Before We Begin...

All links can be found on:
github.com/UWB-ACM/git-gud

1. Install Git (command line)

   git-scm.com/downloads

2. Create a GitHub account if you don't have one already.

   github.com/

```
$ git gud
git: 'gud' is not a git command. See 'git --help'.

The most similar command is
        gui
```

Git Gud

Workshop

By your friends at

UWB ACM

Presenters: Ryan Russell, Lizzy Presland

Agenda

- ➔ Introduction to Git
- ➔ Commands Overview
- ➔ Workshop #1: First Commit
- ➔ Workshop #2: Sync Changes
- ➔ Best Practices
- ➔ Workshop #3: Collaborating with others

The Land Before Git

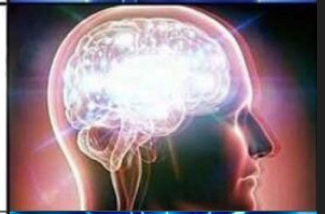
How have you worked on a project with multiple people in the past?

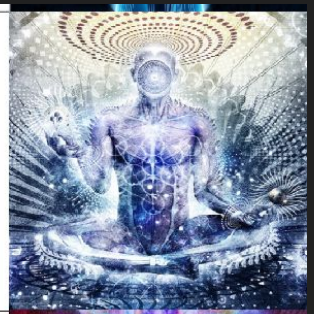
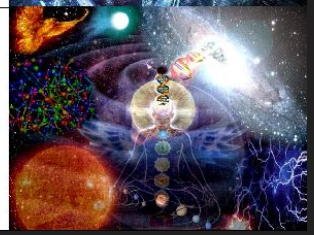
Did everyone code on their own machines and use a USB to exchange code?

Did you use a Google Doc that everyone edited?

Now imagine a project with 50 people. **That's a lot of USBs**.


draft_4_final_v2_new
Is this Version Control

Git	
Google Drive	
Uploading the code to an external hard drive via USB	
Mailing the code	
Printing the code	

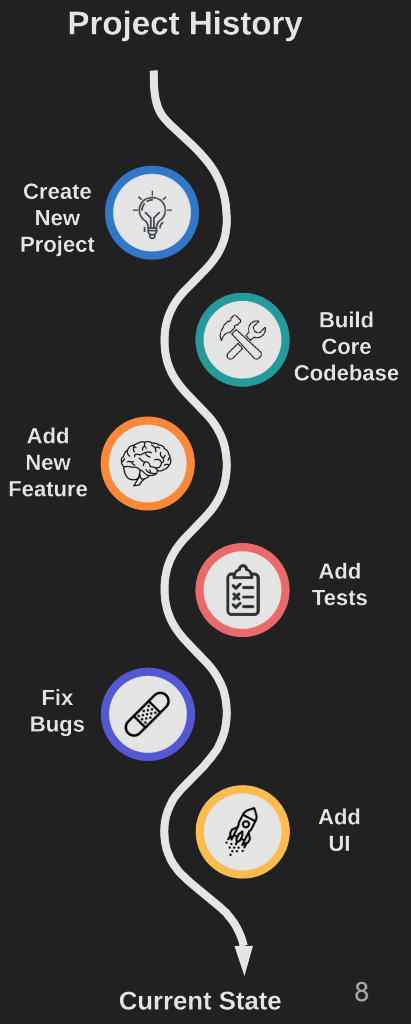
Using a single file on a shared computer	
Placing a video camera recording the keyboard	
Keeping the IDE open permanently and using ctrl-z to go back to previous versions	
Wiping the hard drive and re-writing the program	

Introduction to Git

What version control is + why it matters

What's Version Control?

- Tracks changes
  - See which user(s) made changes to document(s)
- Save the history of changes to a document
  - Shows the long-term evolution of document(s)
- Implemented in cloud drive platforms
  - e.g. Google Drive

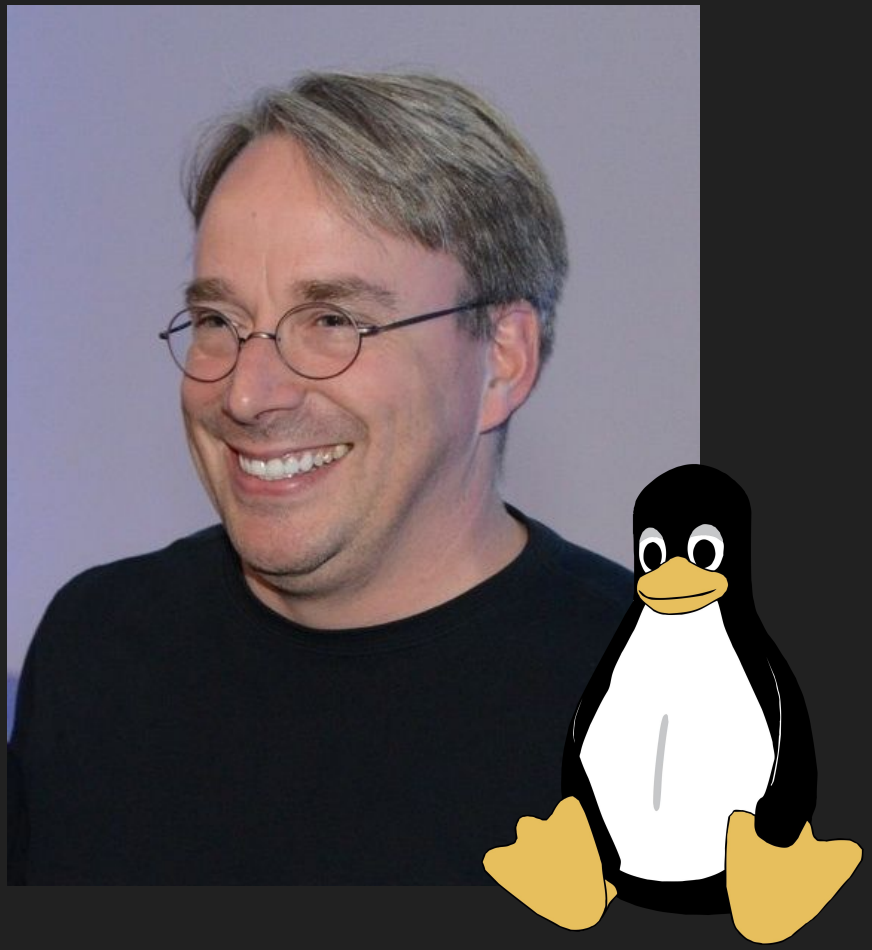


Linus Torvalds

Linus Torvalds, the creator of the Linux kernel, wanted a n**ew form of version control**.

The project's goal was to synchronize code between fellow programmers and make the development process easy and lightweight.

So in April 2005, his team started development of Git.



What's Git?

Version Control Software!

- Powerful command-line toolbox
- Used for:
  - tracking revisions to files
  - viewing revision history
  - selectively managing revisions by many different people
  - uploading new changes to remote file storage

What *isn't* Git?

Git != GitHub

GitHub is a **remote file storage platform** that **uses** Git

Think about it like:

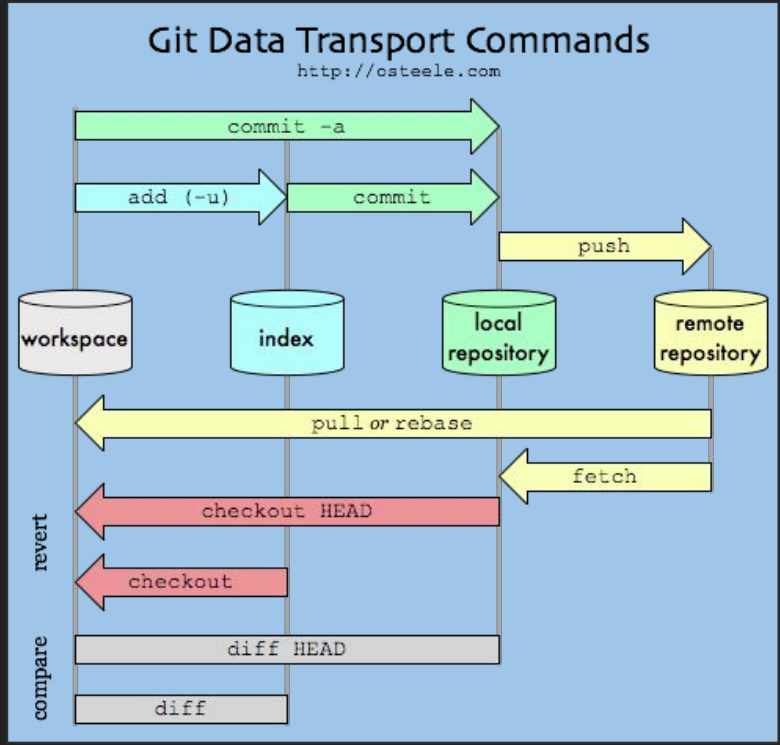
Git is the interface and **GitHub is the storage**

Git != Google Drive

(Git doesn't sync in real-time)

Why Git?

- Keep files in sync!
  - Among workstations
  - Among teammates
- Backup source code
  - Hard drive crashes
- Distributed collaboration
  - Work remote!
- Manage complex workflows
  - Bug fixes, new features, release cycles, and more!



It’s great for code!

Who Uses Git?

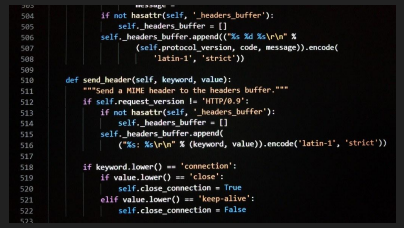
- Industry leaders in software!
  - Amazon, Microsoft, Facebook, Netflix, Twitter, Linux, Android, Eclipse, Starbucks, Google, Hashicorp, eBay…
- Open source developers!
  - Tens of millions of users on GitHub, GitLab, BitBucket, SourceHut, and others
  - Hosted on GitHub: NodeJS, Kubernetes, React, Bootstrap, OpenCV, and many other major software projects!
- Your classmates!
  - Some professors (like Prof. Pisan) structure programming assignments in GitHub Classroom
  - Many other students use it on their own or for group projects

Usage

How to use git

How Local Usage Works - Overview

Step 1 - Code



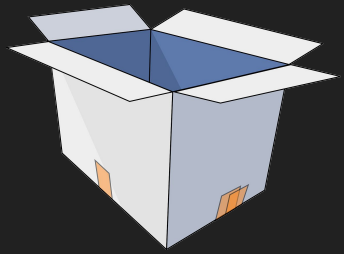
```
            if not hasattr(self, '_headers_buffer'):
                self._headers_buffer = []
            self._headers_buffer.append(("%s %d %s\r\n" %
                    (self.protocol_version, code, message)).encode(
                        'latin-1', 'strict'))

    def send_header(self, keyword, value):
        """Send a MIME header to the headers buffer."""
        if self.request_version != 'HTTP/0.9':
            if not hasattr(self, '_headers_buffer'):
                self._headers_buffer = []
            self._headers_buffer.append(
                ("%s: %s\r\n" % (keyword, value)).encode('latin-1', 'strict'))

        if keyword.lower() == 'connection':
            if value.lower() == 'close':
                self.close_connection = True
            elif value.lower() == 'keep-alive':
                self.close_connection = False
```

Code on your **local computer.**

Step 2 - Stage

Choose which file changes you want to save.

Step 3 - Commit



Save your changes to your code in a commit.

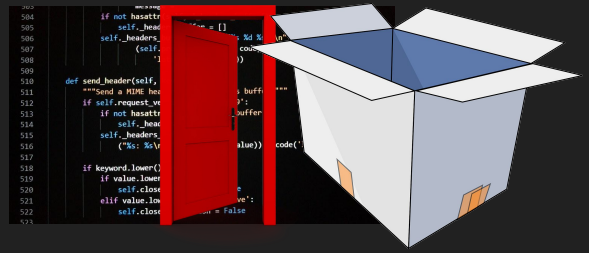
We'll go into more detail later in this workshop

How Remote Syncing Works - Overview

Step 1 - Pull

Download (aka pull) new changes and update your local copy of the repository.

Step 2 - Commit



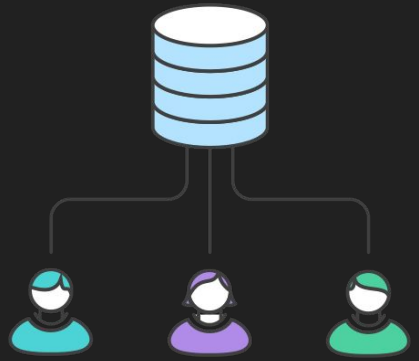
Make changes and **save your changes** in a commit.

Step 3 - Push

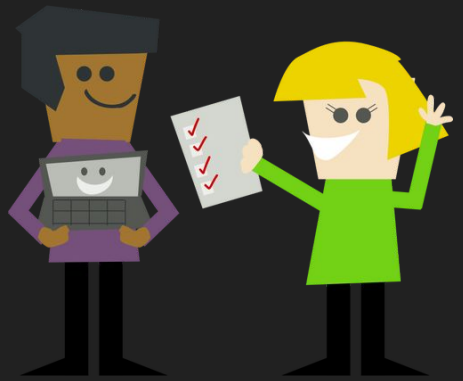
Upload (aka push) your commit(s) to the server.
Now others can view the code with your changes included.

We'll go into more detail later in this session

How Collaboration Works - Overview



Multiple people can collaborate on the same code easily.



Bugs, feature requests, and large projects can be tracked alongside the code.

Collaborators can easily review each other's code to find bugs faster and build better software.

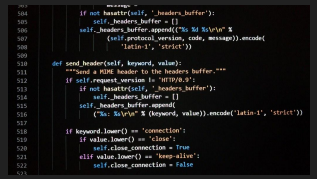
We'll go into more detail in the second session, Git Better (2/28/2020)

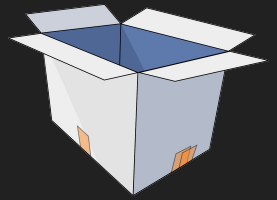
Workshop #1

Create your first commit

Code Commit Upload

Vocabulary: Repo





GitHub

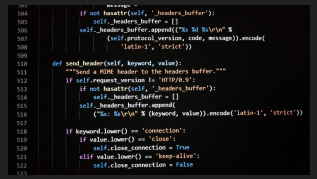
- **Repo / Repository**

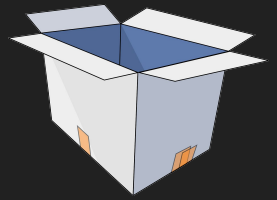
A directory tree which is named `.git`.

The repository contains a representation of the contents of a directory tree, or *project*, on your computer.

Git tracks changes to files in your project, and stores the revision history of the project in the repository folder.

Code Commit Upload





GitHub

Vocabulary: Commit

- **Commit**

A set of changes applied to files which is permanently saved to the repository history.

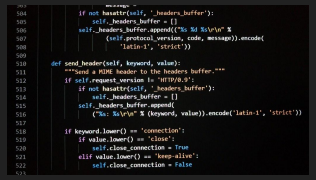
A commit is always linked to one or more *previous commits* (called *parents*), creating a chain of revisions.

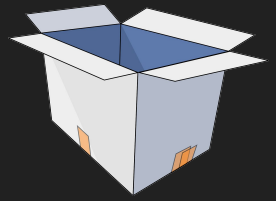
Commits also have authors and messages associated with them, detailing who created the changes and why.

Commits are uniquely identified using a SHA256 hash.

Code Commit Upload

Vocabulary: More Goodies





GitHub

- **Status**

The current state of your repository. It has lots of great information. If (or when) you feel lost, run `git status` to see what's up with your project.

- **Staging**

Staging changes in git ensures those changes will be included in your next commit.

Typically, this is done through the git add command.

The staged changes will be in your ***staging area*** until you commit them or remove them from the staging area.

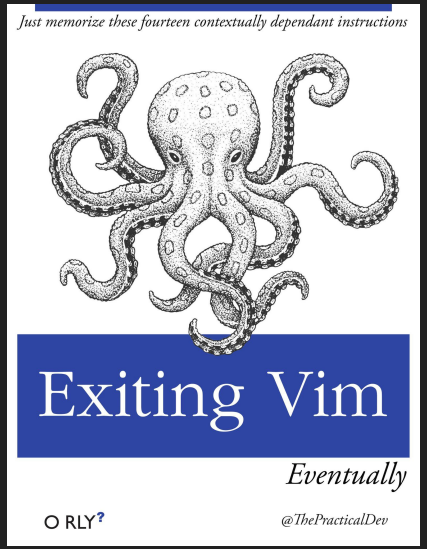
Git Config (First-Time Setup)

Git needs to know your username and e-mail to associate your work with you.

This is the information included in the “author” metadata for commits.

Use the following commands:

```
git config --global user.name “Bobby Tables”

git config --global user.email bobby@tables.com
```



Commands: Creating the Repo

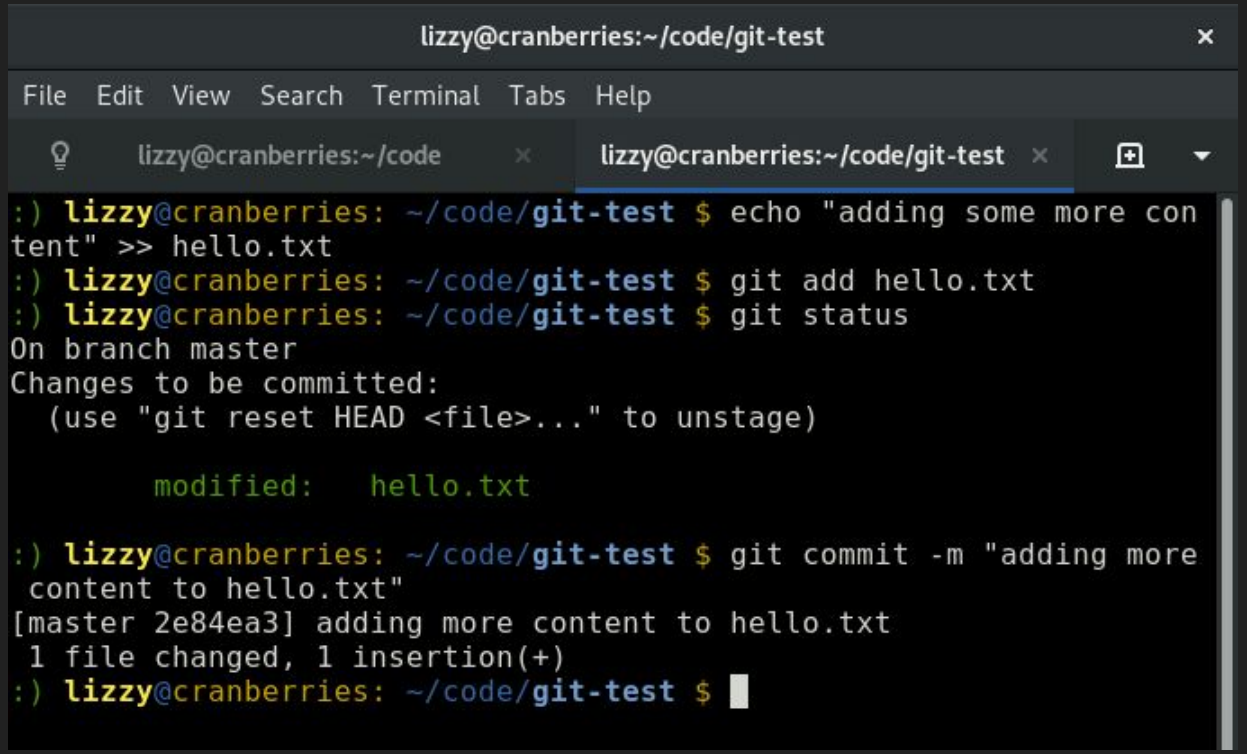
`git init` : Makes the current directory into a Git repository.

```
:) lizzy@cranberries: ~/code $ mkdir git-test
:) lizzy@cranberries: ~/code $ cd git-test/
:) lizzy@cranberries: ~/code/git-test $ git init
Initialized empty Git repository in /home/lizzy/code/git-test/.git/
:) lizzy@cranberries: ~/code/git-test $ git status
On branch master

No commits yet

nothing to commit (create/copy files and use "git add" to track)
:) lizzy@cranberries: ~/code/git-test $
```

Commands: Make changes to repo

`git add [files]`
Adds the specified files to the staging area.

`git commit`
Associates a message with the changes in the staging area, and add these changes to the repo's history.



Workshop 1: Purpose and Outcome

Purpose:

Create a local repository, and commit a file to it.

Outcome:

A local repository with the created file in it.

Workshop #1: Our First Commit

Step	Task	Command
1	Create a local repo	`mkdir git-gud && cd git-gud` `git init`
2	Create new file(s)	`echo “Hi!” >> hello.txt`
3	Check repository status	`git status`
4	Add files to our index	`git add .`
5	Commit changes to local repo	`git commit`

Workshop #1: Example

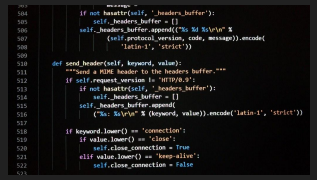
1. Initialize repo
2. Create text file
3. Add file to index (staging area)
4. Commit file to repo

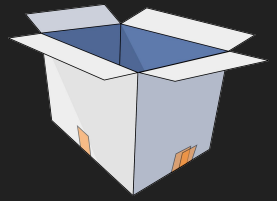
```
:~/ACM/test$ git init
pacekatt/ACM/test/.git/
:~/ACM/test$ echo "Hello, World!" >> hello.txt
:~/ACM/test$ git add hello.txt
:~/ACM/test$ git commit -m "Add hello world doc"
rld doc


:~/ACM/test$
```

Workshop #2

Commit & Push to Remote Repository

Code Commit Upload





GitHub

Vocabulary

- **Remote**

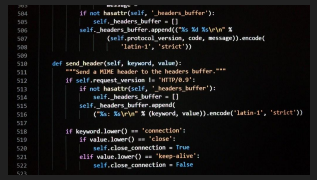
The repository's remote points to a remote storage endpoint which contains a copy of the current repository.

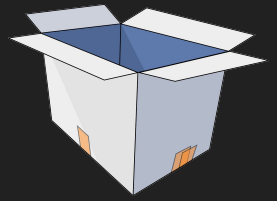
The remote has a name; a common convention is to call the remote `origin`.

- **Clone**

Create a local copy of an existing remote repository. Cloning a repo retrieves the full filesystem and commit history for that repository.

Code Commit Upload





GitHub

Vocabulary

- **Push**

Sync local changes to the repository by uploading local commits to remote storage (GitHub, GitLab, BitBucket, SourceHut, private servers, etc.).

- **Pull**

Retrieve changes from repository by downloading commits from remote storage.

Note: you can only run push & pull when you have a remote identified in your repository.

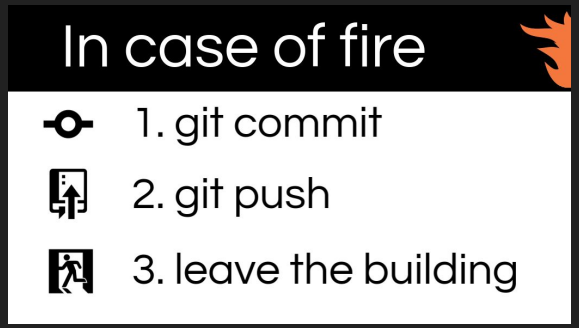
Commands: Syncing with remote repo

`git remote -v` : get information about remote repositories associated with the local repository

`git remote add <nickname> <URL>` : associates a local repository with a remotely hosted repository (GitHub, GitLab, etc)

`git push <nickname> <branch>` : Uploads changes.

`git pull <nickname> <branch>` : Downloads changes.




```
:) lizzy@cranberries: ~/code/git-test $ git remote -v
:) lizzy@cranberries: ~/code/git-test $ git remote add origin https://github.com/etcadinfinitum/musical-carnival.git
:) lizzy@cranberries: ~/code/git-test $ git remote -v
origin  https://github.com/etcadinfinitum/musical-carnival.git (fetch)
origin  https://github.com/etcadinfinitum/musical-carnival.git (push)
:) lizzy@cranberries: ~/code/git-test $ git push origin master
Username for 'https://github.com': etcadinfinitum
Password for 'https://etcadinfinitum@github.com':
Enumerating objects: 6, done.
```

Workshop #2: Syncing to remote (GitHub)

Step	Task	Command
1	Follow instructions in open issue, then clone this repo to your machine	`git clone https://github.com/UWB-ACM/Git-Gud-Spring2020`

2	Create and commit a new file named <github-username>.txt	`cd Git-Gud-Spring2020`
		`touch <username>.txt`
		`git add <username>.txt && git commit`

3	Sync local changes to remote	`git push origin master`

Uh Oh!

Help! I got a scary error message!

```
:) lizzy@cranberries: ~/code/git-gud $ git remote -v
origin  https://github.com/UWB-ACM/git-gud (fetch)
origin  https://github.com/UWB-ACM/git-gud (push)
:) lizzy@cranberries: ~/code/git-gud $ git log
commit e0523d7bf469aef7adaba2fca33b6f065aeab78b (HEAD -> master)
Author: etcadinfinitum <lizzy.presland@gmail.com>
Date:   Tue Feb 18 17:20:22 2020 -0800

    Add hello.txt
:) lizzy@cranberries: ~/code/git-gud $ git push origin master
Username for 'https://github.com': etcadinfinitum
Password for 'https://etcadinfinitum@github.com':
To https://github.com/UWB-ACM/git-gud
 ! [rejected]        master -> master (fetch first)
error: failed to push some refs to 'https://github.com/UWB-ACM/git-gud'
hint: Updates were rejected because the remote contains work that you do
hint: not have locally. This is usually caused by another repository pushing
hint: to the same ref. You may want to first integrate the remote changes
hint: (e.g., 'git pull ...') before pushing again.
hint: See the 'Note about fast-forwards' in 'git push --help' for details.
:( lizzy@cranberries: ~/code/git-gud $
```

You may have accidentally **created a commit in the remote repository.** (README, license, .gitignore…)

The **remote repo** has commits that your **local repo** doesn't have -- they are out of sync!

Don't worry -- this is easy to fix!

Uh Oh! [RESOLVED]

We can fix this very easily!

We need to **update our local repository** with the changes we don't have. To do this, run: `git pull --rebase origin master`

```
:) lizzy@cranberries: ~/code/git-gud $ git pull --rebase origin master
warning: no common commits
remote: Enumerating objects: 8, done.
remote: Counting objects: 100% (8/8), done.
remote: Compressing objects: 100% (8/8), done.
remote: Total 8 (delta 0), reused 3 (delta 0), pack-reused 0
Unpacking objects: 100% (8/8), done.
From https://github.com/UWB-ACM/git-gud
 * branch            master     -> FETCH_HEAD
 * [new branch]      master     -> origin/master
First, rewinding head to replay your work on top of it...
Applying: Add hello.txt
```

Then, **try pushing your changes again**.

Note: More on this in Workshop 3

Refresh Repo Page on GitHub

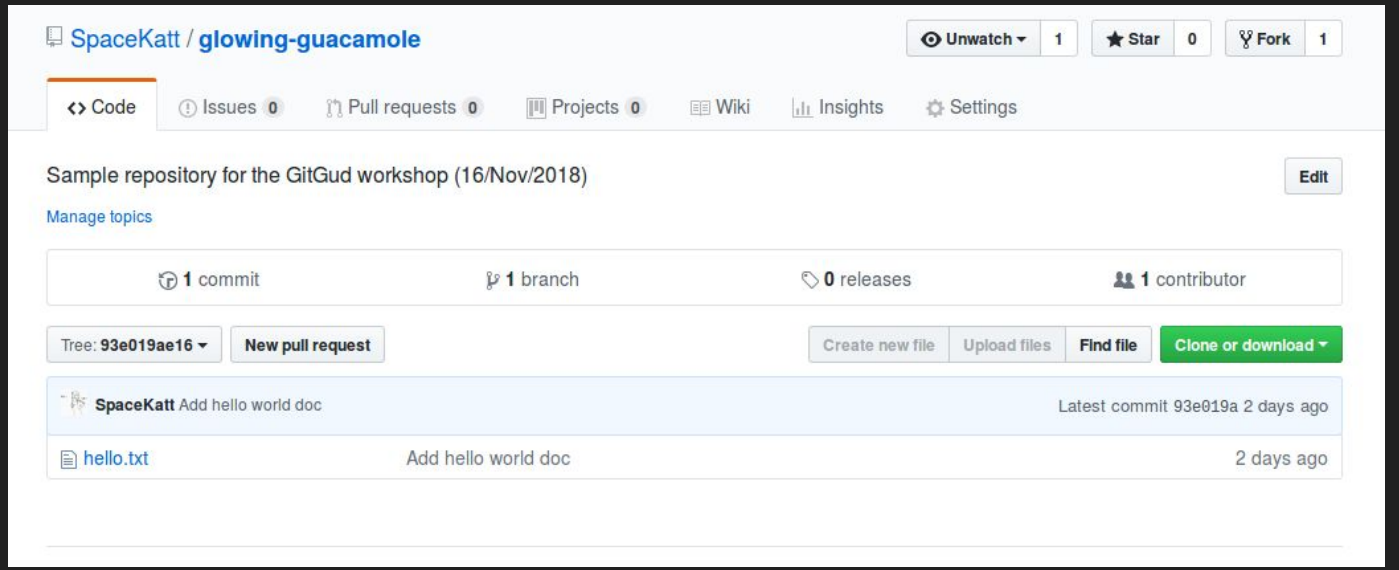
We now see the file we pushed to our remote, `origin`

Exciting!

Much open source!

wowe

Heckin' `origin`



Best Practices

Git Gud, Git Gr8, m8

Writing Good Commit Messages

Qualities of a good commit message:

- Use the imperative mood
  - “Add config file”
  - “Fix nginx SSL bug”
- Subject is clear and descriptive, while under 50 characters in length.
- Body adds detail and explanations
- **Avoid using `git commit -m`**
  (do as I say, not as I do)

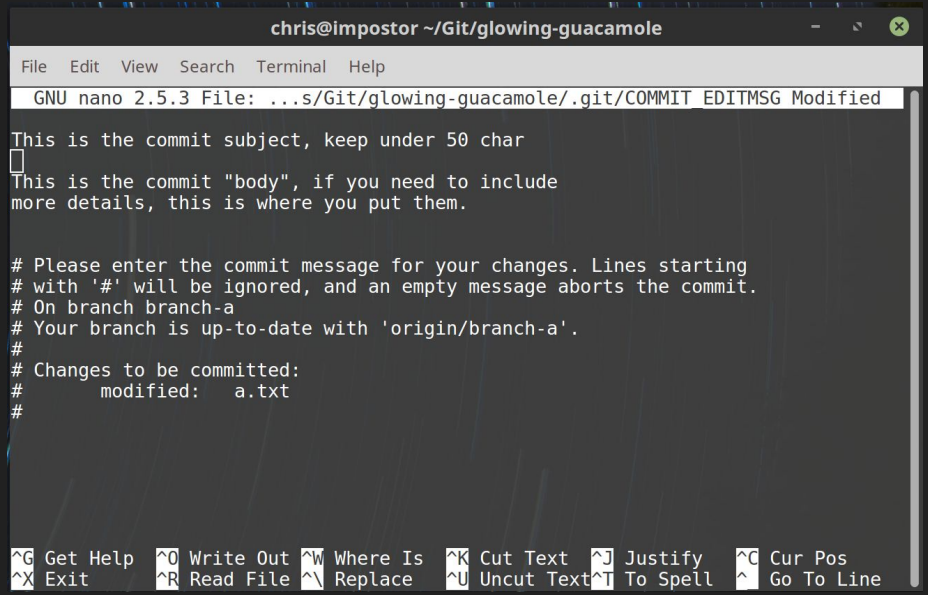
Further reading:

https://chris.beams.io/posts/git-commit/

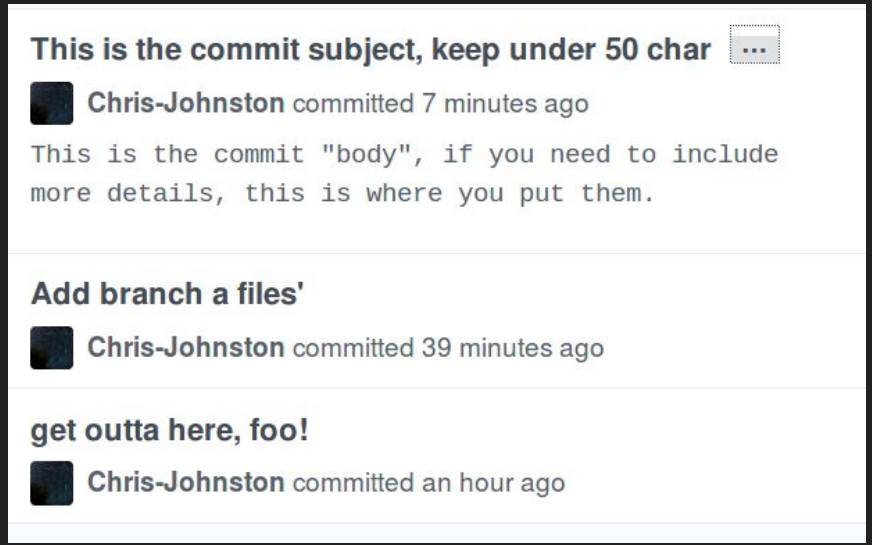
https://help.github.com/articles/closing-issues-using-keywords/

Commit Message Example

What you will see:



How others will see your message in GitHub:



Viewing the log

View previous commit messages with...

```
git log
```

Benefits of a well-kept log...

- Workflow transparency
- Process traceability
- Bug tracking
- Smaller commits
- Easier merging

```
commit 3199695f77bdb35fd9d510208b8ee95f04e7f3a3
Author: Thomas Kercheval <spacekattpoispin@gmail.com>
Date:   Thu Nov 8 18:56:23 2018 -0800

    Update HTML style

commit 08fa02f8155d73dedbec152e05e3640b5632e408
Author: Thomas Kercheval <spacekattpoispin@gmail.com>
Date:   Thu Nov 8 16:49:47 2018 -0800

    Fix bug where service starts before loading profile

    Since AWS credentials are provisioned at deployment, I believe
    the gunicorn service was being started by systemd before the
    credential files existed, causing an error (sometimes). Restarting
    the service after Terraform provisions everything seems to fix it.

commit b0299d535f0b1013c399a9ecaee75e7f21d722ef
Author: Thomas Kercheval <spacekattpoispin@gmail.com>
Date:   Thu Nov 8 13:08:49 2018 -0800

    Add alert message to user for empty input

commit ece5c4048e93913ef26d5cf0a324124190a6297f
Author: Thomas Kercheval <spacekattpoispin@gmail.com>
Date:   Thu Nov 8 12:56:30 2018 -0800

    Handle ommisions in query field

commit 29011a7ab3923bfa5d07ddd1bcf8dcf77ecfd172
Author: Thomas Kercheval <spacekattpoispin@gmail.com>
Date:   Thu Nov 8 12:34:01 2018 -0800

    Add all attributes to table

commit ac282eaac3871148bb52e7bbbd87dc2f001254fa
Author: Thomas Kercheval <spacekattpoispin@gmail.com>
Date:   Thu Nov 8 11:45:08 2018 -0800

    Add simple HTML table in React
```

Workshop #3

Handling Merge Conflicts

What is a merge conflict?

Imagine 2 people are working on the same file.

Each person has their own copy of the file, and they make changes.

What happens when the **two people change the same line of code**?

Who's **code do we decide to keep**?

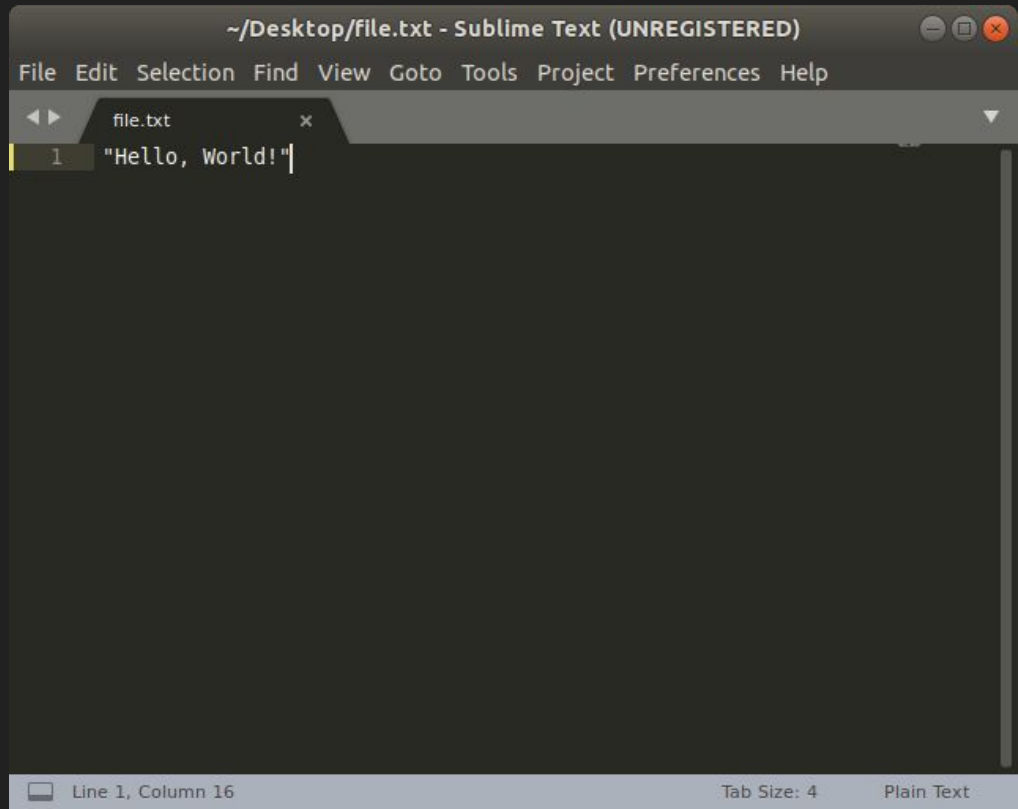
Merge conflicts happen when **multiple people edit** the **same line** in the **same file**.

Merge Conflicts: Example

Let's say we have a file called `file.txt`

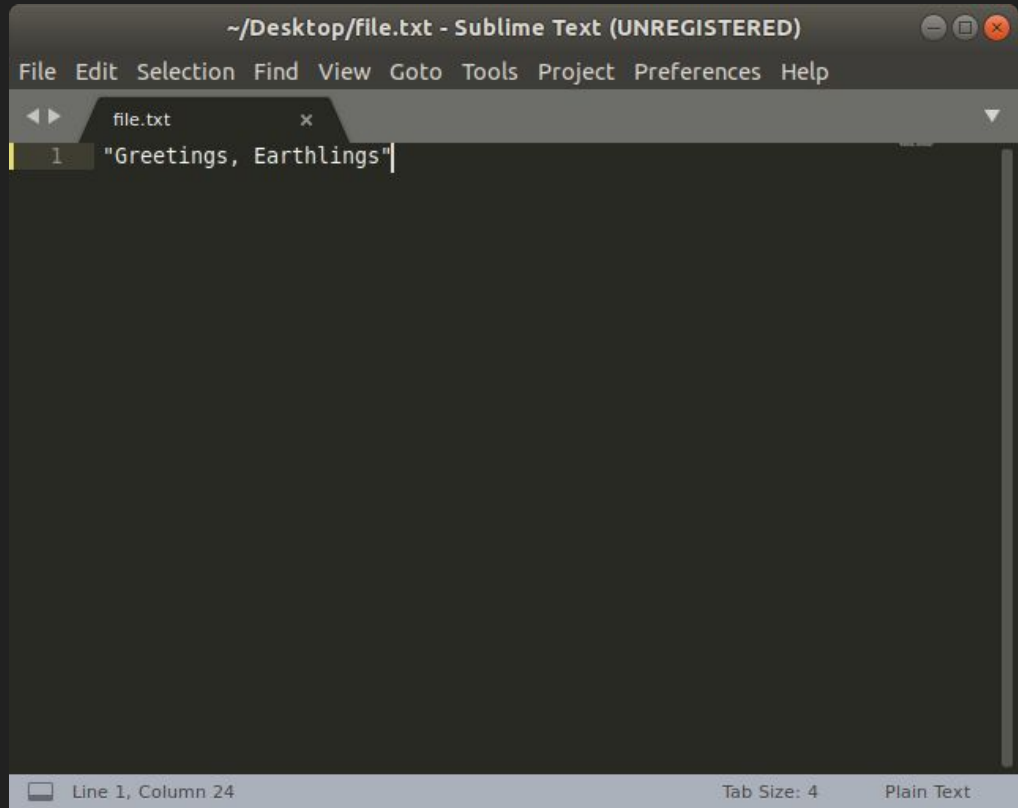
Johnny changes **line 1** to say "Hello, World!"

He then pushes the changes to the repository.



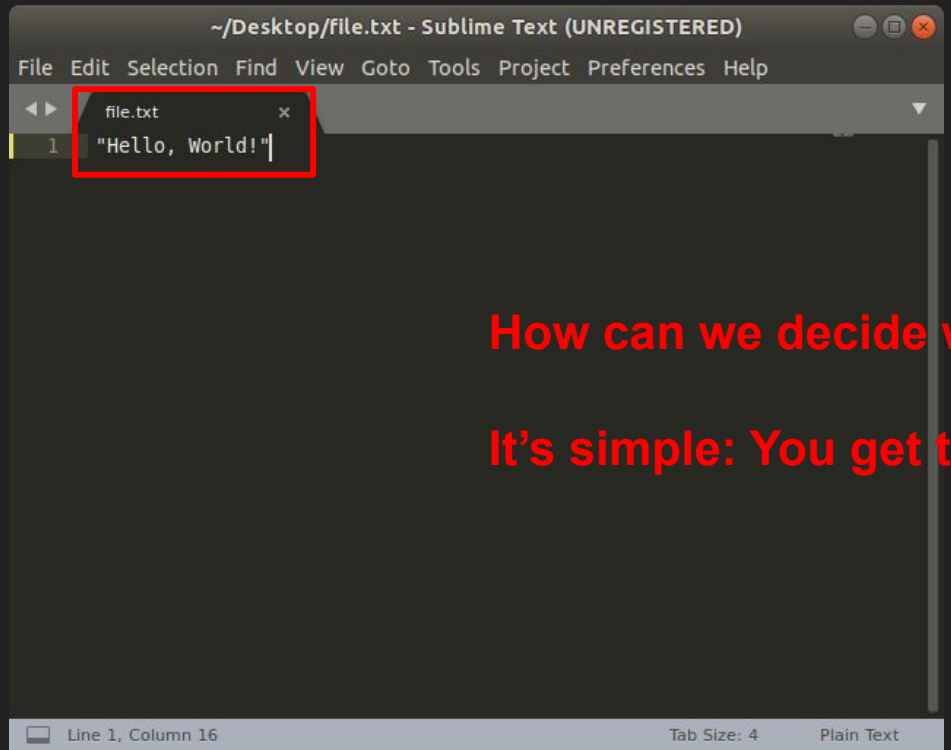
Merge Conflicts: Example

Without first pulling the file, Sally changes **line 1** to say “Greetings, Earthlings”

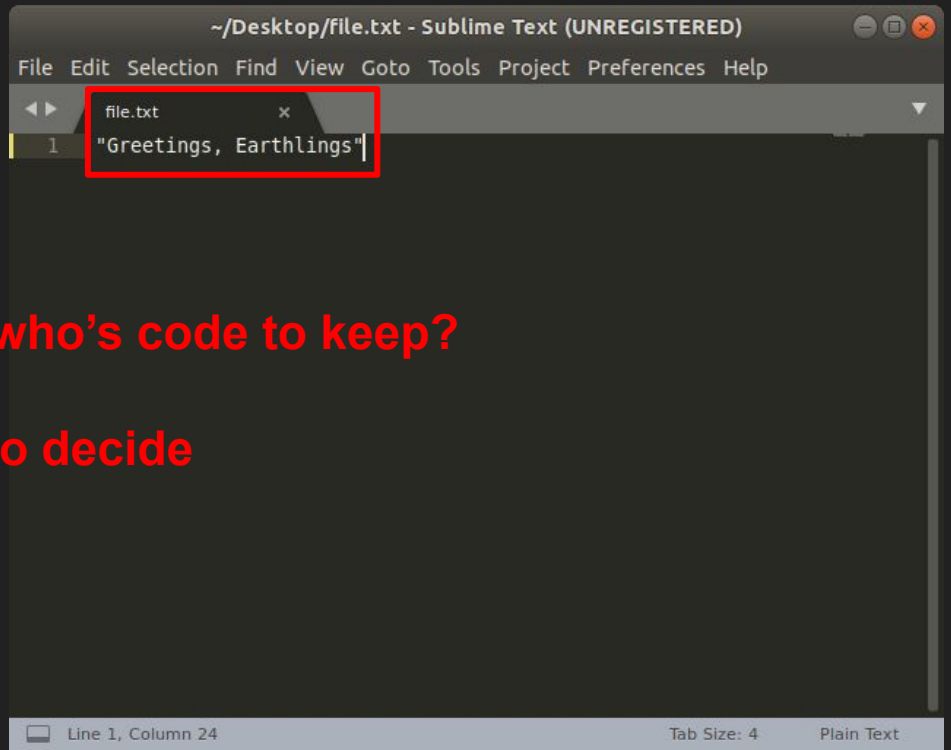


Merge Conflicts: Example

`file.txt` in the Remote Repo



`file.txt` in Sally's Repo



How can we decide who's code to keep?

It's simple: You get to decide

Workshop 3: Merge Conflict Exercise

In the cloned repo for https://github.com/UWB-ACM/Git-Gud-Spring2020, add a new line at the end of the README.md file.

It can say anything you like, but we recommend adding a joke ;)

You will see a message like this when you do **`git push`**

```
ryan@ryan-Inspiron-7573:~/Coding/Testing$ git push
To github.com:RyanRussell00/Testing.git
 ! [rejected]        master -> master (fetch first)
error: failed to push some refs to 'git@github.com:RyanRussell00/Testing.git'
hint: Updates were rejected because the remote contains work that you do
hint: not have locally. This is usually caused by another repository pushing
hint: to the same ref. You may want to first integrate the remote changes
hint: (e.g., 'git pull ...') before pushing again.
hint: See the 'Note about fast-forwards' in 'git push --help' for details.
ryan@ryan-Inspiron-7573:~/Coding/Testing$
```

Run `git pull` and read the output

There should be a message like this:

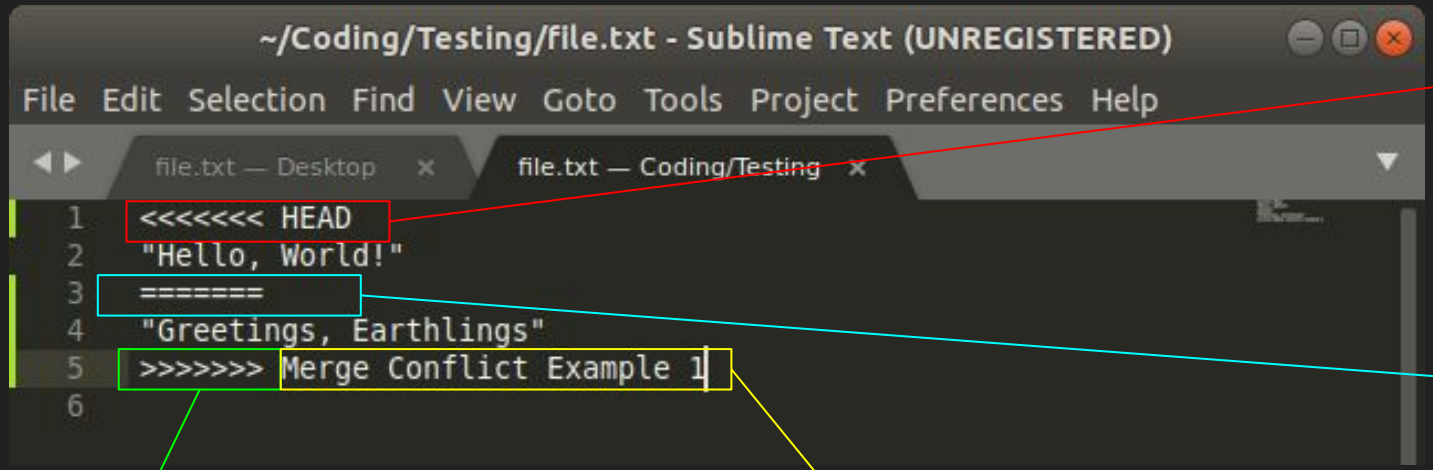
```
First, rewinding head to replay your work on top of it...
Applying: Merge Conflict Example 1
Using index info to reconstruct a base tree...
Falling back to patching base and 3-way merge...
Auto-merging file.txt
CONFLICT (add/add): Merge conflict in file.txt
error: Failed to merge in the changes.
Patch failed at 0001 Merge Conflict Example 1
Use 'git am --show-current-patch' to see the failed patch
```

Conflicted File

Line Number of Conflict

Reading the Merge Conflict

This is what your file looks like when you have a merge conflict:



Start of **incoming** changes

End of incoming changes AND **Start of current** changes

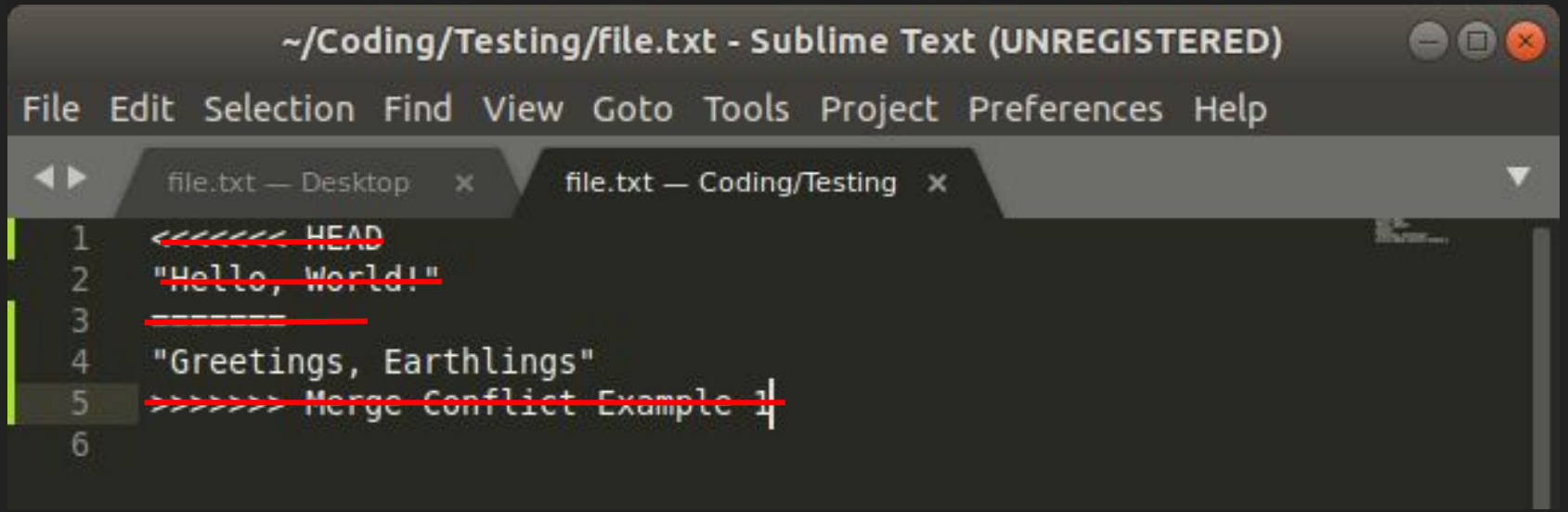
End of **current** changes

Commit message of the commit causing the conflict

Solving the Merge Conflict

Let's say we want our **current** changes to **override** the **remote** changes.

Quick & Easy Solution: Delete the code that you don't want!
Make sure to delete the <<HEAD, ==, >>>, and Commit Message



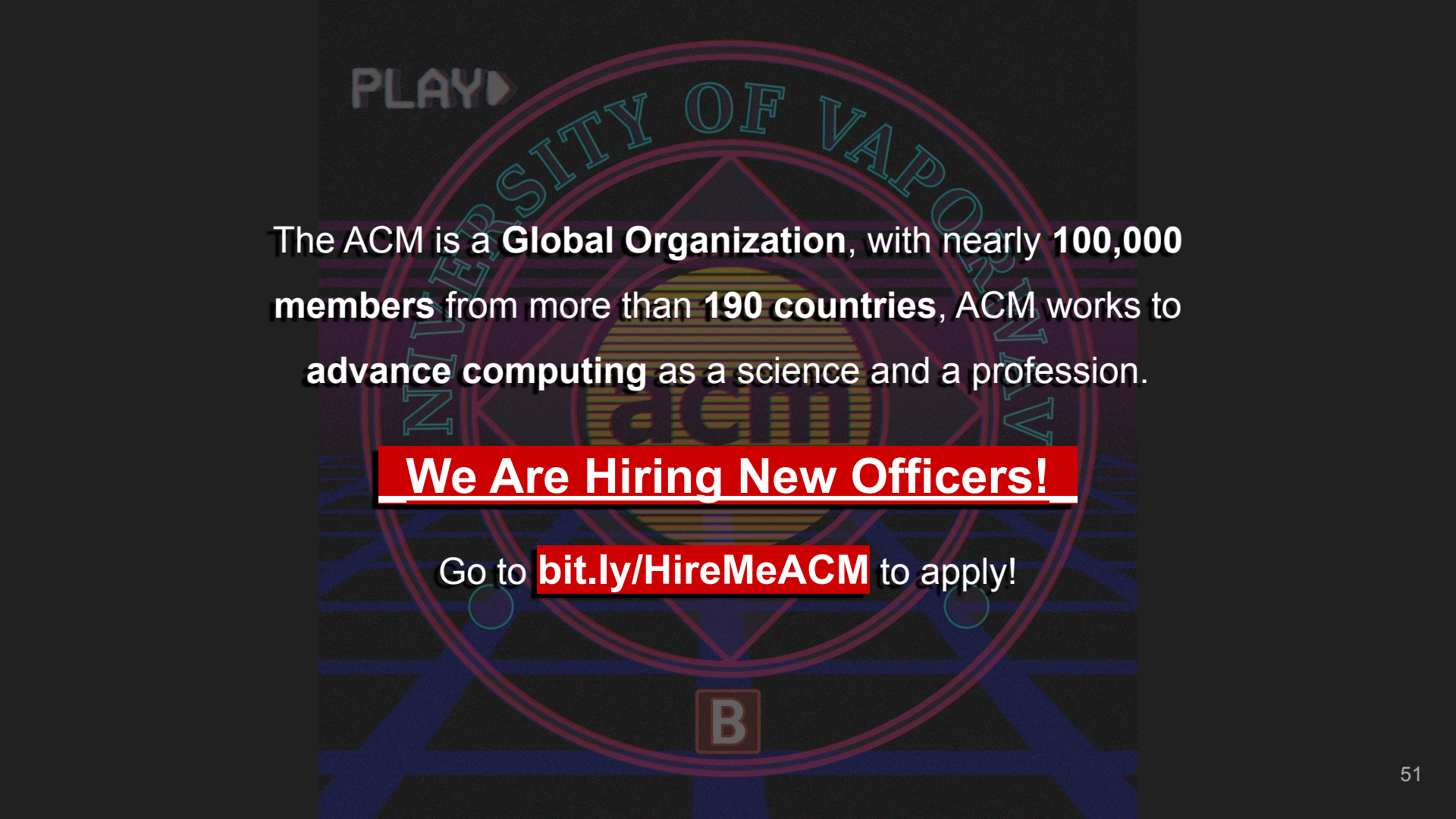
Finish up!

```
git push origin master
```

Note: you may have to resolve a conflict many times, because each time one of you pushes your changes successfully, it could create a conflict with someone who hasn’t pushed yet!

Lessons Learned

- Why git is important
- How to make a commit
- How to push local repository to remote (GitHub)
- How to manage files with git
- How to contribute to open source projects
- **Git is fun!**



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Questions? Comments? Concerns?

Join us next week for advanced topics on git usage!

Slides available at bit.ly/ACMGitGud

Day 2: Our mission: build the **Enterprise Calculator v1.0**

We are the development team for **UWB ACM Incorporated**. Our company has just bought a startup: FancyCal. Our management has asked this team to use this as a starting point to create our new flagship product: The Enterprise Calculator.