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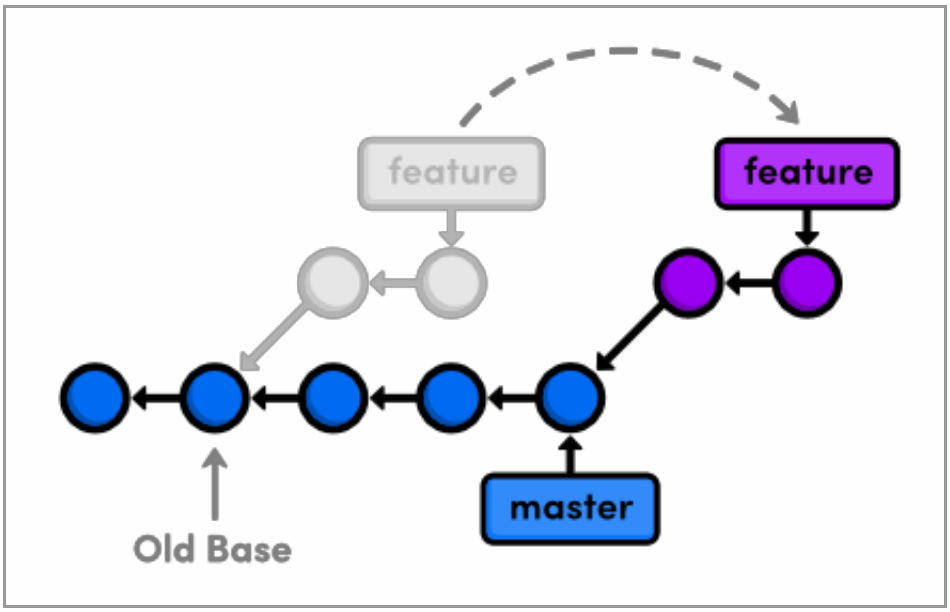
Rebasing

Let's start this module by taking an in-depth look at our history. The six commits asterisked below are part of the same train of thought. We even developed them in their own feature branch. However, they show up interspersed with commits from other branches, along with a superfluous merge commit (`b9ae1bc`). In other words, our repository's history is kind of messy:

```
ec1b8cb Merge branch 'crazy'
*42fa173 Add news item for rainbow
3db88e1 Add 1st news item
*7147cc5 Link index.html to rainbow.html
*6aa4b3b Add CSS stylesheet to rainbow.html
b9ae1bc Merge branch 'master' into crazy
ae4e756 Link HTML pages to stylesheet
98cd46d Add CSS stylesheet
*33e25c9 Rename crazy.html to rainbow.html
*677e0e0 Add a rainbow to crazy.html
506bb9b Revert "Add a crazzzy experiment"
*514fbe7 Add a crazzzy experiment
1c310d2 Add navigation links
54650a3 Create blue and orange pages
b650e4b Create index page
```

Fortunately, Git includes a tool to help us clean up our commits: `git rebase`. Rebasing lets us move branches around by changing the commit that they are *based* on. Conceptually, this is what it allows us to do:



Rebasing a feature branch onto `master`

After rebasing, the `feature` branch has a new parent commit, which is the same commit pointed to by `master`. Instead of joining the branches with a merge commit, rebasing integrates the `feature` branch by building *on top of* `master`. The result is a perfectly linear history that reads more like a story than the hodgepodge of unrelated edits shown above.

To explore Git's rebasing capabilities, we'll need to build up our example project so that we have something to work with. Then, we'll go back and rewrite history using `git rebase`.

Download the repository for this module

If you've been following along from the previous module, you already have everything you need. Otherwise, download the zipped Git repository from the above link, uncompress it, and you're good to go.

Create an About Section

We'll begin by creating an about page for the website. Remember, we should be doing all of our work in isolated branches so that we don't cause any unintended changes to the stable version of the project.

```
git branch about
```

```
git checkout about
```

The next few steps break this feature into several unnecessarily small commits so that we can see the effects of a rebase. First, make a new directory in `my-git-repo` called `about`. Then, create the empty file `about/index.html`. Stage and commit a snapshot.

```
git add about
git status
git commit -m "Add empty page in about section"
```

Note that `git add` can also add entire directories to the staging area.

Add an About Page

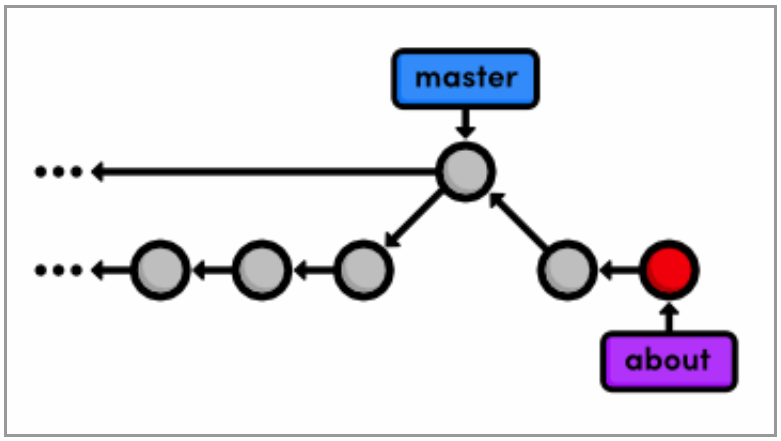
Next, we'll add some HTML to `about/index.html`:

```
<!DOCTYPE html>
<html lang="en">
<head>
  <title>About Us</title>
  <link rel="stylesheet" href="../style.css" />
  <meta charset="utf-8" />
</head>
<body>
  <h1>About Us</h1>
  <p>We're a small, colorful website with just two employees:</p>

  <ul>
    <li><a href="me.html">Me: The Developer</a></li>
    <li><a href="mary.html">Mary: The Graphic Designer</a></li>
  </ul>

  <p><a href="../index.html">Return to home page</a></p>
</body>
</html>
```

Stage and commit the snapshot.

```
git status
git commit -a -m "Add contents to about page"
```

After a few commits on this branch, our history looks like the following.



Adding the about *branch*

Another Emergency Update!

Our boss just gave us some more breaking news! Again, we'll use a hotfix branch to update the site without affecting our about page developments. Make sure to base the updates on `master`, not the `about` branch:

```
git checkout master
git branch news-hotfix
git checkout news-hotfix
git branch
```

Change the "News" section in `index.html` to:

```
<h2 style="color: #C00">News</h2>
<ul>
  <li><a href="news-1.html">Blue Is The New Hue</a></li>
  <li><a href="rainbow.html">Our New Rainbow</a></li>
  <li><a href="news-2.html">A Red Rebellion</a></li>
```

```
</ul>
```

Commit a snapshot:

```
git status
git commit -a -m "Add 2nd news item to index page"
```

Then, create a new page called `news-2.html`:

```
<!DOCTYPE html>
<html lang="en">
<head>
  <title>A Red Rebellion</title>
  <link rel="stylesheet" href="style.css" />
  <meta charset="utf-8" />
</head>
<body>
  <h1 style="color: #C03">A Red Rebellion</h1>

  <p>Earlier today, several American design firms
  announced that they have completely rejected the use
  of blue in any commercial ventures. They have
  opted instead for <span style="color: #C03">Red</span>.</p>

  <p><a href="index.html">Return to home page</a></p>
</body>
</html>
```

Stage and commit another snapshot:

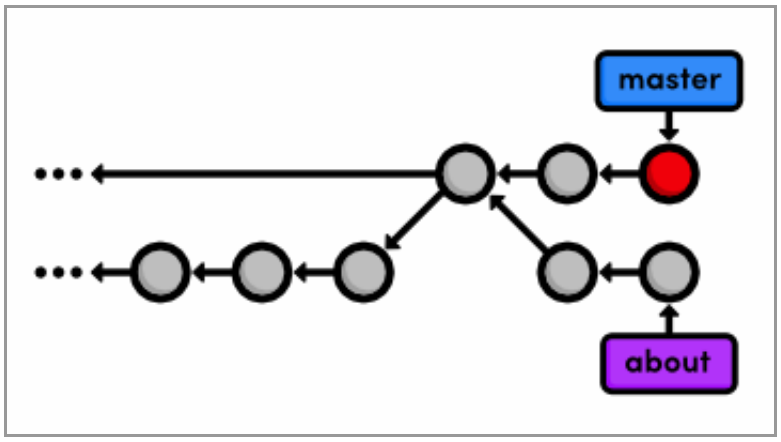
```
git add news-2.html
git status
git commit -m "Add article for 2nd news item"
```

Publish News Hotfix

We're ready to merge the news update back into `master`.

```
git checkout master
git merge news-hotfix
git branch -d news-hotfix
```

The `master` branch hasn't been altered since we created `news-hotfix`, so Git can perform a fast-forward merge. Our repository now looks like the following.



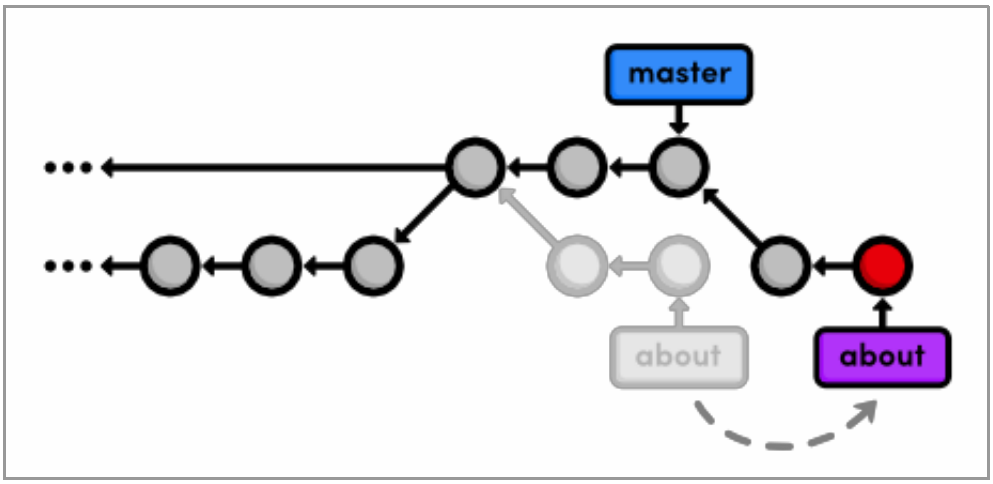
Fast-forwarding `master` *to the* `news-hotfix`

Rebase the About Branch

This puts us in the exact same position as we were in before our first 3-way merge. We want to pull changes from `master` into a feature branch, only this time we'll do it with a rebase instead of a merge.

```
git checkout about
git rebase master
git log --oneline
```

Originally, the `about` branch was based on the `Merge branch 'crazy-experiment'` commit. The rebase took the entire `about` branch and plopped it onto the *tip* of the `master` branch, which is visualized in the following diagram. Also notice that, like the `git merge` command, `git rebase` requires you to be on the branch that you want to move.



Rebasing the about *branch onto* master

After the rebase, about is a linear extension of the master branch, enabling us to do a fast-forward merge later on. Rebasing also allowed us to integrate the most up-to-date version of master *without a merge commit*.

Add a Personal Bio

With our news hotfix out of the way, we can now continue work on our about section. Create the file about/me.html with the following contents:

```
<!DOCTYPE html>
<html lang="en">
<head>
  <title>About Me</title>
  <link rel="stylesheet" href="../style.css" />
  <meta charset="utf-8" />
</head>
<body>
  <h1>About Me</h1>
  <p>I'm a big nerd.</p>

  <h2>Interests</h2>
  <ul>
    <li>Computers</li>
    <li>Mathematics</li>
    <li>Typography</li>
  </ul>
```

```
  <p><a href="index.html">Return to about page</a></p>
</body>
</html>
```

Then, commit the changes to the repository.

```
git add about/me.html
git commit -m "Add HTML page for personal bio"
git log --oneline
```

Remember that thanks to the rebase, `about` rests on top of `master`. So, all of our about section commits are grouped together, which would not be the case had we merged instead of rebased. This also eliminates an unnecessary fork in our project history.

Add Dummy Page for Mary

Once again, the next two snapshots are unnecessarily trivial. However, we'll use an *interactive* rebase to combine them into a single commit later on. That's right, `git rebase` not only lets you move branches around, it enables you to manipulate individual commits as you do so.

Create a new empty file in the about section: `about/mary.html`.

```
git add about
git status
git commit -m "Add empty HTML page for Mary's bio"
```

Link to the About Section

Then, add a link to the about page in `index.html` so that its "Navigation" section looks like the following.

```
<h2>Navigation</h2>
```

```
<ul>
  <li>
    <a href="about/index.html">About Us</a>
  </li>
  <li style="color: #F90">
    <a href="orange.html">The Orange Page</a>
  </li>
  <li style="color: #00F">
    <a href="blue.html">The Blue Page</a>
  </li>
  <li>
    <a href="rainbow.html">The Rainbow Page</a>
  </li>
</ul>
```

Don't forget to commit the change:

```
git commit -a -m "Add link to about section in home page"
```

Clean Up the Commit History

Before we merge into the `master` branch, we should make sure we have a clean, meaningful history in our feature branch. By rebasing interactively, we can choose *how* each commit is transferred to the new base. Specify an interactive rebase by passing the `-i` flag to the rebase command:

```
git rebase -i master
```

This should open up a text editor populated with all of the commits introduced in the `about` branch, listed from oldest to newest. The listing defines exactly how Git will transfer the commits to the new base. Leaving it as is will do a normal `git rebase`, but if we move the lines around, we can change the order in which commits are applied.

In addition, we can replace the `pick` command before each line to edit it or combine it with other commits. All of the available commands are shown in the comment

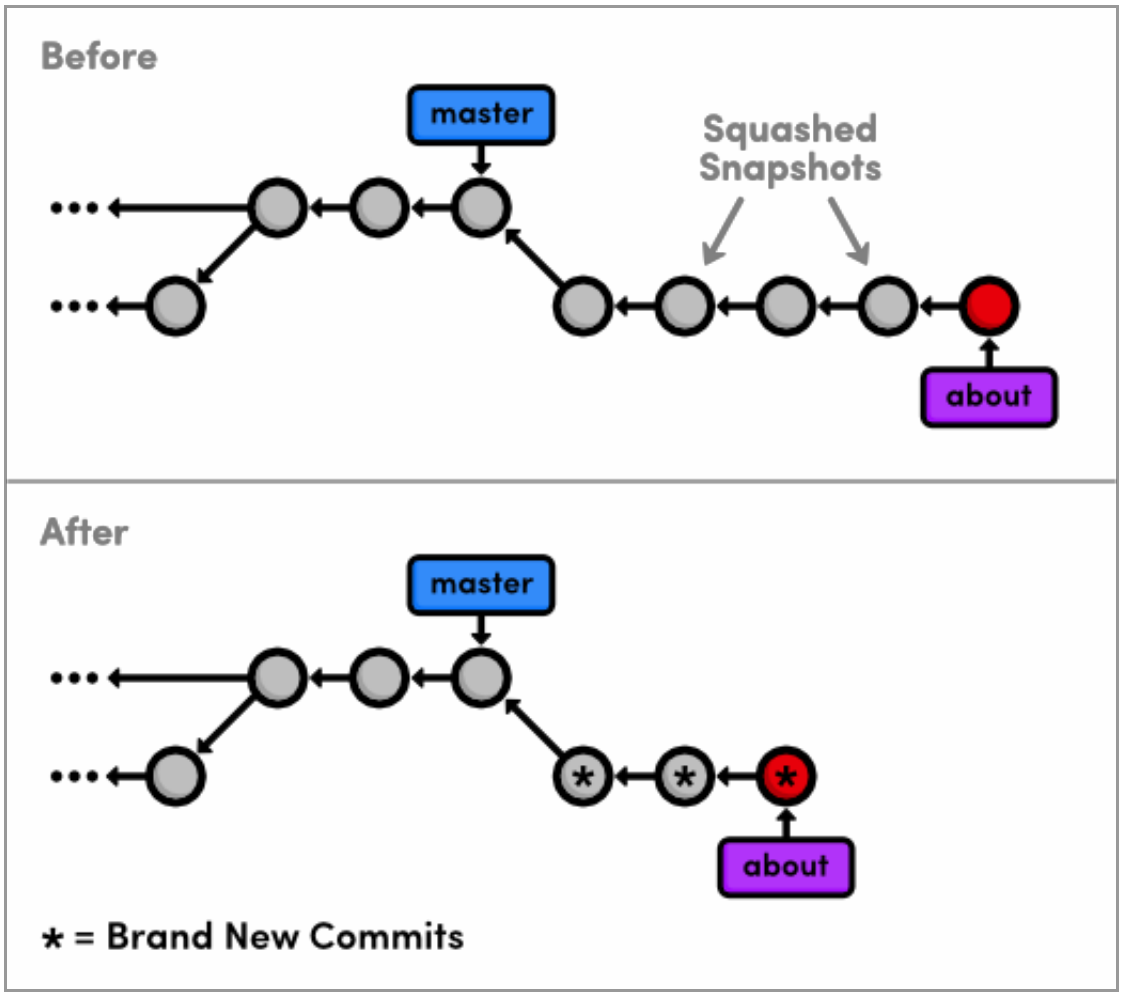
section of the rebase listing, but right now, we only need the `squash` command. This will condense our unnecessarily small commits into a single, meaningful snapshot. Change your listing to match the following:

```
pick 5cf316e Add empty page in about section
squash 964e013 Add contents to about page
pick 89db9ab Add HTML page for personal bio
squash 2bda8e5 Add empty HTML page for Mary's bio
pick 915466f Add link to about section in home page
```

Then, begin the rebase by saving and closing the editor. The following list describes the rebasing process in-depth and tells you what you need to change along the way.

1. Git moves the `5cf316e` commit to the tip of `master`.
2. Git combines the snapshots of `964e013` and `5cf316e`.
3. Git stops to ask you what commit message to use for the combined snapshot. It automatically includes the messages of both commits, but you can delete that and simplify it to just `Create the about page`. Save and exit the text editor to continue.
4. Git repeats this process for commits `89db9ab` and `2bda8e5`. Use `Begin creating bio pages` for the message.
5. Git adds the final commit (`915466f`) on top of the commits created in the previous steps.

You can see the result of all this activity with `git log --oneline`, as well as in the diagram below. The five commits originally in `about` have been condensed to three, and two of them have new messages. Also notice that they all have different commit ID's. These new ID's tell us that we didn't just *move* a couple of commits—we've literally rewritten our repository history with brand new commits.



Results of the interactive rebase

Interactive rebasing gives you complete control over your project history, but this can also be very dangerous. For example, if you were to delete a line from the rebase listing, the associated commit wouldn't be transferred to the new base, and its content would be lost forever. In a future module, we'll also see how rewriting history can get you in trouble with public Git repositories.

Stop to Amend a Commit

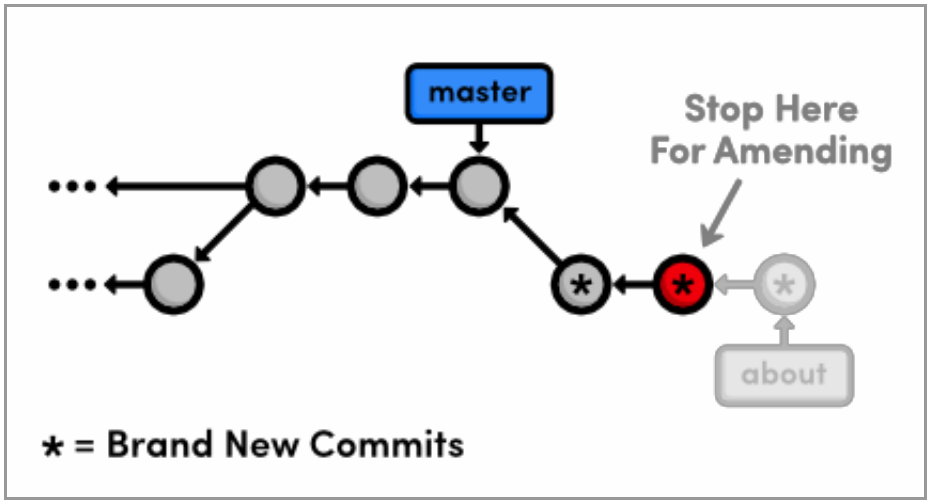
The previous rebase only stopped us to edit the *messages* of each commit. We can take this one step further and alter a *snapshot* during the rebase. Start by running another interactive rebasing session. Note that we've still been using `master` as the new base because it selects the desired commits from the `about` branch.

```
git rebase -i master
```

Specify the `edit` command for the second commit, as shown below.

```
pick 58dec2a Create the about page
edit 6ac8a9f Begin creating bio pages
pick 51c958c Add link to about section in home page
```

When Git starts to move the second commit to the new base, it will stop to do some "amending." This gives you the opportunity to alter the staged snapshot before committing it.



Stopping to amend a commit

We'll leave a helpful note for Mary, whom we'll meet in the Remotes module. Open up `about/mary.html` and add the following.

```
[Mary, please update your bio!]
```

We're currently between commits in a rebase, but we can alter the staged snapshot in the exact same way as we have been throughout this entire tutorial:

```
git add about/mary.html
git status
git commit --amend
```

You can use the default message created by `git commit`. The new `--amend` flag tells Git to *replace* the existing commit with the staged snapshot instead of creating a

new one. This is also very useful for fixing premature commits that often occur during normal development.

Continue the Interactive Rebase

Remember that we're in the middle of a rebase, and Git still has one more commit that it needs to re-apply. Tell Git that we're ready to move on with the `--continue` flag:

```
git rebase --continue
git log --oneline
```

Note that our history still appears to be the same (because we used the default commit message above), but the `Begin creating bio pages` commit contains different content than it did before the rebase, along with a new ID.

If you ever find yourself lost in the middle of a rebase and you're afraid to continue, you can use the `--abort` flag to abandon it and start over from scratch.

Publish the About Section

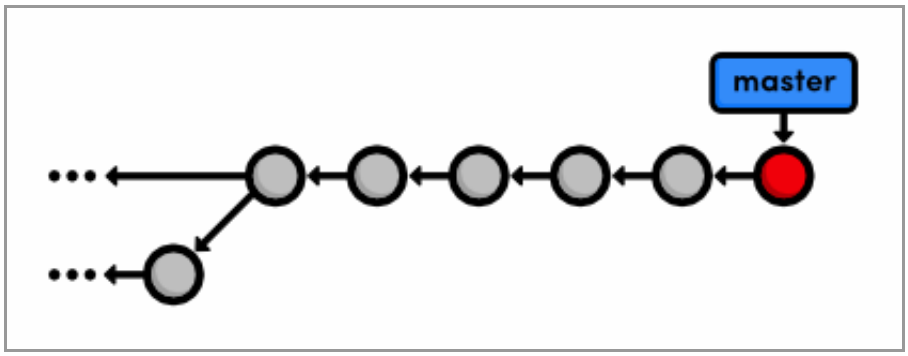
The point of all this interactive rebasing is to generate a *meaningful* history that we can merge back into `master`. And, since we've rebased `about` onto the tip of `master`, Git will be able to perform a fast-forward merge instead of using a merge commit to join the two branches.

```
git checkout master
git log --oneline
git merge about
git log --oneline
```

Don't forget to delete the obsolete `about` branch.

```
git branch -d about
```

Our final history is shown in the figure below. As you can see, a linear history is much easier to comprehend than the back-and-forth merging of the previous module. But on the other hand, we don't have the slightest notion of *how* we got to our current state.



Merging and deleting the `about` *branch*

Conclusion

Rebasing enables fast-forward merges by moving a branch to the tip of another branch. It effectively eliminates the need for merge commits, resulting in a completely linear history. To an outside observer, it will seem as though you created every part of your project in a neatly planned sequence, even though you may have explored various alternatives or developed unrelated features in parallel. Rebasing gives you the power to choose exactly what gets stored in your repositories.

This can actually be a bit of a controversial topic within the Git community. Some believe that the benefits discussed in this module aren't worth the hassle of rewriting history. They take a more "pure" approach to Git by saying that your history should reflect *exactly* what you've done, ensuring that no information is ever lost. Furthermore, an advanced configuration of `git log` can display a linear history from a highly-branched repository.

But, others contend that merge commits should be *meaningful*. Instead of merging at arbitrary points just to access updates, they claim that merge commits should represent a symbolic joining of two branches. In particular, large software projects (such as the Linux kernel) typically advocate interactive rebasing to keep the repository as clean and straightforward as possible.

The use of `git rebase` is entirely up to you. Customizing the evolution of your project can be very beneficial, but it might not be worth the trouble when you can accomplish close to the same functionality using merges exclusively. As a related

note, you can use the following command to force a merge commit when Git would normally do a fast-forward merge.

```
git merge --no-ff <branch-name>
```

The next module will get a little bit more involved in our project history. We'll try fixing mistakes via complex rebases and even learn how to recover deleted commits.

Quick Reference

`git rebase <new-base>`
Move the current branch's commits to the tip of `<new-base>`, which can be either a branch name or a commit ID.

`git rebase -i <new-base>`
Perform an interactive rebase and select actions for each commit.

`git commit --amend`
Add staged changes to the most recent commit instead of creating a new one.

`git rebase --continue`
Continue a rebase after amending a commit.

`git rebase --abort`
Abandon the current interactive rebase and return the repository to its former state.

`git merge --no-ff <branch-name>`
Force a merge commit even if Git could do a fast-forward merge.

Continue to *Rewriting History* ›

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