PyCon 2015 Montréal

Advanced Git

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The Story So Far

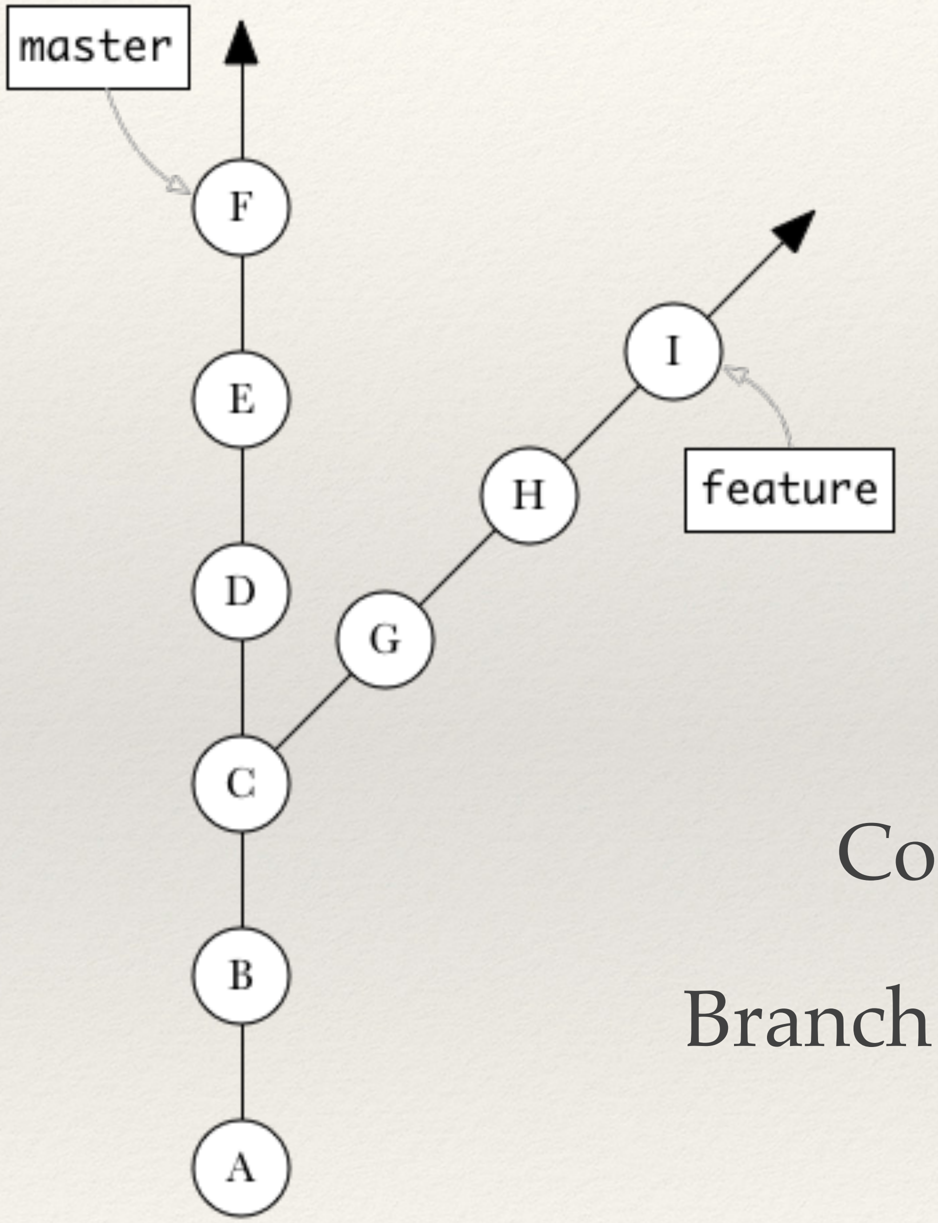
`$ git clone <url>`	Download the repo
`$ git checkout <branch>`	Switch to a feature branch

Edit some files

`$ git commit`	Commit your changes
`$ git push/pull`	Sync changes to GitHub

Merge pull request on GitHub

Visual Terminology



Commit: ○

Branch label: master

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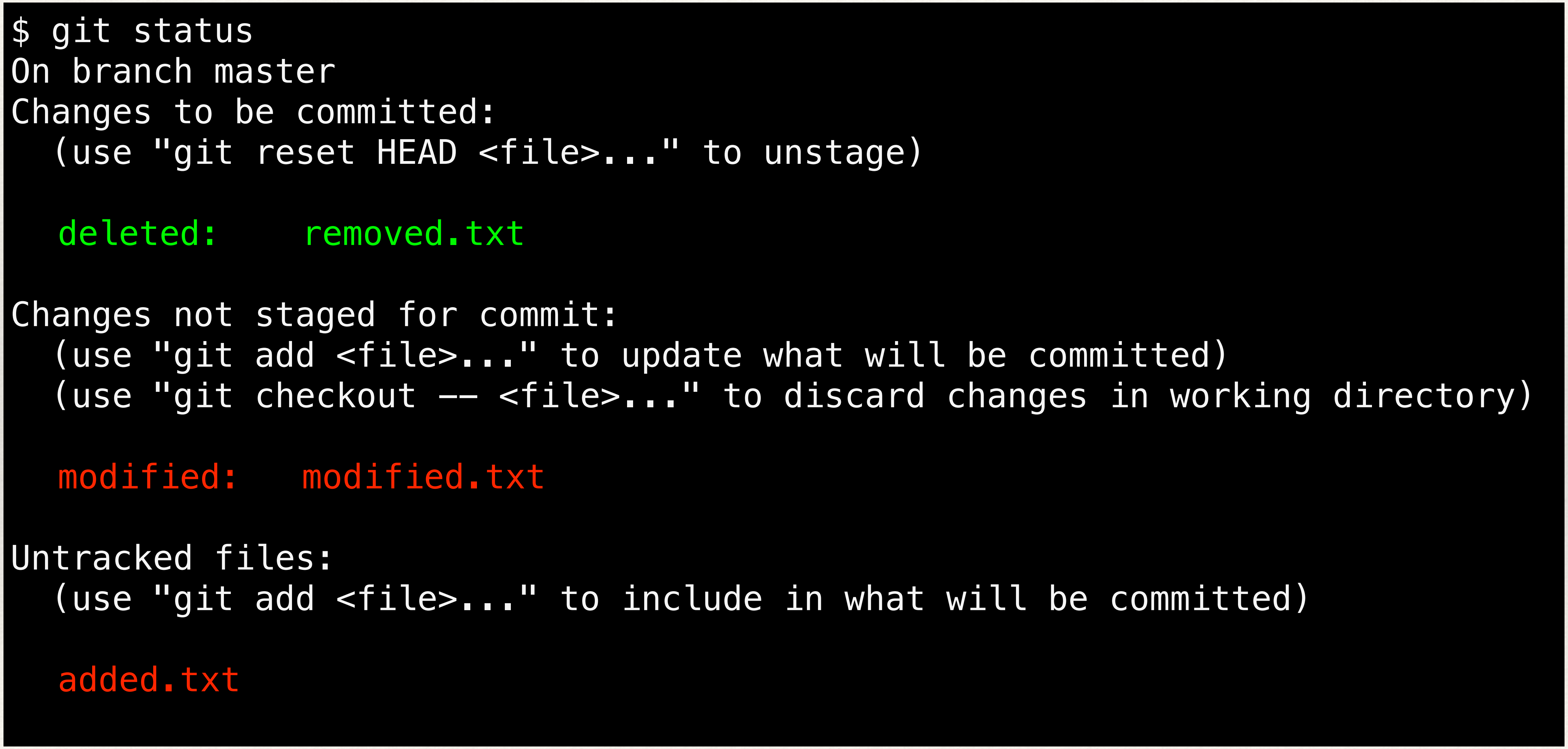
Preface: `status`

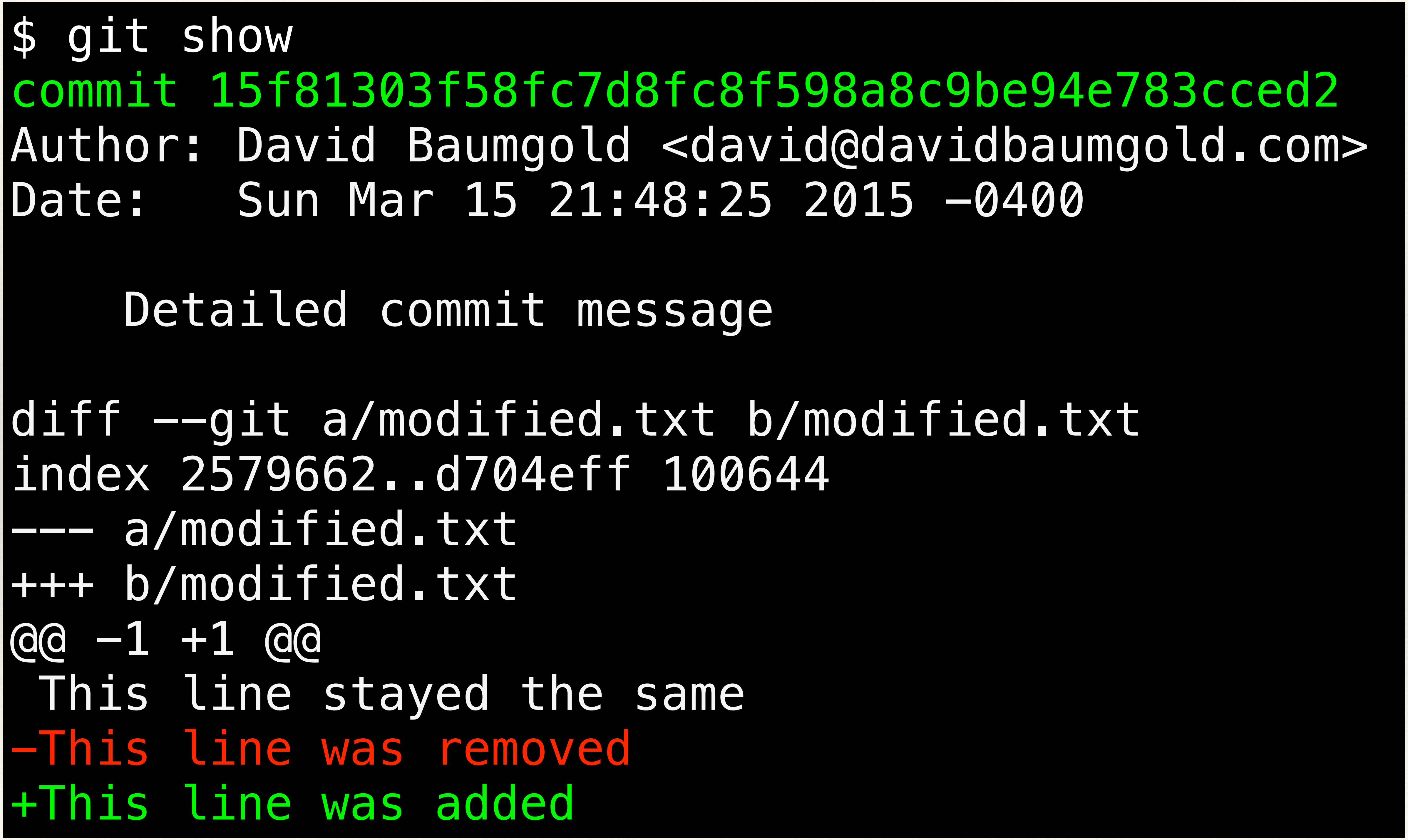
```
$ git status
On branch master
nothing to commit, working directory clean
```

Preface: status



```
$ git status
On branch master
Changes to be committed:
  (use "git reset HEAD <file>..." to unstage)

  deleted:    removed.txt

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:   modified.txt

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

  added.txt
```

Preface: show



```
$ git show
commit 15f81303f58fc7d8fc8f598a8c9be94e783cced2
Author: David Baumgold <david@davidbaumgold.com>
Date:   Sun Mar 15 21:48:25 2015 -0400

    Detailed commit message

diff --git a/modified.txt b/modified.txt
index 2579662..d704eff 100644
--- a/modified.txt
+++ b/modified.txt
@@ -1 +1 @@
 This line stayed the same
-This line was removed
+This line was added
```

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Ch 1: `blame`

"What the…
who wrote this code?"

```
$ git blame path/to/file.py
```

will tell you who to blame!

Ch 1: `blame`

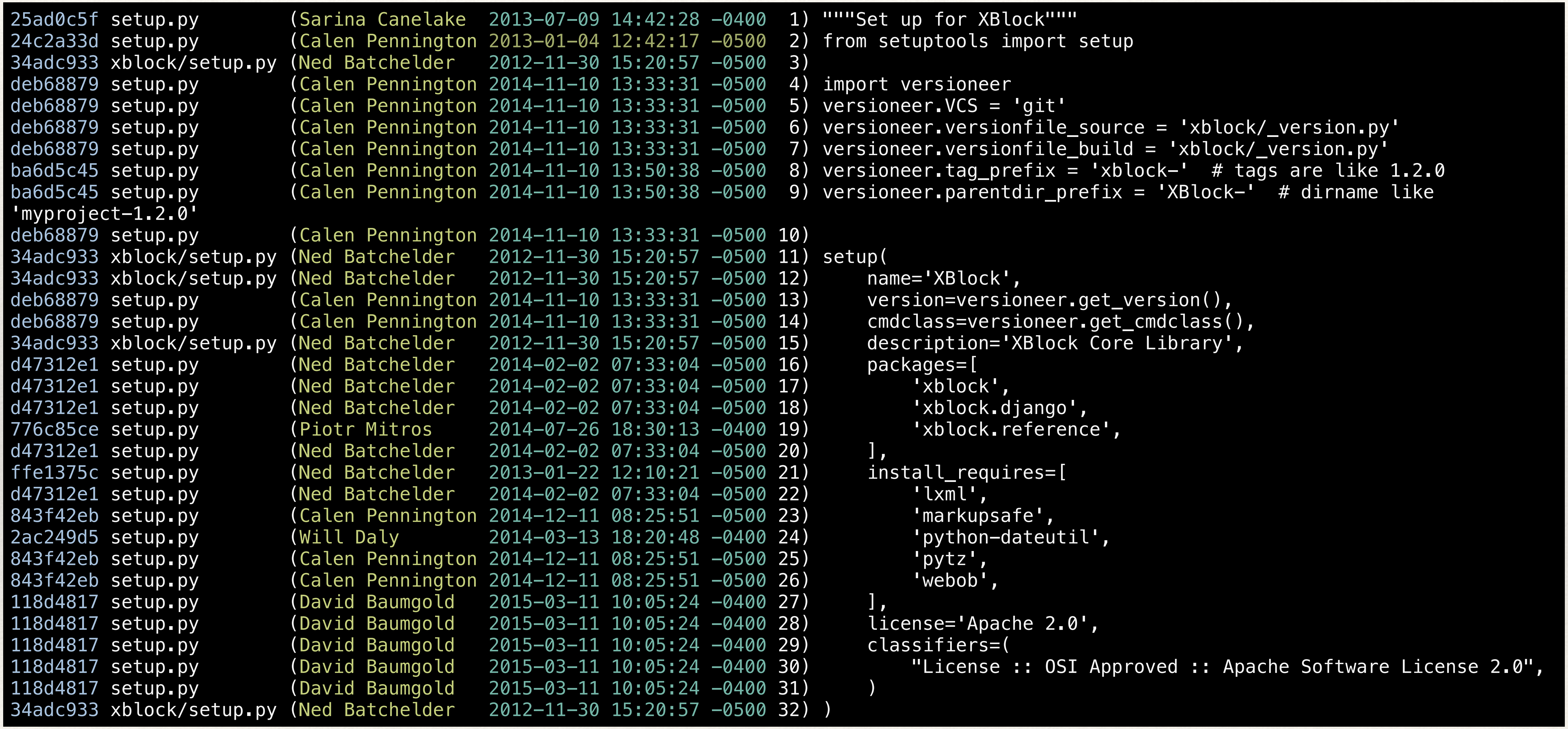
For each line of the file, `blame` will find the last commit to edit the line, and it will tell you:

- Commit hash
- Author’s name
- Date of commit

ProTip: use `show` to look up the commit message!

```
$ git show d47312e1
```

Ch 1: blame



```
25ad0c5f setup.py        (Sarina Canelake  2013-07-09 14:42:28 -0400  1) """Set up for XBlock"""
24c2a33d setup.py        (Calen Pennington 2013-01-04 12:42:17 -0500  2) from setuptools import setup
34adc933 xblock/setup.py (Ned Batchelder   2012-11-30 15:20:57 -0500  3)
deb68879 setup.py        (Calen Pennington 2014-11-10 13:33:31 -0500  4) import versioneer
deb68879 setup.py        (Calen Pennington 2014-11-10 13:33:31 -0500  5) versioneer.VCS = 'git'
deb68879 setup.py        (Calen Pennington 2014-11-10 13:33:31 -0500  6) versioneer.versionfile_source = 'xblock/_version.py'
deb68879 setup.py        (Calen Pennington 2014-11-10 13:33:31 -0500  7) versioneer.versionfile_build = 'xblock/_version.py'
ba6d5c45 setup.py        (Calen Pennington 2014-11-10 13:50:38 -0500  8) versioneer.tag_prefix = 'xblock-'  # tags are like 1.2.0
ba6d5c45 setup.py        (Calen Pennington 2014-11-10 13:50:38 -0500  9) versioneer.parentdir_prefix = 'XBlock-'  # dirname like
'myproject-1.2.0'
deb68879 setup.py        (Calen Pennington 2014-11-10 13:33:31 -0500 10)
34adc933 xblock/setup.py (Ned Batchelder   2012-11-30 15:20:57 -0500 11) setup(
34adc933 xblock/setup.py (Ned Batchelder   2012-11-30 15:20:57 -0500 12)     name='XBlock',
deb68879 setup.py        (Calen Pennington 2014-11-10 13:33:31 -0500 13)     version=versioneer.get_version(),
deb68879 setup.py        (Calen Pennington 2014-11-10 13:33:31 -0500 14)     cmdclass=versioneer.get_cmdclass(),
34adc933 xblock/setup.py (Ned Batchelder   2012-11-30 15:20:57 -0500 15)     description='XBlock Core Library',
d47312e1 setup.py        (Ned Batchelder   2014-02-02 07:33:04 -0500 16)     packages=[
d47312e1 setup.py        (Ned Batchelder   2014-02-02 07:33:04 -0500 17)         'xblock',
d47312e1 setup.py        (Ned Batchelder   2014-02-02 07:33:04 -0500 18)         'xblock.django',
776c85ce setup.py        (Piotr Mitros     2014-07-26 18:30:13 -0400 19)         'xblock.reference',
d47312e1 setup.py        (Ned Batchelder   2014-02-02 07:33:04 -0500 20)     ],
ffe1375c setup.py        (Ned Batchelder   2013-01-22 12:10:21 -0500 21)     install_requires=[
d47312e1 setup.py        (Ned Batchelder   2014-02-02 07:33:04 -0500 22)         'lxml',
843f42eb setup.py        (Calen Pennington 2014-12-11 08:25:51 -0500 23)         'markupsafe',
2ac249d5 setup.py        (Will Daly        2014-03-13 18:20:48 -0400 24)         'python-dateutil',
843f42eb setup.py        (Calen Pennington 2014-12-11 08:25:51 -0500 25)         'pytz',
843f42eb setup.py        (Calen Pennington 2014-12-11 08:25:51 -0500 26)         'webob',
118d4817 setup.py        (David Baumgold   2015-03-11 10:05:24 -0400 27)     ],
118d4817 setup.py        (David Baumgold   2015-03-11 10:05:24 -0400 28)     license='Apache 2.0',
118d4817 setup.py        (David Baumgold   2015-03-11 10:05:24 -0400 29)     classifiers=(
118d4817 setup.py        (David Baumgold   2015-03-11 10:05:24 -0400 30)         "License :: OSI Approved :: Apache Software License 2.0",
118d4817 setup.py        (David Baumgold   2015-03-11 10:05:24 -0400 31)     )
34adc933 xblock/setup.py (Ned Batchelder   2012-11-30 15:20:57 -0500 32) )
```

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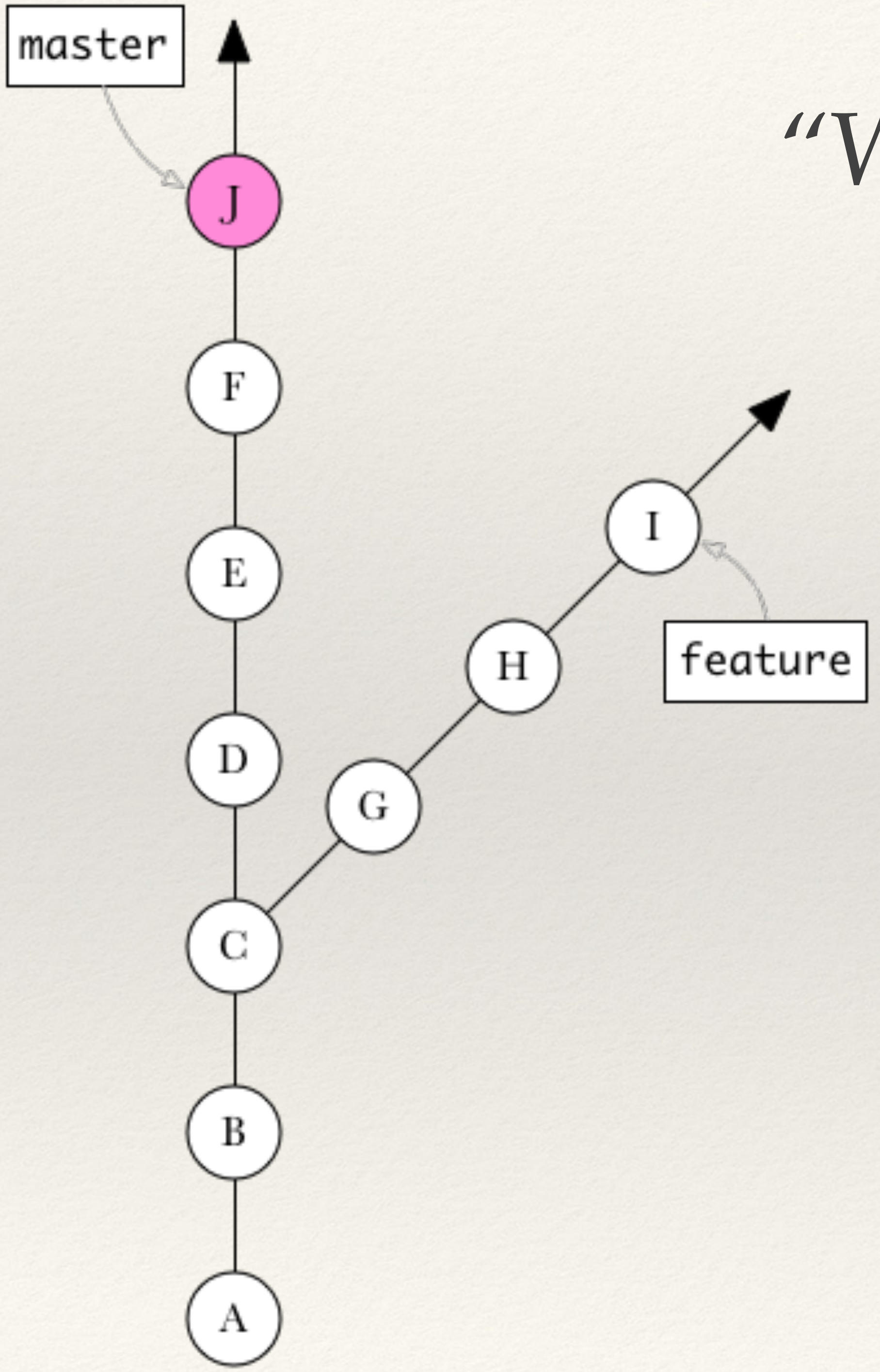
Ch 2: `cherry-pick`

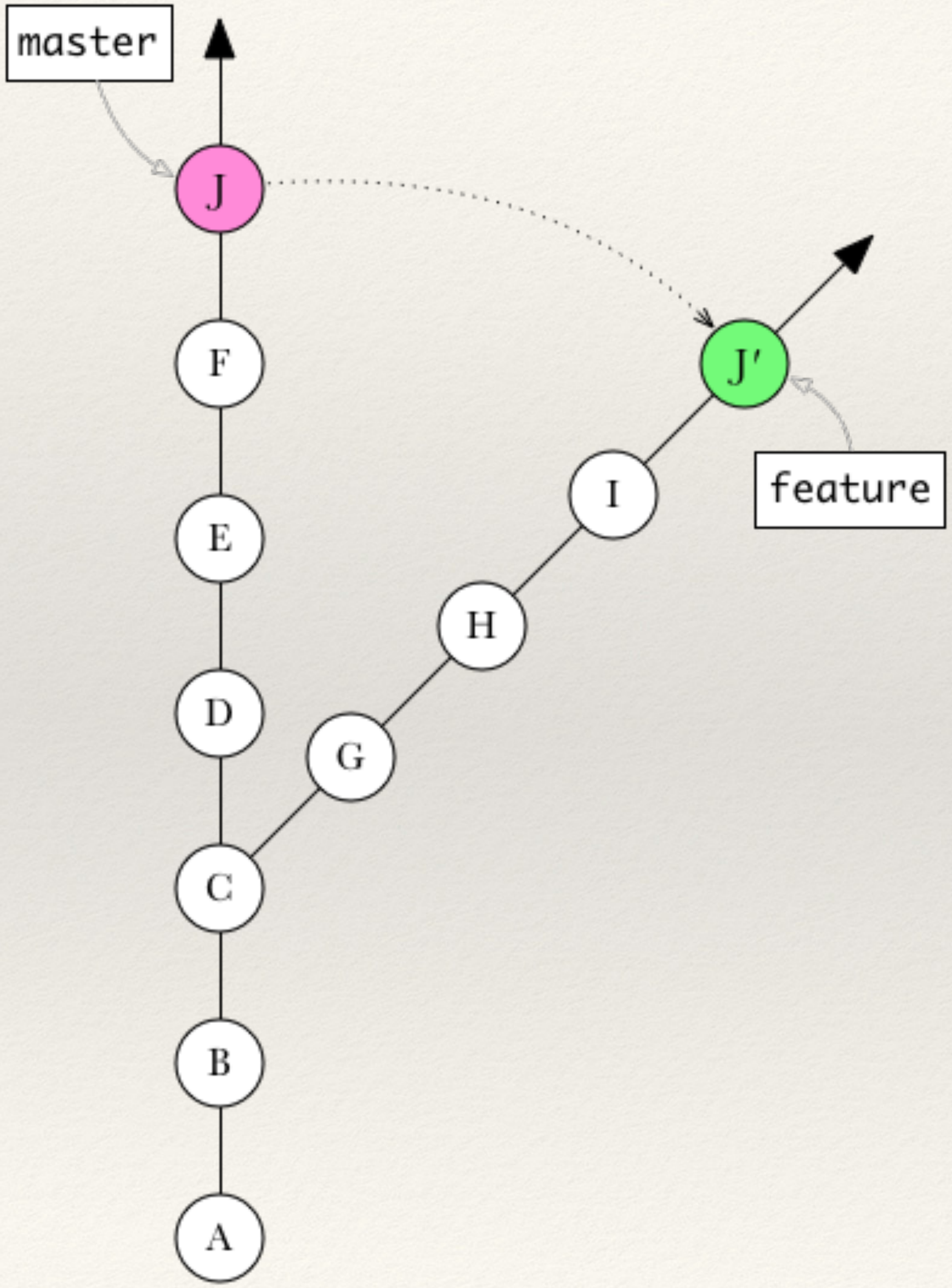


"Whoops, I committed to `master` when I meant to commit to my feature branch. I need to move my commit!"

Ch 2: cherry-pick

```
$ git show
commit 1d5b2e2b273dbb945c6bf5e541d5f1c725ac906d
  # ... ignore the rest ...

$ git checkout feature
Switched to branch 'feature'

$ git cherry-pick 1d5b2e
[master 8b8d32c] original commit message
 Date: Sun Mar 15 22:04:48 2015 -0400
 1 file changed, 1 insertion(+)
```

Ch 2: `cherry-pick`



`cherry-pick`

creates an

entirely new commit

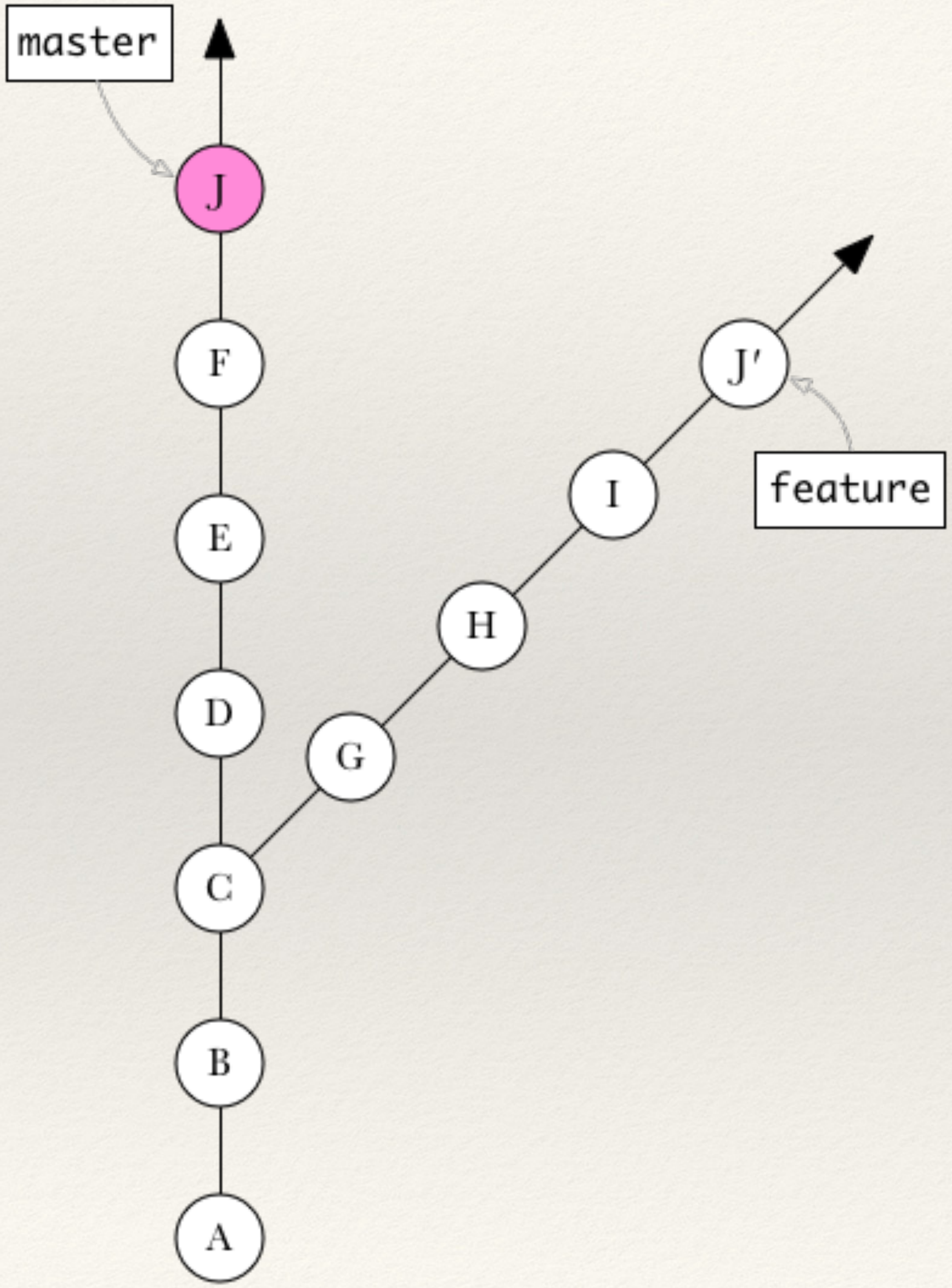
based off the original,

and it

does *not* delete

the original commit

Ch 3: `reset`



"Alright, how do I remove J from `master`?"

Ch 3: reset

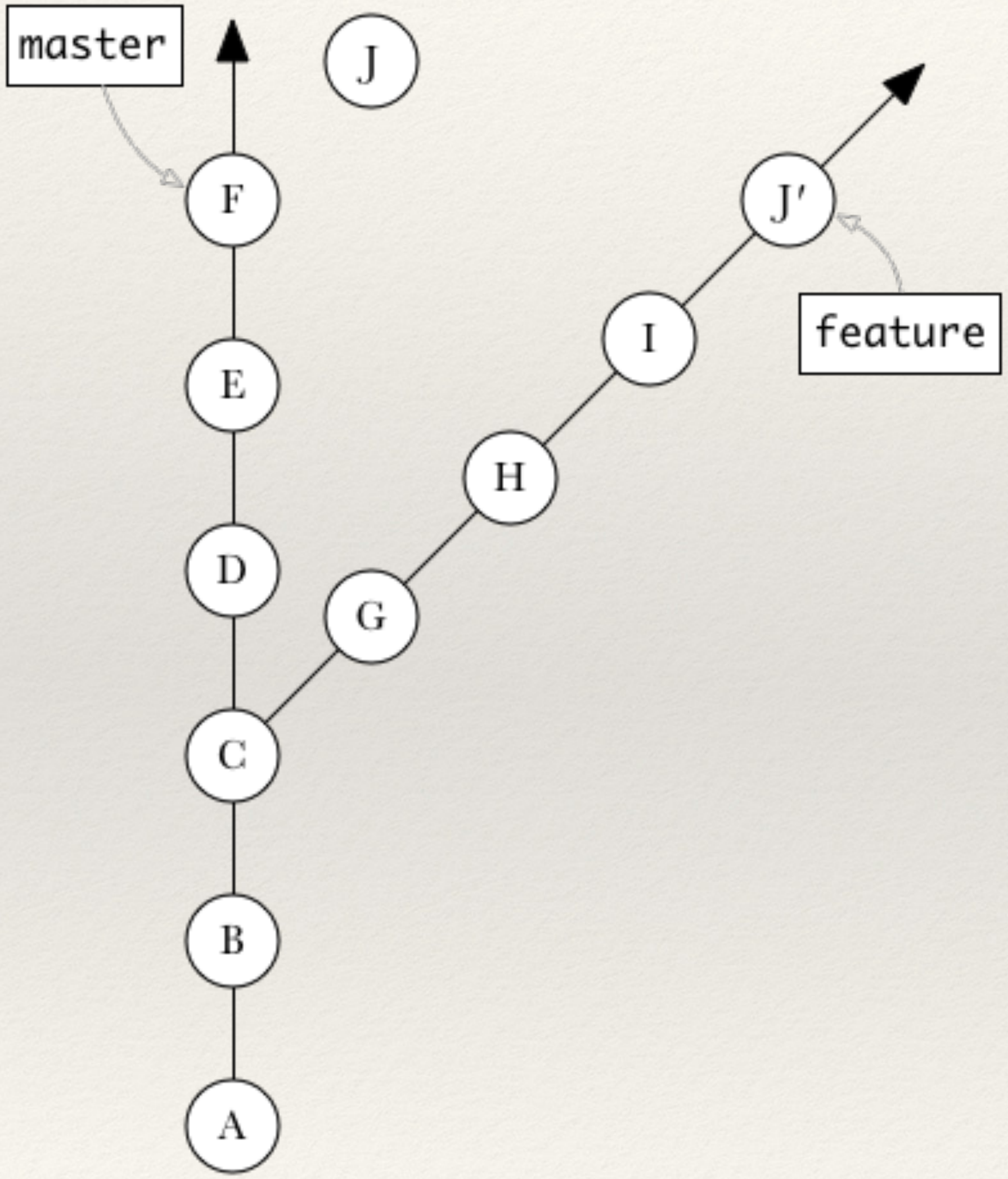
```
$ git checkout master
Switched to branch 'master'

$ git reset --hard HEAD^
HEAD is now at 15f8130 made things work
```

HEAD == “the commit I’m currently sitting on”

HEAD^ == “this commit’s parent”

HEAD^^ == “this commit’s grandparent” (etc)

Ch 3: `reset`



`reset` reassigns the branch pointer

J will get cleaned up by git's garbage collector eventually

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WARNING

`rebase` is a command for changing history!
Use its awesome power responsibly!

wibbly
wobbly
timey
wimey

is no fun
when you're on
the receiving end.

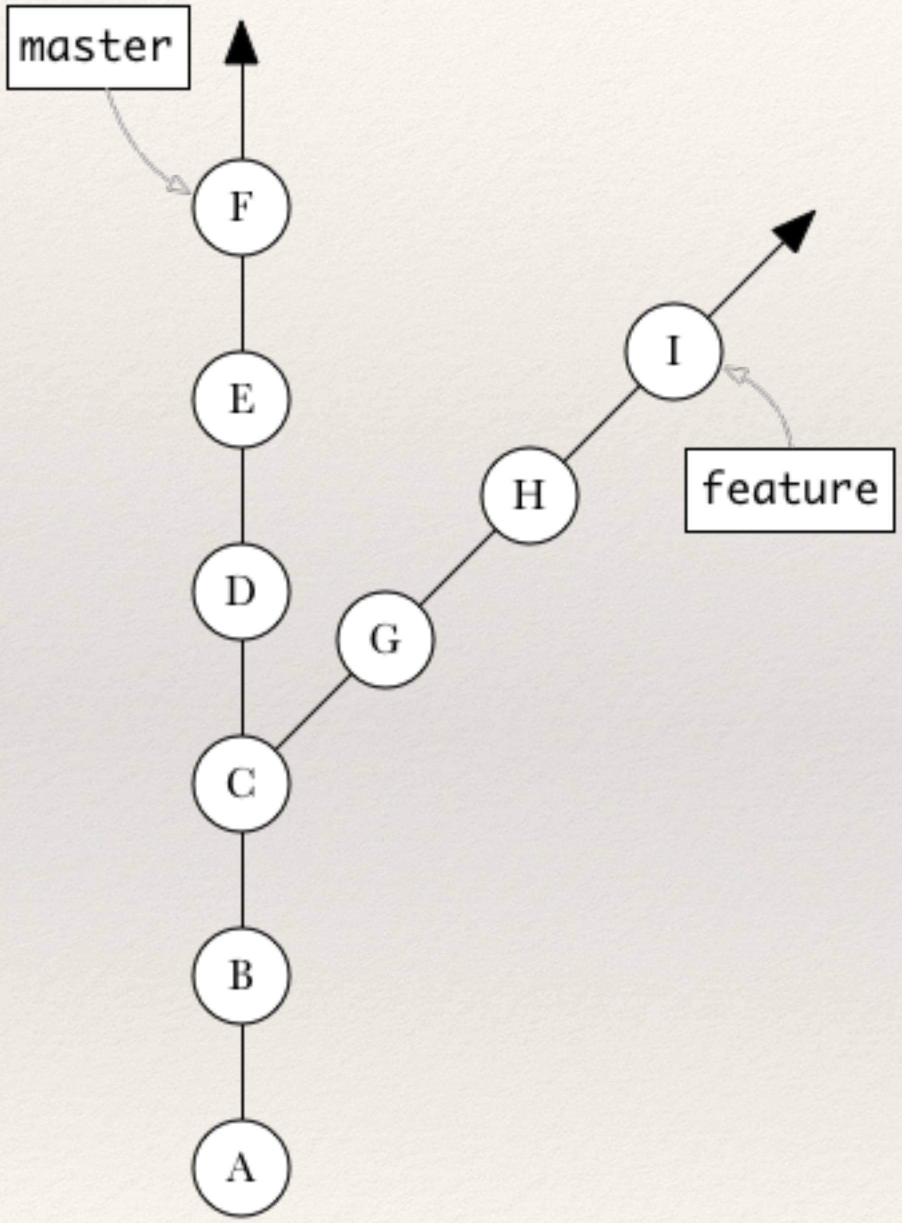
WARNING

Never change history when
other people might be using your branch,
unless they know you're doing so.

Never change history on `master`.

Best practice: only change history
for commits that have not yet been pushed.

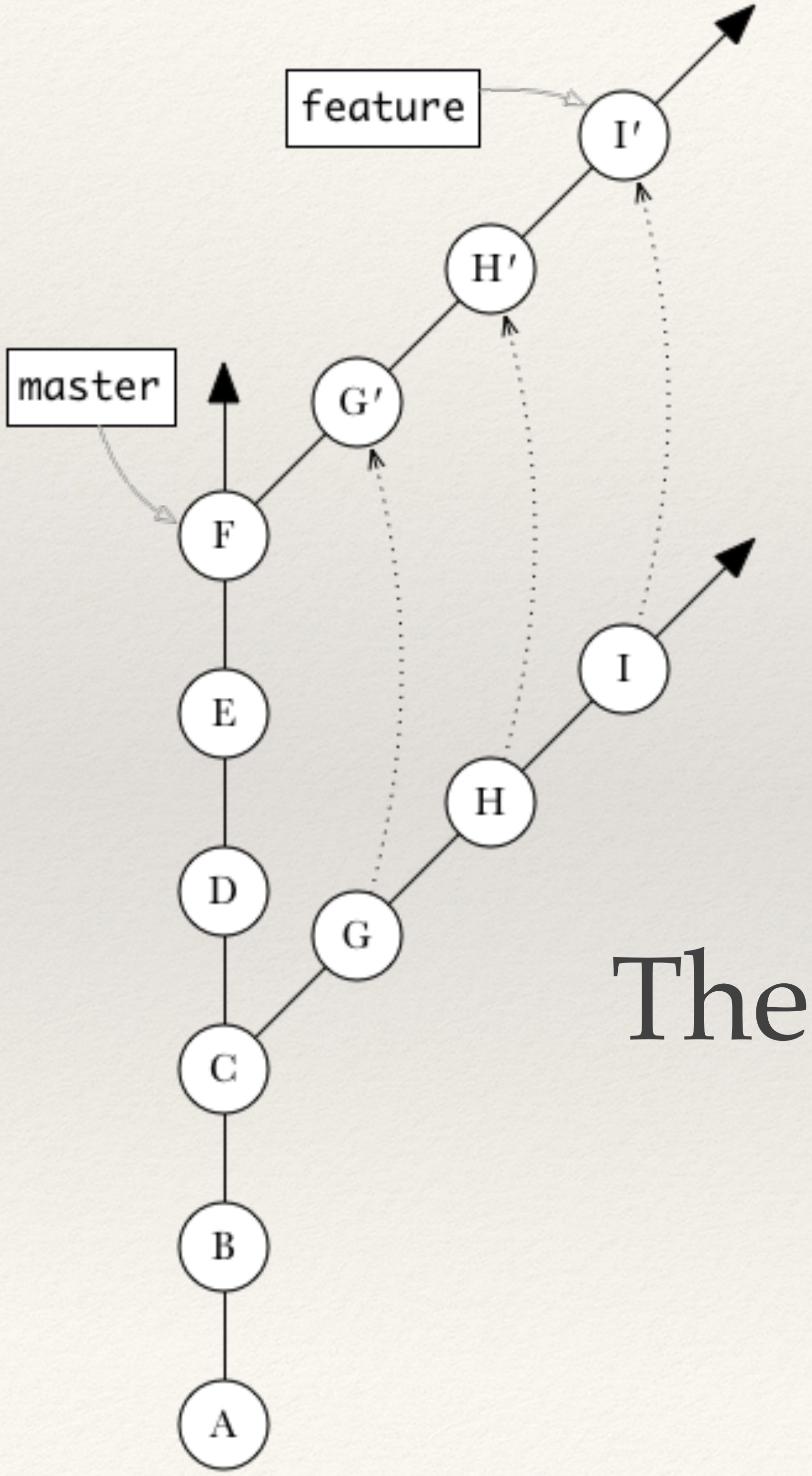
Ch 4: `rebase`



"`master` has changed since I started my feature branch, and I want to bring my branch up to date with `master`. What's the best way to do that?"

Don't merge — rebase!

Ch 4: `rebase`



- Finds the merge base
- Cherry-picks all commits
- Reassigns the branch pointer

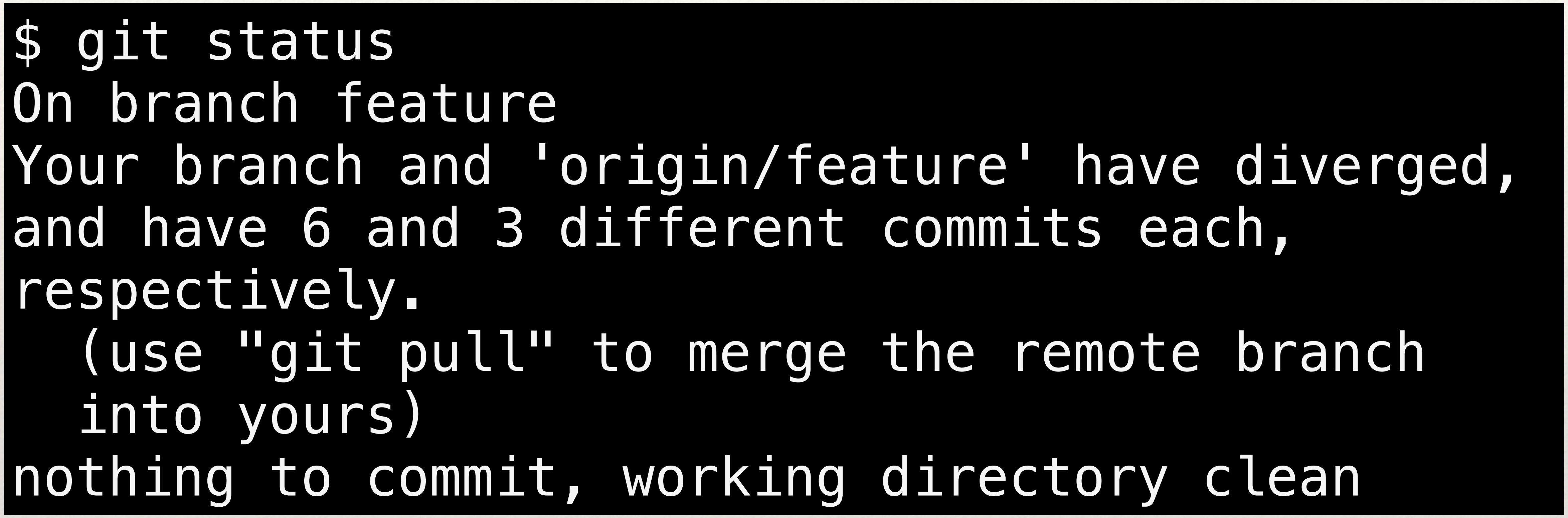
The branch has a new base —
it has been re-based!

Ch 4: rebase

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

$ git rebase master
First, rewinding head to replay your work on top of
it...
Applying: Added B.txt
Applying: Added another line for B.txt
Applying: Added a third line for B.txt
```

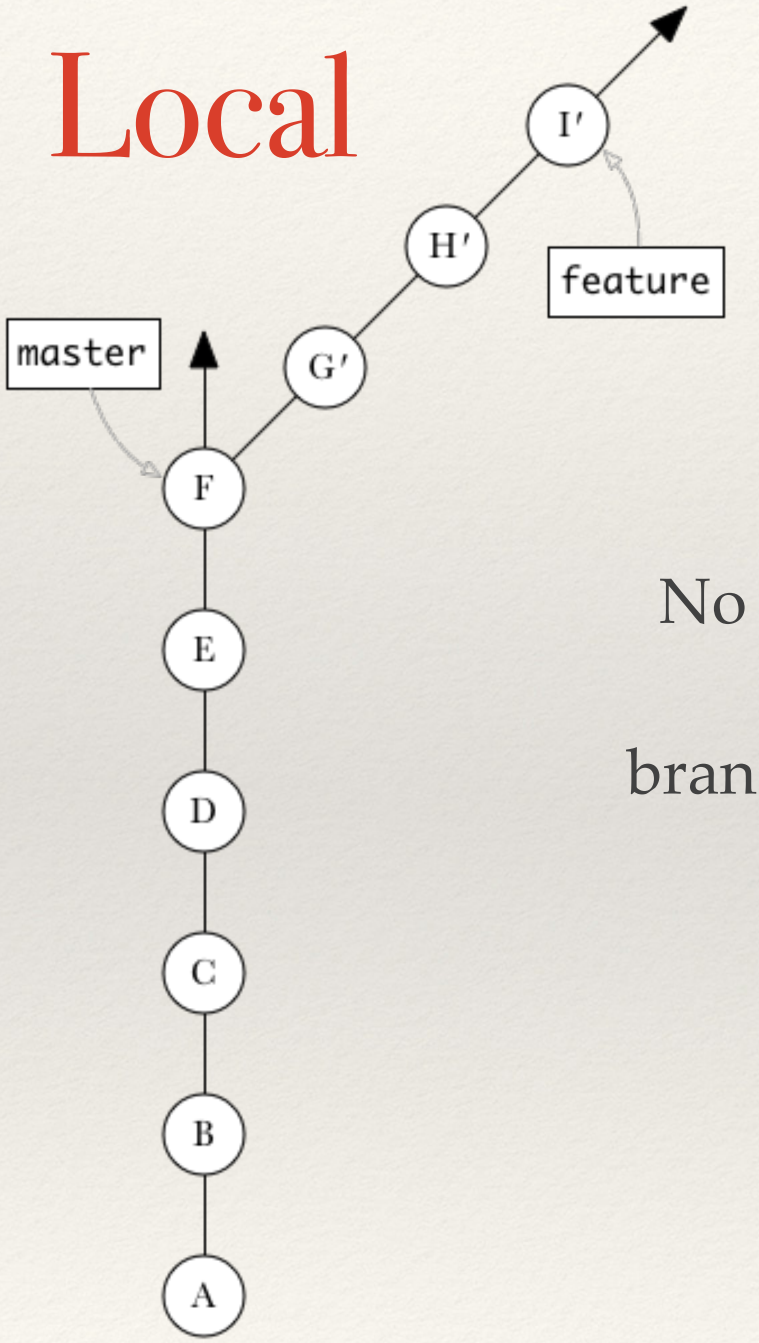
Ch 4: rebase



```
$ git status
On branch feature
Your branch and 'origin/feature' have diverged,
and have 6 and 3 different commits each,
respectively.
  (use "git pull" to merge the remote branch
  into yours)
nothing to commit, working directory clean
```

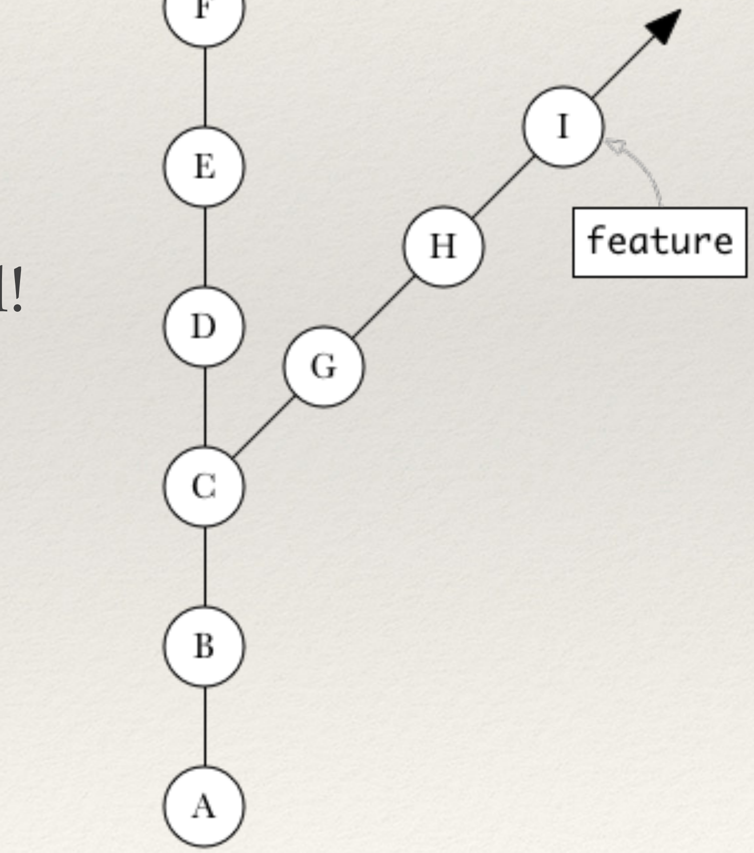
Ch 4: `rebase`

Local

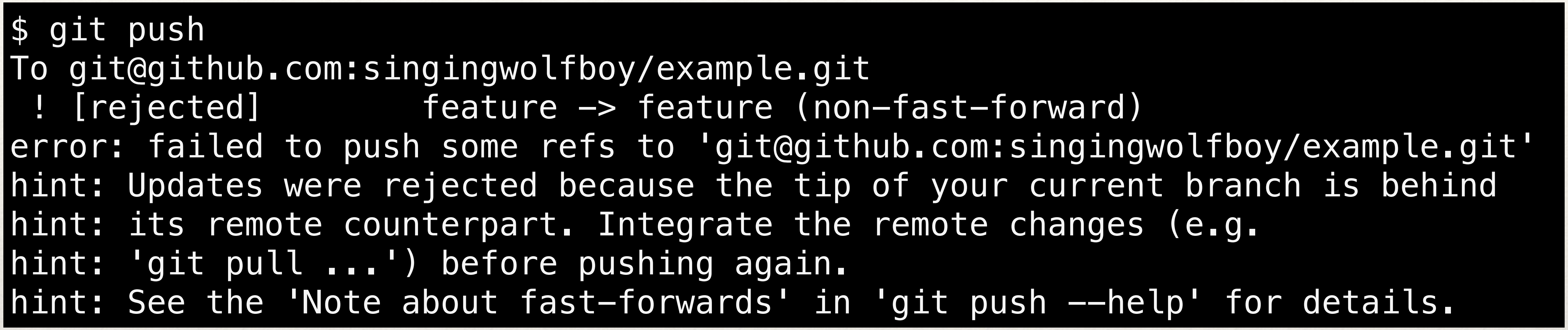


No way to go forward
from I to I′:
branches have diverged!

Remote



Ch 4: rebase



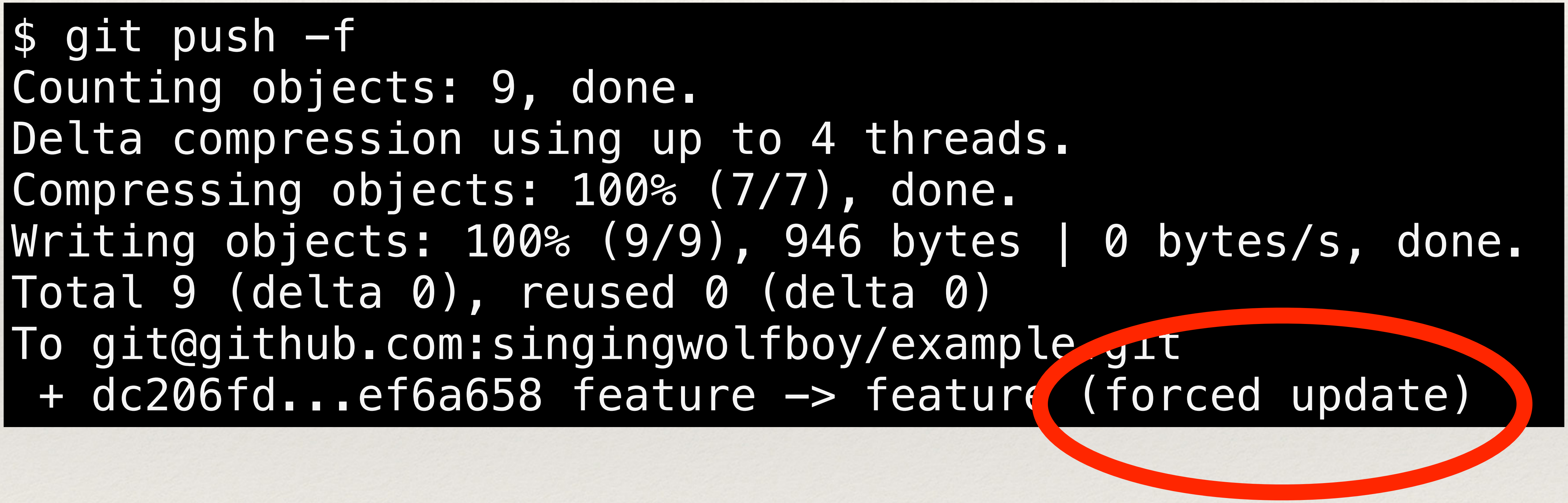
```
$ git push
To git@github.com:singingwolfboy/example.git
 ! [rejected]        feature -> feature (non-fast-forward)
error: failed to push some refs to 'git@github.com:singingwolfboy/example.git'
hint: Updates were rejected because the tip of your current branch is behind
hint: its remote counterpart. Integrate the remote changes (e.g.
hint: 'git pull ...') before pushing again.
hint: See the 'Note about fast-forwards' in 'git push --help' for details.
```

`git push` is saying:

"You want me to do *what*?
But that would mean changing history!
Are you sure that's what you want?"

Ch 4: rebase

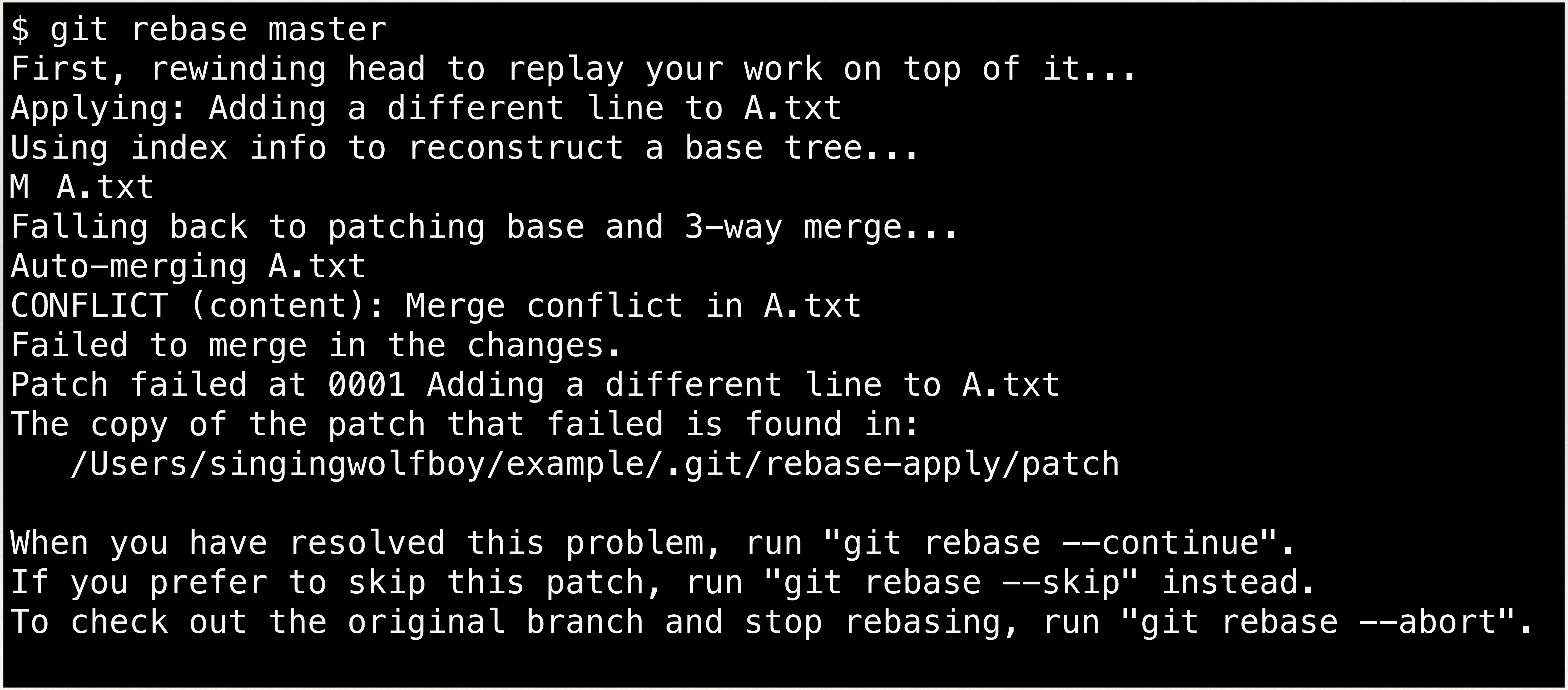
Use `git push -f` to force it:



```
$ git push -f
Counting objects: 9, done.
Delta compression using up to 4 threads.
Compressing objects: 100% (7/7), done.
Writing objects: 100% (9/9), 946 bytes | 0 bytes/s, done.
Total 9 (delta 0), reused 0 (delta 0)
To git@github.com:singingwolfboy/example.git
 + dc206fd...ef6a658 feature -> feature (forced update)
```

Ch 4: rebase

Sometimes you get conflicts…

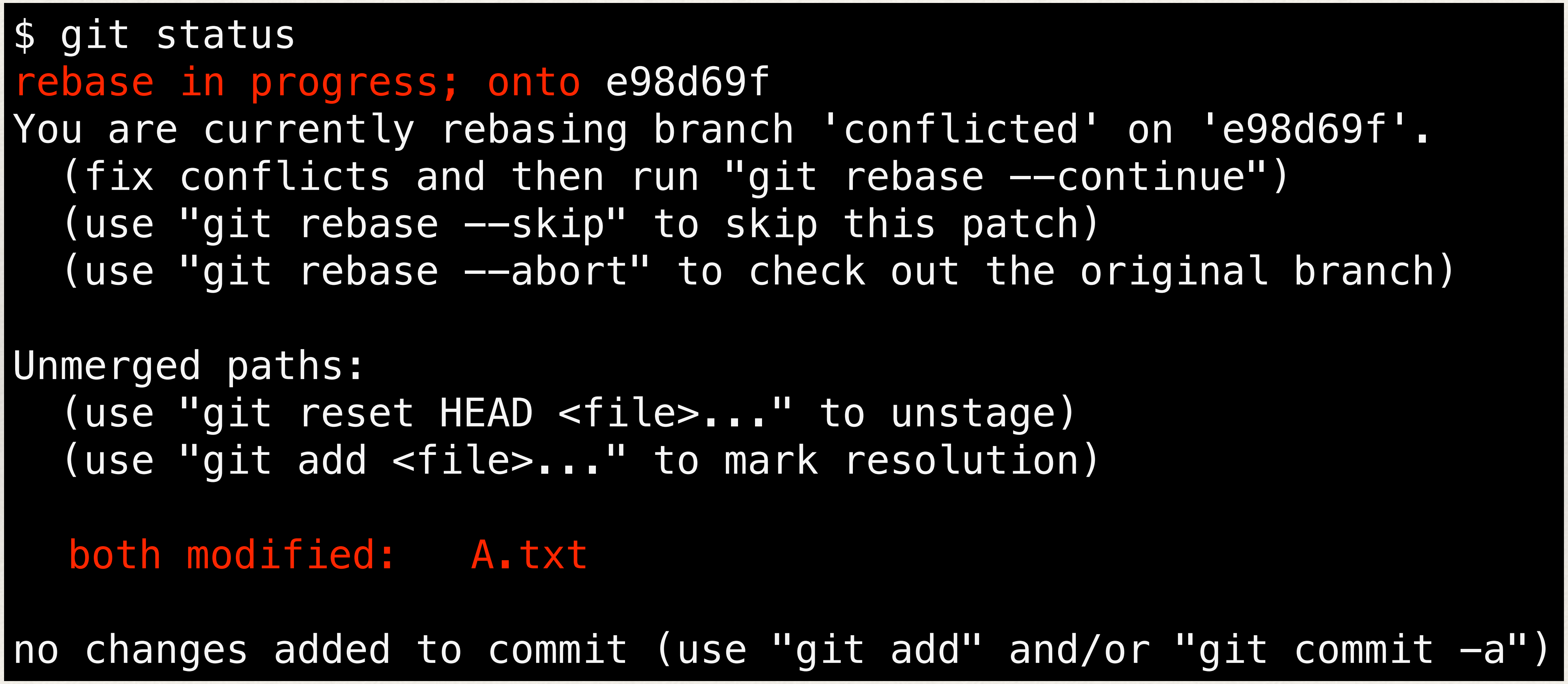


```
$ git rebase master
First, rewinding head to replay your work on top of it...
Applying: Adding a different line to A.txt
Using index info to reconstruct a base tree...
M  A.txt
Falling back to patching base and 3-way merge...
Auto-merging A.txt
CONFLICT (content): Merge conflict in A.txt
Failed to merge in the changes.
Patch failed at 0001 Adding a different line to A.txt
The copy of the patch that failed is found in:
   /Users/singingwolfboy/example/.git/rebase-apply/patch

When you have resolved this problem, run "git rebase --continue".
If you prefer to skip this patch, run "git rebase --skip" instead.
To check out the original branch and stop rebasing, run "git rebase --abort".
```

Ch 4: `rebase`

`git status` will show you which files are in conflict



```
$ git status
rebase in progress; onto e98d69f
You are currently rebasing branch 'conflicted' on 'e98d69f'.
  (fix conflicts and then run "git rebase --continue")
  (use "git rebase --skip" to skip this patch)
  (use "git rebase --abort" to check out the original branch)

Unmerged paths:
  (use "git reset HEAD <file>..." to unstage)
  (use "git add <file>..." to mark resolution)

  both modified:   A.txt

no changes added to commit (use "git add" and/or "git commit -a")
```

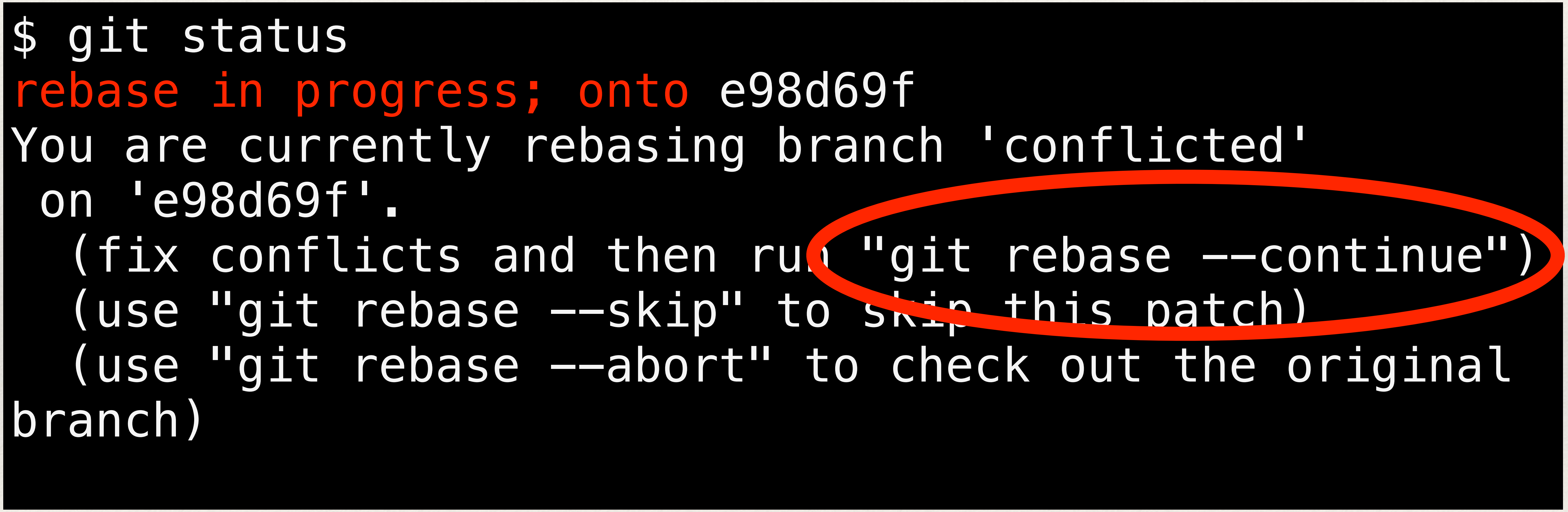
Ch 4: rebase

Looks the same as a merge conflict!

```
$ cat A.txt
line one
<<<<<<< HEAD
line two
line three
=======
this line is different
>>>>>>> Adding a different line to A.txt
```

Ch 4: rebase

But the resolution is different…

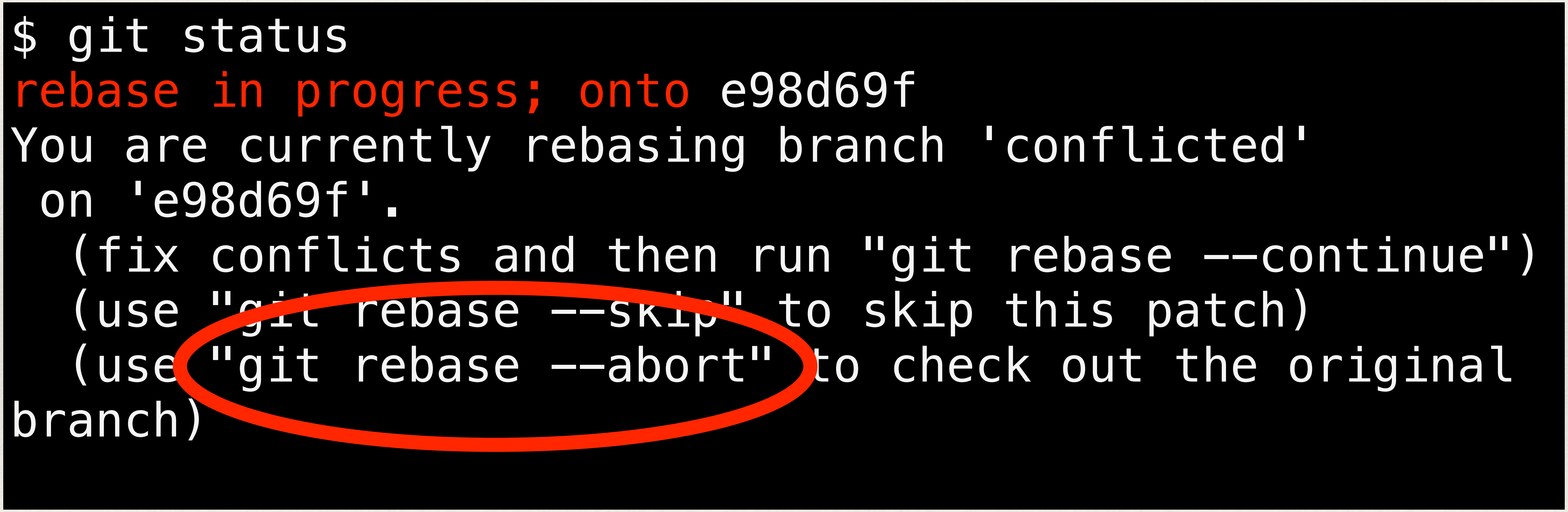


```
$ git status
rebase in progress; onto e98d69f
You are currently rebasing branch 'conflicted'
 on 'e98d69f'.
  (fix conflicts and then run "git rebase --continue")
  (use "git rebase --skip" to skip this patch)
  (use "git rebase --abort" to check out the original
branch)
```

```
git rebase --continue
```

Ch 4: rebase

If something's wrong, and you want to start over…

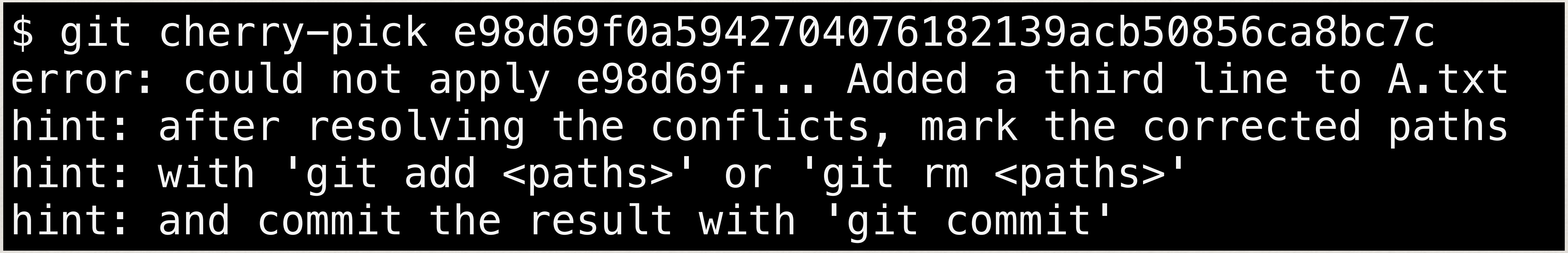


```
$ git status
rebase in progress; onto e98d69f
You are currently rebasing branch 'conflicted'
 on 'e98d69f'.
  (fix conflicts and then run "git rebase --continue")
  (use "git rebase --skip" to skip this patch)
  (use "git rebase --abort" to check out the original
branch)
```

`git rebase --abort`

Ch 2: `cherry-pick`

You can get conflicts with `cherry-pick`, as well

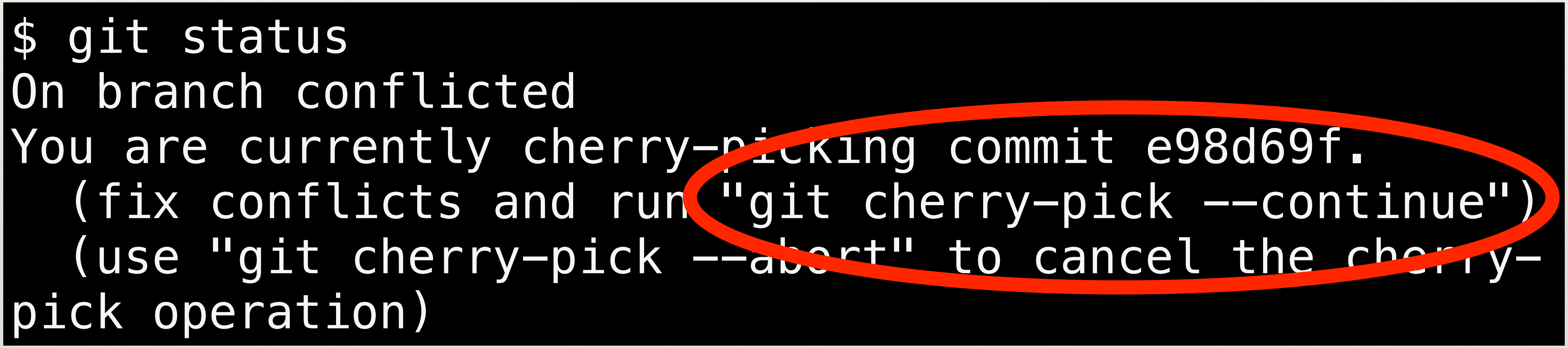


```
$ git cherry-pick e98d69f0a5942704076182139acb50856ca8bc7c
error: could not apply e98d69f... Added a third line to A.txt
hint: after resolving the conflicts, mark the corrected paths
hint: with 'git add <paths>' or 'git rm <paths>'
hint: and commit the result with 'git commit'
```

`git status` is still your friend!

Ch 2: cherry-pick

Resolve the conflicts and then

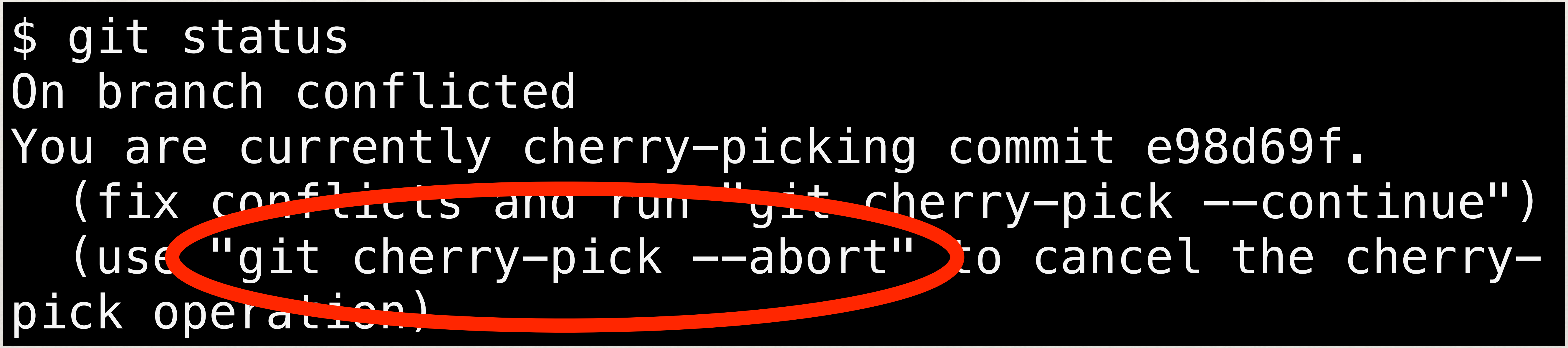


```
$ git status
On branch conflicted
You are currently cherry-picking commit e98d69f.
  (fix conflicts and run "git cherry-pick --continue")
  (use "git cherry-pick --abort" to cancel the cherry-
pick operation)
```

```
git cherry-pick --continue
```

Ch 2: cherry-pick

Not worth the trouble?



```
$ git status
On branch conflicted
You are currently cherry-picking commit e98d69f.
  (fix conflicts and run "git cherry-pick --continue")
  (use "git cherry-pick --abort" to cancel the cherry-
pick operation)
```

`git cherry-pick --abort`

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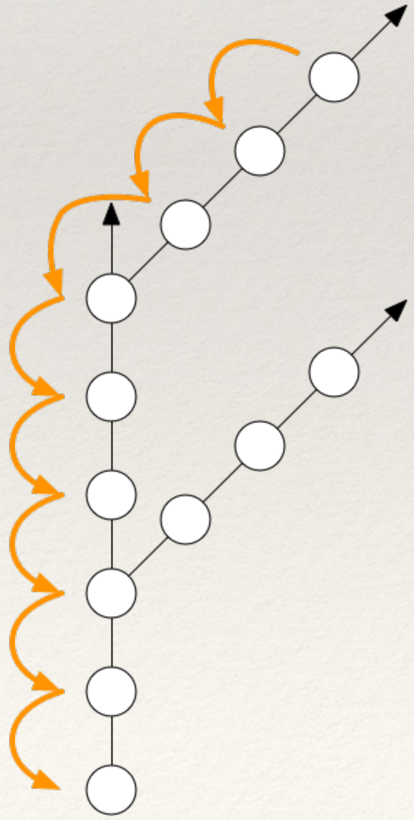
throwback!

Ch 5: `reflog`

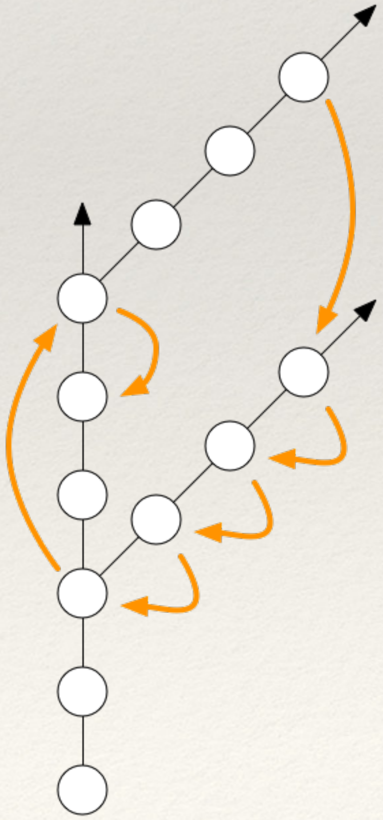
`git log`

shows commits in **ancestor order**



`git reflog`

shows commits in **order of when you lasted referenced them**

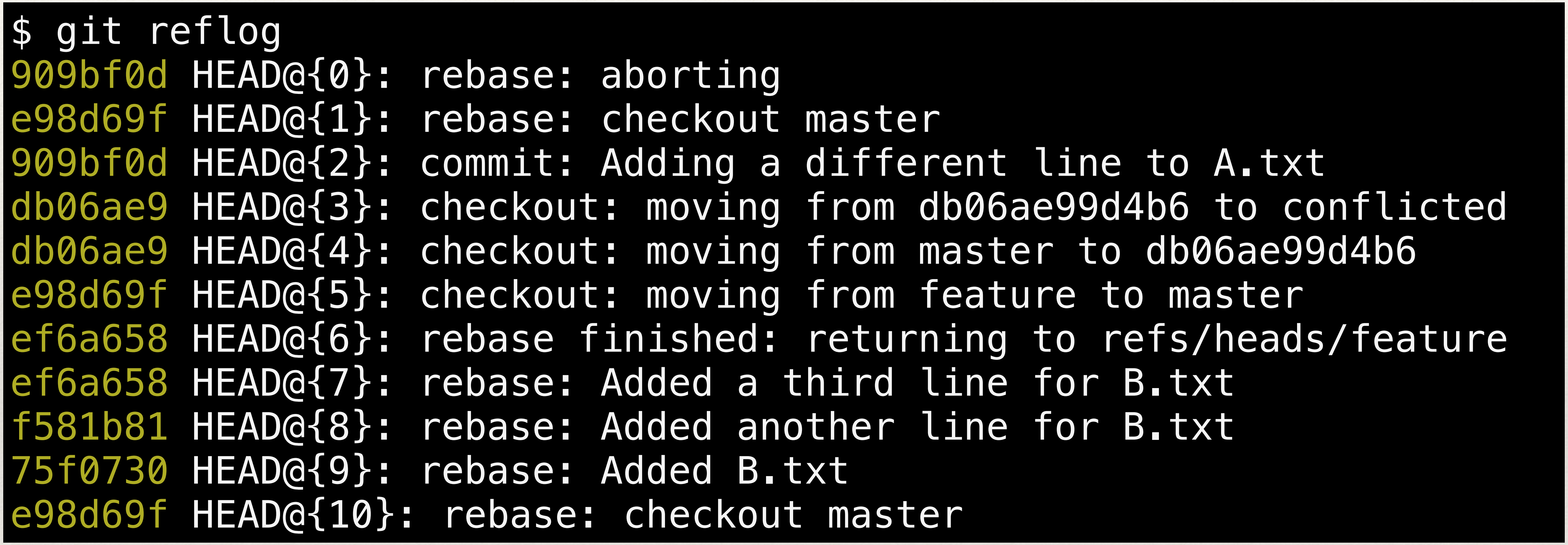


Ch 5: `reflog`

"Oh no, I screwed up
and I want to get back
to the way things were before,
but I didn't write down
the commit hash!"

`reflog` to the rescue!

Ch 5: reflog



```
$ git reflog
909bf0d HEAD@{0}: rebase: aborting
e98d69f HEAD@{1}: rebase: checkout master
909bf0d HEAD@{2}: commit: Adding a different line to A.txt
db06ae9 HEAD@{3}: checkout: moving from db06ae99d4b6 to conflicted
db06ae9 HEAD@{4}: checkout: moving from master to db06ae99d4b6
e98d69f HEAD@{5}: checkout: moving from feature to master
ef6a658 HEAD@{6}: rebase finished: returning to refs/heads/feature
ef6a658 HEAD@{7}: rebase: Added a third line for B.txt
f581b81 HEAD@{8}: rebase: Added another line for B.txt
75f0730 HEAD@{9}: rebase: Added B.txt
e98d69f HEAD@{10}: rebase: checkout master
```

Step 1: find the commit you want

Ch 5: reflog

Step 2: checkout the commit,
and make sure it's what you want

```
$ git checkout 3ca7892
```

Step 3: reset the branch pointer
back to the commit

```
$ git checkout feature
$ git reset --hard 3ca7892
```

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Ch 6: squashing commits

“Darn, I forgot to include this file
in the commit I just made!”

```
$ git add missing-file.txt
$ git commit --amend
```

Makes a new commit with your file added,
and replaces the most recent commit with the new one!
No more “added missing file” commit messages!

Ch 6: squashing commits

“But I already have lots of commits like that!
It’s not just my most recent commit…”

```
$ git rebase --interactive
```

Time to bring out the big guns.

Ch 6: squashing commits

Interactive rebase needs somewhere to start.
To look at the last 5 commits, you can use `HEAD~5`
(or use whatever number you want)

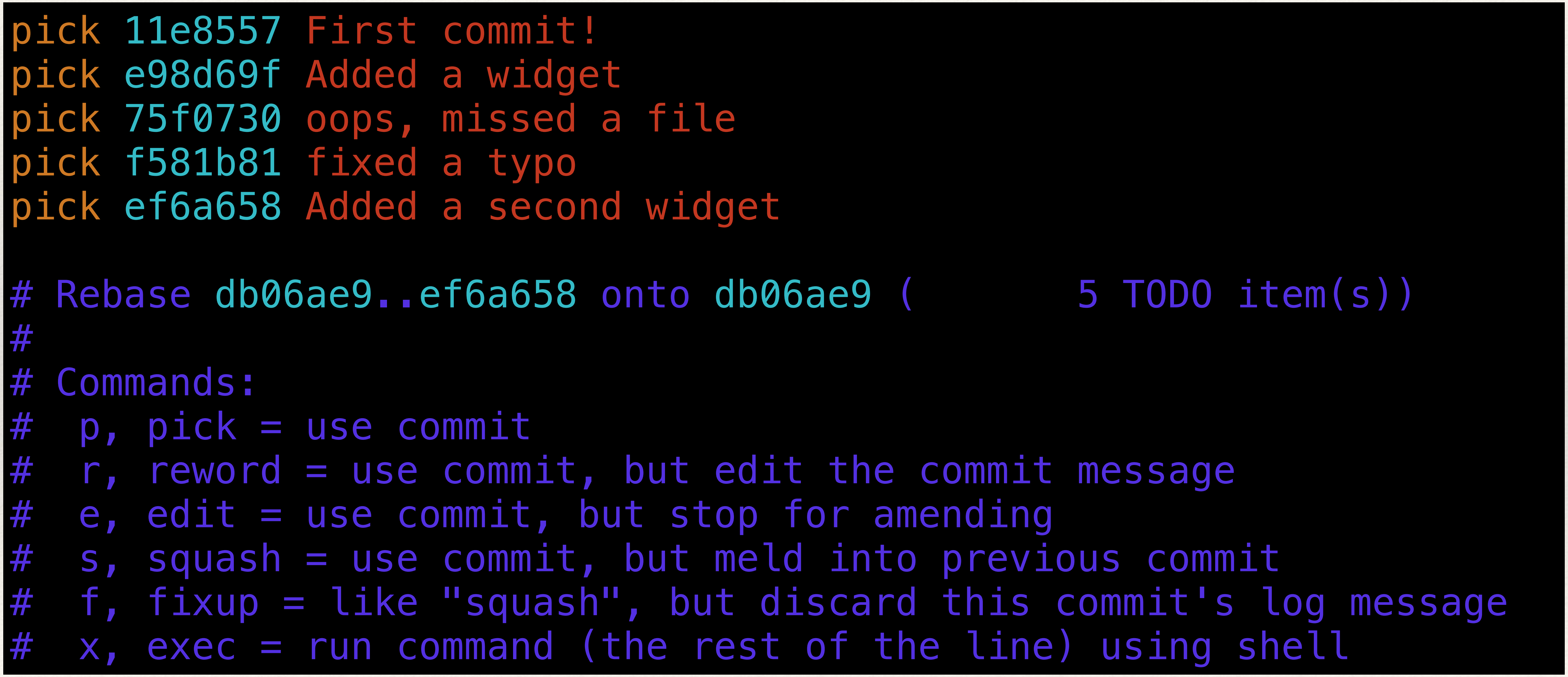
```
$ git rebase --interactive HEAD~5
```

Git will open a file in your text editor,
so that you can provide further instructions

Ch 6: squashing commits

actions

commits



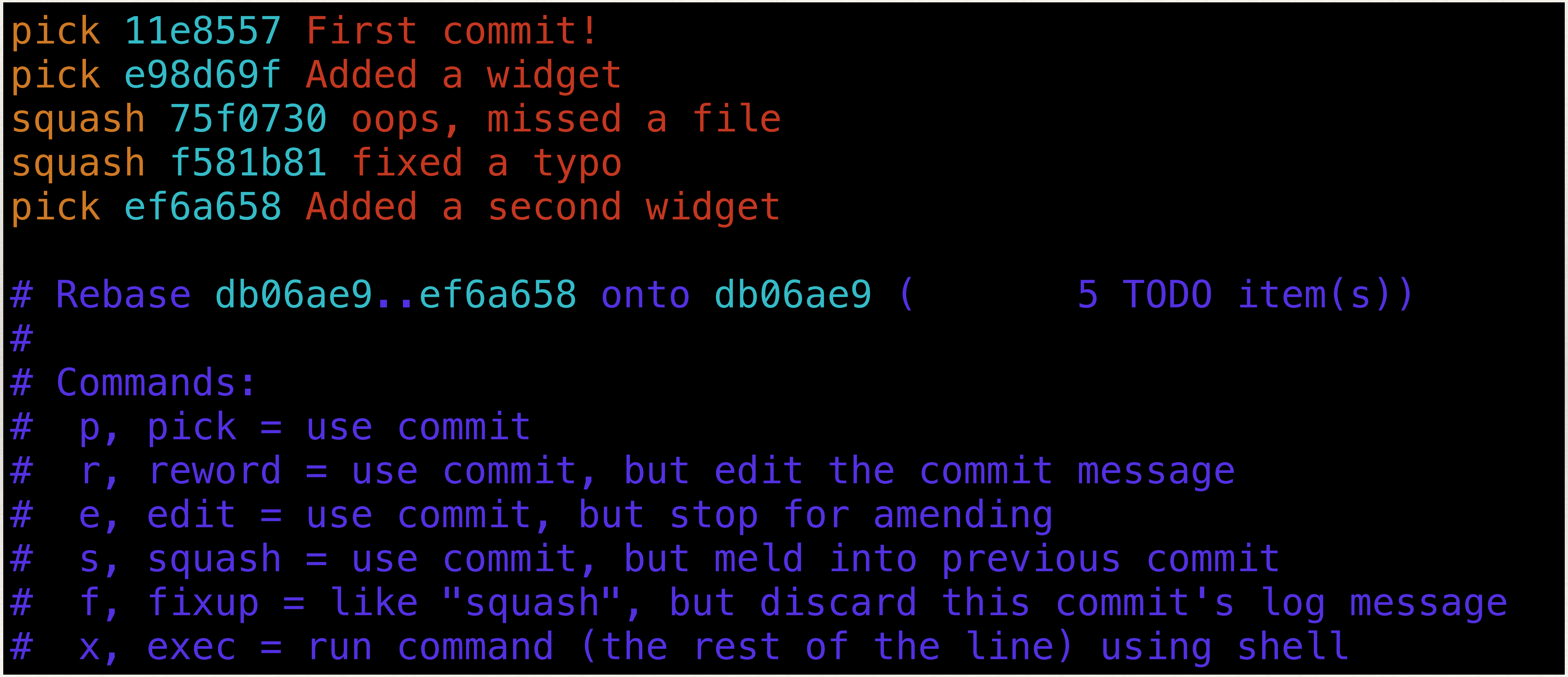
```
pick 11e8557 First commit!
pick e98d69f Added a widget
pick 75f0730 oops, missed a file
pick f581b81 fixed a typo
pick ef6a658 Added a second widget

# Rebase db06ae9..ef6a658 onto db06ae9 (       5 TODO item(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
```

instructions

Ch 6: squashing commits

actions

commits

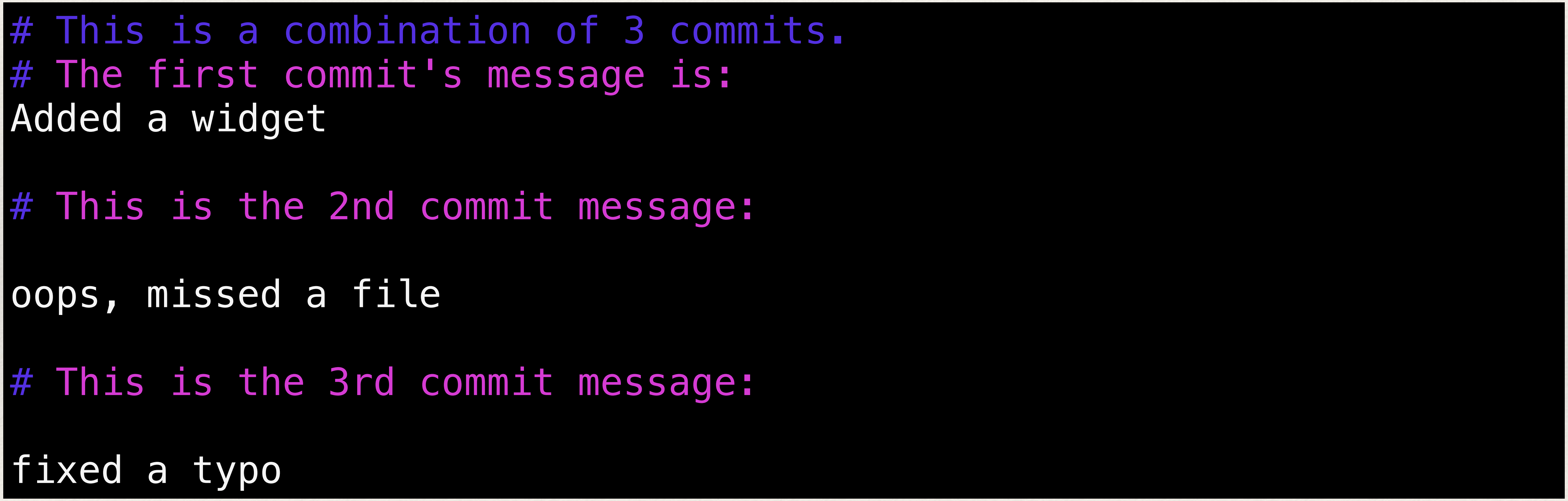


```
pick 11e8557 First commit!
pick e98d69f Added a widget
squash 75f0730 oops, missed a file
squash f581b81 fixed a typo
pick ef6a658 Added a second widget

# Rebase db06ae9..ef6a658 onto db06ae9 (       5 TODO item(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
```

instructions

Ch 6: squashing commits

Saving and quitting your editor
will cause it to immediately reopen



```
# This is a combination of 3 commits.
# The first commit's message is:
Added a widget

# This is the 2nd commit message:

oops, missed a file

# This is the 3rd commit message:

fixed a typo
```

so that you can write a new message
for your single, squashed commit

Ch 6: squashing commits

Save and quit again,
and Git will apply
the changes you requested.
No more "fixed typo" commits!

WARNING: squashing commits changes history!
Only do this for unpushed commits!

Ch 6: splitting commits

"My commit is too big,
can I split it into smaller ones?"

Sort of.
You can make new commits that are smaller,
and replace your big commit with
several smaller commits.

Ch 6: splitting commits

Step 1: `reset` to just before the big commit

```
$ git reset big-commit^
```

Step 2: make new commits

```
$ git add file1.txt
$ git commit -m "does one thing well"
$ git add file2.txt
$ git commit -m "does something else"
```

Ch 6: splitting commits

Step 3: if necessary,
use `cherry-pick` or `rebase`
to move the smaller commits
into place.

Done!

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Ch 7: `bisect`

"The feature's broken?
But it was working just fine
two months ago… what changed?"

`bisect` will help you quickly find
the commit that introduced the problem

Ch 7: `bisect`

You need three things to use `bisect`:

- A test to determine if things are broken (manual is OK, automated is better)
- A commit where things were working
- A commit where things are broken

`bisect` will use binary search
to find the commit where
things went from good to bad

Ch 7: bisect

```
$ git bisect start
$ git checkout broken–commit
$ git bisect bad
$ git checkout working–commit
$ git bisect good
```

Git will checkout the commit in between the two you've provided, and ask you to test it and determine if its working or broken

Ch 7: bisect

If it’s working, run

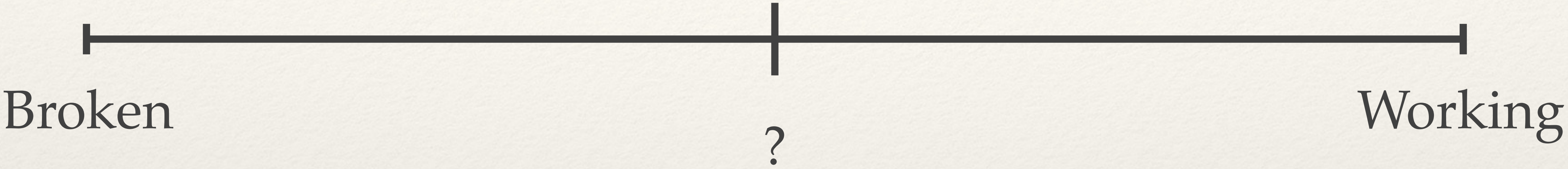
```
$ git bisect good
```

If it’s broken, run

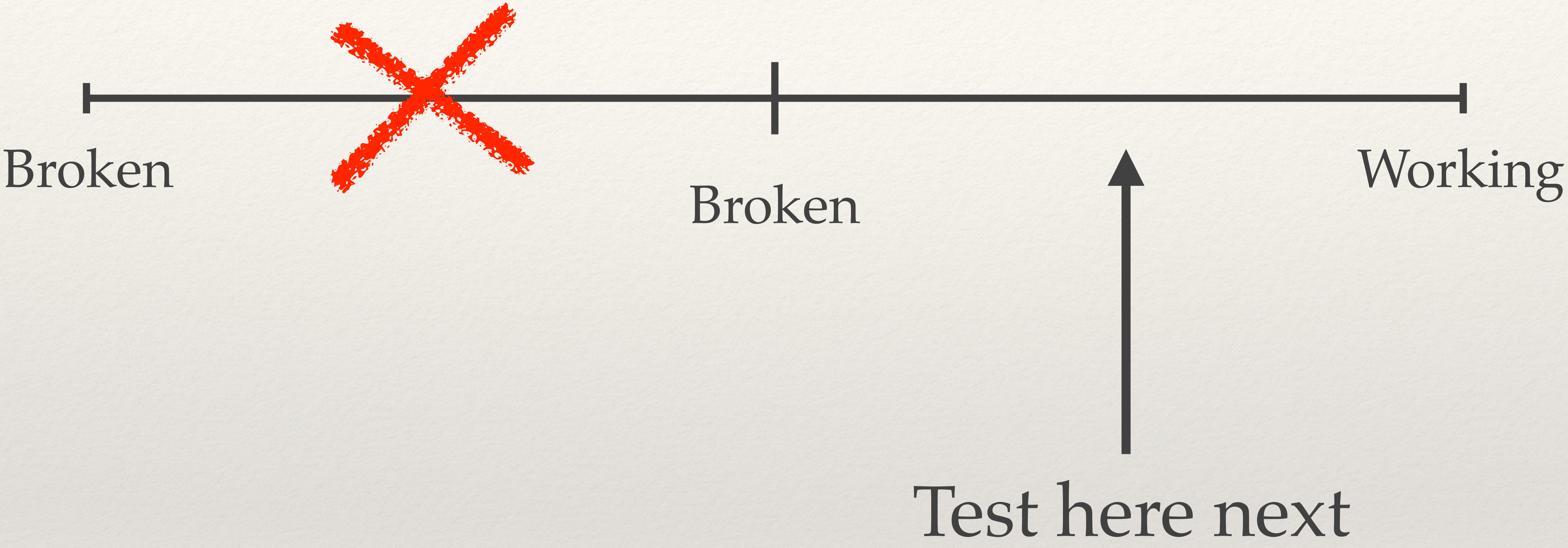
```
$ git bisect bad
```

Either way, Git will use that information to determine the best commit to test next

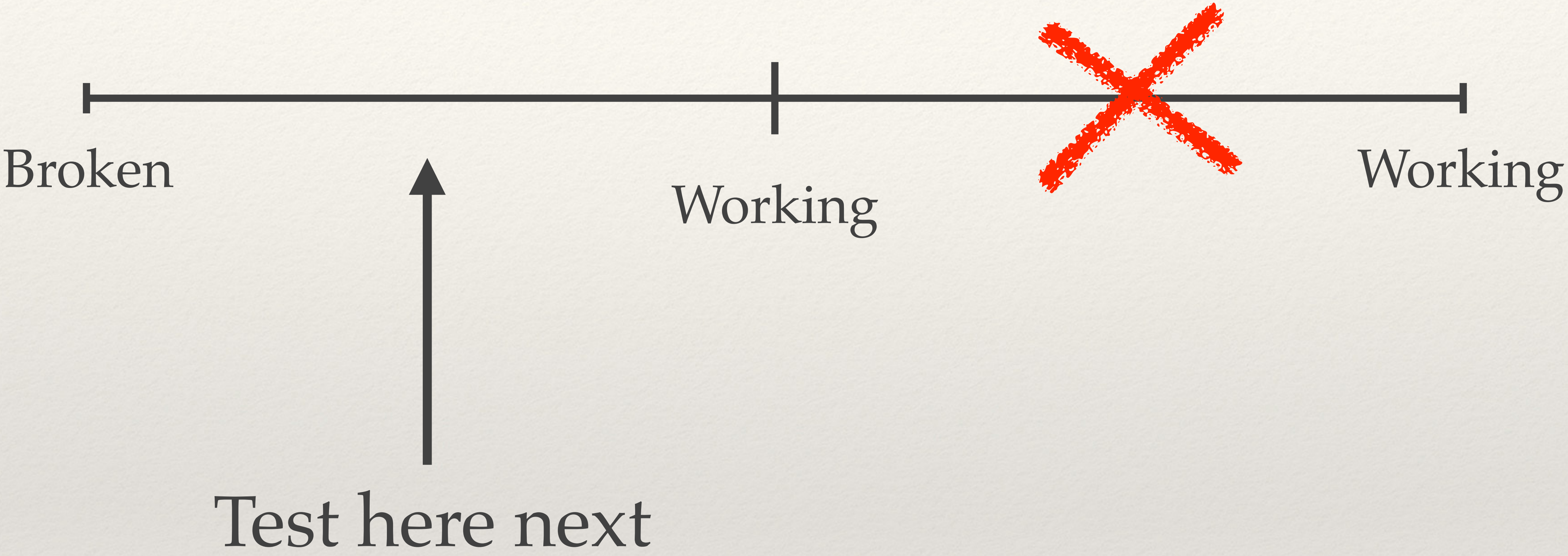
Ch 7: `bisect`



Ch 7: `bisect`



Ch 7: `bisect`



Broken

Working

Working

Test here next

And keep going recursively….

Ch 7: bisect

If you have an automated test, it's even faster!

```
$ git bisect run my_test.sh
```

With that, Git can
test, checkout, test, checkout, test
until it finds the commit
that caused the failure

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DONE!

There's so much more…

```
$ git help rebase
```

http://git-scm.com/doc

Any questions?

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```
blame cherry-pick reset rebase reflog squash split bisect
```