CS 50:
Software Design and Implementation

Git and GitHub

Agenda

1. Git vs GitHub
2. Working with a repo
3. Branches
4. Activity

Git is a local Version Control System (VCS)

Person 1

Git is a version control system

- **Runs on your laptop**
- **Keeps local copy of code**
- **Can edit while offline**
- **Change history tracked in local database (.git directory)**

Multiple people working on the same project can run Git at the same time

Person 1 **Person 2** **Person n**

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Multiple people can run Git

- **Each person keeps a local copy of code on their computer**
- **Can edit code locally**
- **Each has history of all changes**

Github is a cloud-based data repository

GitHub is an online repository
- **Stores code**
- **Can sync to local computers**
- **There are others (bitbucket)**

Person 1

Person 2

...

Person n

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Changes made locally are pushed to GitHub

"Push" changes made locally to remote repository

GitHub

GitHub is an online repository
- Stores code
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Other team members can pull the changes from GitHub to stay in sync

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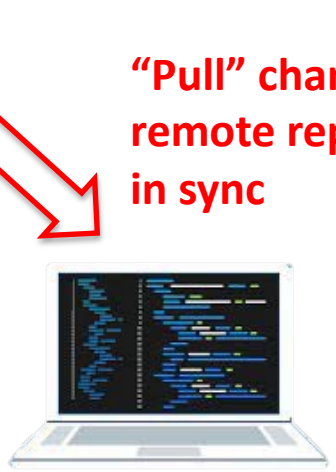
"Push" changes made locally to remote repository

"Pull" changes from remote repository to stay in sync

...



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"Push" changes made locally to remote repository

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"Pull" changes from remote repository to stay in sync

All local databases reflect changes, even if changes made by someone else

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Multiple people can run Git
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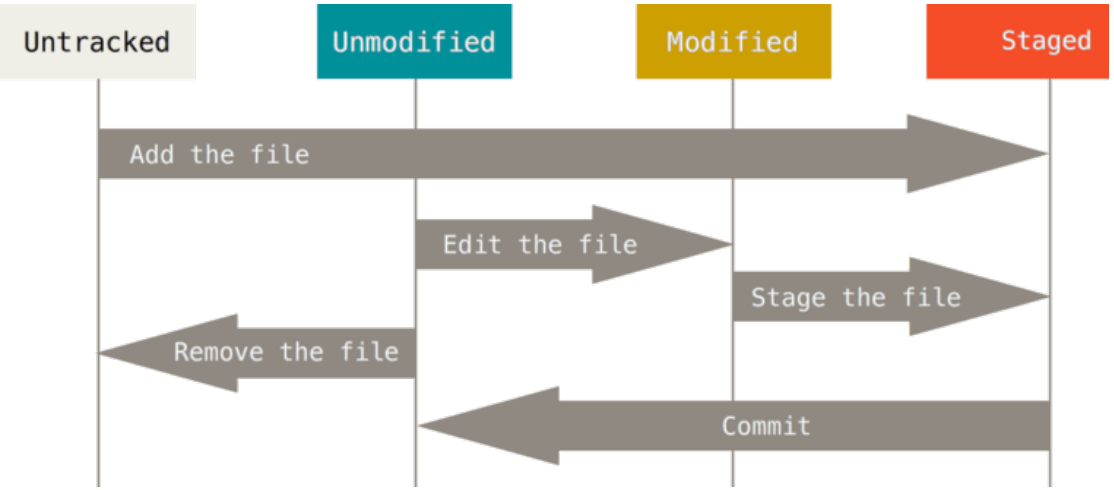
Files in Git can be one of several states; initially they are untracked

Git on your laptop

Files are not tracked by Git unless you tell it to track them

GitHub



Add/Delete/Modify files in local working directory

Adapted from https://git-scm.com/book/en/v2/Getting-Started-What-is-Git%3F

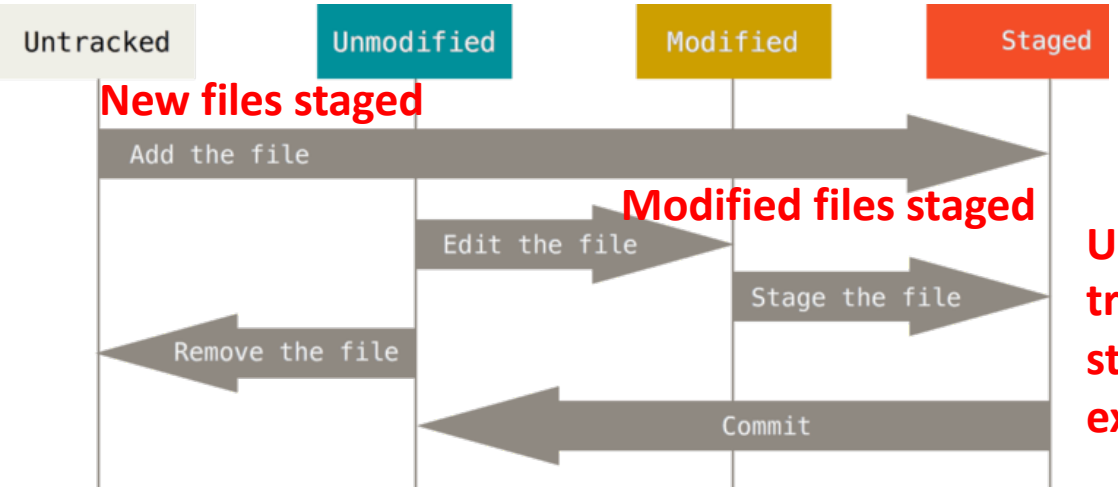
Use `git add` to tell Git to track new files or to stage changes to existing files

Git on your laptop

Example:

`git add README.md`

README is now *staged* to be committed



Use `git add` to track new files or stage modified existing files

Add/Delete/Modify files in local working directory ▷ **Stage updates to go into next commit**

Adapted from https://git-scm.com/book/en/v2/Getting-Started-What-is-Git%3F

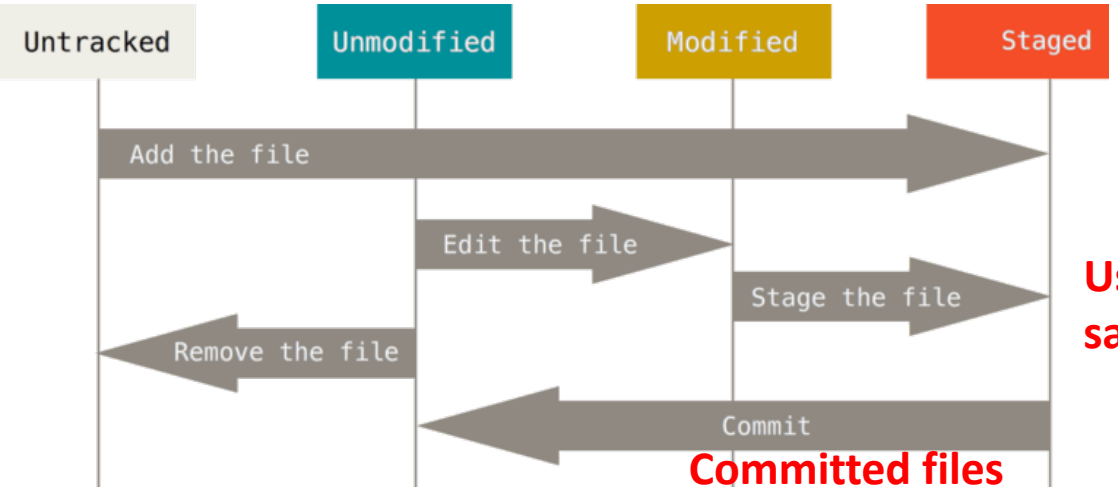
Use `git commit` to take a snapshot of the code in your local database

Git on your laptop

Example:

`git commit –m "message"`

Git takes a snapshot of the added files, stores in local database



Use `git commit` to save snapshot

Committed files revert to unmodified

Add/Delete/Modify files in local working directory ▷ **Stage updates to go into next commit** ▷ **Commit staged changes to local git database (.git/)**

Adapted from https://git-scm.com/book/en/v2/Getting-Started-What-is-Git%3F

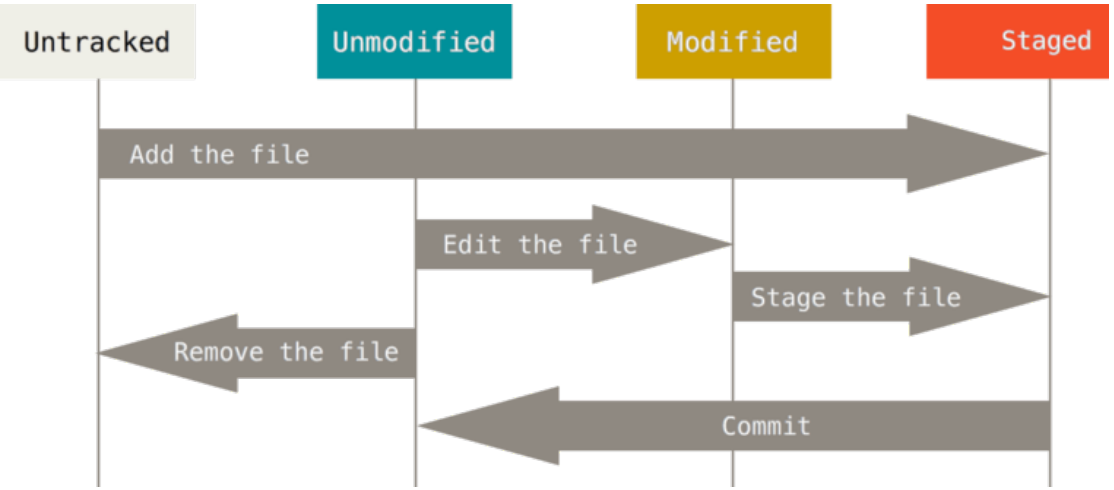
Use `git commit` to take a snapshot of the code in your local database

Git on your laptop

Example:

`git push –u origin main`

Send changes to remote



After completing milestones, push code to Github repository in the cloud

Add/Delete/Modify files in local working directory → **Stage updates to go into next commit** → **Commit staged changes to local git database (.git/)**

Adapted from https://git-scm.com/book/en/v2/Getting-Started-What-is-Git%3F

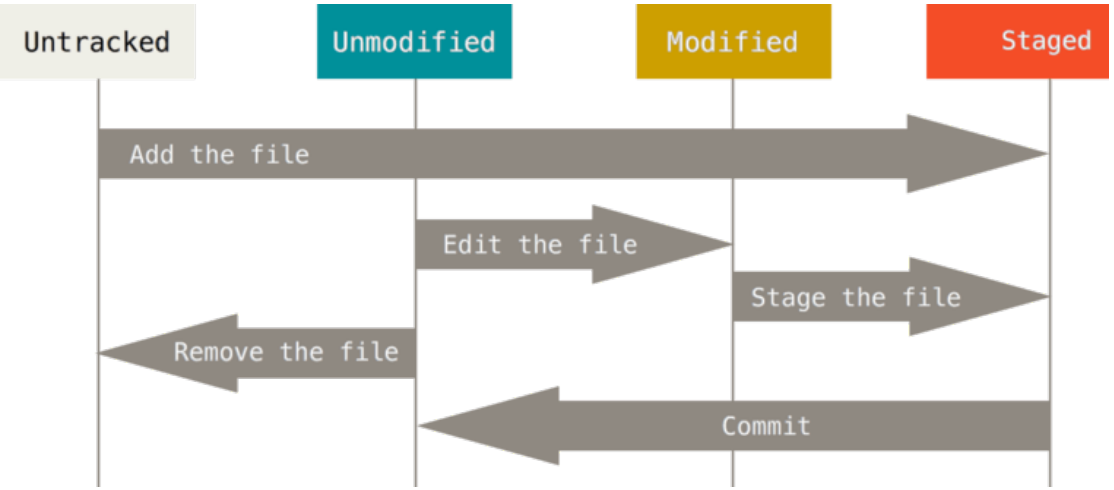
Use `git commit` to take a snapshot of the code in your local database

Git on your laptop

Example:

`git pull`

Update local code with remote repo



After completing milestones, `push` code to Github repository in the cloud

Other team members can now `pull` your changes and stay in sync

Add/Delete/Modify files in local working directory → **Stage updates to go into next commit** → **Commit staged changes to local git database (.git/)**

DO NOT edit files directly in GitHub web interface, use push and pull!

Adapted from https://git-scm.com/book/en/v2/Getting-Started-What-is-Git%3F

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Starting a new project with Git begins with `git init` in the working directory

Make a directory for a project and change into it

```
$ cd ~/cs50/activities/day13
$ mkdir demo1
$ cd demo1
$ git init
Initialized empty Git repository in
/thayerfs/home/d84xxxx/cs50/activities/day13/demo1/.git/
$ ls -a
./ ../ .git/
```

Initialize Git in directory
Git creates subdirectory called `.git`

`.git` directory holds git preferences for this project and database of changes to files

Currently no files are tracked by Git

Git only tracks files we tell it to track

Use `git clone <repo URL>` to begin with existing code already on GitHub

Files added to the working directory are not tracked unless we tell Git to track them

```
$ cd ~/cs50/activities/day13
$ mkdir demo1
$ cd demo1
$ git init
Initialized empty Git repository in
/thayerfs/home/d84xxxx/cs50/activities/day13/demo1/.git/
$ ls -a
./ ../ .git/
$ vi README.md
```

Add a README.md file

Not tracked unless we Git to track it

`git status` gives the current state of the working directory

```
$ git status
On branch main


No commits yet


Untracked files:
  (use "git add <file>..." to include in what will be
committed)
README.md


nothing added to commit but untracked files present (use
"git add" to track)
```

Git knows README.md exists, but is not tracking it

Use `git add` to track files to tell Git which files to track

Tell Git to track README.md

To track all files, use `git add .`

(Well not quite all files, .gitignore is discussed shortly)

```
$ git add README.md
$ git status
On branch main


No commits yet


Changes to be committed:
  (use "git rm --cached <file>..." to unstage)
new file:   README.md
```

Check status again

README.md is now *staged* to be saved in next commit (snapshot)

Not saved to history yet!

Use `git commit` to save a snapshot of the code in the local history

Commit writes change to *local* database
Can think of this like taking a snapshot
-m flag provides short message about changes made

```
$ git commit -m "Initial commit"
[main (root-commit) 2aec1ce] Initial commit
 1 file changed, 2 insertions(+)
 create mode 100644 README.md
$ git status
On branch main
nothing to commit, working tree clean
```

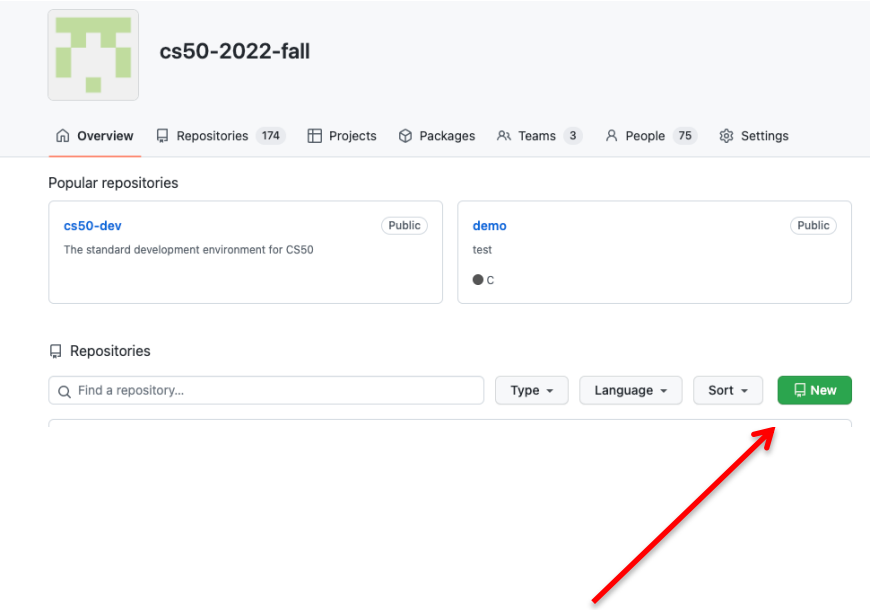
Version are identified by a SHA-1 hash of files

After commit, snapshot is taken

Git is up to date

Files are still only on local machine, but not yet pushed to online repo (Github)

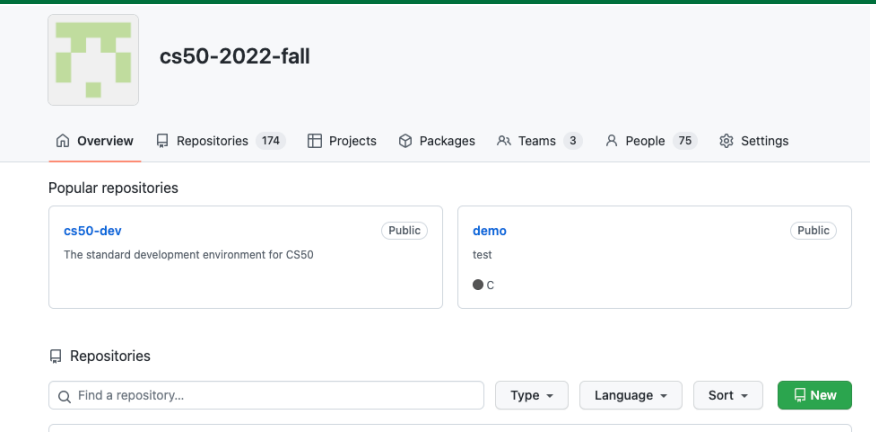
Create a repo on GitHub via web interface

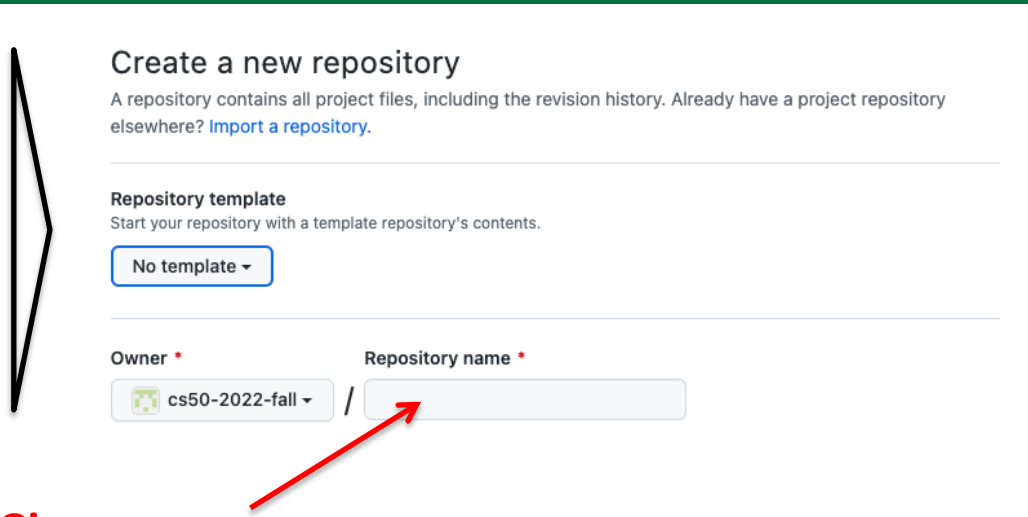


Log into GitHub

Click New to create a new repo

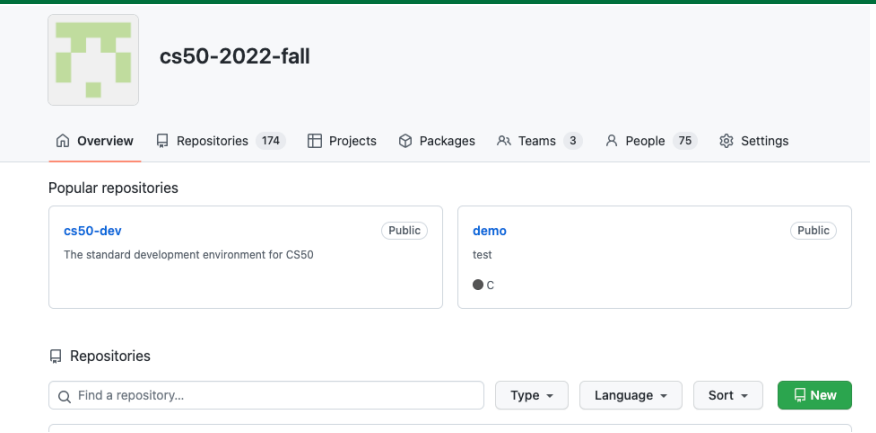
Create a repo on GitHub via web interface

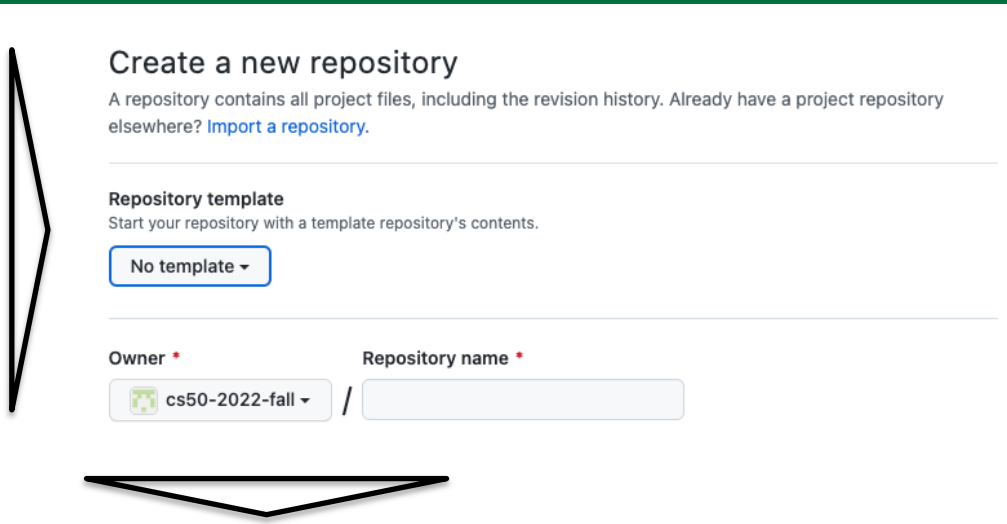




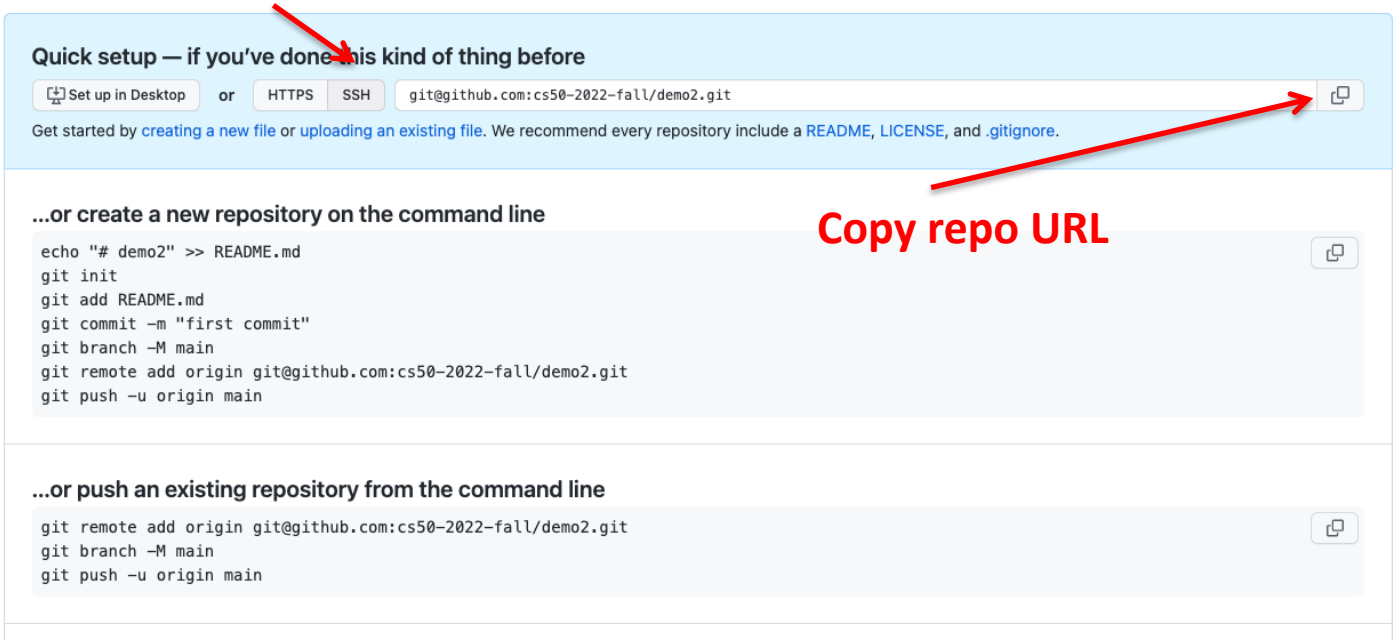
Give repo a name

Create a repo on GitHub via web interface





Make sure SSH is selected



Copy repo URL

Add the repo and push your code to that repo

Currently not configured with a remote

```
$ git remote -v
$ git remote add origin git@github.com:cs50-2022-fall/demo1.git
$ git push -u origin main
Enumerating objects: 3, done.
Counting objects: 100% (3/3), done.
Writing objects: 100% (3/3), 253 bytes | 19.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
To github.com:cs50-2022-fall/demo1.git
 * [new branch]      main -> main
Branch 'main' set up to track remote branch 'main' from
'origin'.
```

Add remote called origin with repo URL

Push code to GitHub repo

Summary

Init

Edit file -> Add file -> Commit -> Push -> Repeat

Others can clone the code from GitHub

On MacBook, not plank

Clone repo using repo URL

```
[MacBook]$ git clone git@github.com:cs50-2022-fall/demo1.git
Cloning into 'demo1'...
remote: Enumerating objects: 3, done.
remote: Counting objects: 100% (3/3), done.
remote: Total 3 (delta 0), reused 3 (delta 0), pack-reused 0
Receiving objects: 100% (3/3), done.
[MacBook]$ ls
demo1/
[MacBook]$ cd demo1
[MacBook]$ ls
README.md
```

Files clone to local machine

We normally include a .gitignore file so we don’t push unnecessary files to the remote

```
$ vi $loc/activities/day13/.gitignore  #standard CS50 .gitignore
```

```
<snip>

# Object files and libraries
*.o
*.a
a.out
<snip>
```

.gitignore file tells Git not to track files that do not need to be tracked (normally because they can be easily recreated like *.o or executables)

```
$ cp $loc/activities/day13/.gitignore .
$ git status
On branch main
Your branch is up to date with 'origin/main’.

Untracked files:
  (use "git add <file>..." to include in what will be committed)
.gitignore

nothing added to commit but untracked files present (use "git add" to track)
$ git add .gitignore
$ git commit -m "added gitignore"
[main cc9defd] added gitignore
 1 file changed, 38 insertions(+)
 create mode 100644 .gitignore
$ git push
Enumerating objects: 4, done.
Counting objects: 100% (4/4), done.
Delta compression using up to 40 threads
Compressing objects: 100% (3/3), done.
Writing objects: 100% (3/3), 715 bytes | 65.00 KiB/s, done.
Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
To github.com:cs50-2022-fall/demo1.git
   2aec1ce..cc9defd  main -> main
```

Copy .gitignore into Git directory, add, commit, and push

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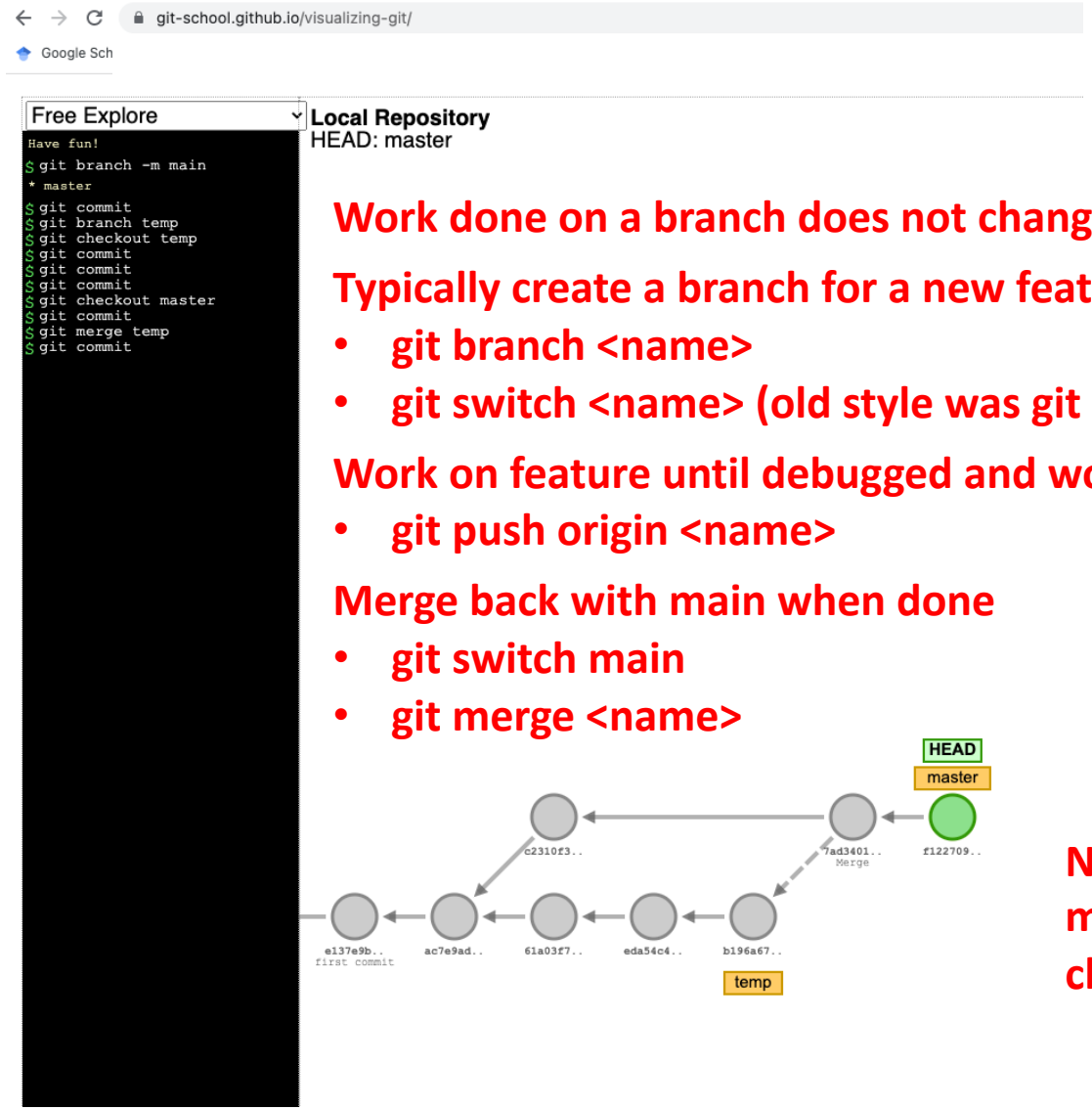
Branches allow you to work on a branch without changing other branches



Work done on a branch does not change other branches

Typically create a branch for a new feature and switch to that branch

- **git branch <name>**
- **git switch <name> (old style was git checkout <name>)**

Work on feature until debugged and working

- **git push origin <name>**

Merge back with main when done

- **git switch main**
- **git merge <name>**

NOTE: This site uses the old master branch and uses checkout instead of switch

https://git-school.github.io/visualizing-git/

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