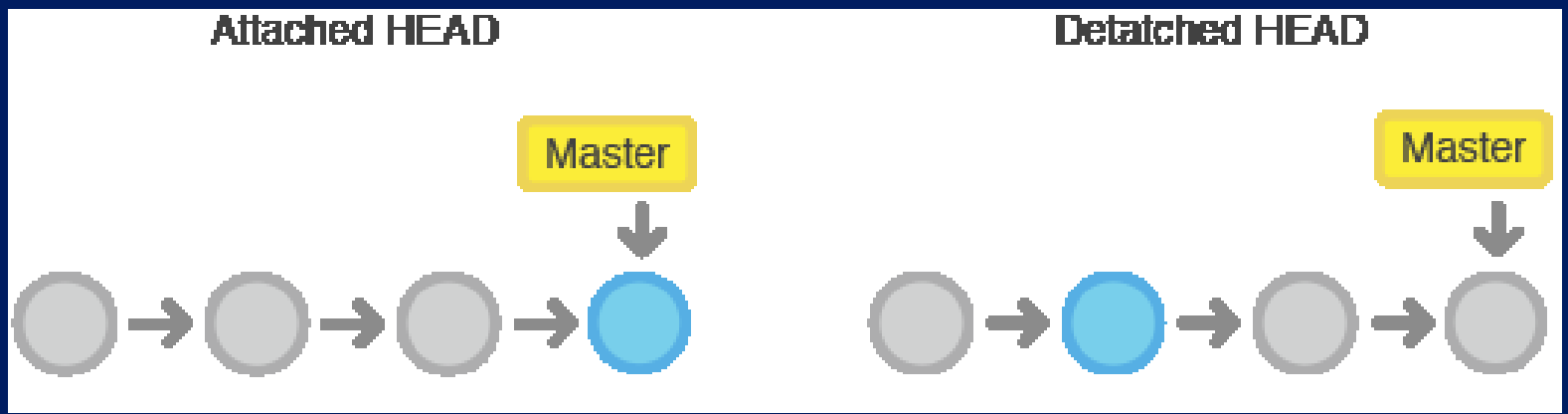


- A *branch* is a pointer to a commit.
- By default there is one branch: **`master`**.

The Git commit graph

The current commit: `HEAD`

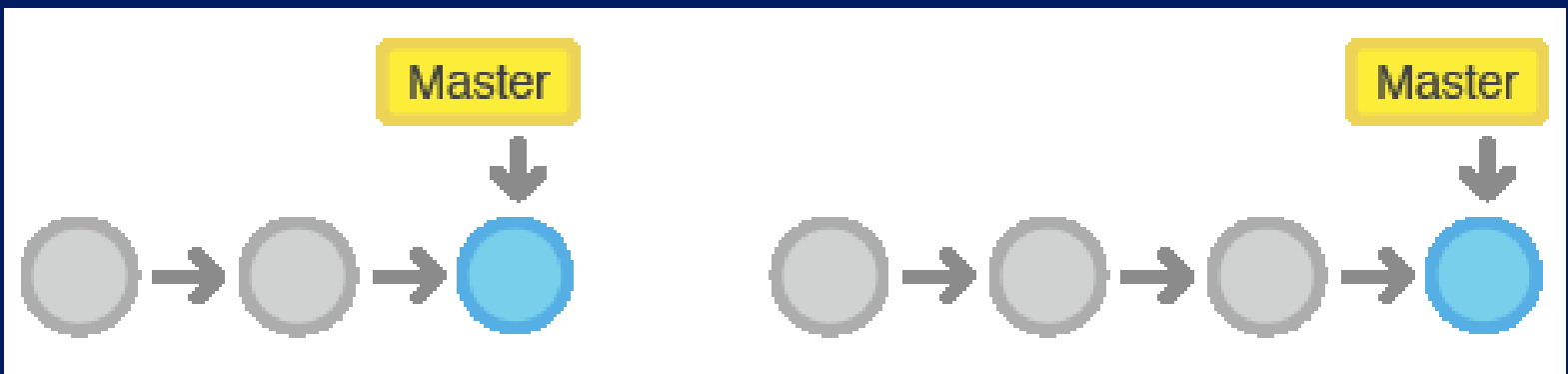
- The current commit is called **`HEAD`** (shown in blue).
- **`HEAD`** normally points to the current branch.
- Or to a commit if there is no current branch.



The Git commit graph

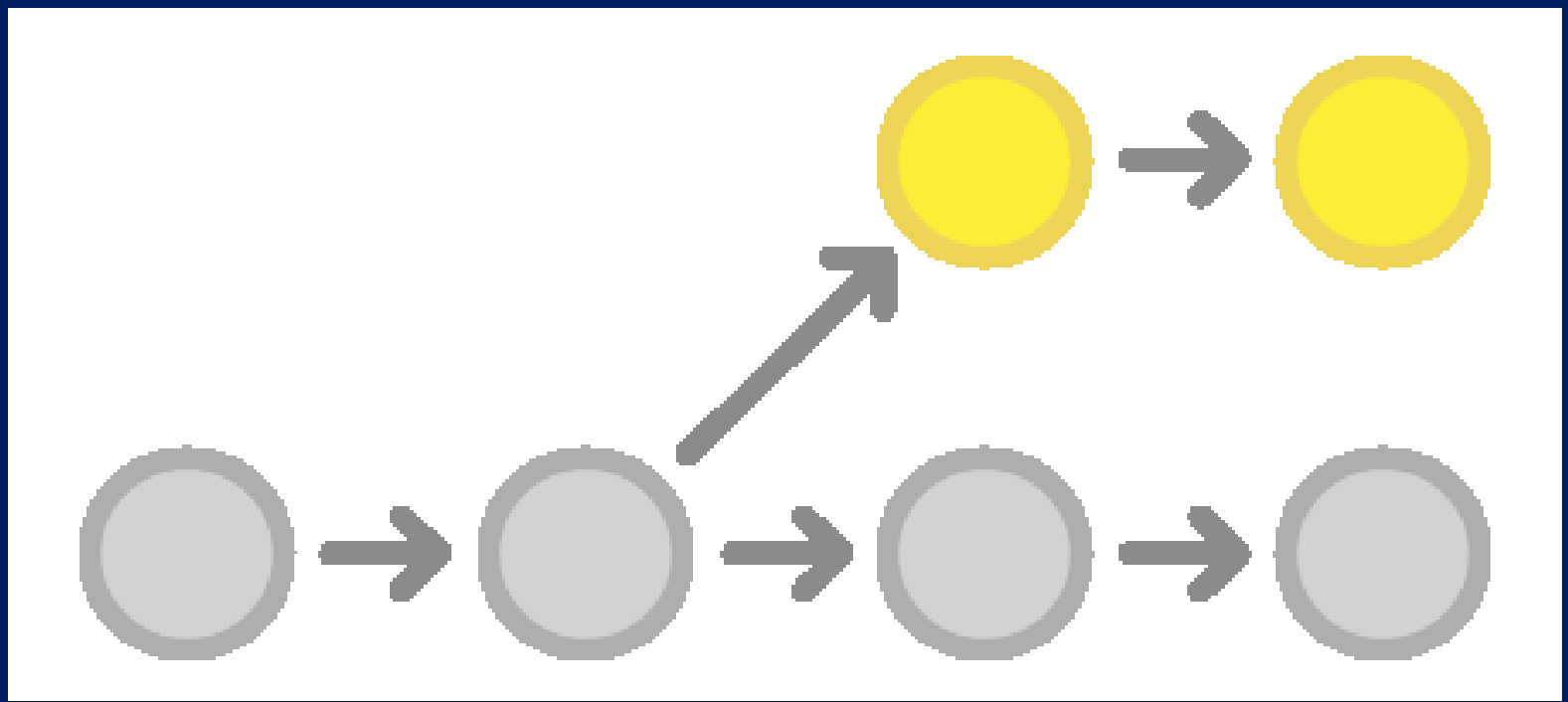
Committing moves `HEAD` and the current branch

- Committing moves the current branch to the new commit.
- Of course, **`HEAD`** moves with it.
- If there is no current branch, only **`HEAD`** moves.



The Git commit graph

A non-linear history

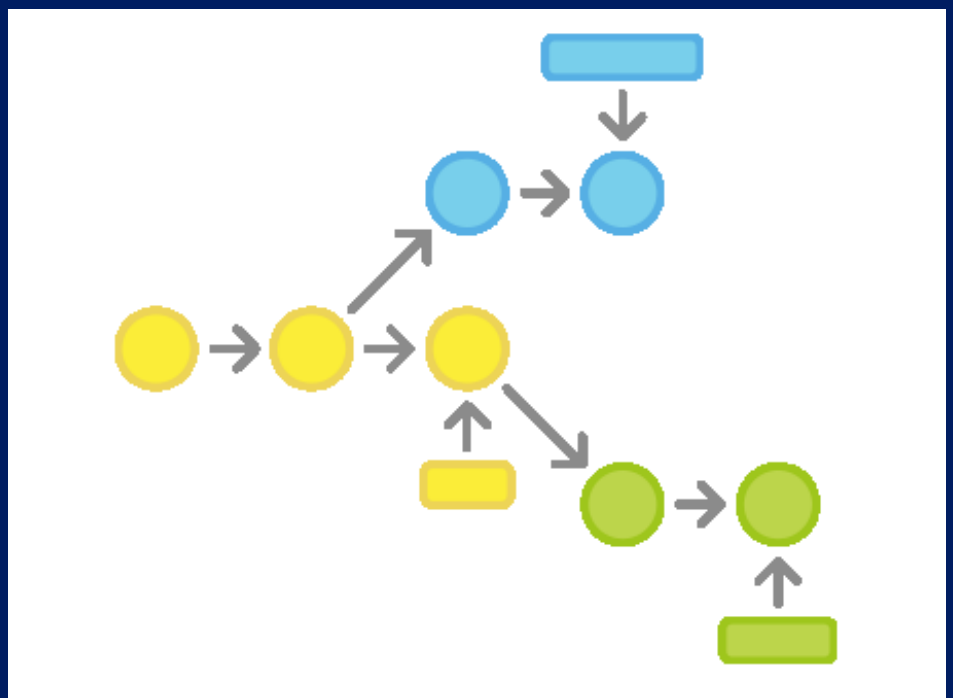


- The commit graph can become non-linear.
- Usually by committing from the same commit twice.

The Git commit graph

Use branches to keep track of different code paths

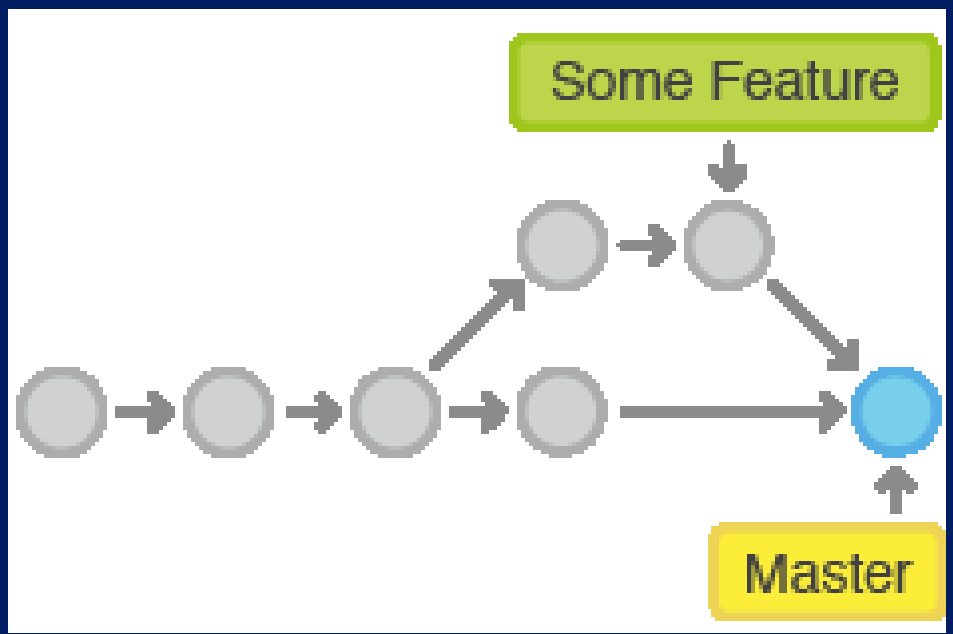
- Branch names are easier to remember than commit hashes.
- Branch names make it clear what commits are about.



The Git commit graph

Different code paths may later join

- Commits from different branches can be brought together.
- We call this *merging*.



Inspecting the commit graph

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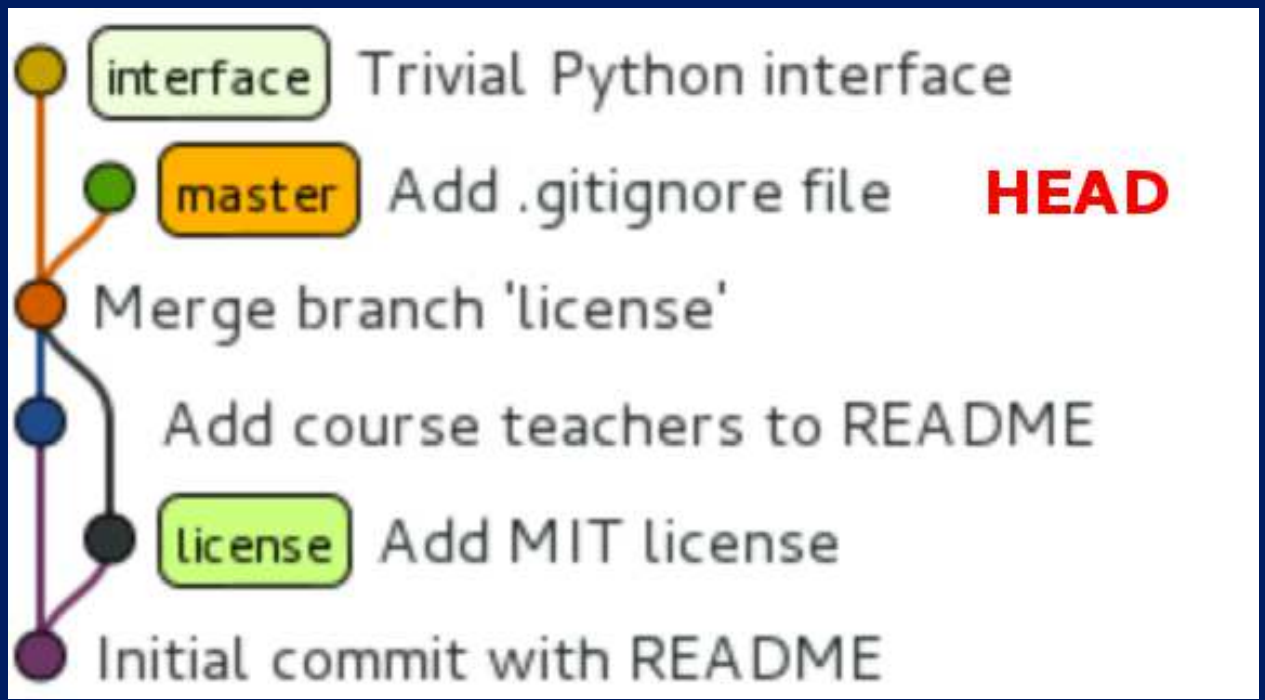
Inspecting the commit graph

An example repository



- Branches **`license`** and **`interface`** diverged from **`master`**.
- Only **`license`** has been merged back into **`master`**.
- Current branch is **`master`**.

Inspecting the commit graph

Showing the current branch: `git status`

```
$ git status
# On branch master
nothing to commit (working directory clean)
```

Remember: you cannot type **`git status`** enough!

Inspecting the commit graph

Listing branches: `git branch`

```
$ git branch
  interface
  license
* master
```

Three branches, current branch is **`master`**.

Inspecting the commit graph

Listing branches: `git branch`

```
$ git branch
  interface
  license
* master
```

Three branches, current branch is **`master`**.

```
$ git branch -v
  interface 8fc25c1 Trivial Python interface
  license   0fbe3e3 Add MIT license
* master    c7f3bd9 Add .gitignore file
```

`-v`: Shows the commit each branch points to.

Inspecting the commit graph

The commit log: `git log`

```
$ git log --oneline --decorate
c7f3bd9 (HEAD, master) Add .gitignore file
4a44c4e Merge branch 'license'
64af1ee Add course teachers to README
0fbe3e3 (license) Add MIT license
d1c7fd7 Initial commit with README
```

`--oneline`: Shows commit summary on one line.
`--decorate`: Adds branch information.

Inspecting the commit graph

The commit log as a graph: `git log`

```
$ git log --oneline --decorate --graph --all
* 8fc25c1 (interface) Trivial Python interface
| * c7f3bd9 (HEAD, master) Add .gitignore file
|/
*   4a44c4e Merge branch 'license'
|\
| * 0fbe3e3 (license) Add MIT license
* | 64af1ee Add course teachers to README
|/
* d1c7fd7 Initial commit with README
```

`--graph`: Shows the commit graph.
`--all`: Includes all branches instead of just the current.

Inspecting the commit graph

Switching to another branch: `git checkout`

```
$ git checkout interface
Switched to branch 'interface'
```

This points **`HEAD`** to the named branch and updates your working directory.

Inspecting the commit graph

Switching to another branch: `git checkout`

```
$ git checkout interface
Switched to branch 'interface'
```

This points **HEAD** to the named branch and updates your working directory.

```
$ git status
# On branch interface
nothing to commit (working directory clean)
```

Manipulating the commit graph

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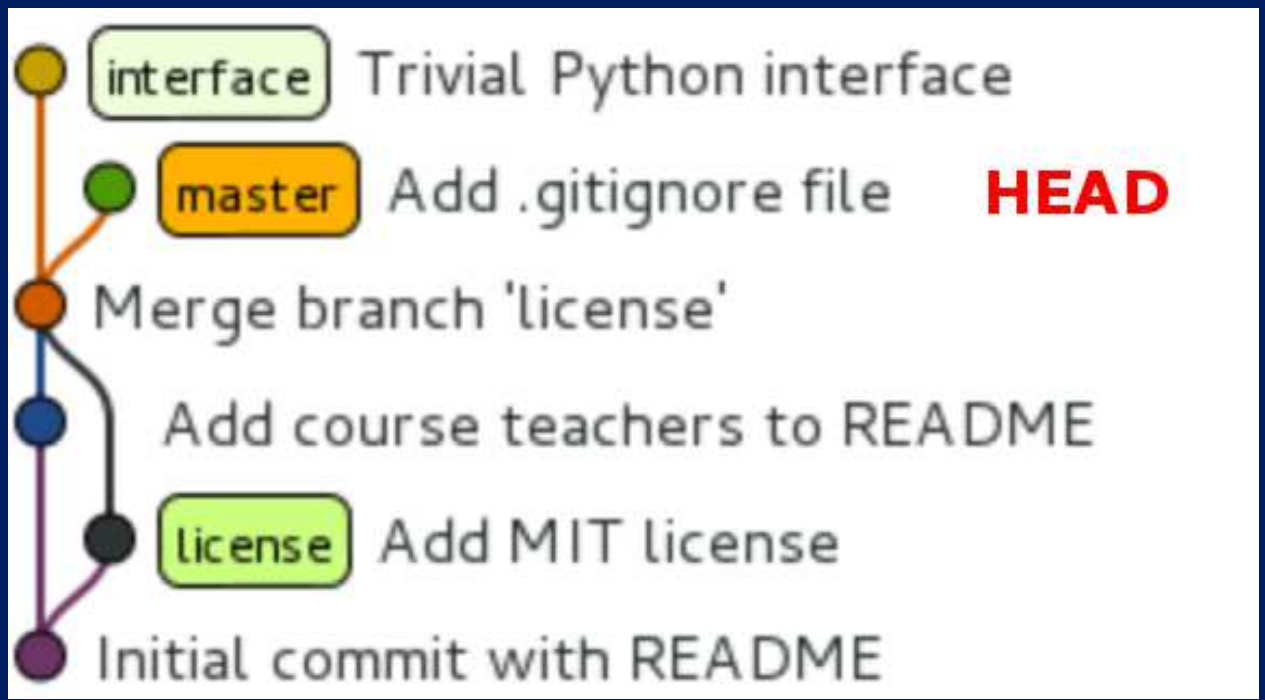
Manipulating the commit graph

An example repository



- Branches **`license`** and **`interface`** diverged from **`master`**.
- Only **`license`** has been merged back into **`master`**.
- Current branch is **`master`**.

Manipulating the commit graph

Creating a new branch: `git branch`

```
$ git branch lib
```

Creates branch **`lib`** at **`HEAD`**.

Manipulating the commit graph

Creating a new branch: `git branch`

```
$ git branch lib
```

Creates branch **`lib`** at **`HEAD`**.

```
$ git checkout lib
Switched to branch 'lib'
```

Manipulating the commit graph

Creating a new branch: `git branch`

```
$ git branch lib
```

Creates branch **`lib`** at **`HEAD`**.

```
$ git checkout lib
Switched to branch 'lib'
```

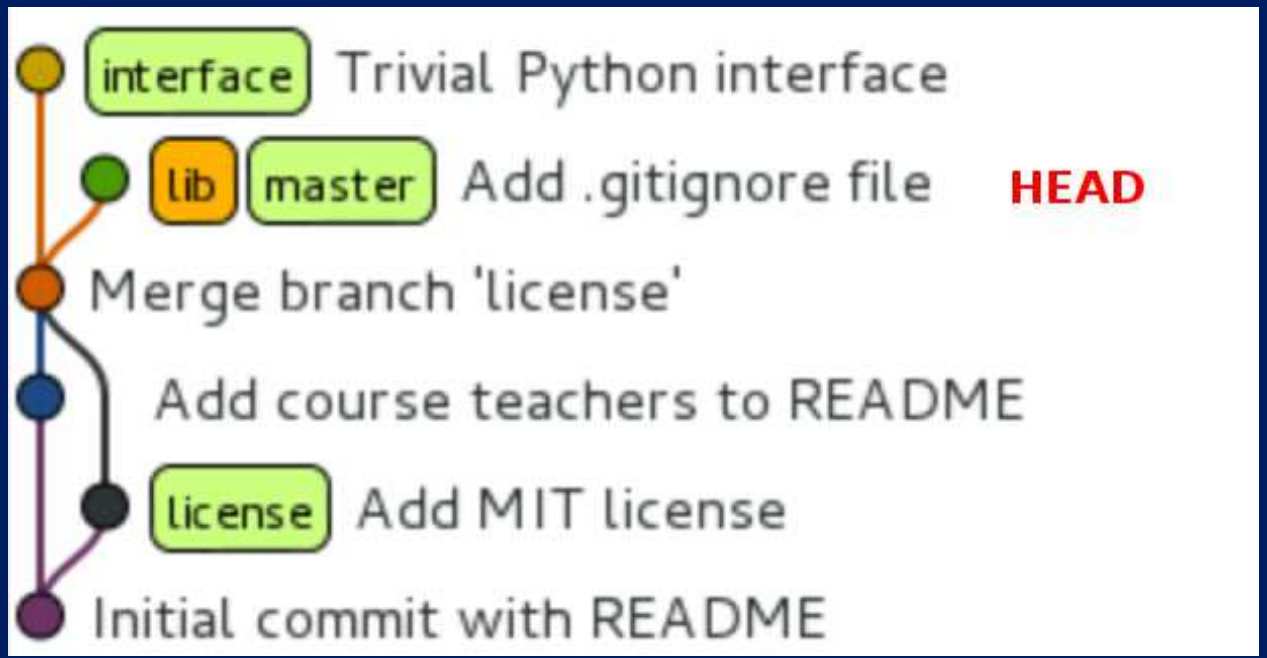
Or, for Git pro's, in one command:

```
$ git checkout -b lib
Switched to a new branch 'lib'
```

At this point, **`lib`** is just a label to the same commit as **`master`**.

Manipulating the commit graph

Our example repository



Created branch `lib` from `master`.

Manipulating the commit graph

Working on a branch: `git commit`

We can extend the **`lib`** branch by adding commits.

```
$ echo 'VERSION=1' > testlib.py
$ git add testlib.py
$ git commit -m 'Add empty testlib'
```

Manipulating the commit graph

Working on a branch: `git commit`

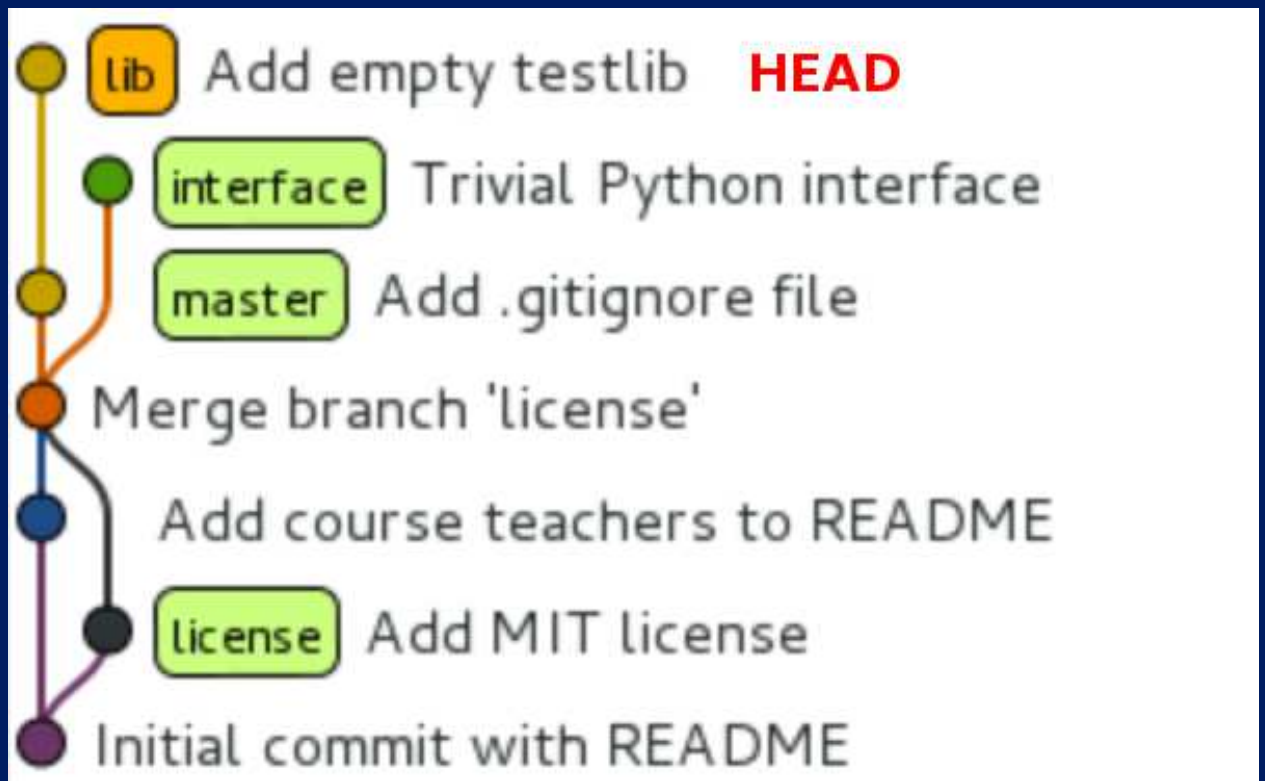
We can extend the **`lib`** branch by adding commits.

```
$ echo 'VERSION=1' > testlib.py
$ git add testlib.py
$ git commit -m 'Add empty testlib'

$ git log --oneline --decorate --graph --all
* 251a51b (HEAD, lib) Add empty testlib
* c7f3bd9 (master) Add .gitignore file
| * 8fc25c1 (interface) Trivial Python interface
|/
*   4a44c4e Merge branch 'license'
|\
| * 0fbe3e3 (license) Add MIT license
...
```

Manipulating the commit graph

Our example repository



Extended branch `lib`.

Manipulating the commit graph

Fast forward merging: `git merge`

Let's merge our work on **`lib`** back into **`master`**.

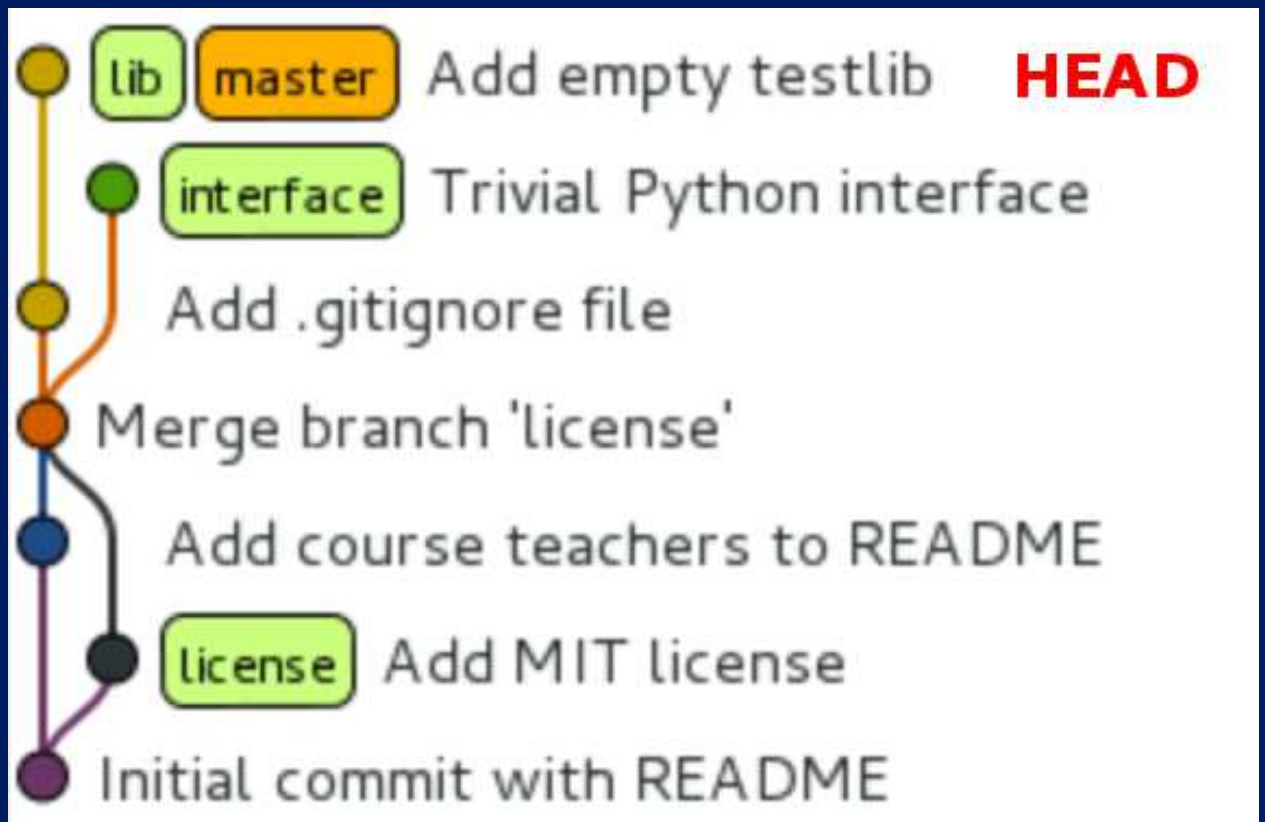
```
$ git checkout master
Switched to branch 'master'
$ git merge lib
Updating c7f3bd9..251a51b
Fast-forward
 testlib.py |    1 +
 1 file changed, 1 insertion(+)
 create mode 100644 testlib.py
```

This merge was easy:

- **`lib`** was directly upstream of **`master`**.
- Git just moves **`HEAD`** and **`master`** to point to **`lib`**.
- This is called a *fast forward merge*.

Manipulating the commit graph

Our example repository



Merged branch `lib` into `master` (fast forward).

Manipulating the commit graph

Three-way merging: `git merge`

Let's merge our work on **`interface`** back into **`master`**.

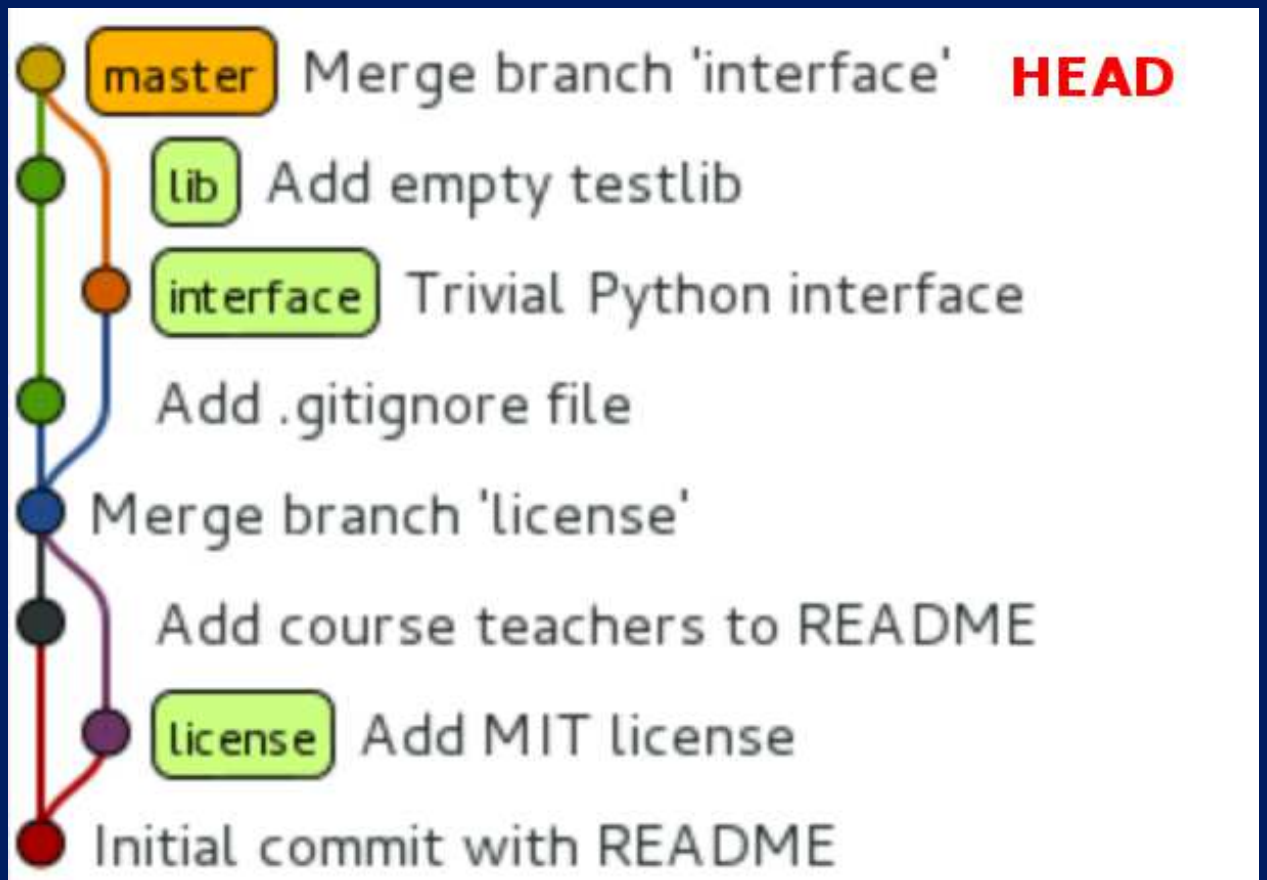
```
$ git merge interface
Merge made by the 'recursive' strategy.
 interface.py |    3 +++
 1 file changed, 3 insertions(+)
 create mode 100755 interface.py
```

This merge was harder:

- **`interface`** and **`master`** had diverged.
- Git determines changes in **`interface`** and **`master`** since their most recent common ancestor and creates a new commit from that.
- This is called a *recursive three-way merge* and the resulting merge a *merge commit*.

Manipulating the commit graph

Our example repository



Merged branch **`interface`** into **`master`**.

Manipulating the commit graph

Deleting branches: `git branch`

Old branches that have been merged can be deleted.

```
$ git branch -d interface
Deleted branch interface (was 8fc25c1).
```

```
$ git branch -d lib license
Deleted branch lib (was 251a51b).
Deleted branch license (was 0fbe3e3).
```

No history is lost, just labels removed.

Basic merge conflicts

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Basic merge conflicts

Merge conflicts

Git is pretty good at merging:

- The changes might have been in different files.
- Or in different parts of the same file.
- Git tries to figure out a sensible result.

Basic merge conflicts

Merge conflicts

Git is pretty good at merging:

- The changes might have been in different files.
- Or in different parts of the same file.
- Git tries to figure out a sensible result.

Sometimes this is not possible:

- The changes might be incompatible.
- When we try `git merge`, Git gives up.
- This situation is called a *merge conflict*.

Basic merge conflicts

Setting the stage (1/3)

```
$ git log --oneline --decorate --graph --all
* 9d2ad27 (HEAD, master) State character preference
| * 374ab60 (simpsons) State character preference
|/
* 4012f4f Initial commit
```

We'd like to merge branch **`simpsons`** into **`master`**.

Basic merge conflicts

Setting the stage (2/3)

The last commit on **`master`**:

```
$ git show --oneline
9d2ad27 State character preference
diff --git a/README b/README
index de15194..ef40359 100644
--- a/README
+++ b/README
@@ -1,2 +1,4 @@
 Facts about television series
 ==============================
+
+My favorite character is Eric Cartman.
```

Basic merge conflicts

Setting the stage (3/3)

The last commit on **`simpsons`**:

```
$ git show --oneline simpsons
374ab60 State character preference
diff --git a/README b/README
index de15194..9dd729b 100644
--- a/README
+++ b/README
@@ -1,2 +1,4 @@
 Facts about television series
 ==============================
+
+My favorite character is Homer Simpson.
```

Basic merge conflicts

Creating a merge conflict

```
$ git merge simpsons
Auto-merging README
CONFLICT (content): Merge conflict in README
Automatic merge failed; fix conflicts and then
commit the result.


$ git status
# On branch master
# Unmerged paths:
#   (use "git add/rm <file>.." as appropriate to
#    mark resolution)
#
#               both modified:      README
#
no changes added to commit (use "git add" and/or
"git commit -a")
```

Basic merge conflicts

Resolving a merge conflict (1/2)

```
$ cat README
Facts about television series
==============================

<<<<<<< HEAD
My favorite character is Eric Cartman.
=======
My favorite character is Homer Simpson.
>>>>>>> simpsons
```

What we had is under **`HEAD`**, what **`simpsons`** had is above **`simpsons`**.

Basic merge conflicts

Resolving a merge conflict (1/2)

```
$ cat README
Facts about television series
==============================

<<<<<<< HEAD
My favorite character is Eric Cartman.
=======
My favorite character is Homer Simpson.
>>>>>>> simpsons
```

What we had is under **`HEAD`**, what **`simpsons`** had is above **`simpsons`**.

```
$ emacs README
```

Basic merge conflicts

Resolving a merge conflict (1/2)

We resolve the conflict by hand.

```
$ cat README
Facts about television series
==============================

My favorite characters are Eric Cartman
and Homer Simpson.
```

Basic merge conflicts

Resolving a merge conflict (1/2)

We resolve the conflict by hand.

```
$ cat README
Facts about television series
==============================

My favorite characters are Eric Cartman
and Homer Simpson.
```

And can now finish the merge commit.

```
$ git add README
$ git commit
[master 1e496cb] Merge branch 'simpsons'
```

Basic merge conflicts

Resolving conflicts with `git mergetool`

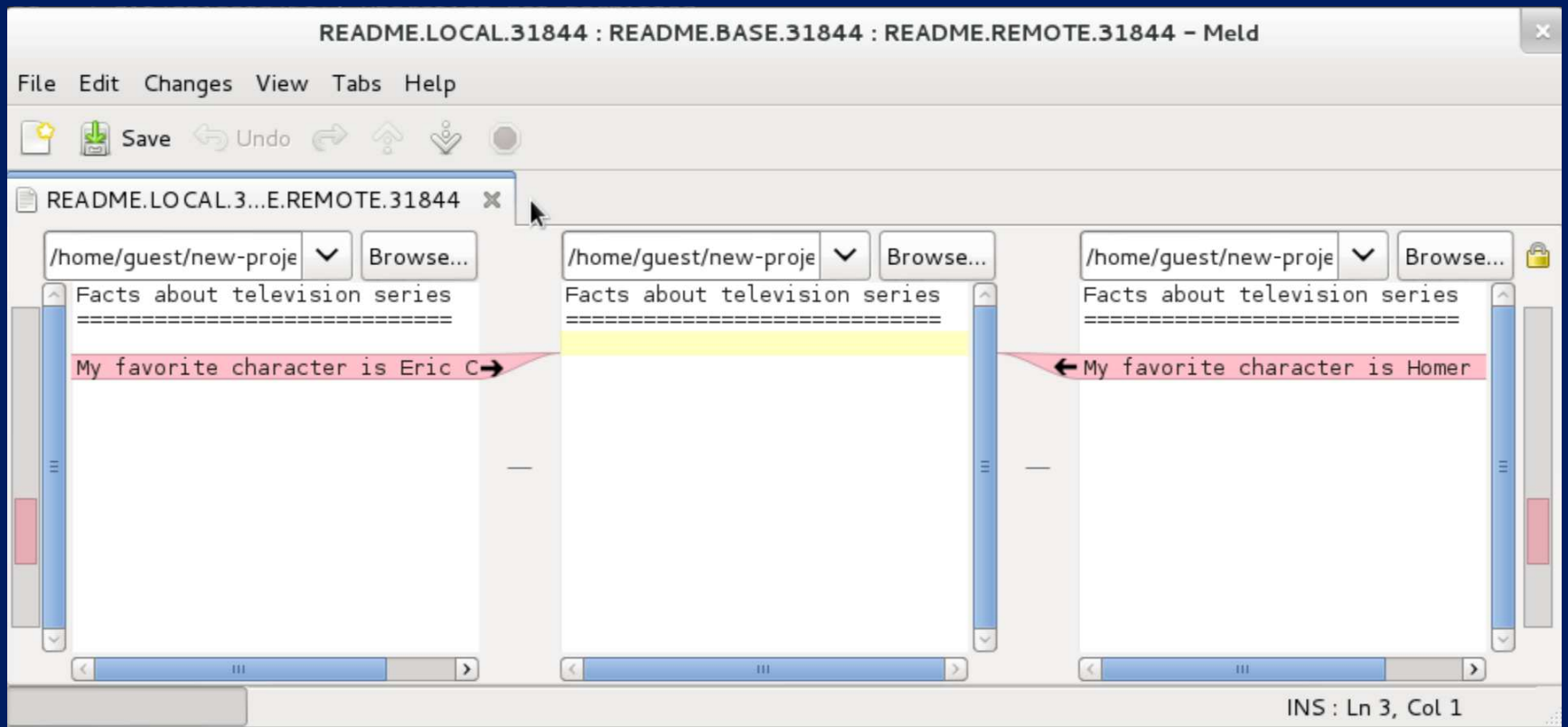
We can also use graphical merge tools such as *Meld*.

```
$ git mergetool
merge tool candidates: meld opendiff kdiff3 ...
Merging:
README

Normal merge conflict for 'README':
  {local}: modified file
  {remote}: modified file
Hit return to start merge resolution tool (meld):
```

Basic merge conflicts

Meld example



Tools like Meld provide an editable three-way diff.

Questions?

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Questions?

Acknowledgements:

Jeroen Laros
Zuotian Tatum

http://git-scm.com/book

https://www.atlassian.com/git