



Week 3 : SOFTWARE DEVELOPMENT TOOLS AND ENVIRONMENTS

Week 3

Branches and Working with Others

Week 3 Branches and Working with Others

- **Review:**

- So far we've learned how to create repositories, add changes to the stage, and commit them to the repository.
- We've also learned how to push and pull code back and forth from local machines to remote branches on GitHub.

Week 3 Branches and Working with Others

- **Week 3**

- Today it's time to learn about a critical concept in Git: **branches**.
- Branches allow us to organize a repository and split it apart so multiple people can work on it or so a solo developer can work on different aspects of a project on a separated work.

Week 3 Branches and Working with Others

- **Week 3 Topics:**

- Master/Main Branch and Branches
- Understanding HEAD
- Git Branch Commands:
 - **git branch, git switch, git checkout**
- Delete or Rename Branch
- Merging Branches and Conflicts
- Using **git diff**
- Exercise and Solution

Let's get started!

Week 3

Branches

Week 3 Branches and Working with Others

- Let's review what our current commit process looks like...

Week 3 Branches and Working with Others

- **Commit Process**

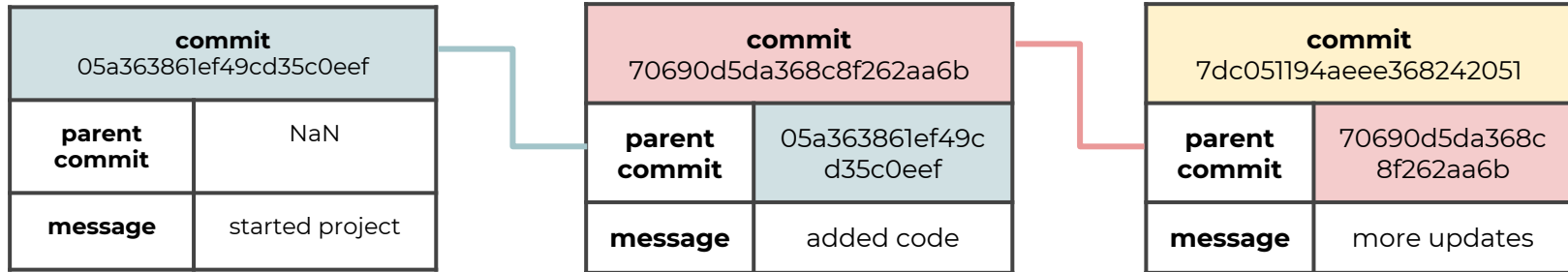
- As we create commits, we are linking to a parent commit, showing the log of the commit history.

commit 05a363861ef49cd35c0eef	
parent commit	NaN
message	started project

Week 3 Branches and Working with Others

- **Commit Process**

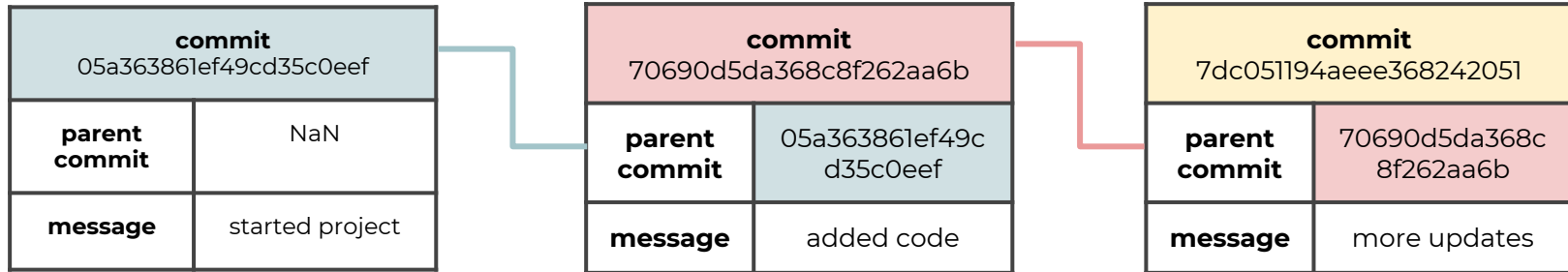
- As we create commits, we are linking to a parent commit, showing the log of the commit history.



Week 3 Branches and Working with Others

- **Commit Process**

- As we need incorporate the workflows of others or be able to focus on new updates without breaking old code, we need **branches**.



Week 3 Branches and Working with Others

- **Branches**

- A branch represents an independent line of development.
- Branches serve as an abstraction for the edit/stage/commit process.
- They are a way to request a brand new working directory, staging area, and project history.

Week 3 Branches and Working with Others

- **Branches**

- Branches are just pointers to commits.
- When you create a branch, all Git needs to do is create a new pointer, it doesn't change the repository in any other way.
- Let's explore why branches are useful for workflows...

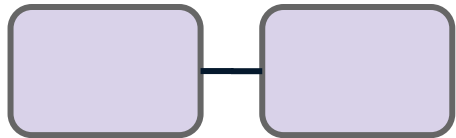
Week 3 Branches and Working with Others

- **Branches**



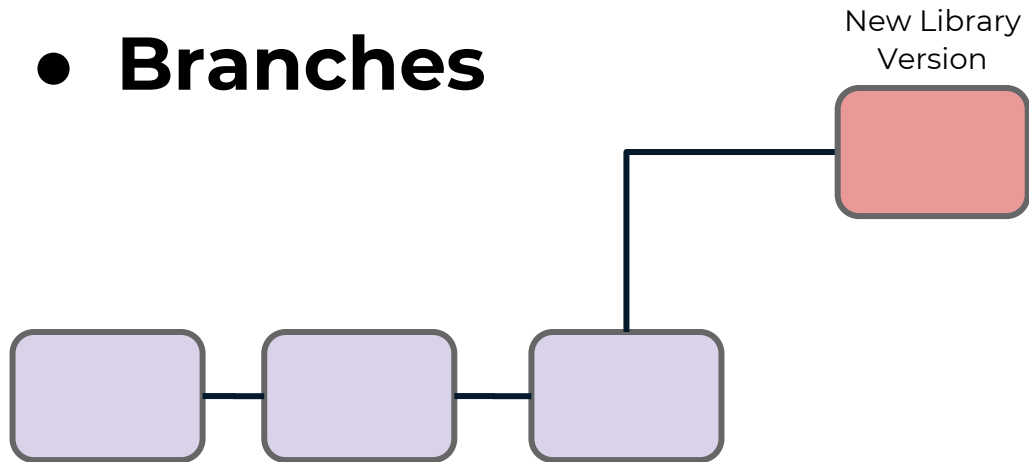
Week 3 Branches and Working with Others

- **Branches**



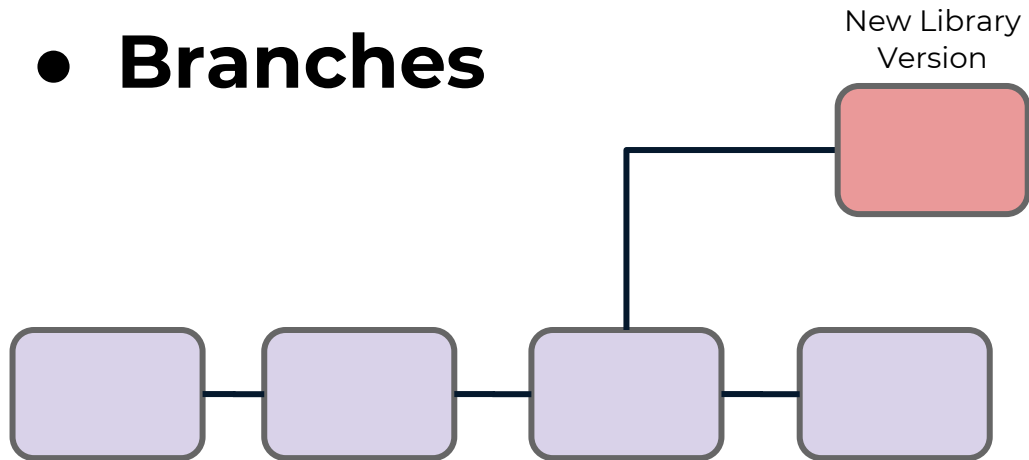
Week 3 Branches and Working with Others

- **Branches**



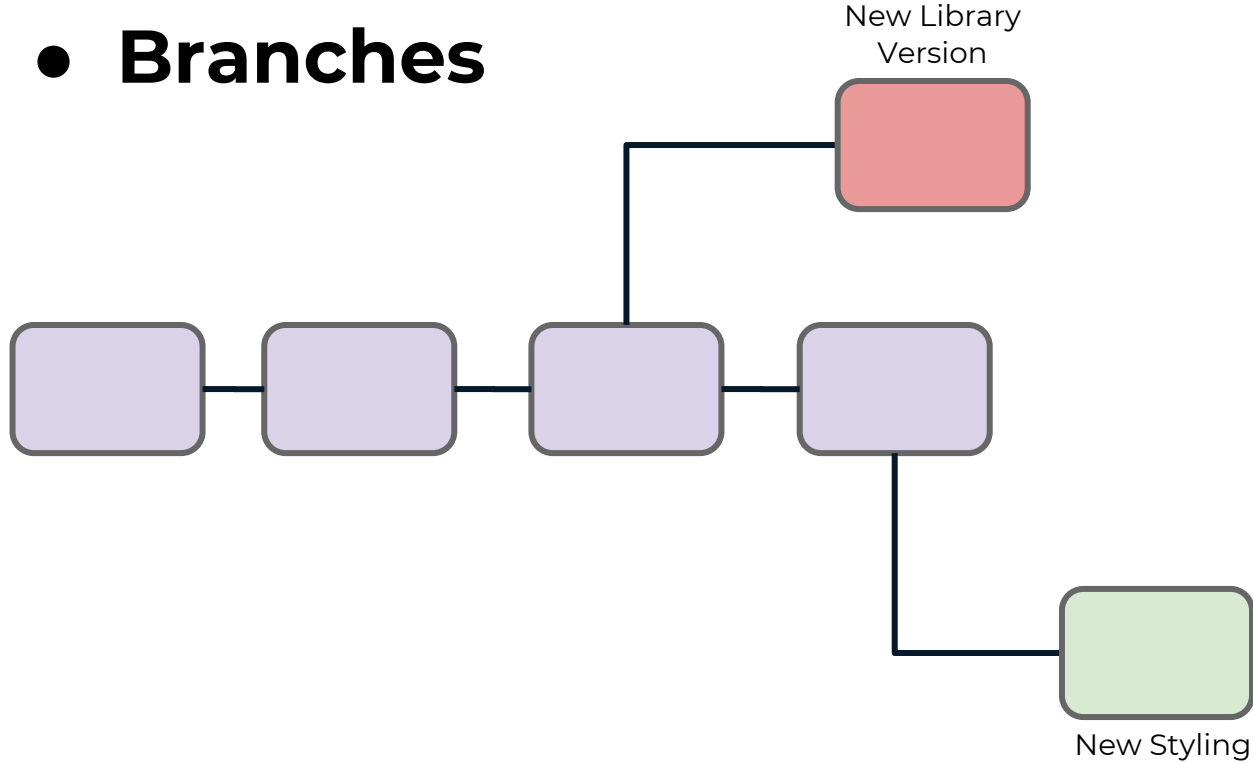
Week 3 Branches and Working with Others

- **Branches**



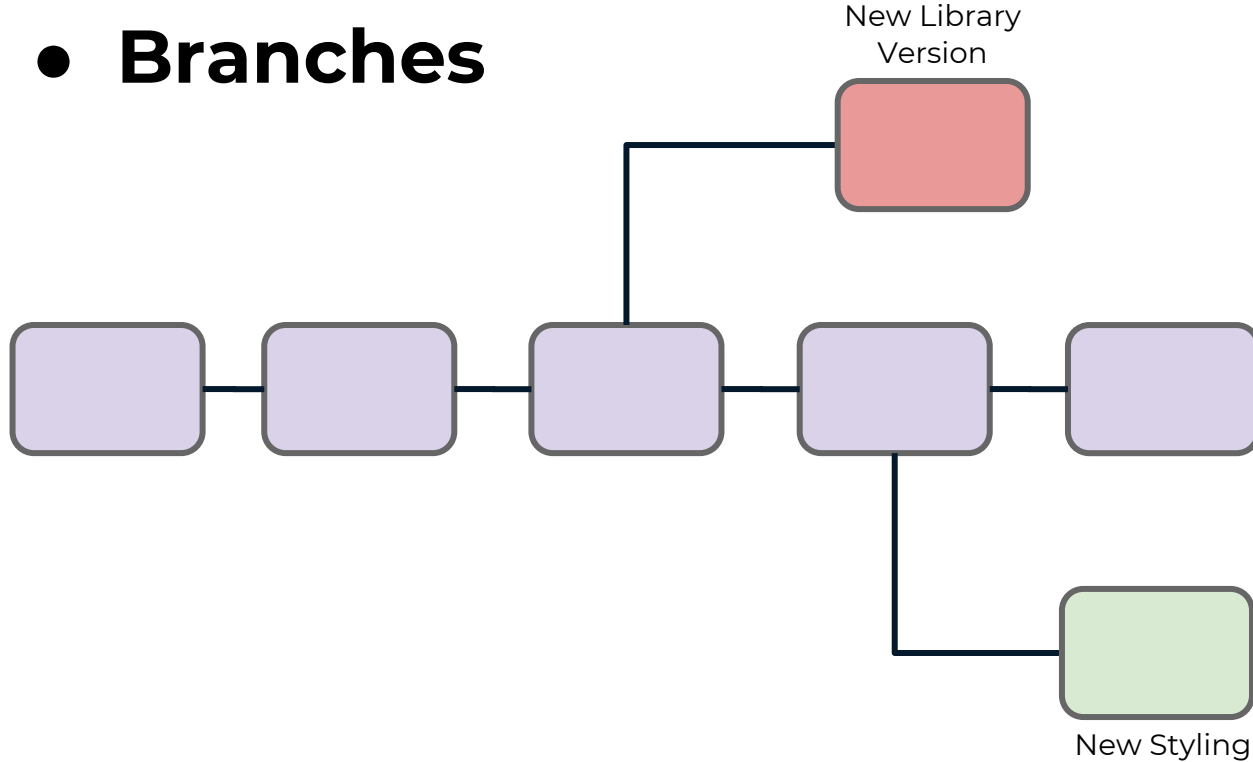
Week 3 Branches and Working with Others

- **Branches**



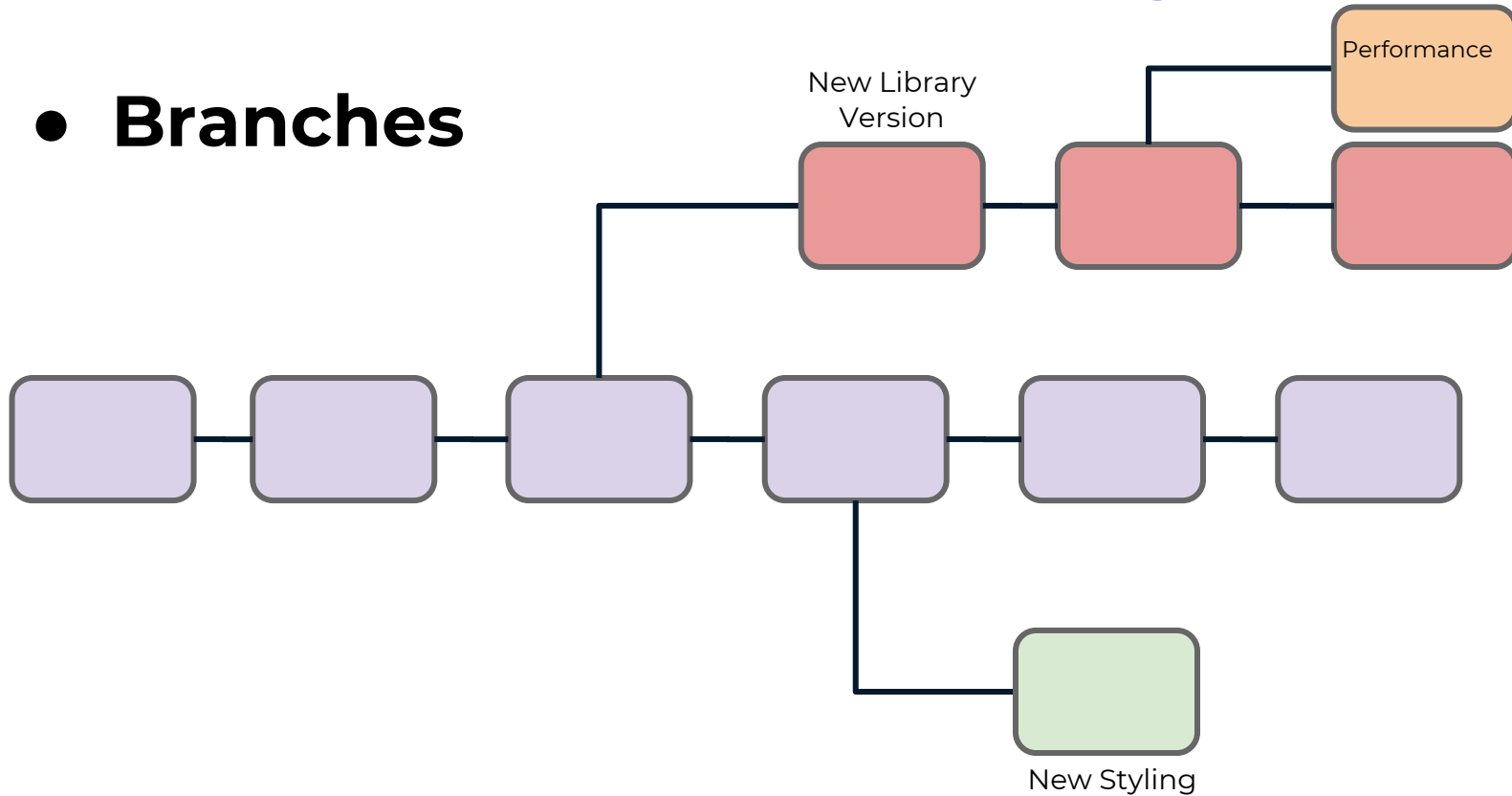
Week 3 Branches and Working with Others

- **Branches**



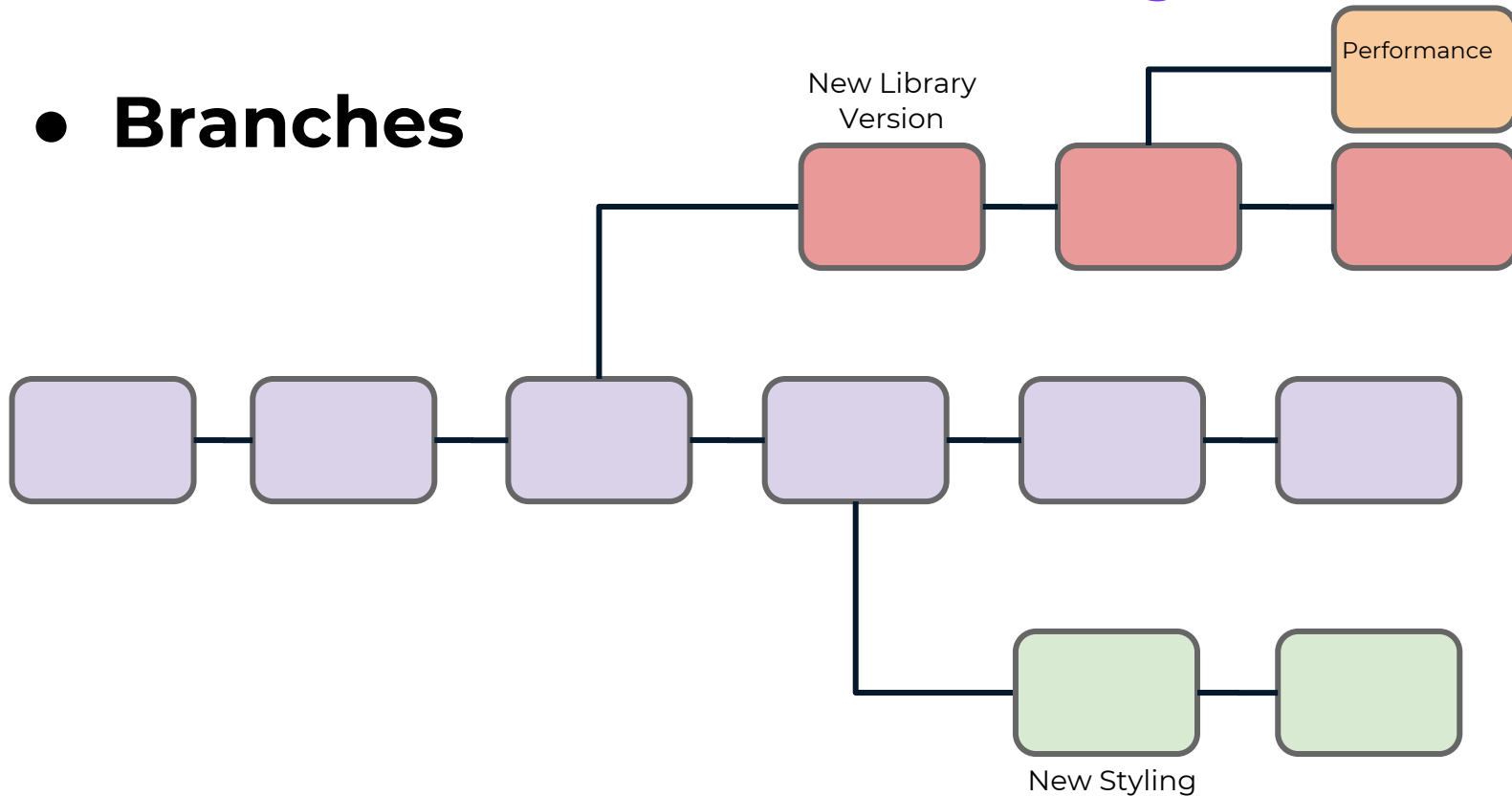
Week 3 Branches and Working with Others

- **Branches**



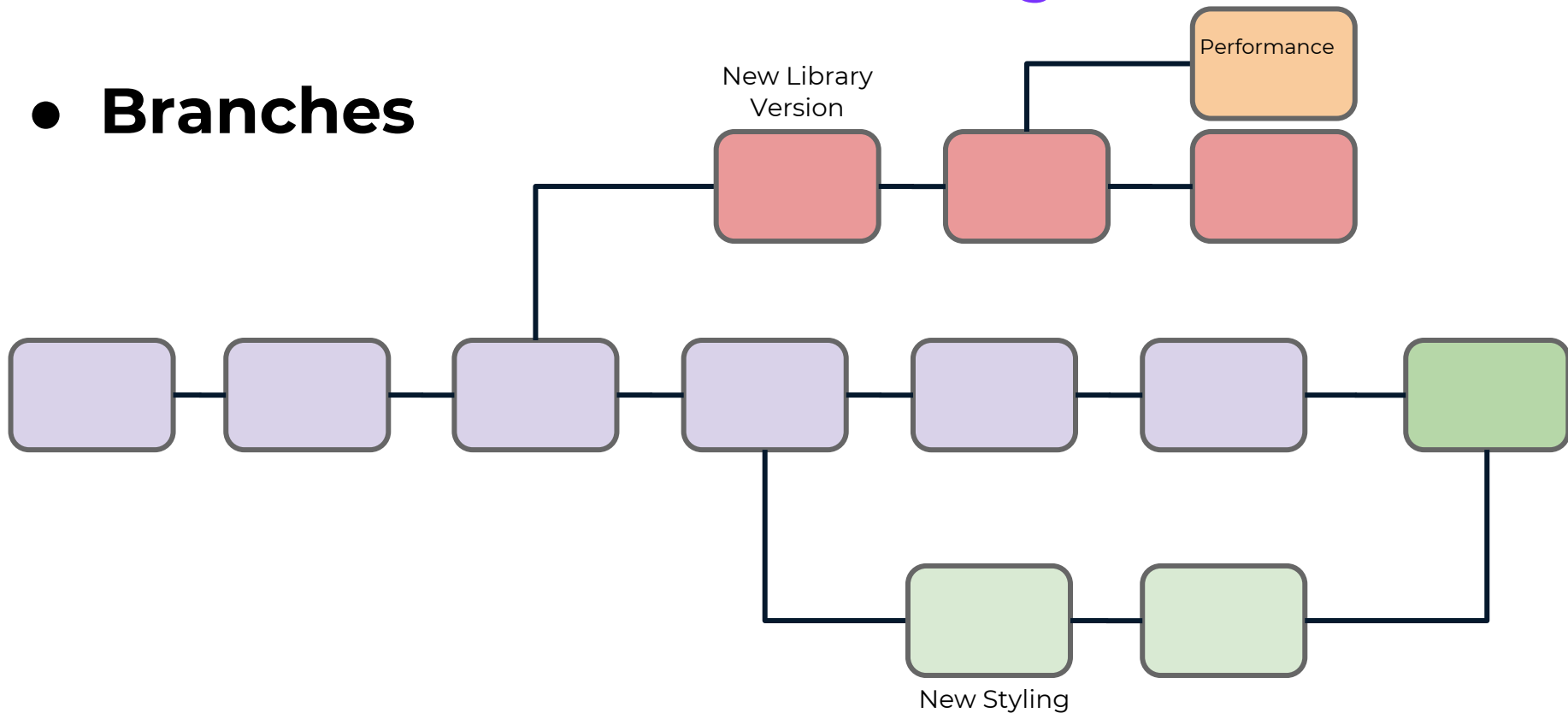
Week 3 Branches and Working with Others

- **Branches**



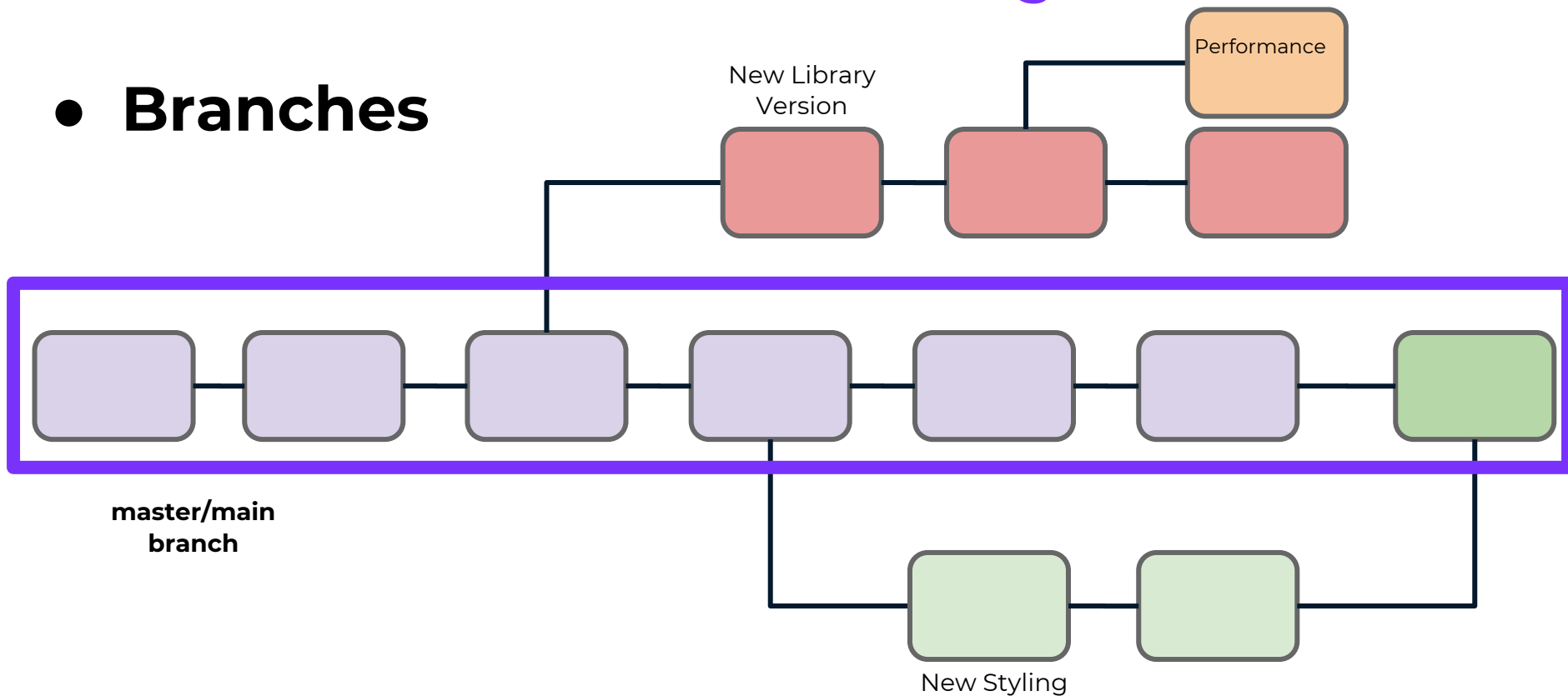
Week 3 Branches and Working with Others

- **Branches**



Week 3 Branches and Working with Others

- **Branches**



Week 3 Branches and Working with Others

- **Branches**

- Upon creating a new repo with **git init** you create a new branch called the **master branch** (or **main branch**).
- This is a branch just like any other, but it's simply the first one created.
 - *Should code pushed to master branch always be in working condition?*

Week 3 Branches and Working with Others

- **Branches**

- While organizations and developers often treat this master branch as the official branch for things like deployment, this is not a requirement.
- You can use any branch for code deployment or code that's actually "in-use".

Week 3 Branches and Working with Others

- **Branches**

- Master vs. Main

- As we've discussed previously, GitHub has changed the nomenclature for this initial branch to be **main branch** while Git is still using **master branch** (but this may change in the future).
 - You can also rename any branch (**trunk branch**).

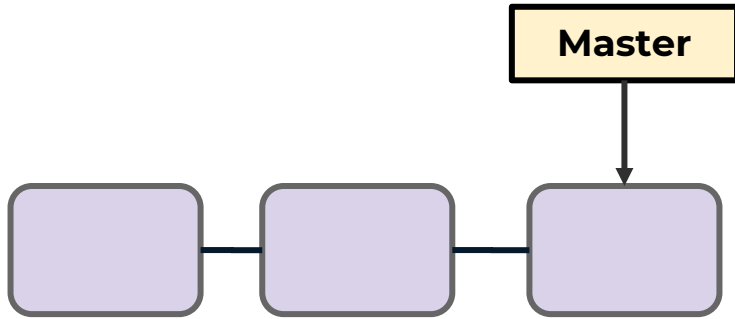
Week 3 Branches and Working with Others

- **Creating a New Branch**

- Before we conclude, let's quickly go into more detail about what happens when first create a new branch.
- Branches are just pointers to commits.
- When you create a branch, all Git needs to do is create a new pointer, it doesn't change the repository in any other way.

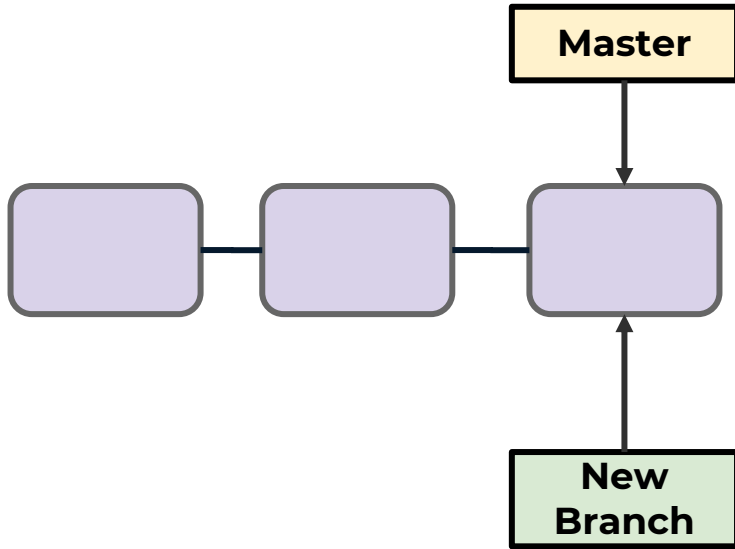
Week 3 Branches and Working with Others

- **Creating a New Branch**



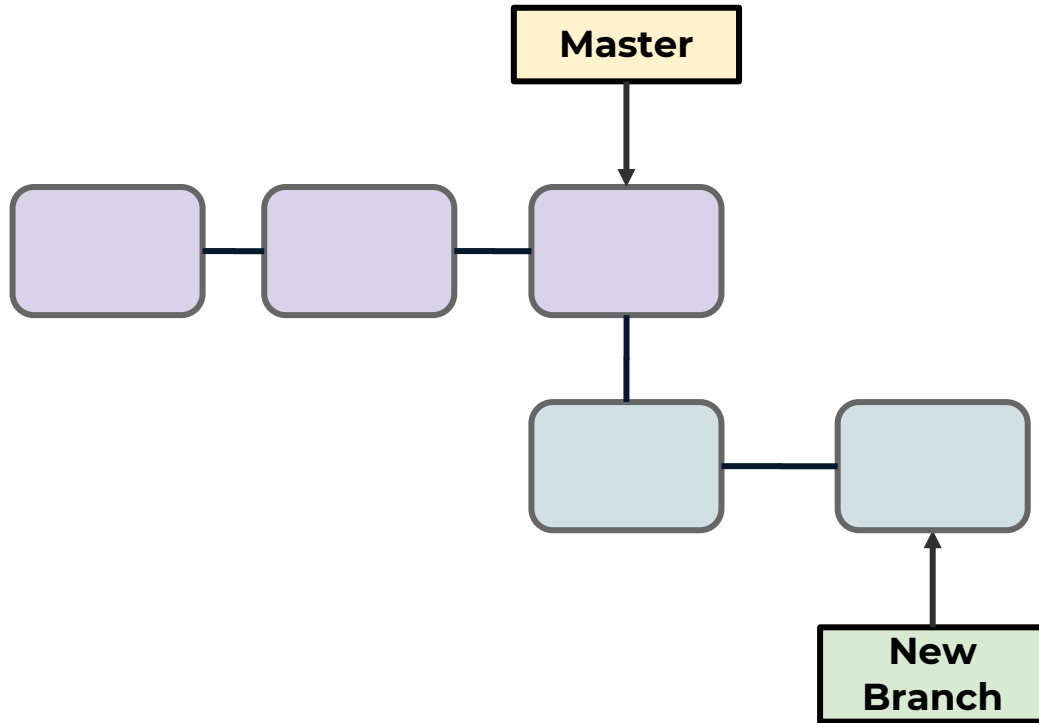
Week 3 Branches and Working with Others

- **Creating a New Branch**



Week 3 Branches and Working with Others

- **Creating a New Branch**



Week 3 Branches and Working with Others

- Now that we've seen how branches point to commits, we need to learn about HEAD.
- HEAD will help us understand what we are currently “viewing” or where we are “located” in regards to branches and commits.

Week 3 Branches and Working with Others

- **Up Next:**

- We'll explore and visualize specific actions and commands related to branches, including **HEAD**, **git checkout**, **git branch**, **git switch**, and more.

Week 3

Understanding HEAD

Week 3 Branches and Working with Others

- **Branches**

- As we work more with branches, you will probably notice a term show up during your commits: **HEAD**.
- When viewing the most recent commit using **git log** you may see:
 - **commit 05as..3e2 (HEAD -> master)**

Week 3 Branches and Working with Others

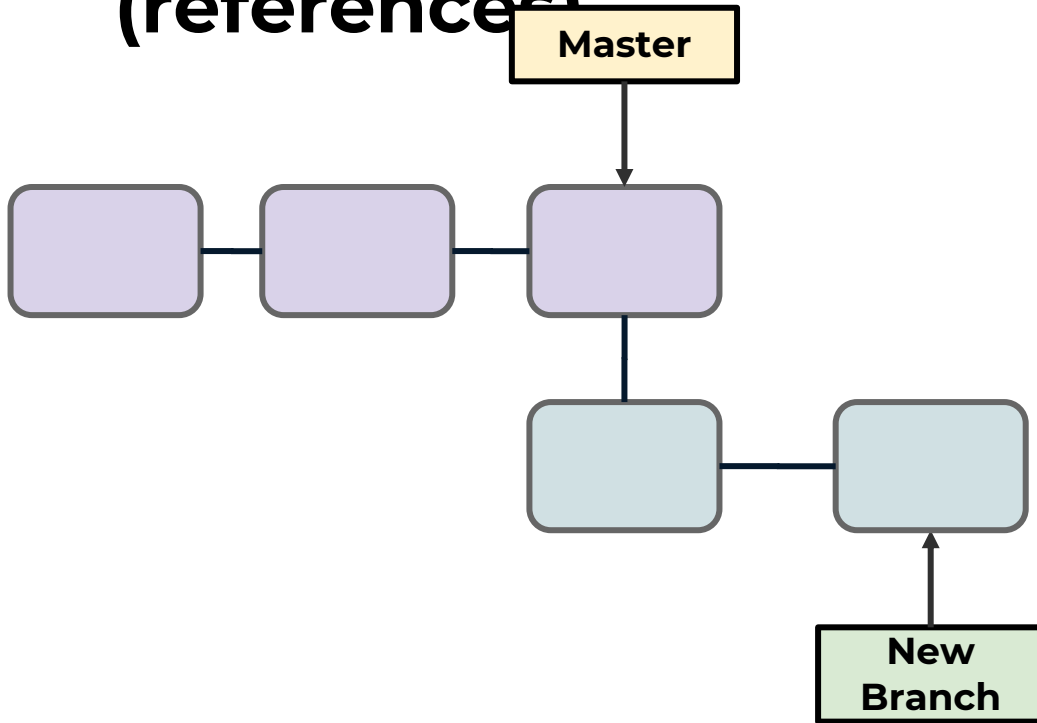
- **HEAD**

- In all of our examples so far, HEAD has always been pointing to the most recent commit in the master branch.

- **HEAD -> master**

Week 3 Branches and Working with Others

- Recall we have branch points (references)



Week 3 Branches and Working with Others

- **Branches and Commits**

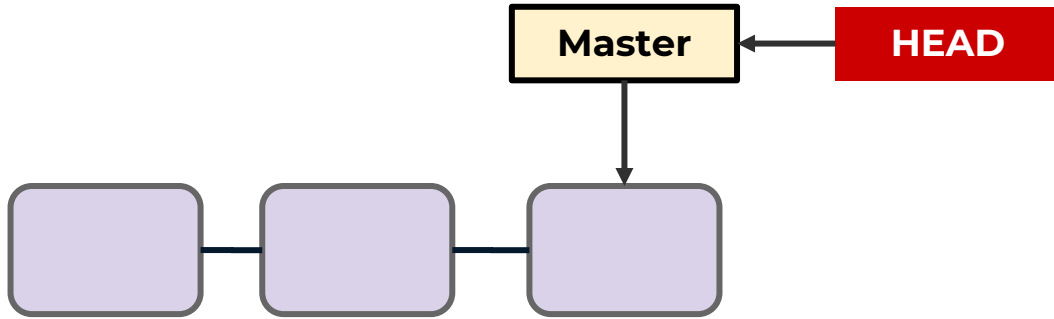
- Git stores a branch as a reference to a commit.
- In this sense, a branch represents the tip of a series of commits—it's not a container for commits.
- The history for a branch is extrapolated through the commit relationships.

Week 3 Branches and Working with Others

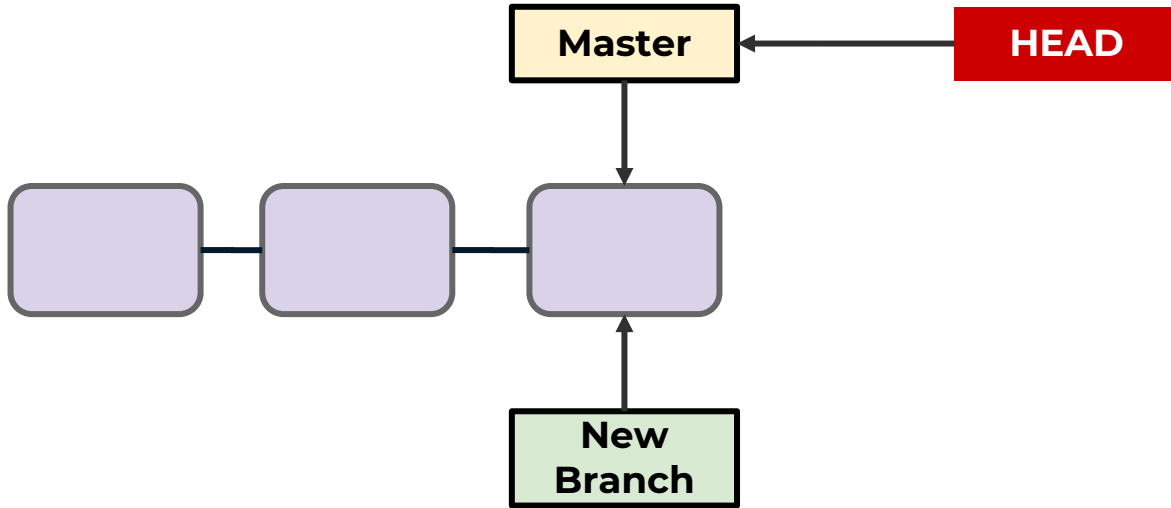
- **HEAD**

- A HEAD is simply a reference to a commit object.
- We can think of HEAD as pointing to a specific commit in a branch that we are currently viewing.

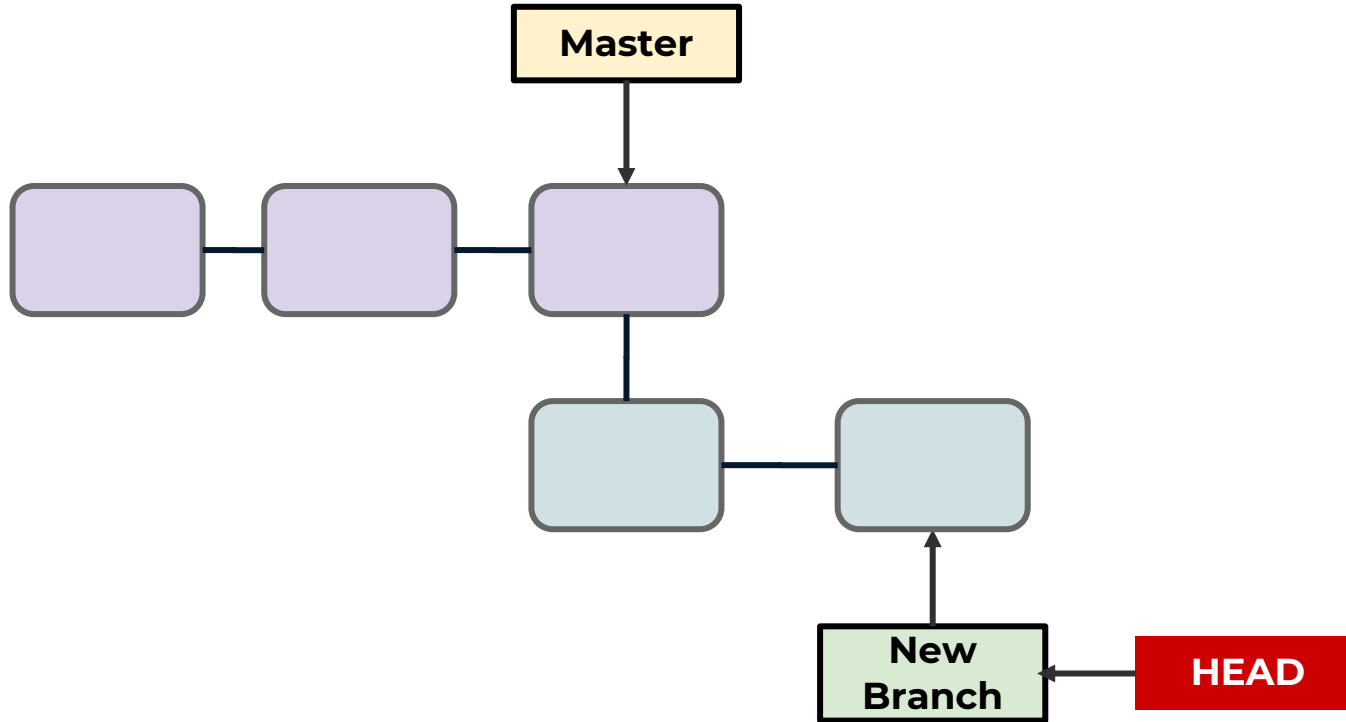
Week 3 Branches and Working with Others



Week 3 Branches and Working with Others



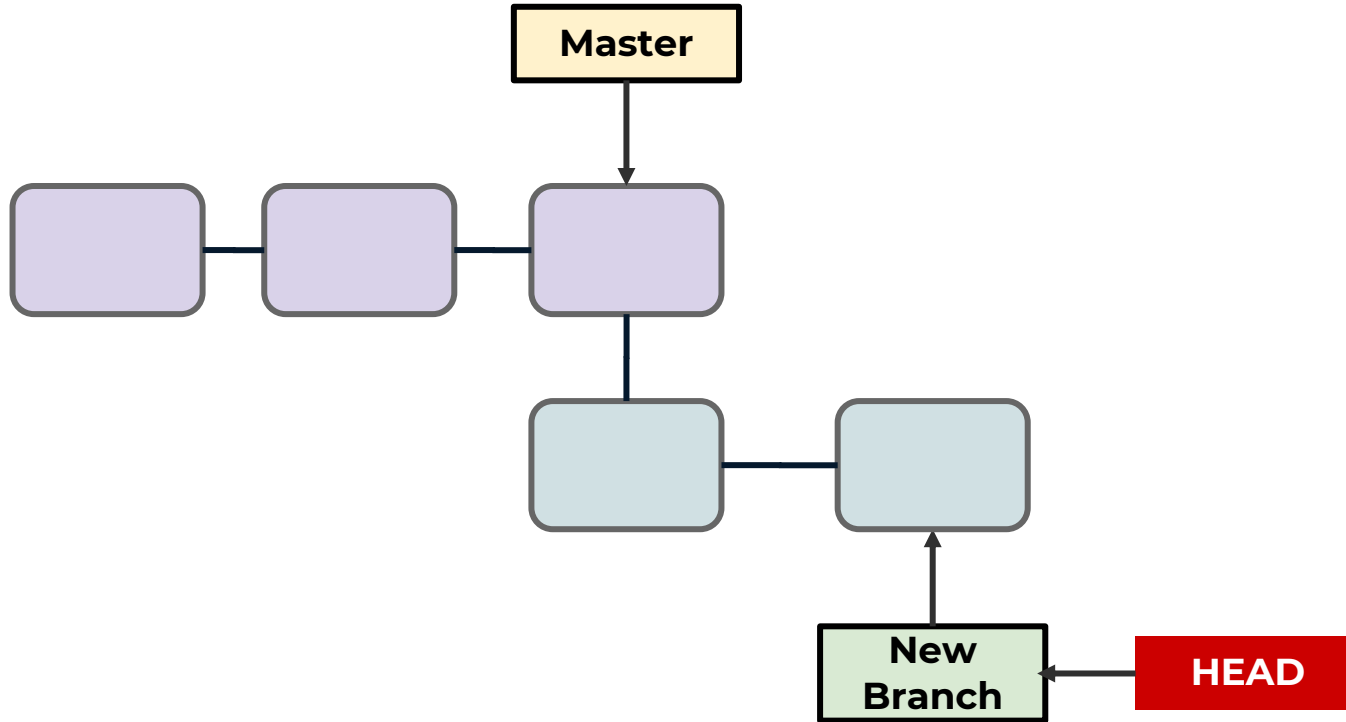
Week 3 Branches and Working with Others



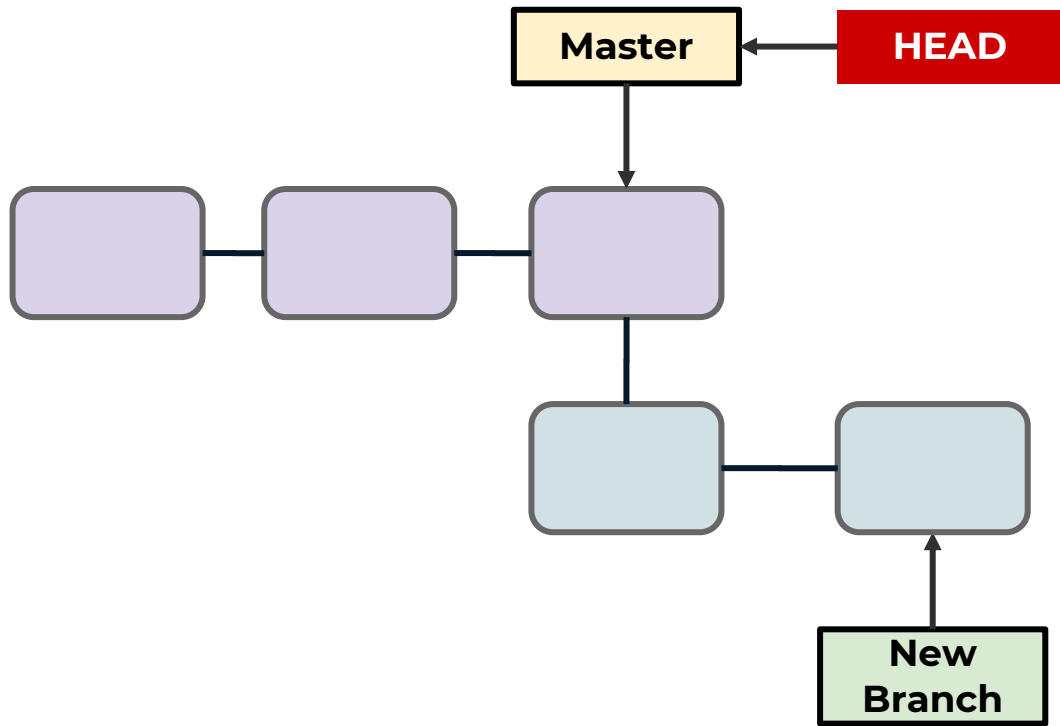
Week 3 Branches and Working with Others

- We can think of these branches as just references to a commit.
- Using HEAD tells us which branch reference we are currently “checking out”.
- We can always switch back out HEAD to some other branch (which is a pointer to a commit reference).

Week 3 Branches and Working with Others



Week 3 Branches and Working with Others



Week 3 Branches and Working with Others

- **Up Next:**

- Now that we understand the theory behind branches and HEAD, let's begin to explore the actual commands that let us create branches and navigate between them.

Week 3

Git Branch Commands

Week 3 Branches and Working with Others

- **Git Branch Commands**

- Create a New Repo
- Add File
- Create a New Branch
 - **git branch <branch_name>**
- Report Branches
 - **git branch**
- Switch Branches
 - **git switch**

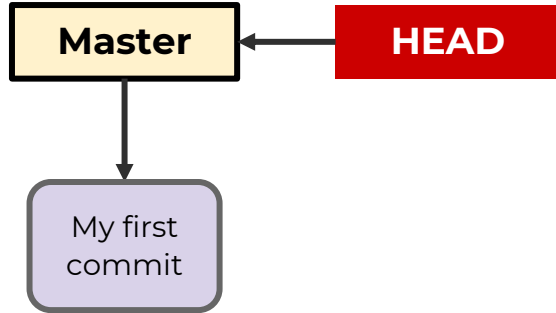
Week 3 Branches and Working with Others

- **Git Branch Commands**

- Add and Commit Changes on New Branch
- Use **git log** and **git switch** to explore differences between branches.

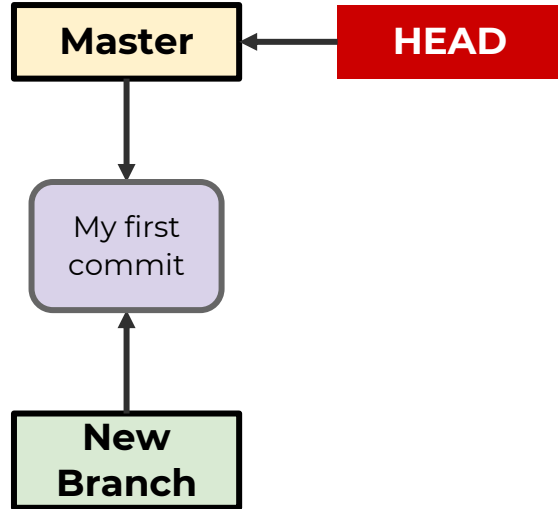
Week 3 Branches and Working with Others

- **git init, git add, git commit**



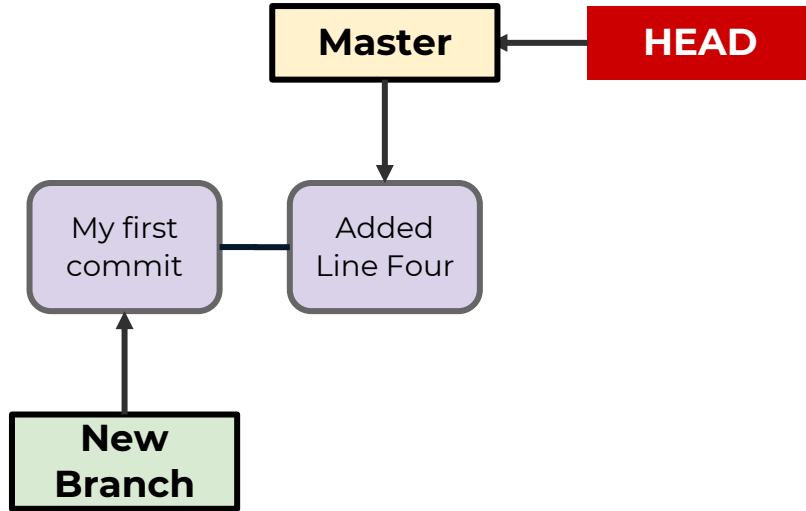
Week 3 Branches and Working with Others

- **git branch new_branch**



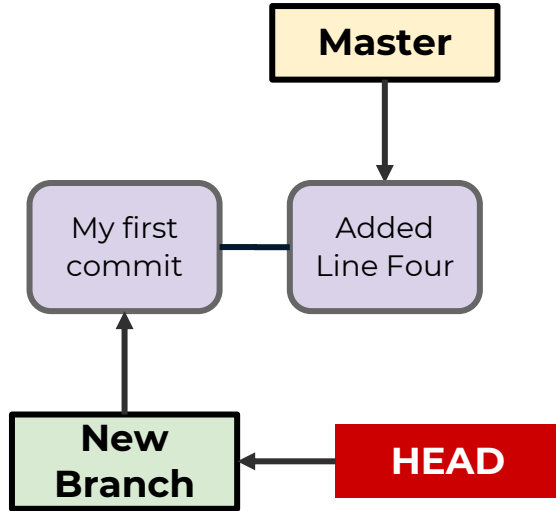
Week 3 Branches and Working with Others

- **git add, git commit, git log**



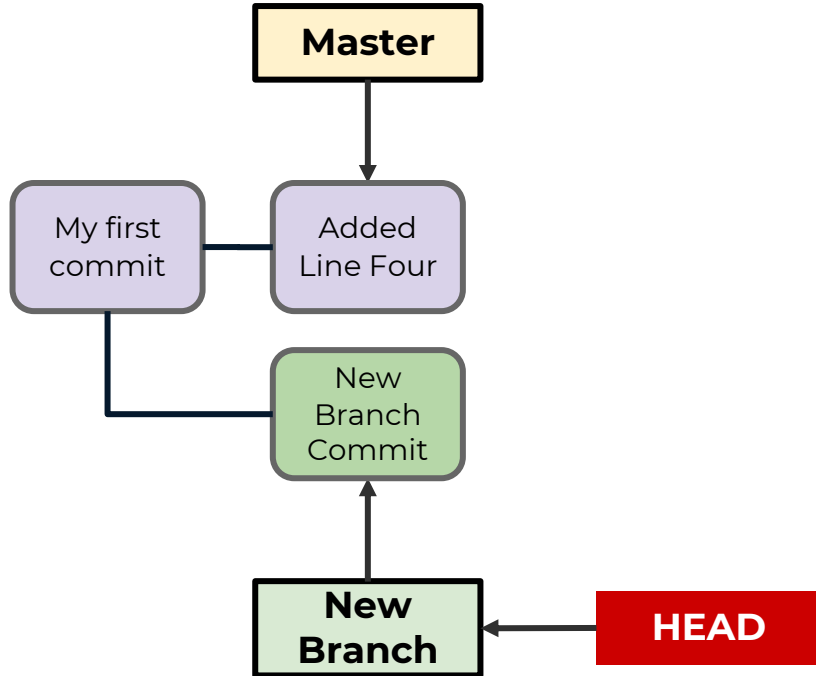
Week 3 Branches and Working with Others

- **git switch new_branch**



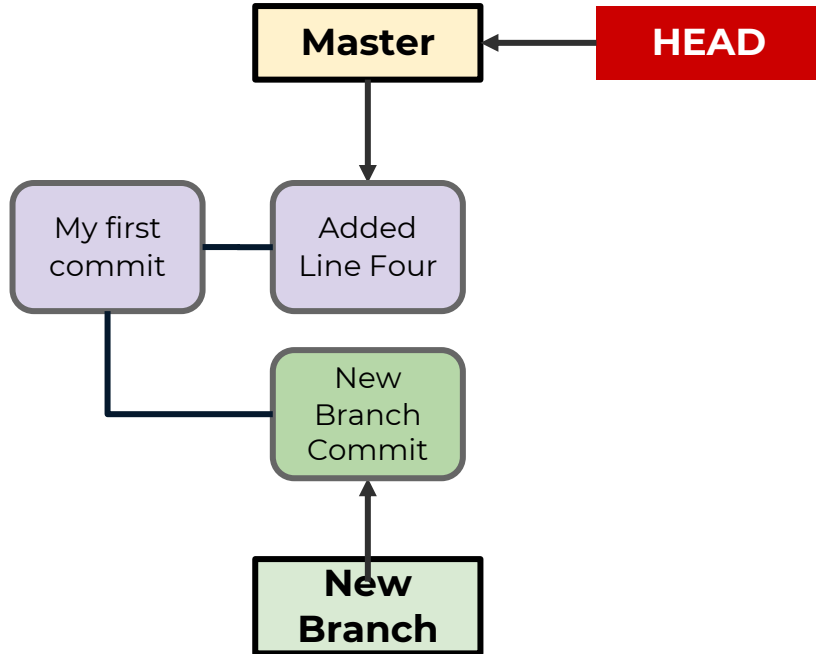
Week 3 Branches and Working with Others

- **git add , git commit, git log**



Week 3 Branches and Working with Others

- **git switch master**



Week 3

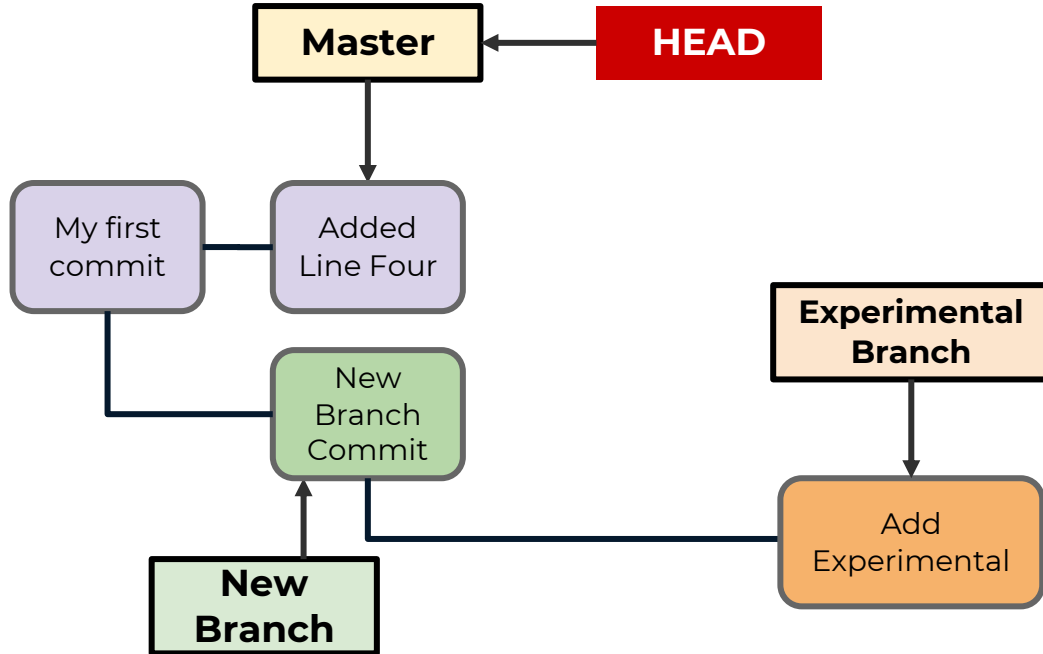
Delete and Rename Branches

Week 3 Branches and Working with Others

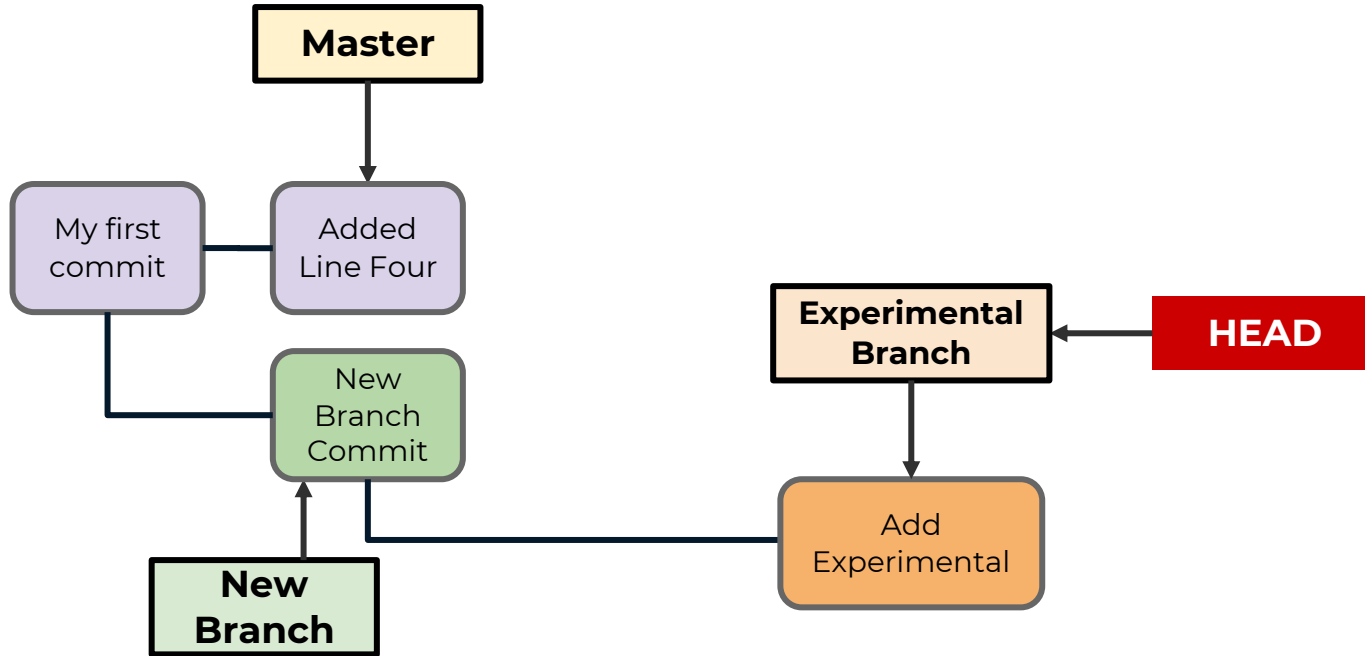
- Let's quickly explore how to rename and delete branches.
- Keep in mind that we still need to learn how to merge branches together.

Week 3 Branches and Working with Others

- **Previously:**



Week 3 Branches and Working with Others

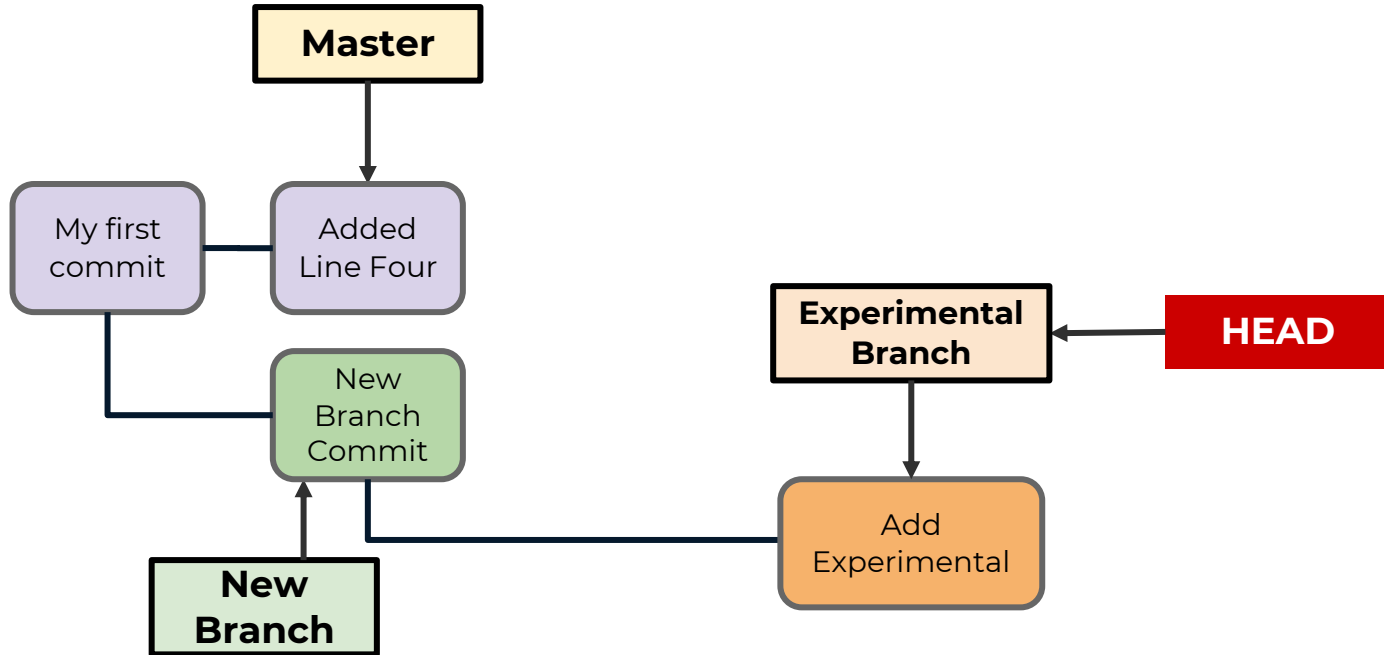


Week 3 Branches and Working with Others

- **Renaming a Branch**
 - **git switch branch_to_rename**
 - **git branch -m new_name**
 - You must be checked out on the branch you will rename.

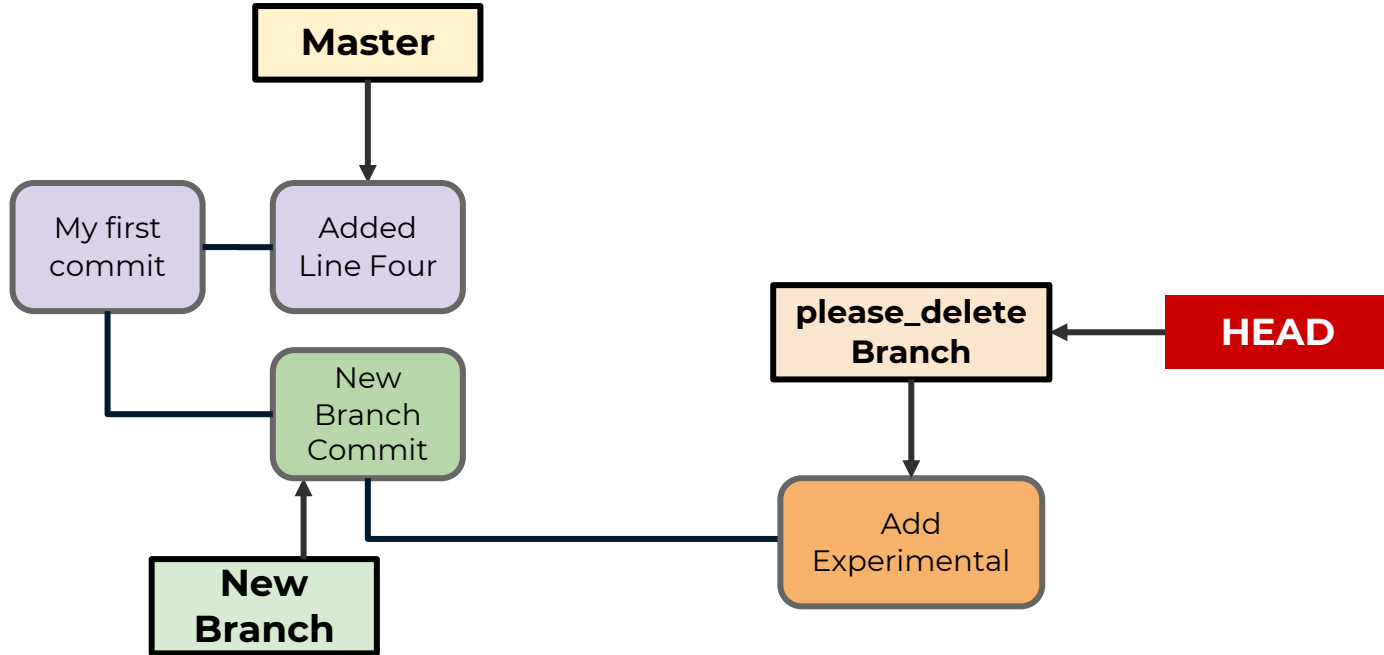
Week 3 Branches and Working with Others

- **git switch experimental**



Week 3 Branches and Working with Others

- **git branch -m please_delete**



Week 3 Branches and Working with Others

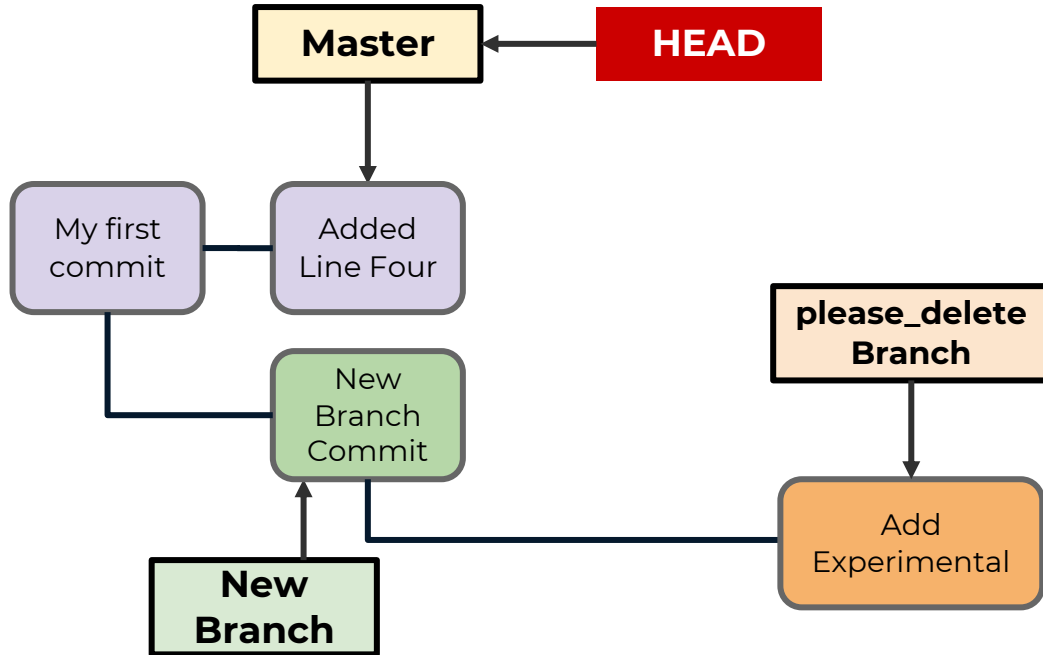
- **Deleting a Branch**

- **git branch -d branch_to_delete_name**
 - You can not delete a branch you are checked out at.
 - You also will get a warning if the branch is not merged.
 - You can confirm you want to do this anyways with **-D**



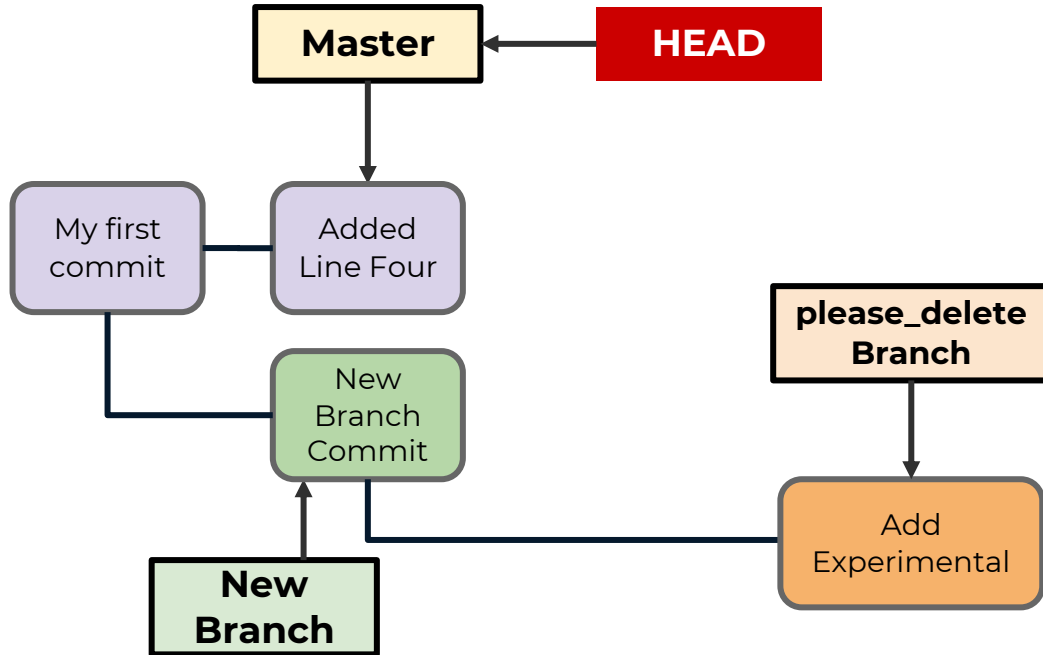
Week 3 Branches and Working with Others

- **git switch master**



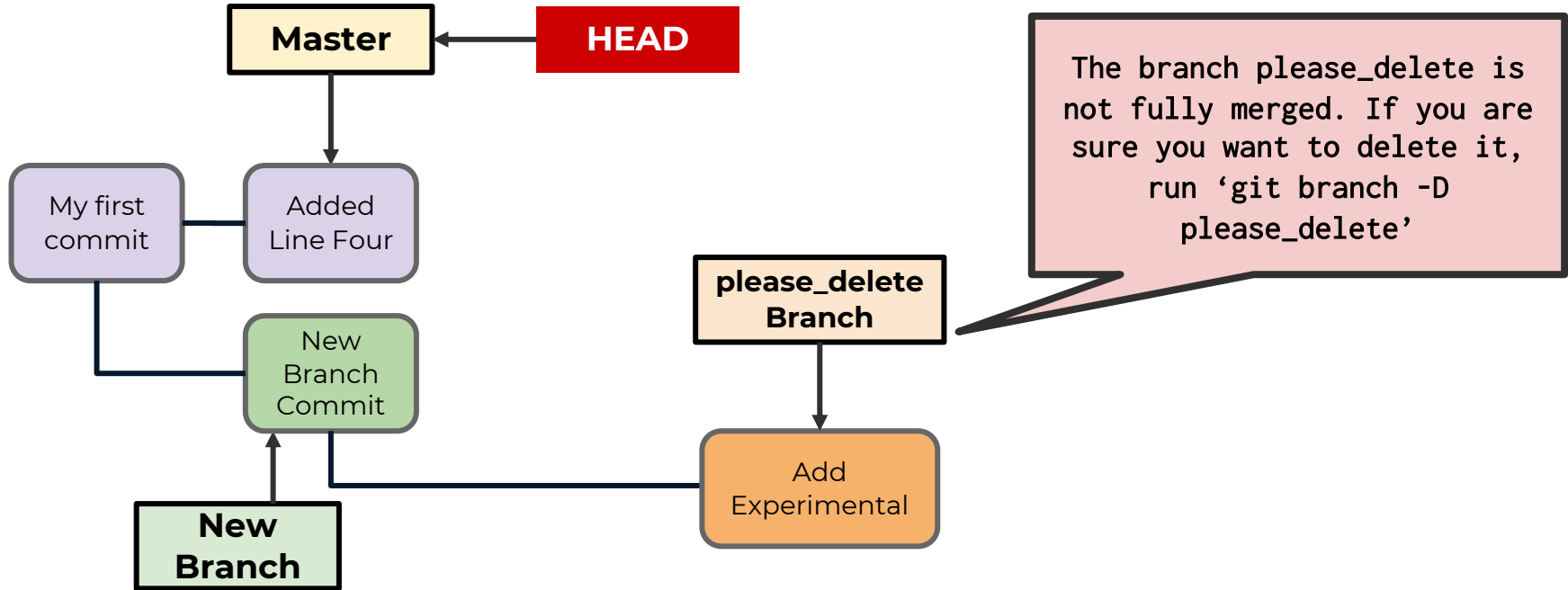
Week 3 Branches and Working with Others

- **git branch -d please_delete**



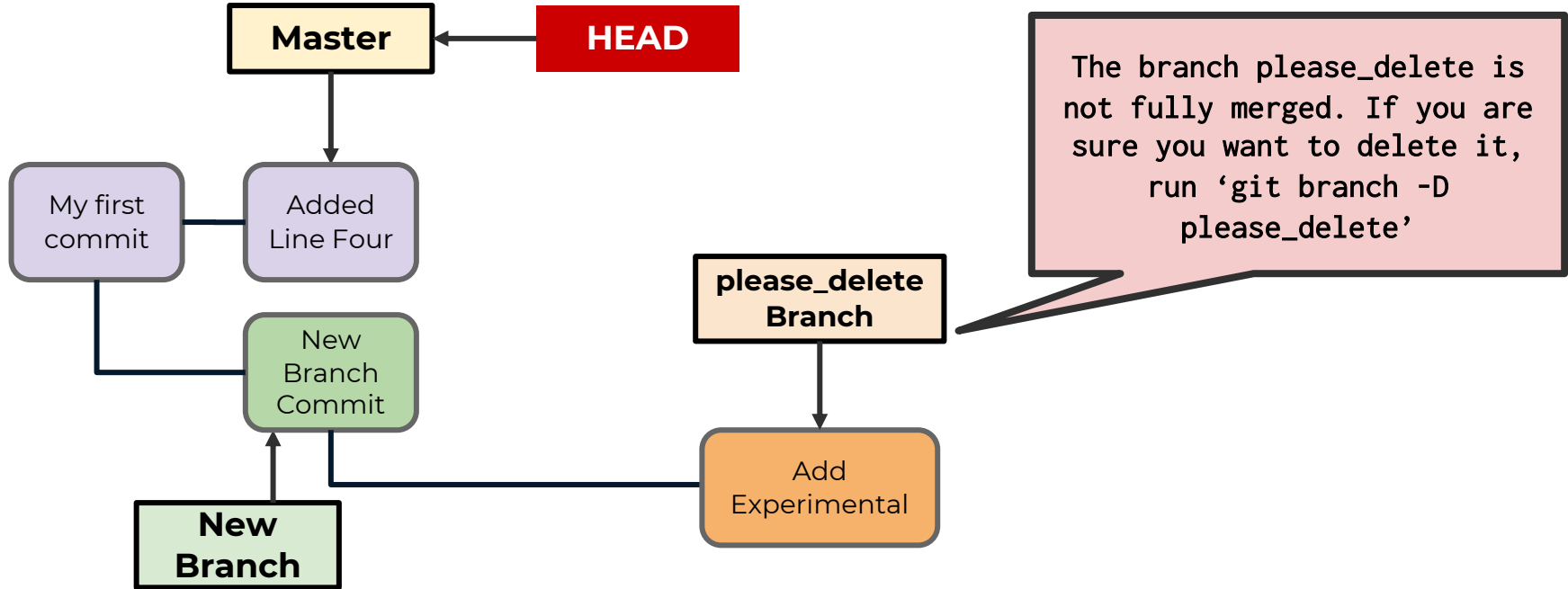
Week 3 Branches and Working with Others

- **git branch -d please_delete**



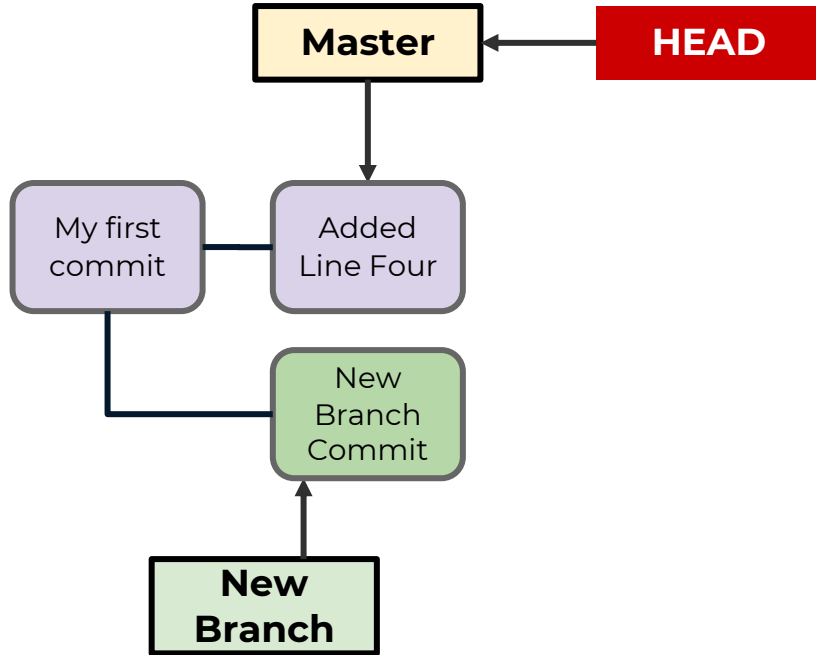
Week 3 Branches and Working with Others

- **git branch -D please_delete**



Week 3 Branches and Working with Others

- **git branch -D please_delete**



Week 3

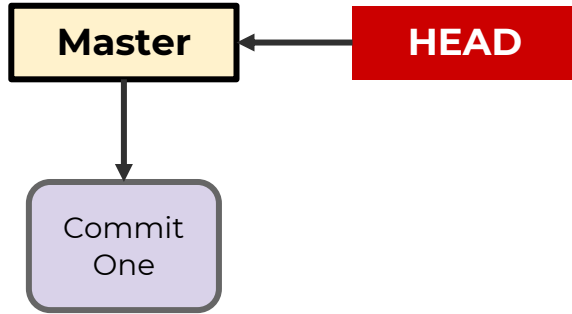
Merging Branches and Conflicts

Week 3 Branches and Working with Others

- Now that we understand creating new branches, let's shift focus to merging branches back together.
- Let's explore a simple type of merge, where a new branch is created, but the original branch it stemmed from has no additional commits.
 - This is known as a “fast-forward” merge

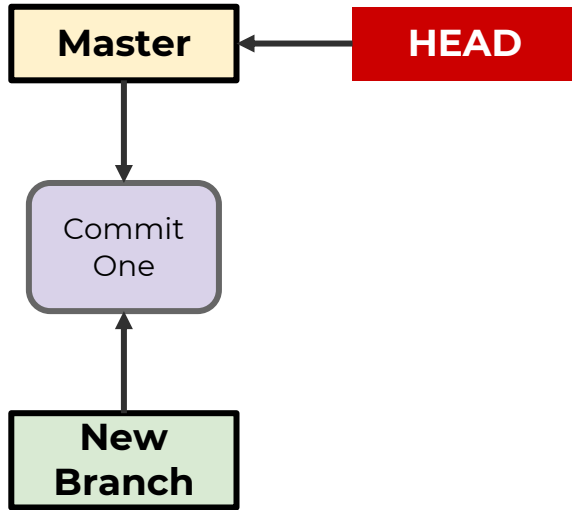
Week 3 Branches and Working with Others

- **“Fast Forward” Merge**



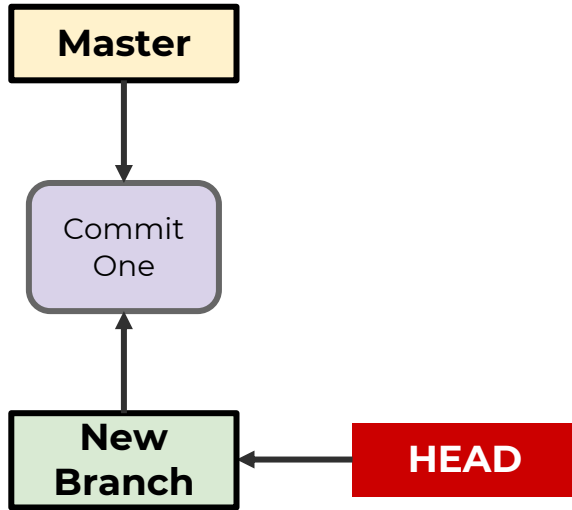
Week 3 Branches and Working with Others

- **“Fast Forward” Merge**



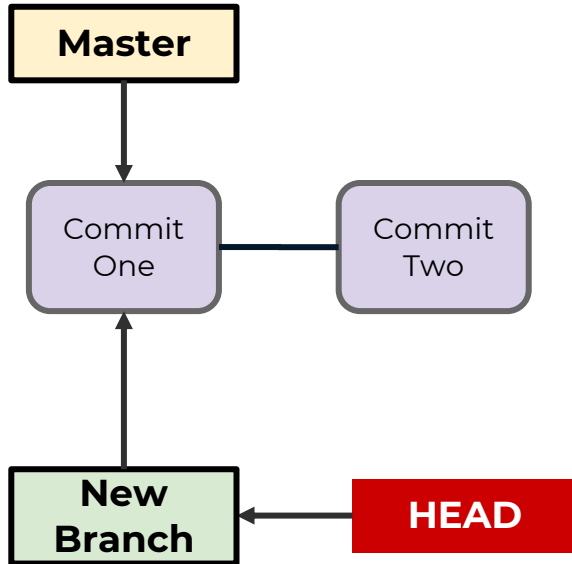
Week 3 Branches and Working with Others

- **“Fast Forward” Merge**



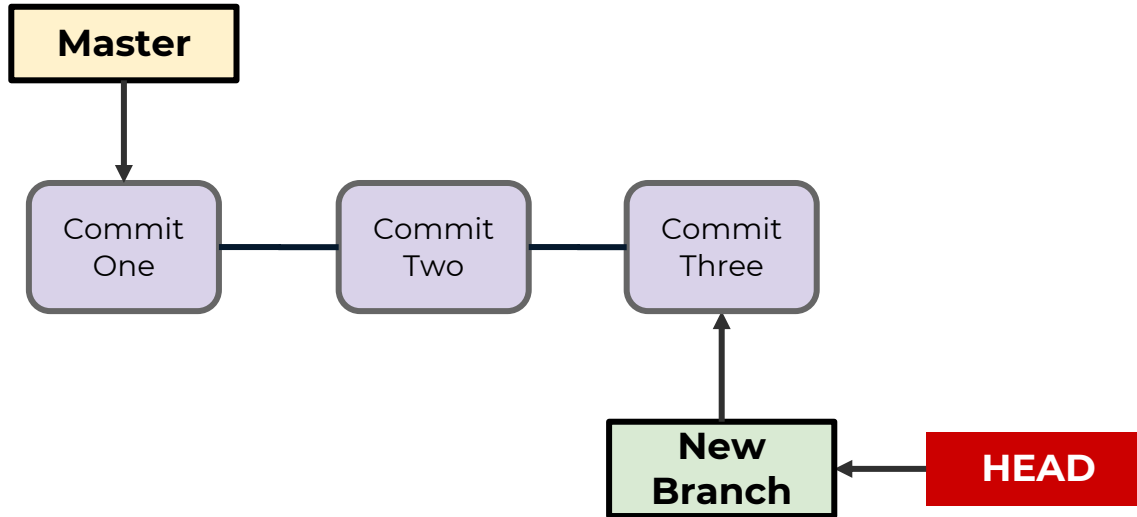
Week 3 Branches and Working with Others

- **“Fast Forward” Merge**



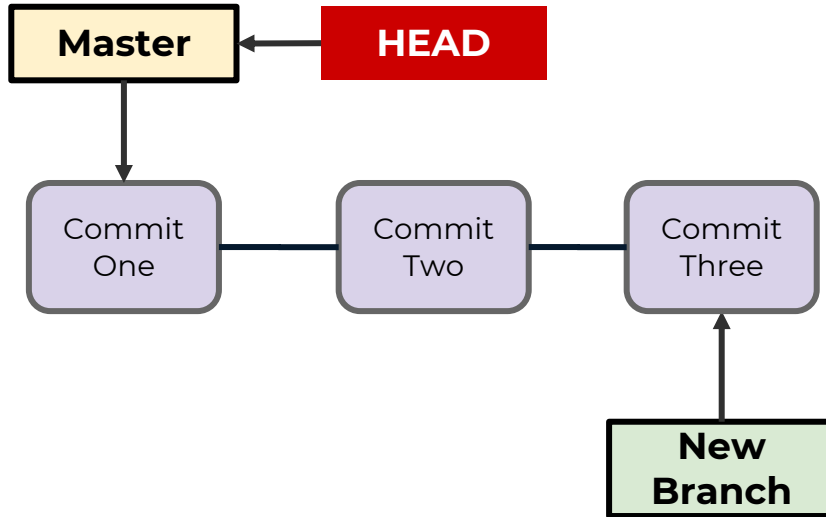
Week 3 Branches and Working with Others

- **“Fast Forward” Merge**



Week 3 Branches and Working with Others

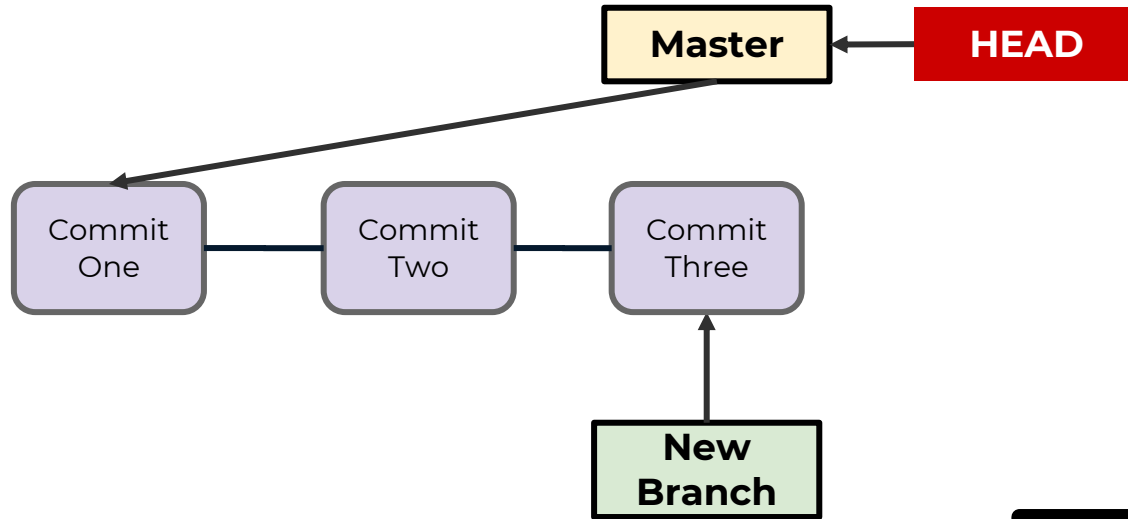
- “Fast Forward” Merge



```
>> git switch master
```

Week 3 Branches and Working with Others

- **“Fast Forward” Merge**



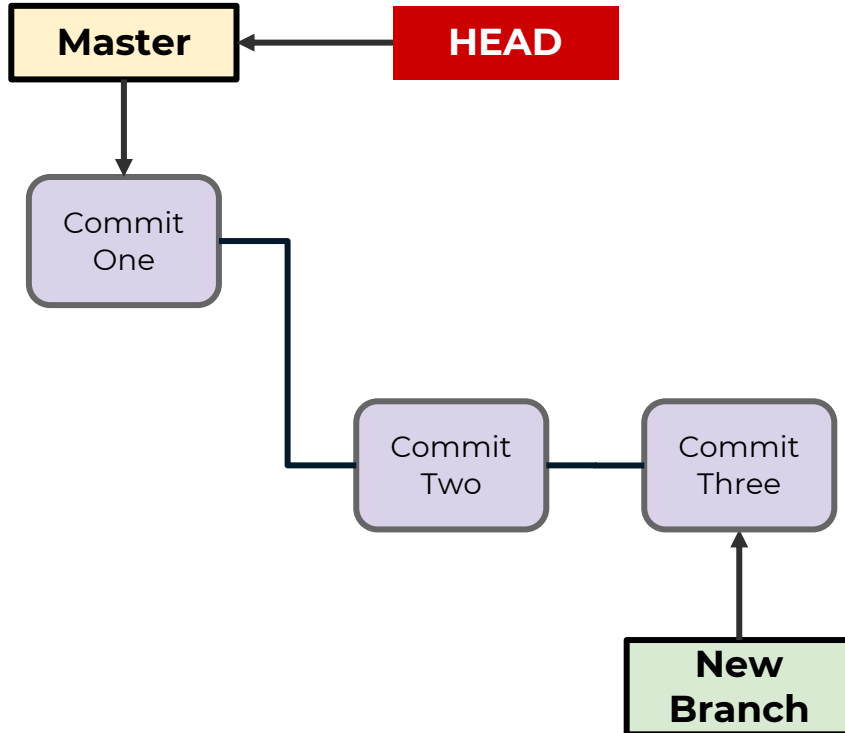
```
>> git merge new_branch
```

Week 3 Branches and Working with Others

- Now let's explore what happens for a merge where we have different commits in the branches.

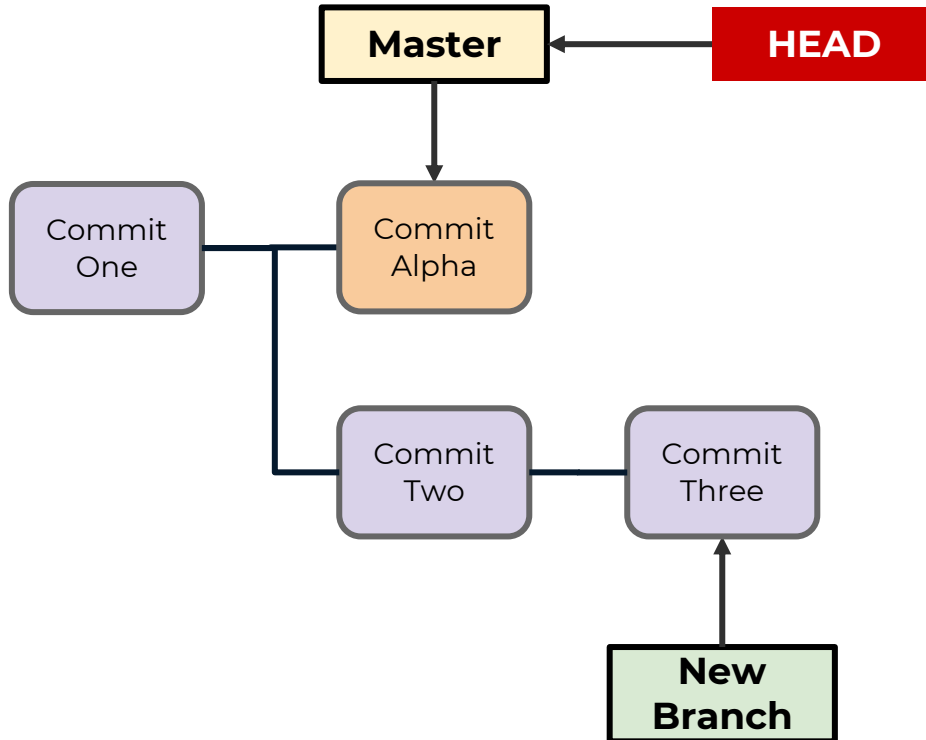
Week 3 Branches and Working with Others

- **Git Merge**



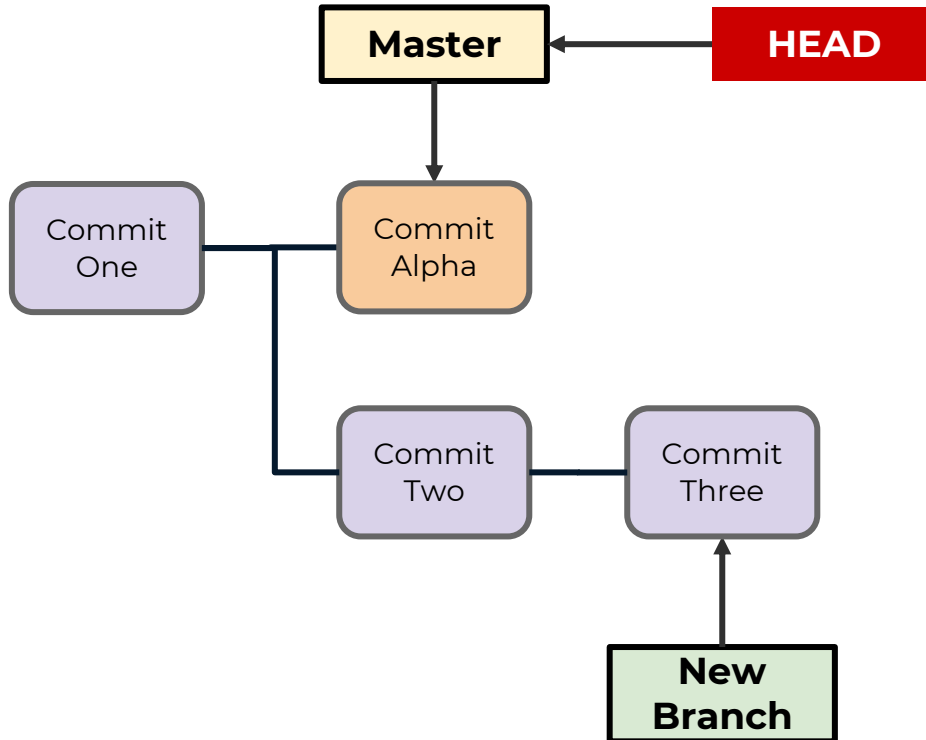
Week 3 Branches and Working with Others

- **Git Merge**



Week 3 Branches and Working with Others

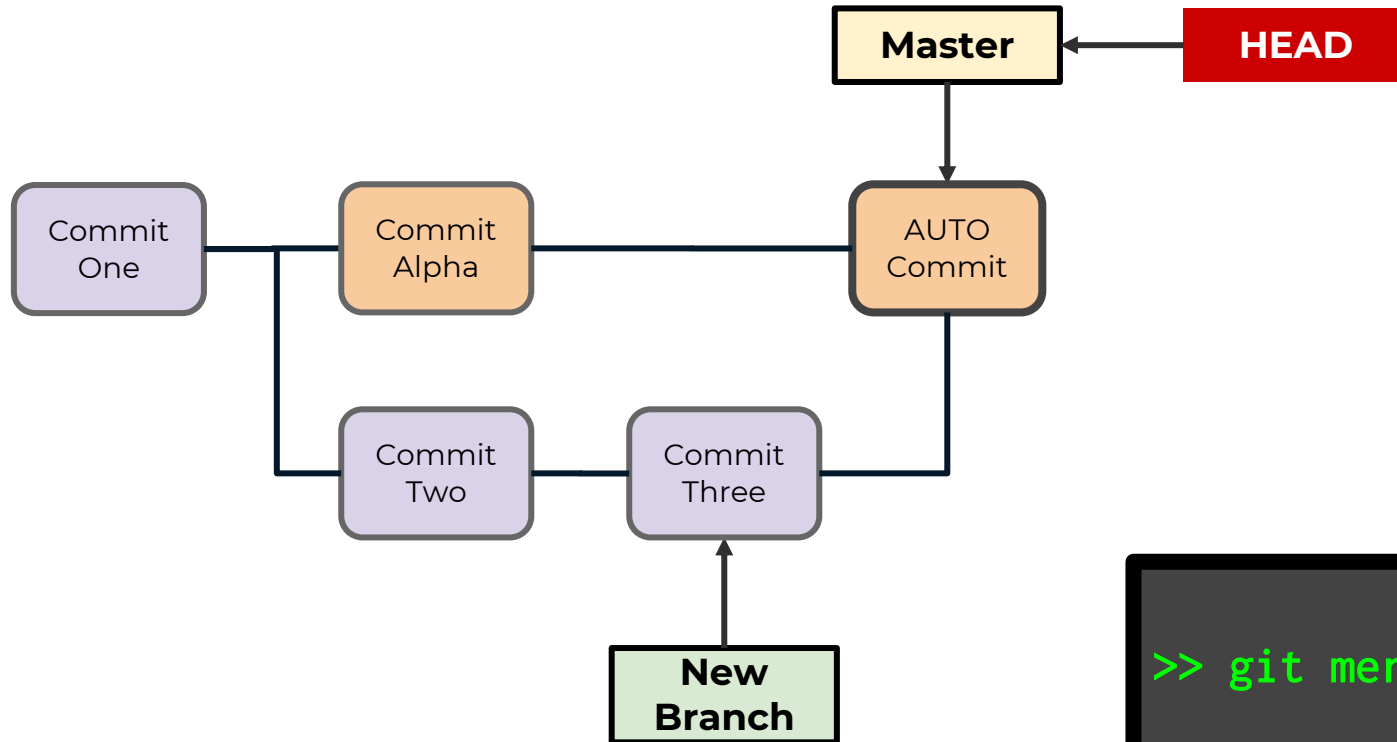
- **Git Merge**



```
>> git merge new_branch
```

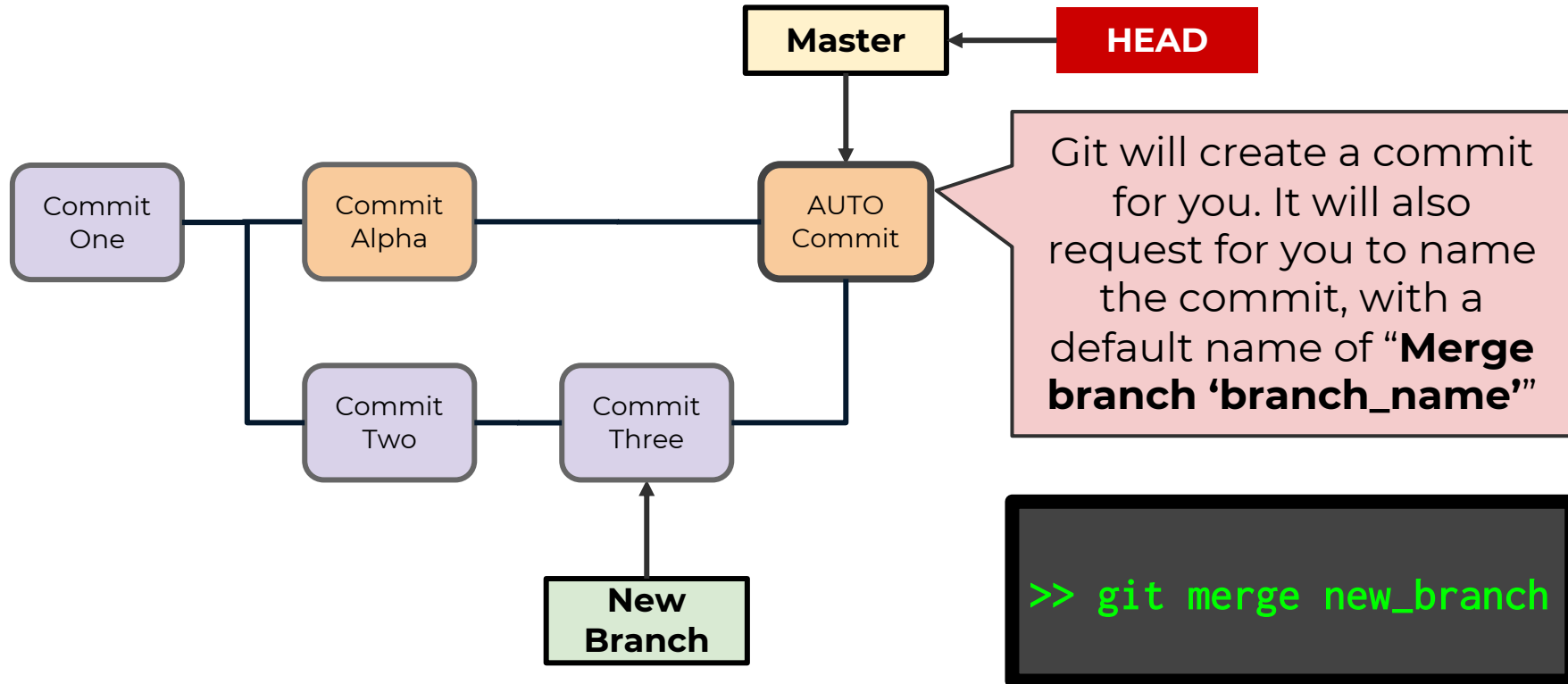

Week 3 Branches and Working with Others

- **Git Merge**



Week 3 Branches and Working with Others

- **Git Merge**



Week 3 Branches and Working with Others

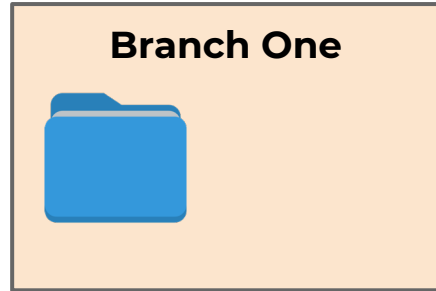
- Git creates the new commit for us, and will attempt the merge.
- Sometimes there are no conflicts, for example:
 - The branch only focused on files not in the receiving branch, thus the merge simply adds the new files to the receiving branch.

Week 3 Branches and Working with Others

- Git will try to automatically create the merge, and can do so in cases where no information from a specific branch would be lost, for example:

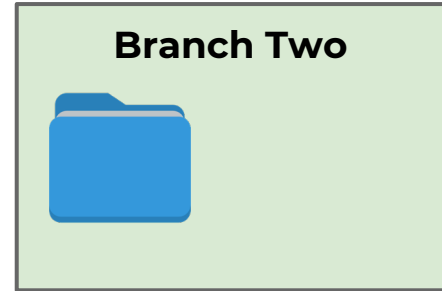
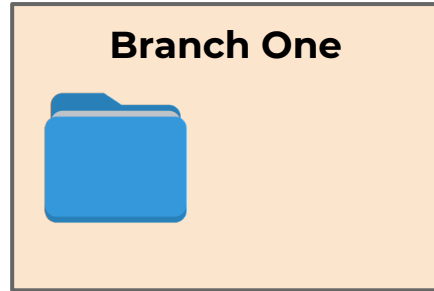
Week 3 Branches and Working with Others

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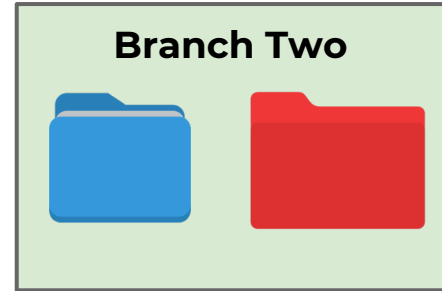
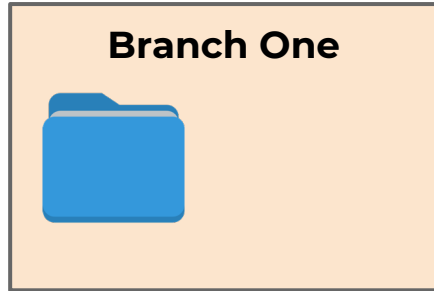
Week 3 Branches and Working with Others

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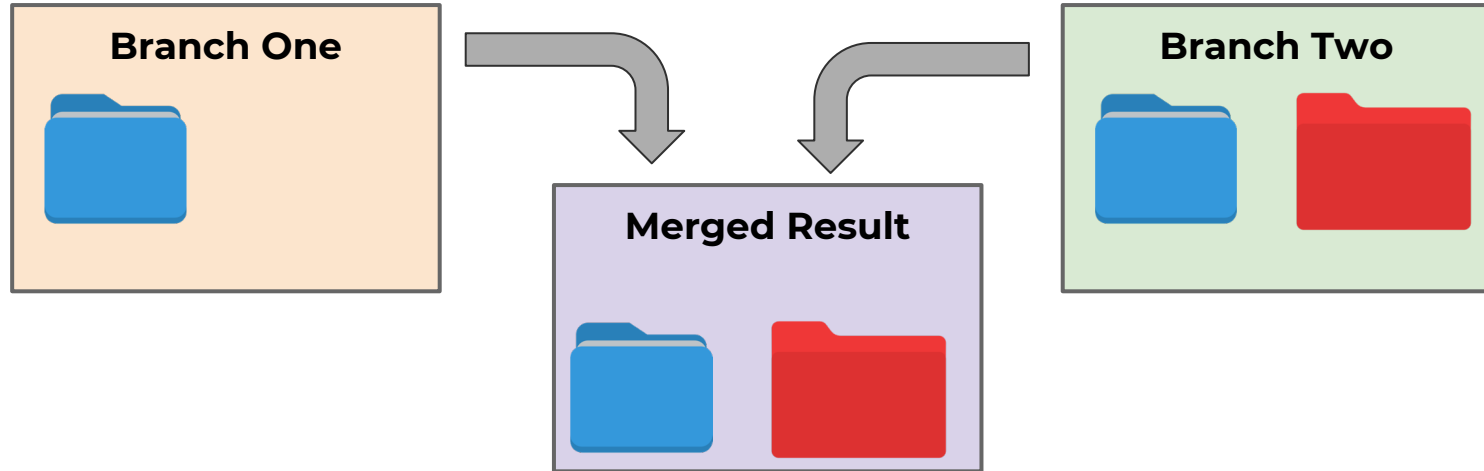
Week 3 Branches and Working with Others

- Git will try to automatically create the merge, and can do so in cases where no information from a specific branch would be lost, for example:



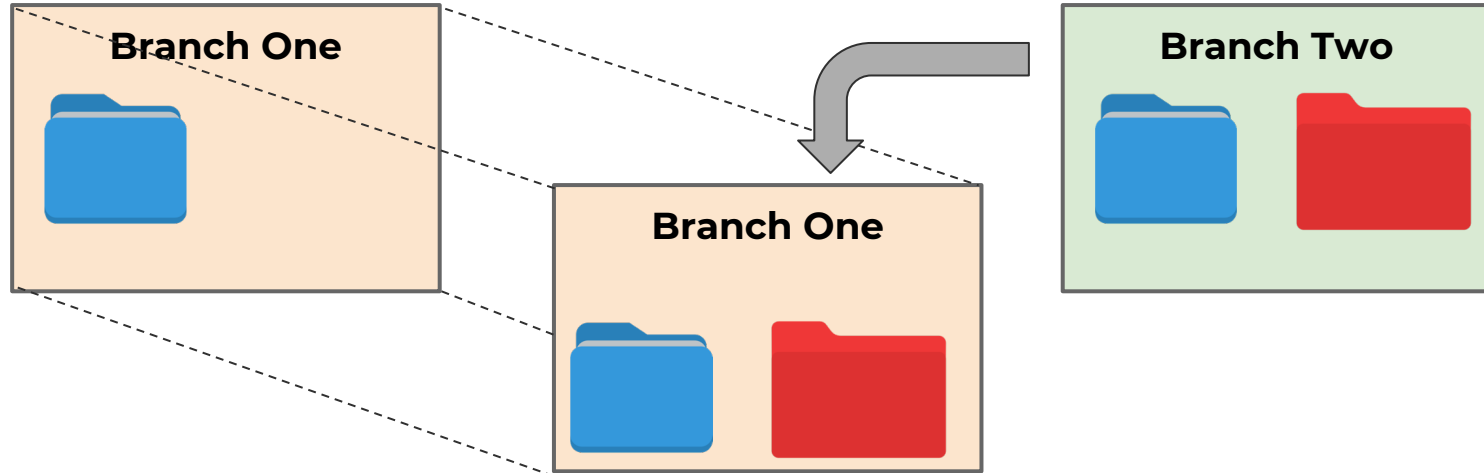
Week 3 Branches and Working with Others

- Git will try to automatically create the merge, and can do so in cases where no information from a specific branch would be lost, for example:



Week 3 Branches and Working with Others

- Git will try to automatically create the merge, and can do so in cases where no information from a specific branch would be lost, for example:



Week 3 Branches and Working with Others

- However, there will be many instances where there are conflicts, for example changes in the file on lines that are different between the branches.
- These are known as **merge conflicts**, and we need to resolve (fix) the conflicts between the branches in order to merge them.

Week 3 Branches and Working with Others

- Git will warn you about files in conflict.
- Then you must edit the files in order to remove the conflicts.
 - Fortunately, Git also provides specialized markdown to indicate the differences between the files and what differences come from which branch.
 - Modern editors (e.g. VS Code) have syntax highlighting to reflect this.

Week 3 Branches and Working with Others

- Merge Conflict Example

```
$ cat merge.txt
<<<<<< HEAD
Some content from the text file
=====
Different content from the other branch
>>>>>> new_branch
```

Week 3 Branches and Working with Others

- Merge Conflict Example

```
$ cat merge.txt
```

```
<<<<<< HEAD
```

```
Some content from the text file
```

```
=====
```

```
Different content from the other branch
```

```
>>>>>> new_branch
```

Content below this and above the ===== means that the content already exists in the current HEAD branch.

Week 3 Branches and Working with Others

- Merge Conflict Example

```
$ cat merge.txt
```

```
<<<<<< HEAD
```

```
Some content from the text file
```

```
=====
```

```
Different content from the other branch
```

```
>>>>>> new_branch
```

Division line between the conflicting content between the branches.

Week 3 Branches and Working with Others

- Merge Conflict Example

```
$ cat merge.txt
```

```
<<<<<< HEAD
```

```
Some content from the text file
```

```
=====
```

```
Different content from the other branch
```

```
>>>>>> new_branch
```

Content between ===== and >>>>branch is the content from the branch you are trying to merge from.

Week 3 Branches and Working with Others

- Let's explore these merge concepts in practice in the next lecture!

Week 3

Merge in Practice

Week 3 Branches and Working with Others

- **Merge in Practice**

- Fast Forward Merge
- Multiple Branch Commit Merge with No Conflict
- Multiple Branch Commit Merge with a Conflict

Week 3

Git Diff

Week 3 Branches and Working with Others

- **Checking differences with git diff**
 - When working with multiple branches or file versions, it is useful to have a tool that can display the differences between versions.
 - **git diff** is a powerful tool that can show the differences between data sets.

Week 3 Branches and Working with Others

- **Checking differences with git diff**
 - For the scope of this course, we will only be exploring the default behaviour of **git diff** which displays the differences between the original file and unstaged changes.
 - Before we explore this, let's understand the syntax that git diff uses to display changes.

Week 3 Branches and Working with Others

- **Checking differences with git diff**

myfile.txt

```
LINE ONE  
LINE TWO  
LINE THREE
```

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- **Checking differences with git diff**

myfile.txt

```
LINE ONE  
LINE TWO  
LINE THREE
```

myfile.txt

```
LINE ONE  
NEW LINE  
LINE THREE
```

Week 3 Branches and Working with Others

- **Checking differences with git diff**

myfile.txt

```
LINE ONE  
LINE TWO  
LINE THREE
```

myfile.txt

```
LINE ONE  
NEW LINE  
LINE THREE
```

git diff output

```
diff --git a/myfile.txt b/myfile.txt  
index a163a61..42fcb28 100644  
--- a/myfile.txt  
+++ b/myfile.txt  
@@ -1,3 +1,3 @@  
  ONE LINE  
- TWO LINE  
+ NEW LINE  
  THREE LINE
```


Week 3 Branches and Working with Others

- **git diff syntax - comparison input**
 - Comparison input at the first line displays the sources of the diff, notice how it's actually the same file, just versions a and b.

```
diff --git a/myfile.txt b/myfile.txt
index a163a61..42fcb28 100644
--- a/myfile.txt
+++ b/myfile.txt
@@ -1,3 +1,3 @@
ONE LINE
-TWO LINE
+NEW LINE
THREE LINE
```

Week 3 Branches and Working with Others

- **git diff syntax - metadata**
 - Metadata is just internal Git metadata you are unlikely to use, such as some hash information.

```
diff --git a/myfile.txt b/myfile.txt
index a163a61..42fcb28 100644
--- a/myfile.txt
+++ b/myfile.txt
@@ -1,3 +1,3 @@
ONE LINE
-TWO LINE
+NEW LINE
THREE LINE
```

Week 3 Branches and Working with Others

- **git diff syntax - markers for changes**
 - Legend that assigns symbols to each diff input source. Changes from a/myfile.txt are marked with - and the changes from b/myfile.txt are marked with + symbol.

```
diff --git a/myfile.txt b/myfile.txt
index a163a61..42fcb28 100644
--- a/myfile.txt
+++ b/myfile.txt
@@ -1,3 +1,3 @@
ONE LINE
-TWO LINE
+NEW LINE
THREE LINE
```

Week 3 Branches and Working with Others

- **git diff syntax - diff chunks**

- The remaining output will be a list of “chunks” of code, showing the changes as well as a few lines for context above and below the change.

```
diff --git a/myfile.txt b/myfile.txt
index a163a61..42fcb28 100644
--- a/myfile.txt
+++ b/myfile.txt
@@ -1,3 +1,3 @@
ONE LINE
-TWO LINE
+NEW LINE
THREE LINE
```

Week 3 Branches and Working with Others

- **git diff syntax - diff chunks**
 - @@ -start_line,num +start_line, num@@

```
diff --git a/myfile.txt b/myfile.txt
index a163a61..42fcb28 100644
--- a/myfile.txt
+++ b/myfile.txt
@@ -1,3 +1,3 @@
ONE LINE
-TWO LINE
+NEW LINE
THREE LINE
```

Week 3 Branches and Working with Others

- **git diff syntax - diff chunks**
 - Displays what was in file ---a/myfile.txt

```
diff --git a/myfile.txt b/myfile.txt
index a163a61..42fcb28 100644
--- a/myfile.txt
+++ b/myfile.txt
@@ -1,3 +1,3 @@
ONE LINE
-TWO LINE
+NEW LINE
THREE LINE
```

Week 3 Branches and Working with Others

- **git diff syntax - diff chunks**
 - Displays what was in file +++b/myfile.txt

```
diff --git a/myfile.txt b/myfile.txt
index a163a61..42fcb28 100644
--- a/myfile.txt
+++ b/myfile.txt
@@ -1,3 +1,3 @@
ONE LINE
-TWO LINE
+NEW LINE
THREE LINE
```

Week 3 Branches and Working with Others

- **Git Diff**

- This is a very powerful command, and we've only scratched the surface of what it can do, let's explore it in practice, but you can learn more at:
- **<https://git-scm.com/docs/git-diff>**

Week 3

Exercise and Solution

Week 3 Branches and Working with Others

- **Perform the following tasks:**
 - Create a new repository
 - Create a text file with the numbers 1-3 written out in english (one,two, three).
 - Add and Commit these Updates
 - Create a new branch called **translation**
 - Switch to the new branch and translate the numbers to another language(unos, dos, tres).

Week 3 Branches and Working with Others

- **Perform the following tasks:**
 - ***Bonus Task:***
 - ***Can you figure out how to use git diff to view the differences between the two branches before a merge?***
 - Merge the **translation** branch back to your initial master branch, it should be a “fast forward” merge since there were no other commits on master.

Week 3 Branches and Working with Others

- Overall this task should be a straight forward review of many of the concepts covered so far.
- Let's walk you through it!