

# Working with Branches

 (<https://github.com/learn-co-curriculum/git-github-working-with-branches>)  (<https://github.com/learn-co-curriculum/git-github-working-with-branches/issues/new>)

## Learning Goals

- Explain what branches are and why they're useful.
- List and create branches with the `git branch` command.
- Navigate between branches with the `git switch` and `git checkout` commands.
- Compare branches with `git diff`.
- Stash changes with the `git stash` command.

## Introduction

In earlier lessons, we talked about the fact that Git automatically creates a default `main` (or `master`) branch for us. It also allows us to create additional branches, as many as we like. Using branches helps us organize our work, protects our code from breaking, and makes it easier to collaborate with others.

In this lesson, we'll learn a bit more about what branches are and how to work with them. Then, in the next lesson, we'll learn how to incorporate the work we've done in a branch into the `main` branch, a process known as `merging`.

## What is a Branch?

Imagine you've been working on a project and have gotten your code doing what you want, but you now want to go back and refactor. Your code is working now, but you know that once you start refactoring — reorganizing, renaming variables, creating functions for repetitive code, etc. — things will likely break (temporarily, of course). You could just jump in and hope for the best, but there's a better approach: create a new branch for your refactoring.

A "golden rule" of working with Git is that you should keep the `main` branch of your project functioning at all times. The way to do this is by creating a new branch for any work you're doing that might break something — or, even, for any work at all! This will become especially important when you're working as part of a team, and it's a very good habit to get into. Making sure you always have a working version of your code will also free you up to make major changes and improvements, and to try new things!

So what exactly is a branch? Basically, it's just a particular history of your code (a series of commits) that can be referenced using the branch name. Just as the `main` branch consists of a series of saved (committed) versions of your code, so too do any other branches you create.

Once you've created a branch off of the `main` branch (often called a *feature branch*), any work you do in that branch will have no effect on the `main` branch — it's basically a "parallel universe":



In the diagram above, the `new-feature` branch was created after the second commit on the `main` branch. `main` knows nothing about the three commits that have been made on `new-feature`, and `new-feature` knows nothing about the last four commits made on `main` (the ones made after the `new-feature` branch was created). If we were to run `git log` on the `new-feature` branch, it would include (in reverse chronological order) the three commits on `new-feature` and the first two commits on `main`.

Once we've finished the work on our new feature and we're ready to incorporate it into the code base, we need to *merge* those changes into the `main` branch. (We'll learn how to do that in the next lesson.) Or we may never incorporate changes back into `main`. If we decide to abandon the new feature, we won't have to undo all that work — we can just abandon the `new-feature` branch. As long as we haven't merged those changes in, our working code in the `main` branch will be unaffected.

# Working with Branches

Let's create a list of study resources to help us learn Python. Be sure to code along, and to follow the instructions carefully.

Get set up by completing the following steps:

- Create a new directory to contain the project.
- Navigate into the directory and initialize it as a Git repo.
- Create a blank document, `python-resources.md`.
- Make your initial commit.

Then add the following to the document:

```
# Python Study Resources

## Books

- Composing Programs (Chapter 1-2) [Free]
  - This is a great book for learning compsci concepts in addition to Python
- Automate the Boring Stuff with Python [Free]
  - Has short, easy projects that involve different modules
- Python Crash Course , 2nd Ed
  - Beginner friendly intro to fundamental concepts
```

Recall that, when using markdown, we use `#` and `##` to indicate our top- and second-level headers, respectively. In addition, note that we can create a nested list by simply indenting the nested elements.

Once you've entered the books, add and commit your changes. If you run `git log`, it should look something like this:

```
$ git log
commit 17e1f35776dc41bb27df3351496a810a680b65df (HEAD -> main)
Author: Your Name <youremail@email.com>
Date:   Thu May 5 12:49:53 2022 -0400
```

add books to list

```
commit 360e55abd98041c4542cf826b0b35a8197b2c7f6
```

Author: Your Name <youremail@email.com>

Date: Thu May 5 12:48:26 2022 -0400

initial commit

Note, in the first line of the output, that `HEAD` is currently pointing to the `main` branch and, more specifically, to the last commit on the `main` branch.

Next, we want to add links for each of the books on our list, so let's create a feature branch where we can do that.

Currently, our repo should contain just the `main` branch. We can verify that using the `git branch` command:

```
$ git branch
* main
```

This command lists all the branches we currently have in our local repo. The asterisk indicates the branch that we are currently on.

To create a new branch, we use `git branch` again, followed by the name of the branch to create. It's a good idea to make your branch name descriptive (without getting too carried away). The name cannot contain any spaces:

```
$ git branch add-links
```

Nothing is displayed after running the command above, so let's run `git branch` again to see our new branch:

```
$ git branch
  add-links
* main
```

We can see that our new branch has been created, but we're still on the `main` branch. To switch to our feature branch, we use the `git switch` command:

```
$ git switch add-links  
Switched to branch 'add-links'
```

You may recall from an earlier lesson that `git switch` is a relatively new Git command. Before `git switch` was added, `git checkout` was used to switch branches. The syntax is the same.

Let's switch back to `main`, using `checkout` this time:

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

The choice of whether to use `switch` or `checkout` is a matter of preference.

Because, in most cases, when you create a new branch you also want to switch to it, both the `git switch` and `git checkout` commands provide shortcuts that combine the two steps. With `git switch` it looks like this:

```
git switch -c add-links
```

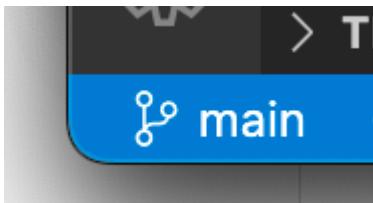
Adding the `c` flag (which stands for "create") to the `switch` command tells Git it first needs to create the branch then switch to it.

Somewhat confusingly, the shortcut for the `checkout` command looks similar, but uses a different flag, `b`:

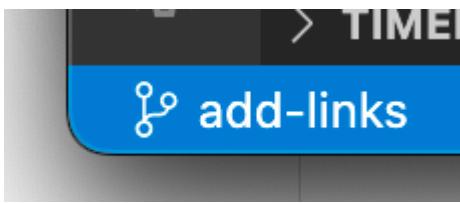
```
git checkout -b add-links
```

**Practice:** using whichever of the shortcuts you prefer, create and switch to a new `test` branch. Run `git branch` to verify that the new branch has been created and that there's an asterisk in front of it, indicating you're on that branch. When you're done, switch back to `main`.

Now that we've created our new branch, we're ready to add the links. At this point, you should be on the `main` branch. One way to verify that is by running `git branch`, but you can also verify it in VS Code. If you look in the lower left corner of the VS Code window, you should see something like this:



Switch back to `add-links` using whichever command you prefer (`git switch` or `git checkout`), then go back to VS Code and verify that the new branch is now shown:



Now that we're on the `add-links` branch, let's go ahead and add our links.

The markdown syntax for creating a hyperlink consists of the text to be displayed enclosed in square brackets, followed by the URL in parentheses, with no space in between:

```
[text to display](url)
```

So we can update the list of books as follows:

- [Composing Programs (Chapter 1-2)](<https://composingprograms.com/>) [Free]
  - This is a great book for learning compsci concepts in addition to Python
- [Automate the Boring Stuff with Python](<https://automatetheboringstuff.com/>) [Free]
  - Has short, easy projects that involve different modules
- [Python Crash Course , 2nd Ed](<https://nostarch.com/pythoncrashcourse2e>)
  - Beginner friendly intro to fundamental concepts

Note that we use the full URL, including the `http` prefix.

If you preview the document (by right-clicking on the name of the file in the file list and selecting "Open Preview"), you should see the links being displayed:

# Python Study Resources

## Books

- [Composing Programs \(Chapter 1-2\) \[Free\]](#)
  - This is a great book for learning compsci concepts in addition to Python
- [Automate the Boring Stuff with Python \[Free\]](#)
  - Has short, easy projects that involve different modules
- [Python Crash Course , 2nd Ed](#)
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If you click one of the links in the preview, it should open the page in your browser.

Go ahead and add and commit the changes, then run `git log`. You should see something like this:

```
$ git log
commit b612a58ebd33ed5c112a1cbd791da3879f32ca5d (HEAD -> add-links)
Author: Your Name <youremail@email.com>
Date: Thu May 5 14:13:20 2022 -0400

    add links for book titles
```

```
commit 17e1f35776dc41bb27df3351496a810a680b65df (main)
Author: Your Name <youremail@email.com>
Date: Thu May 5 12:49:53 2022 -0400
```

```
    add books to list
```

```
commit 360e55abd98041c4542cf826b0b35a8197b2c7f6
Author: Your Name <youremail@email.com>
Date: Thu May 5 12:48:26 2022 -0400
```

```
initial commit
```

On the first line of the output, we can see that HEAD is currently pointing to the `add-links` branch.

As you can see, the history for our new branch includes the commit we just made as well as the two commits from the main branch. These three commits comprise the entire history of our `add-links` branch.

**Question:** if we were to switch back to the `main` branch and run `git log`, what would we see? If you aren't sure, go ahead and try it!

## Compare Branches with `git diff`

Recall in an earlier lesson, we learned that we can use the `git diff` command to compare either the differences between our working directory and an earlier commit, or between any two commits. We can also use it to compare branches!

Now that we've committed our changes to the `add-links` branch, we can use the following command to compare our two branches:

```
$ git diff main add-links
diff --git a/python-resources.md b/python-resources.md
index 26ca4f7..fdfd20f 100644
--- a/python-resources.md
+++ b/python-resources.md
@@ -2,10 +2,10 @@

## Books

-- Composing Programs (Chapter 1-2) [Free]
+- [Composing Programs (Chapter 1-2)](https://composingprograms.com/) [Free]
  - This is a great book for learning compsci concepts in addition to Python
-- Automate the Boring Stuff with Python [Free]
+- [Automate the Boring Stuff with Python](https://automatetheboringstuff.com/) [Free]
  - Has short, easy projects that involve different modules
-- Python Crash Course , 2nd Ed
```

```
+- [Python Crash Course , 2nd Ed](https://nostarch.com/pythoncrashcourse2e)
  - Beginner friendly intro to fundamental concepts
```

The output above shows that each line containing a book title has been removed from the earlier version of the file (in `main`) and replaced (in `add-links`) with a line that includes the links.

Note that you can list the names of the branches to be compared in whichever order makes sense to you. We have listed `main` first in keeping with the convention of having the `a` file represent the earlier point in time.

Now that we've added our hyperlinks and everything is looking the way we want it to, the next step is to merge the changes we made in `add-links` into the `main` branch. We'll learn how to do that in the next lesson, but first, there's one last situation we need to cover.

## git stash

Let's switch back to our `main` branch and add another book to the end of our list:

```
- Serious Python
  - Does a great job of explaining some of the more difficult topics not covered
    in depth in the beginner books
```

Save the file, but **don't** stage or commit it, then try to switch back into the `add-links` branch:

```
$ git switch add-links
error: Your local changes to the following files would be overwritten by checkout:
  python-resources.md
Please commit your changes or stash them before you switch branches.
Aborting
```

Because there are changes that haven't been committed in `main` and would therefore be lost, Git is giving you a chance to save those changes before switching to the other branch. Git is also giving you a clue as to your options for how to do it: **Please commit your changes or stash them before you switch branches.**

As the message says, you can either go ahead and add and commit your changes, or, if you aren't ready to commit yet for some reason, you can use the `git stash` command:

```
$ git stash  
Saved working directory and index state WIP on main: a383ee3 add books to list
```

Go ahead and run `git stash`, then look at the file in VS Code. You'll see that the last book is no longer shown. Git has saved it into the "stash" and will keep it there until you retrieve it.

Now, if you try to switch back to `add-links`, it should work:

```
$ git switch add-links  
Switched to branch 'add-links'
```

And if you check the file in VS Code, you'll see that the links are back.

Once we've finished whatever we needed to do in `add-links`, we can then switch back to `main` and retrieve the stashed changes using `git stash pop`:

```
$ git switch main  
Switched to branch 'main'  
$ git stash pop  
On branch main  
Changes not staged for commit:  
(use "git add <file>..." to update what will be committed)  
(use "git restore <file>..." to discard changes in working directory)  
modified:   python-resources.md
```

```
no changes added to commit (use "git add" and/or "git commit -a")  
Dropped refs/stash@{0} (9e37213057a4dafae11594abc998104b8770e65a)
```

If you look at the file in VS Code, you'll see that the unsaved changes are back. And if you look at the output from the `git stash pop` command, or run `git status`, you'll see that they're unstaged, just as they were before. The last line of the output tells us that the changes

have been removed from the stash.

Note: this issue of switching branches with uncommitted changes can be confusing, because sometimes you'll get the error and sometimes you won't. See the first answer in [this stack overflow thread ↗ \(https://stackoverflow.com/questions/8526279/git-allows-for-branch-change-with-unstaged-changes\)](https://stackoverflow.com/questions/8526279/git-allows-for-branch-change-with-unstaged-changes) for a nice explanation. But for now if you aren't sure when you will and won't get the error, that's okay: just remember that when you do get it, you can use `git stash` to temporarily save any unstaged changes without having to make a commit, and `git stash pop` to retrieve them.

## Exercise

We're going to continue working with our Python Study Resources project in the next lesson, so to simplify things, go ahead return the `main` branch back to what it was before we added that fourth book. In other words, you need to discard the changes that have been made since the last commit. There are several ways you can do it, but try to do it using Git.

**Hint #1:** Take a look at the information in the output of the `git stash pop` command.

**Hint #2:** To refresh your memory, look back at the last lesson on undoing changes.

**Hint #3:** If you aren't sure you've done it correctly, run `git status`. You should see the following:

```
$ git status
On branch main
nothing to commit, working tree clean
```

## Check for Understanding

Before moving on to the next lesson, check your understanding of this material by answering the following question in your own words:

- What are branches and how does using them help us?

## Conclusion

In this lesson, we've learned how to create a new branch where we can make changes without having to be concerned about breaking something. But of course the ultimate goal is not to have our changes on a separate branch, but instead to incorporate them into the working code on our `main` branch. This process is known as `merging`, and we will learn how to do that next.

## Resources

- [Using Branches ↗ \(https://www.atlassian.com/git/tutorials/using-branches\)](https://www.atlassian.com/git/tutorials/using-branches)
- [Git stash ↗ \(https://www.atlassian.com/git/tutorials/saving-changes/git-stash\)](https://www.atlassian.com/git/tutorials/saving-changes/git-stash)