{POWER.CODERS}

Intro to Git

Contents

What is version control?

Version control is a tool that allows you to...

Collaborate

Create anything with other people, from academic papers to entire websites and applications.

Track and revert changes

For example, when you edit a file, version control can help you determine exactly **what** changed, **who** changed it, and **why**.

If something goes wrong, you can **revert** the changes and go back to the last version (checkpoint) that worked.

Version control in use

Do you have files somewhere that look like this?

```
Resume-September2016.docx
Resume-for-Duke-job.docx
ResumeOLD.docx
ResumeNEW.docx
ResumeREALLYREALLYNEW.docx
```

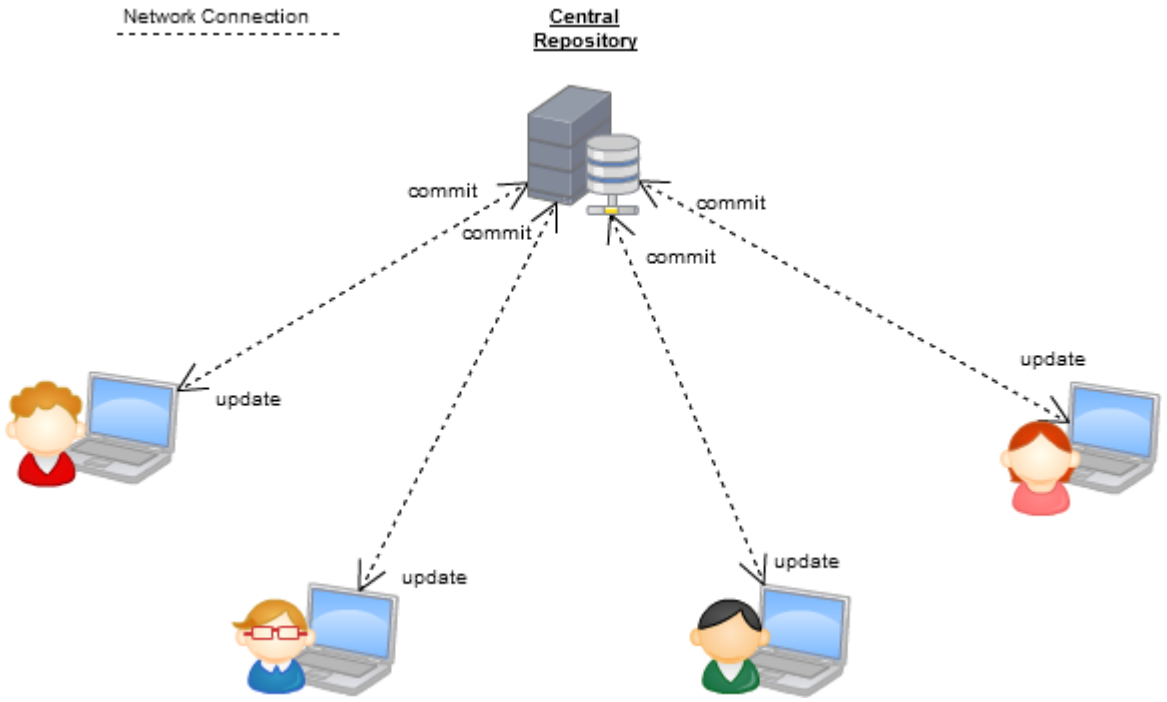
You invented your own version control.

Types of Version Control Systems (VCS)

But first some common vocabulary

- A **repository** is where you keep all the files you want to track.
- If you want to save a new version of your work and define a checkpoint, you **commit** your changes to the repo.
- In case others are working on the same repo, changes from their commits have to be **merged** with yours.

Centralized Version Control



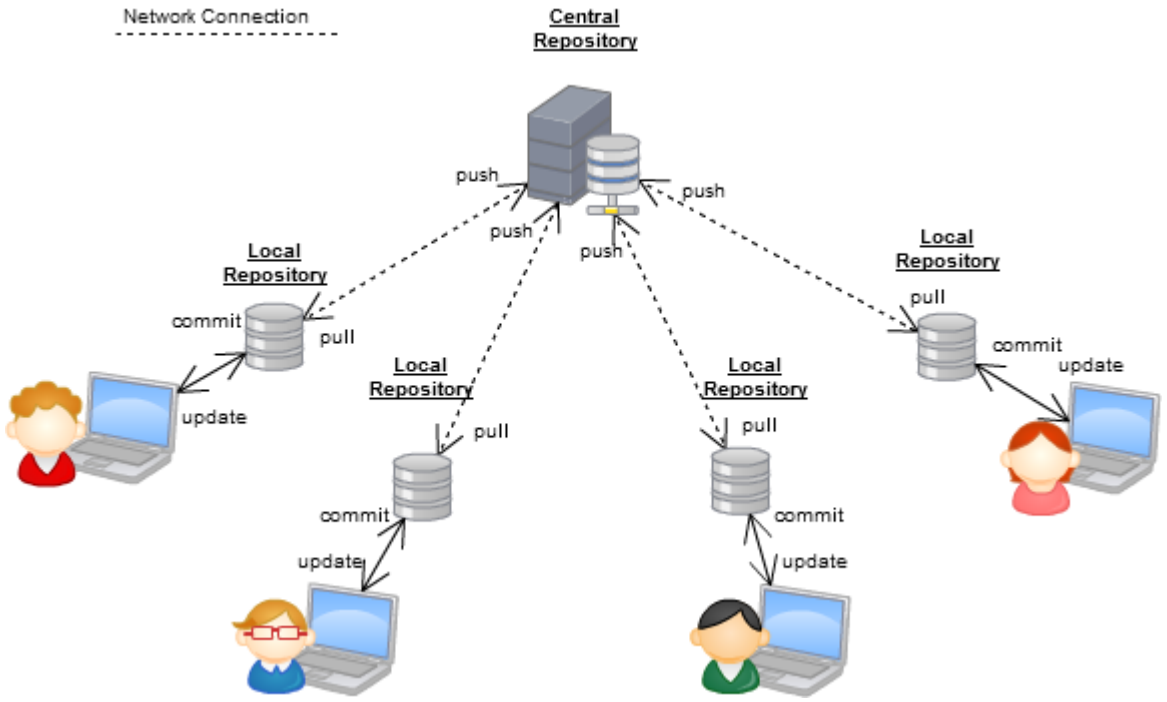
Centralized Version Control

There is one central server. Each client (person) checks out and merges changes to main server.

Examples:

- CVS
- Subversion (SVN)
- Perforce

Distributed Version Control



Distributed Version Control

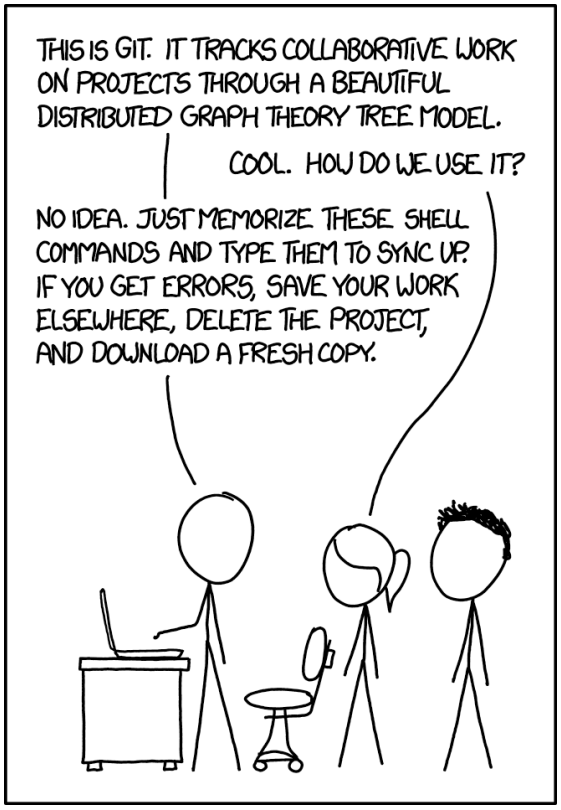
Each client (person) has a local repository, which they can then reconcile with the main server via **push** and **pull**.

Examples:

- Git
- Mercurial

Why Use Git?

- **Fast:** Access information quickly and efficiently.
- **Distributed:** Everyone has his/her own local copy.
- **Scalable:** Enables potentially thousands (even millions) of developers to work on single project.
- **Local:** You don't need a network connection to use it. You only need a remote server if you want to share your code with others (e.g. using GitHub, GitLab or BitBucket).
- **Branches:** Keep your coding experiments separate from code that is already working.
- Everyone has a local copy of the **shared files** and the **history.**


THIS IS GIT. IT TRACKS COLLABORATIVE WORK ON PROJECTS THROUGH A BEAUTIFUL DISTRIBUTED GRAPH THEORY TREE MODEL.
COOL. HOW DO WE USE IT?
NO IDEA. JUST MEMORIZE THESE SHELL COMMANDS AND TYPE THEM TO SYNC UP. IF YOU GET ERRORS, SAVE YOUR WORK ELSEWHERE, DELETE THE PROJECT, AND DOWNLOAD A FRESH COPY.

From xkcd

Git at Powercoders

- We will use Git as a version control system (VCS) for **all of our exercises**.
- Use Git **daily** to get used to the vocabulary and it becomes second nature to commit.
- VCS are commonly used in **web and software development** teams.
- Git is with **89%** the most used VCS.

Installation

1. Download Git
2. Install Git
   double-click on downloaded program and follow the instructions
3. Choose Visual Studio Code as Git's default editor
4. Open Visual Studio Code > Terminal (wsl / zsh) after installation

Setup

Set up name and email in git config. Let's do it together.

```
$ git config --global user.name "Your Name Here"
# Sets the default name for Git to use when you commit
```

```
$ git config --global user.email "your_email@powercoders.org"
# Sets the default email for Git to use when you commit
```

```
$ git config --global init.defaultbranch "main"
# Sets the default branch to the name "main" instead of "master"
```

```
$ git config --global core.editor "code --wait"
# Sets the default editor to VSC
```

```
$ git config --list
```

Git Basics

Making a Repo

What is a repository (repo)?

- Remember: A **repository** is where you keep all the files you want to track.
- Essentially, a Git version of a **project folder**.
- Git will track any changes inside of a repository. Unless you specifically tell it not to via `.gitignore`.

Create a Local Repository

- First, we need to define where the respository should be.
- Let's create a folder called **poco** to the **desktop**.

```
$ cd Desktop

# create the folder
$ mkdir poco

# next go inside
$ cd poco
```

Create a Local Repository

- Check if we are where we want to be

```
$ pwd
```

- Initialize the folder as a local Git repository

```
$ git status
# should show an error because
# we haven't made it a repository yet.

$ git init
$ git status
```

What did we just do?

- `git init` will transform any folder into a Git repostiory.
- You can think of it as giving Git super powers to a folder so that Git starts tracking any changes in that folder.
- If the command `git status` returns no errors, it means your folder has successfully been Git-ified!

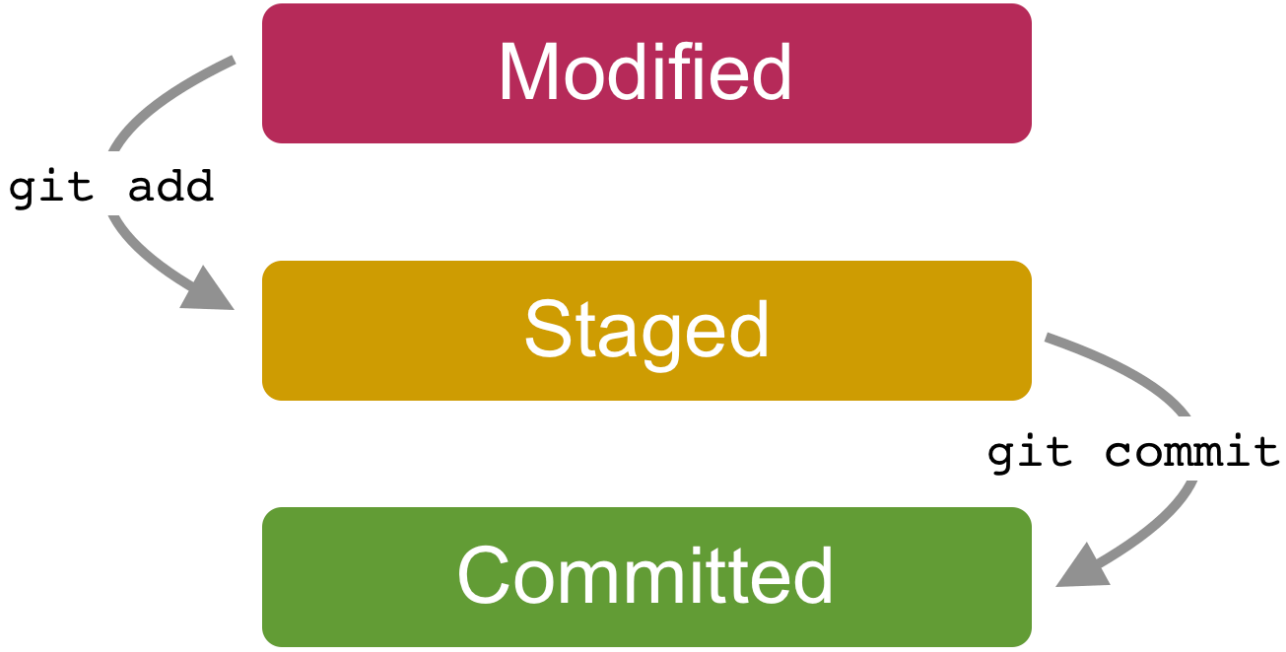
Good repository practices

- Repos are meant to be **self-contained** project folders. 'Project' can be how you define it - one html page or a whole app.
- Name folders with all **lowercase letters** and with **no spaces** - use dashes or underscores instead.
- It's possible to have **multiple repositories** on the computer.
- But don't put a repository **inside** another!

Tracking Changes

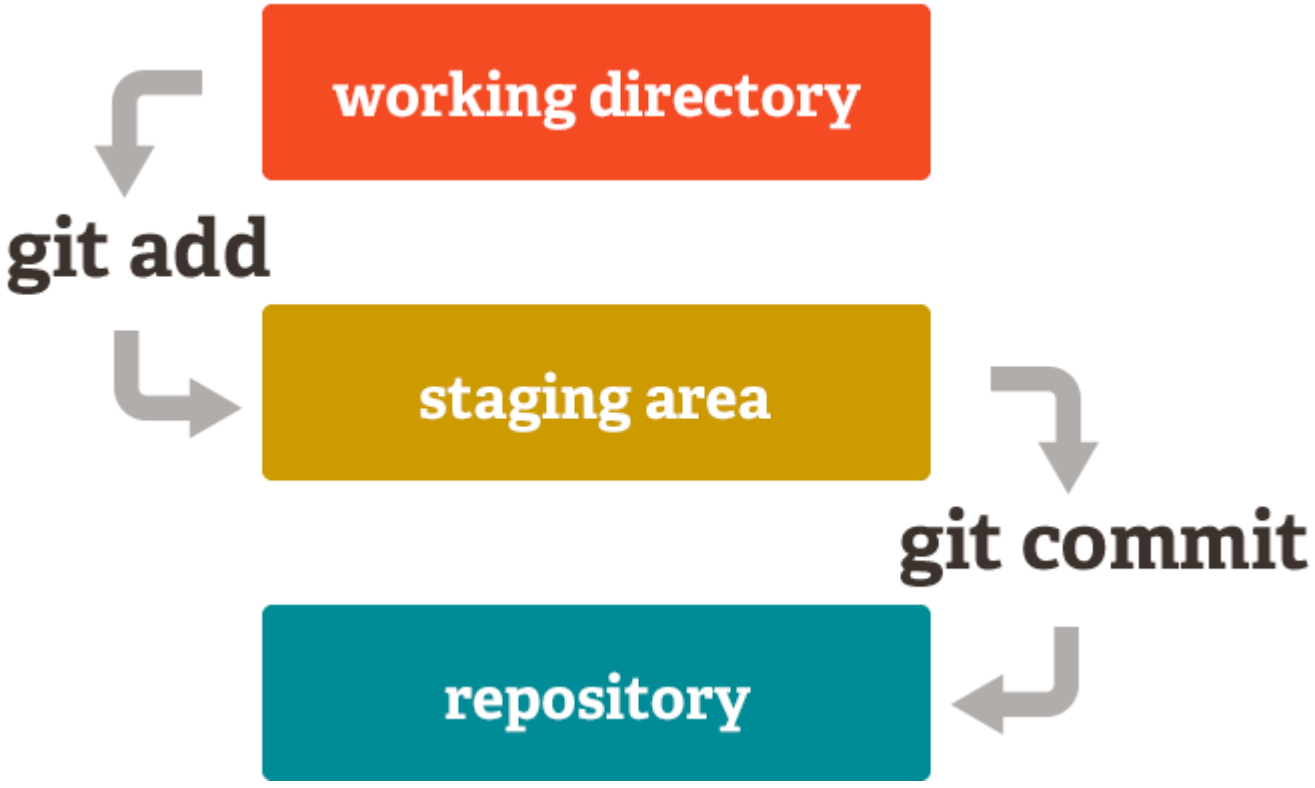
Tracking States in Git

As you make changes in your repo, you can tell Git how to treat those changes.



The Magical Realms of Git

Each of the states of Git corresponds to an area of the Git repo, so here's some vocab:



The Magical Realms of Git

- **Working directory/tree**: The current version of your project where you are making changes (which is reflected in your code editor)
- **Staging Area**: The place where you stage your files when you are readying them to commit
- **Repository**: When you commit, Git permanently saves only the changes from your staging area to the repo's memory

Create a file

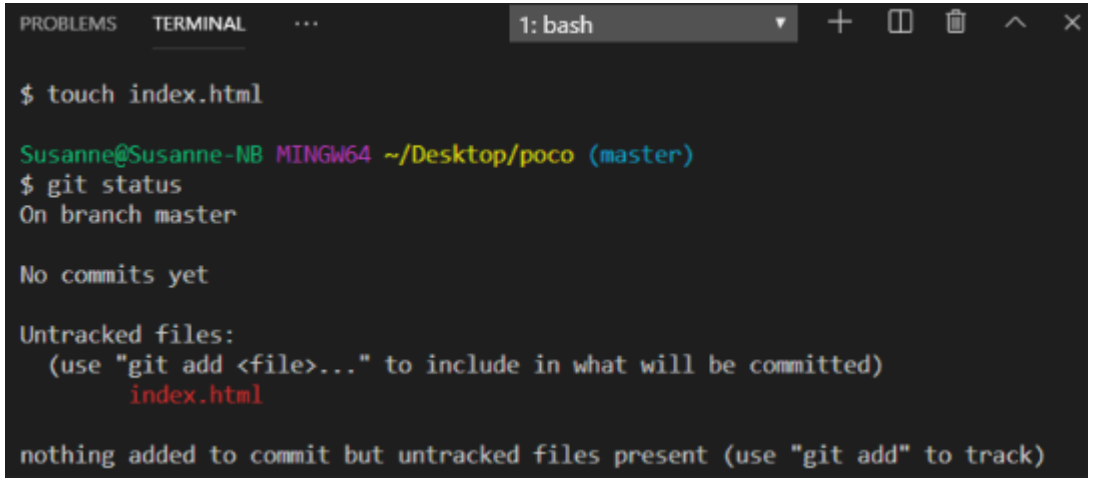
1. Create a new file in your new folder named `index.html`
2. Check the status of your repo with `git status`

Create a file

```
$ touch index.html
```

```
$ git status
```

Modified/Untracked



Status you get when you make changes to a file or add a new file but haven't added or committed yet

Unified diff format

```
 1: @@ -10,6 +10,5 @@
 2:  <p>This was one of my
 3:   multiline sample paragraphs</p>
 4:
 5: -<p>This text will be deleted.</p>
 6: -
 7: -<p>This text will be updated.</p>
 8: +<p>This text will be updated
 9: +  with some extra content.</p>
10:
11: +<p>This one is completely new.</p>
12: +
13:  <p>One more line of text.</p>
14:
```

`@@` is the chunk header

- `-m,n` = Starts at line `m`, continues for `n` lines
- `+o,p` = Starts at line `o`, continues for `p` lines

First column is what happened:

- `Space` This line is not changed
- `-` = This line was deleted
- `+` = This line was added

Add a file to staging

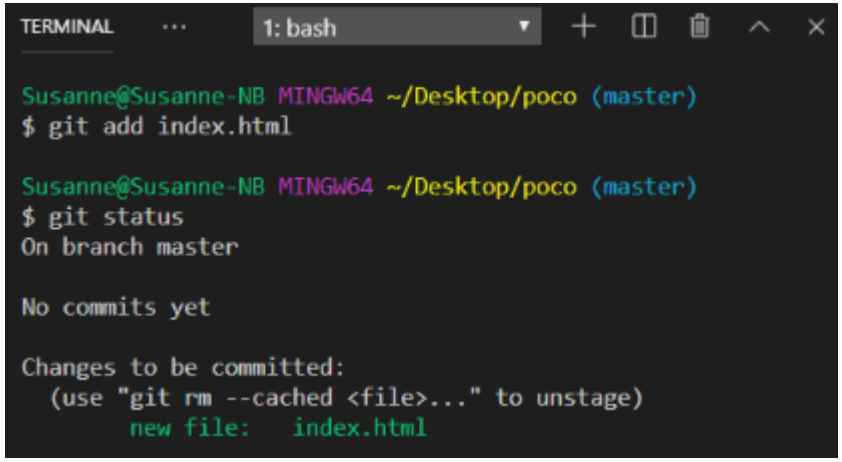
1. Tell Git to track our new file with `git add` plus filename.
2. Check the status of your repo with `git status`.

Add a file to staging

```
$ git add index.html
```

```
$ git status
```

Staged



Status you get when use `git add` to let Git know that these are the files you want to 'stage' or prepare for committing.

Committing changes

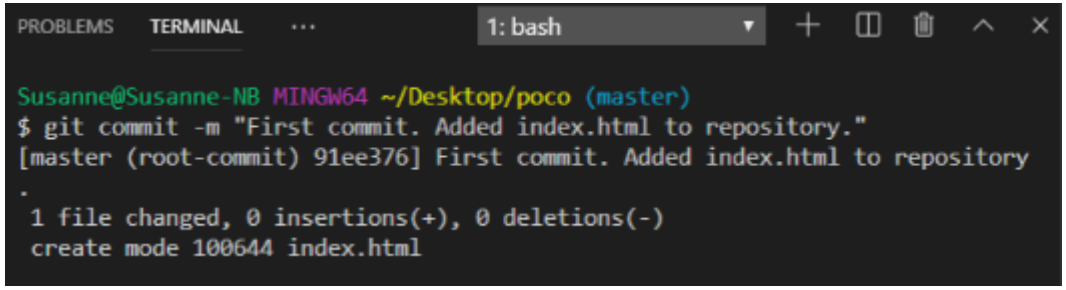
1. Check the status of your repo with `git status`. Make sure that the changes listed represent exactly what you want to commit.
2. Commit the change with a **message** that explains and describes what changes you made.

Committing changes

```
$ git status
```

```
$ git commit -m "Add index.html to repository."
```

Committed!



Success!

Congratulations.
You are now using Git.

What did we just do?

How is this different from just saving a file?

- When we `git add` a new file, we tell Git to add the file to the repository to be **tracked**.
- This is also called **staging** a file. We can see our changes in the **staging area** (aka the **index**, aka the **cache**), ready to be saved.
- A `git commit` saves the changes made to a file, not the file as a whole. The commit will have a unique ID so we can track which changes were committed when and by whom.

In other words...

...a commit is like a snapshot of your project at a current time

Look at your progress

```
$ git log
```

```
commit 91ee3768d599ab7223cbd4247c8752fc1636edad (HEAD -> main)
Author: susanne susanne.koenig@powercoders.org
Date:   Fri Aug 30 16:36:09 2019 +0200

First commit. Added index.html to repository.
```

On Mac, type `q` to exit the log.

What is a HEAD?

HEAD refers to the most recent commit on the current branch.

A **branch** is the name for a separate line of development, with its own history.

By creating a repo, a branch called **main** is automatically created.

When to commit?

- Commit early and often
- When you have completed a mini 'idea' or 'task':
  - You got a function to work
  - You corrected a few misspellings
  - You added some images
- **Only commit when your code works!**
  Try not to commit broken code.

Good commit messages

Include a short but precise message of the changes you have made, in the present tense.

```
$ git commit -m "Add capitalization function for header text"
```

Other people need to be able to read your commit history and understand what you were accomplishing at each step of the way.

Article to read: Art of the commit

Quick recap

- `git init`: turns a folder into a Git repository
- `git status`: checks the status of your files
- `git add [file_name]`: adds file to the staging area
- `git commit -m "your commit message"`: commits your changes
- `git log`: see your commits so far

One more thing: git diff

When files have been modified in the working directory, it might be helpful to easily view what changed to double check that they're what we want.

```
$ git diff
```

This shows the **difference** in the content of the files in the working directory and the ones in the **staging area** (also called index).

Try It Yourself

In this exercise, you will be creating a repository and adding some project folders and files. You will be working on creating a repository for your coming weeks of school phase (13 weeks).

As you read through these steps, think about when would be a good time to commit. As you execute the steps, you get to decide when to commit.

Excerice

1. Create a new folder named **poco** on your desktop and make it a repository.
2. Add for each week of school a folder inside the repository.
3. Add to each folder a file called README.md.
4. Edit each file and add the current week number to it as content.
5. Look at your history with `git log` as you add more commits

Pssst, you find some Hints on the next slide ...

Hints

1. At the beginning, do not be inside of your current project folder when you make a new folder. Make sure you are on your desktop.
2. Make sure you are inside of the folder when you make it a repository.
3. Remember to commit. When would be a good time to commit?
4. Don't forget to run `git status` regularly so that you can see what is happening at each stage.

Reverting Changes

We all make mistakes

Don't worry. Git is your friend.

Try It Yourself

1. Move back to your **poco** repository (see exercise slide 46)
2. Try each of the following scenarios yourself

Scenario 1: Undoing modified/untracked changes

You made some changes to some files and realize you don't want those changes. The files have not git added or committed yet.

Open **index.html** in Visual Studio Code and add a new line of text. Then:

```
$ git restore index.html
```

Look at **index.html** in your editor: your changes are not there anymore. You've gone back to the previous commit state.

Scenario 2: Unstaging a file

You `git add` a modified or new file, but realized you don't want it your next commit.

In Visual Studio Code create a new file and name it **test.txt**. Then:

```
$ git add test.txt
$ git status
$ git reset test.txt
$ git status
```

The file is removed from staging, but your working copy will be unchanged.

Alternative: Unstaging a file

You `git add` a modified or new file, but realized you don't want it your next commit.

In Visual Studio Code create a new file and name it **test2.txt**. Then:

```
$ git add test2.txt
$ git status
$ git restore --staged test2.txt
$ git status
```

The file is removed from staging, but your working copy will be unchanged.

Scenario 3a: Uncommitting, but want to keep all your changes

You made a commit, but then realize that a piece of code doesn't work, so you just want to uncommit.

Open **index.html** and make some changes. Then:

```
$ git add index.html
$ git status
$ git commit -m "Make changes to index file"
$ git reset --soft HEAD~1
$ git status
```

Explanation

Your most recent commit is called the **HEAD**.

Passing `git reset` the options of `--soft HEAD~1` essentially asks to move the HEAD back by one commit (essentially uncommitting your most recent commit).

`--soft` means you won't lose your changes—they'll just move to staging.

Scenario 3b: Uncommitting, but you don't want to keep any changes

You realize you don't want any of the code in your previous commit, so just getting rid of that commit completely.

You still have the change in the staging area for index.html

```
$ git add index.html
$ git status
$ git commit -m "Make changes to index file"
$ git reset --hard HEAD~1
$ git status
```

Explanation

Passing `git reset` the options of `--hard HEAD~1` will delete the last specified commit **and** all the work related to it.

Heads up—there are many, many different ways to undo changes. That's what's powerful about Git. Learn more at Atlassian tutorial

BRANCHING

Branching

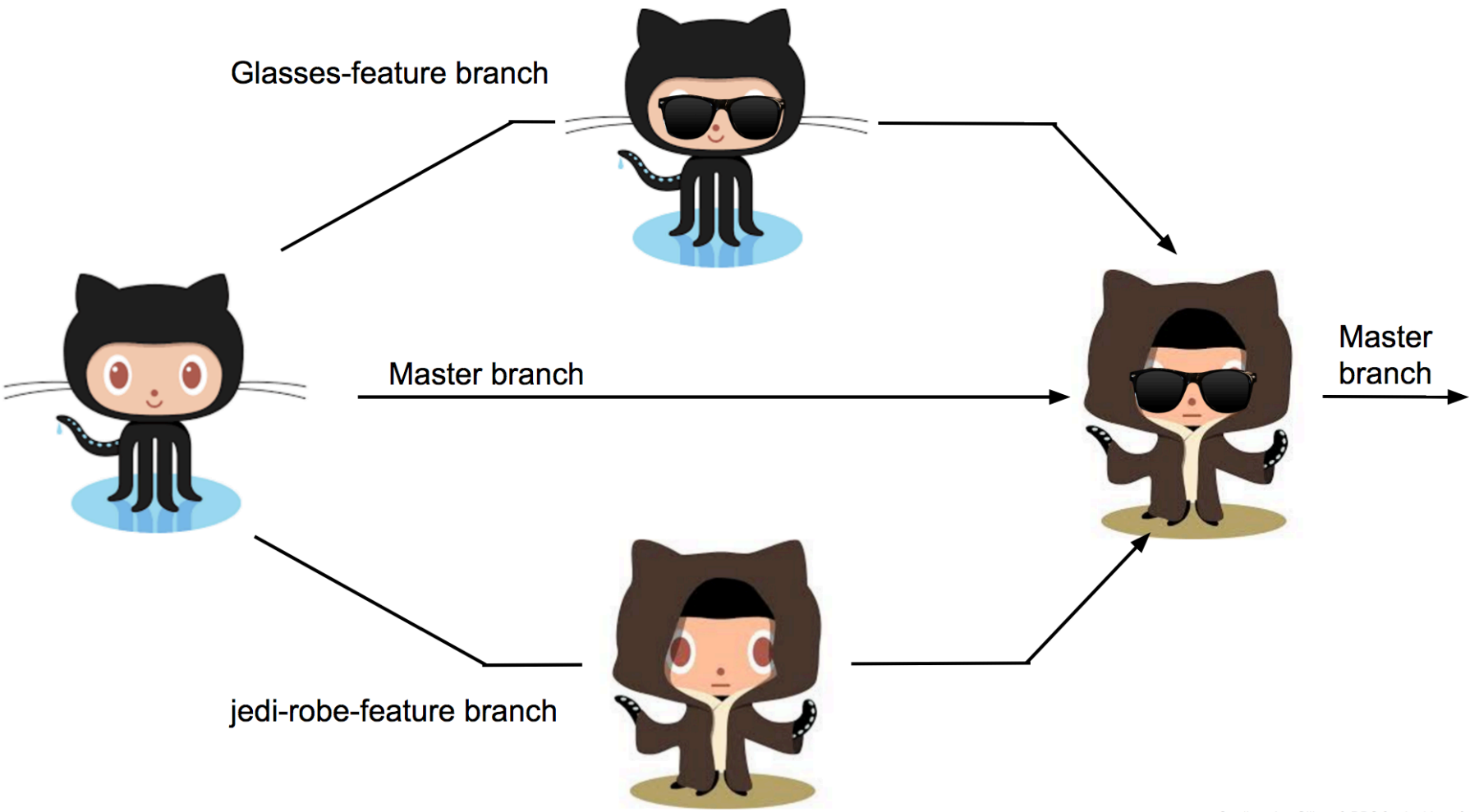
A branch is essentially another **copy of your repo** that will allow you to isolate changes and leave the original copy untouched. You can later choose to combine these changes in whole or part with the "main" copy, or not.

Branches are good for features!

Pssst...what's a feature?

Can be something as big as adding a new section to a site or an app, to a small functionality (a carousel on the homepage)

Branching



Credit to Jen Gilbert & DBC for the idea of this slide

Why Do We Need Branching?

- Develop different code on the **same base**
- Conduct **experimental work** without affecting the work on main branch
- Incorporate changes to your main branch **only if and when you are ready**...or discard them easily

Branches are cheap!

Branching cycle

So, you want to develop a new feature:

1. Make sure you are on main
2. Create a new branch and jump over to it
3. Develop your code. Commit commit commit!
4. When the feature is done, merge it into main
5. Delete your feature branch!

Try It Yourself

Create a new branch called **feature.**

```
$ git branch
// you should see only * main
$ git switch -c feature
$ git branch
// you now see * feature and below main
```

Okay, let's break that down

- `git branch`: tells you what branches (with commits) you have, and `*` indicates which branch you are currently on
- `git switch -c branch-name`: the `-c` creates a new branch, and `switch` will hop you over to that branch
- An older way to do that is by `git checkout -b branch-name`: the `-b` creates a new branch, and `checkout` will hop you over to that branch

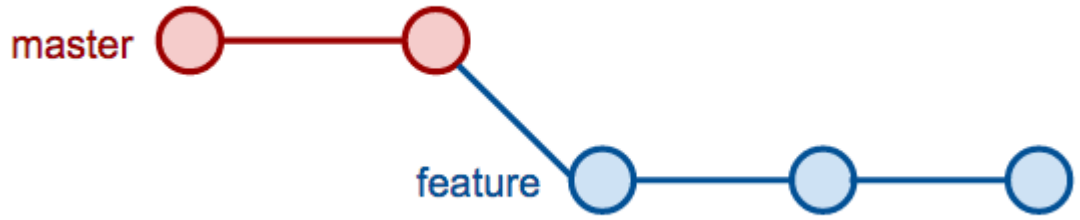
Next: Committing on a new branch

Add new lines to **index.html**

```
$ git add index.html
$ git commit -m "Adding changes to feature"
$ git log --oneline
```

Branching

What we just did, in picture form:



Next: Switching branches

```
$ git branch
```

Switch to main branch and look at the commit history

```
$ git switch main
$ git log --oneline
```

Switch to feature branch and look at the commit history

```
$ git switch feature
$ git log --oneline
```

Next step: Merging

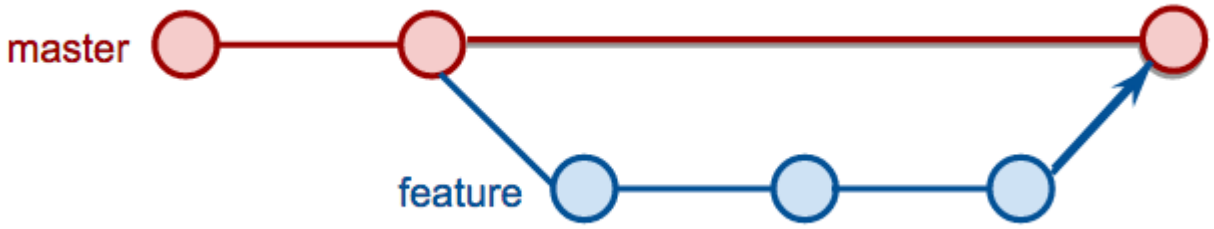
Merge to get changes from one branch into another

Switch to main and merge changes

```
$ git switch main
$ git merge feature
$ git log --oneline
```

Merging Branches

When you merge, you create a new commit on the branch you just merged into



Delete feature branch

Since your code from your feature branch is merged into `main`, you don't need the branch anymore!

```
$ git branch -d feature
```

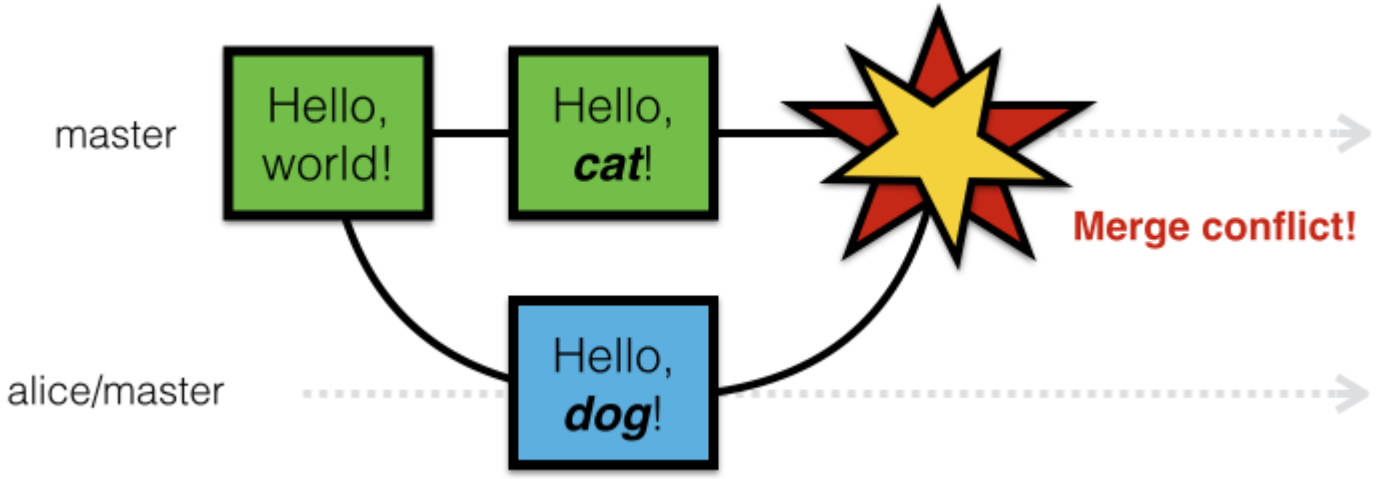
Hint: Make sure not to be on the branch you are deleting.

Quick review

- `git switch -c [branch_name]`: creates a new branch and hops over to it
- `git switch [branch_name]`: switch to another branch
- `git branch`: lists all your branches
- `git merge [branch_name]`: merges branch into the current branch
- `git branch -d [branch_name]`: deletes branch

What could possibly go wrong?

There could be a merge conflict.



Create a Merge Conflict

Go back to your poco project on your desktop.
Change the first line in **index.html** in the **main** branch

```
$ git add index.html
$ git commit -m "Changing index page in main"
```

Now change the first line in **index.html** in **feature** branch

```
$ git switch feature
  # open index.html and change the first line
$ git add index.html
$ git commit -m "Changing index page in feature"
```

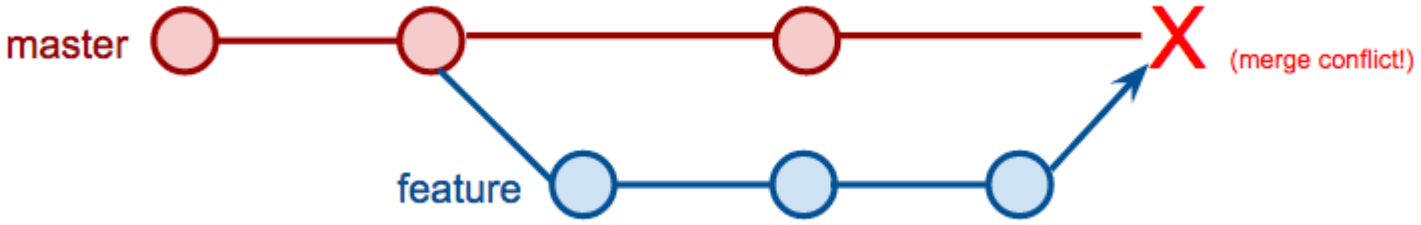
Merge conflicts

Merge the changes from **main** into the **feature** branch

```
$ git merge main
#remember, you are on the feature branch here
```

You will be notified of a conflict. Go to the file in your editor and fix the problem. Then add and commit your edits.

Merging



The merge conflict occurred because the feature branch (which is based off of main) and the main branch both had divergent histories for the same file.

Vocabulary Review

- A **repository** is where you keep all the files you want to track.
- A **branch** is the name for a separate line of development, with its own history.
- A **commit** is an object that holds information about a particular change.
- **HEAD** refers to the most recent commit on the current branch.

Command Review

- `init`
- `status`
- `add`
- `commit`
- `log`
- `restore`
- `switch`
- `branch`
- `merge`

... and many more

Online Material

- Video: Git for dummies
- Video: Git and GitHub for Beginners Tutorial
- Git Cheatsheet
- Understanding the workflow of version control
- Official Git Documentation: glossary, book and videos
- Resources to learn Git
- More resources to learn Git
- Learn Git branching
- New in Git: Switch and Restore