

# Git

A mini-lecture series

CSE498 Collaborative Design (W) - Secure and Efficient C++ Software Development

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# Git, the version manager

- Keeps track of code (file in general) changes
- Collaborate with other when working on the same files
- Allows you to branch off and work on a different part of the project, remerge with main once you are ready.
- Committing is essentially “saving” a state of your repository, allowing you to revert back to this point

# 3 Main “places” where code lives

- Local Disk (working directory)
- Staging area
- Remote repository

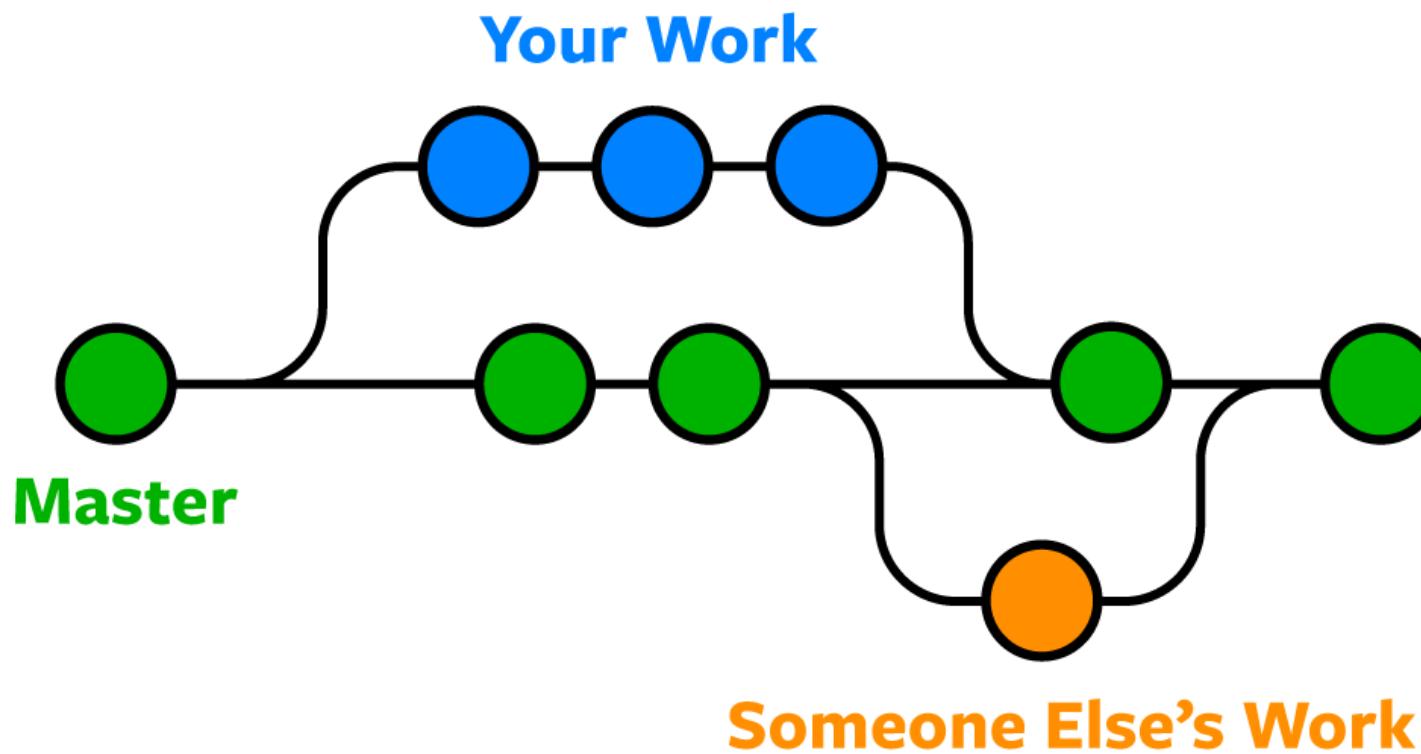
# Cloning a repo

- Copies the file from the repository
- Create an empty directory, and use the following command:
  - `Git clone git@github.com:CSE498/Spring2026-CompanyB.git`
  - Should download a templated company github (from remote) into your (local) working directory

# Branching

- Usually, the **Main** repo only contains fully functional code
- **You should never push to main, ever**
  - Seriously, you will get fired
- When you work on a feature, branch off (so that you are not affecting other teams when working)
- Every company might have a different setup, good to check out the branching to see
- Use *gitlog* to check current branching history

# Branching



# Visualisation

- <https://stackoverflow.com/questions/1057564/pretty-git-branch-graphs>

git lg / git lg1 looks like this:

```
* 525a852 - (9 months ago) notification test - German Laullon (refs/remotes/origin/test_on_10.8)
* 58b5a57 - (9 months ago) morden Objective-c - German Laullon
* aef1d39 - (9 months ago) first build. - German Laullon
* bfff6661 - (9 months ago) Merge pull request #169 from taybin/patch-1 - German Laullon (HEAD, refs/remotes/origin/master)
| \
| * ef61b97 - (1 year, 2 months ago) Update Rakefile to work with ruby-1.9.2. - Taybin Rutkin
* | 3b06317 - (9 months ago) Merge pull request #175 from barrywardell/master - German Laullon
| \
| * | 907e967 - (1 year, 3 months ago) Fix bug where submodules were incorrectly grouped when the first part of their path was the same. - Bar
* | | dd1b324 - (9 months ago) Merge pull request #195 from jphalip/master - German Laullon
| \
| * | 8ebb58c - (11 months ago) Added "Copy Reference to Clipboard" context menu item in sidebar. - Julien Phalip
| * | 238a97a - (11 months ago) Fixed a tiny typo. - Julien Phalip
| * | 3386fc7 - (11 months ago) Make sure the commit view gets refreshed when 'Stage' gets selected and the auto-refresh is on. - Julian Phalip
| * | 7fafdb8 - (11 months ago) Tweaked capitalization of words in contextual menu items. - Julien Phalip
| * | 5958f5b - (11 months ago) Don't display all the files selected for deletion to avoid the confirmation sheet getting too tall if there are many. - Julian Phalip
| * | 3575e87 - (11 months ago) Prevent large files from getting loaded in the commit view to prevent the app from freezing. - Julian Phalip
| * | 748621c - (11 months ago) Made the "(Un)stage lines" functionality in the commit view work only if the Command key is pressed. - Julian Phalip
| * | d249fd6 - (11 months ago) When a branch gets selected in the sidebar, make sure its corresponding commit also gets selected. - Julian Phalip
| * | 839c9b6 - (11 months ago) Made the diff tables adapt nicely to the window's size. Fixes #50. - Julien Phalip
* | | 8badd8a - (9 months ago) Merge pull request #196 from Kyriakis/master - German Laullon
| \
| * | af773ba - (11 months ago) No check for refs on remotes while deleting them - Robert Kyriakis
| \
| * | 47a8ala - (9 months ago) Merge pull request #197 from Uncommon/arcfix - German Laullon
| \
| * | dia8ba9 - (11 months ago) fix for ARC errors and other warnings - David Catmull
| \
| * | b94240c - (9 months ago) [yo so slow] :D - German Laullon
| \
| * | 8ce13ad - (11 months ago) Merge pull request #194 from jphalip/master - German Laullon
| \
| * | 3e045a4 - (11 months ago) Ensure that the previously selected commit remains selected after refreshing. Fixes #192. - Julian Phalip
| \
| * | aae5e7c - (11 months ago) Merge pull request #192 from jphalip/master - German Laullon
| \
| * | cd2e8de - (11 months ago) Made the sign-off button optional and hidden by default, as this is a feature that's
| * | 42304da - (11 months ago) Display file list at the top of the diff window. - Julien Phalip
| * | 24d05af - (11 months ago) Minor UI improvements to commit count status label. - Julien Phalip
| \
| * | f38201d - (11 months ago) Merge pull request #191 from jphalip/8a9b9629246dc7d97d748f8de414e14a3e019c94 - German Laullon
```

and git lg2 looks like this:

```
* 525a852 - Sun, 29 Jul 2012 13:04:46 -0700 (9 months ago) (refs/remotes/origin/test_on_10.8)
| notifications test - German Laullon
* 58b5a57 - Fri, 27 Jul 2012 00:18:16 -0700 (9 months ago)
| morden Objective-c - German Laullon
* aef1d39 - Fri, 27 Jul 2012 00:07:45 -0700 (9 months ago)
| first build. - German Laullon
* bfff6661 - Wed, 25 Jul 2012 10:24:23 -0700 (9 months ago) (HEAD, refs/remotes/origin/master, refs/remotes/origin/HEAD)
| Merge pull request #169 from taybin/patch-1 - German Laullon
| * ef61b97 - Mon, 12 Mar 2012 23:14:01 -0300 (1 year, 2 months ago)
| | Update Rakefile to work with ruby-1.9.2. - Taybin Rutkin
* | 3b06317 - Wed, 25 Jul 2012 10:23:49 -0700 (9 months ago)
| | Merge pull request #175 from barrywardell/master - German Laullon
| * | 907e967 - Wed, 1 Feb 2012 10:23:38 +0000 (1 year, 3 months ago)
| | | Fix bug where submodules were incorrectly grouped when the first part of their path was the same. - Bar
* | | dd1b324 - Wed, 25 Jul 2012 10:23:08 -0700 (9 months ago)
| | | Merge pull request #195 from jphalip/master - German Laullon
* | | 8ebb58c - Mon, 18 Jun 2012 22:42:33 -0700 (11 months ago)
| | | Added "Copy Reference to Clipboard" context menu item in sidebar. - Julien Phalip
* | | 238a97a - Sat, 16 Jun 2012 21:19:58 -0700 (11 months ago)
| | | Fixed a tiny typo. - Julien Phalip
* | | 3386fc7 - Sat, 16 Jun 2012 21:18:14 -0700 (11 months ago)
| | | Make sure the commit view gets refreshed when 'Stage' gets selected and the auto-refresh is on. - Julian Phalip
* | | 7fafdb8 - Sun, 10 Jun 2012 13:36:48 -0700 (11 months ago)
| | | Tweaked capitalization of words in contextual menu items. - Julien Phalip
* | | 5958f5b - Sun, 10 Jun 2012 13:24:46 -0700 (11 months ago)
| | | Don't display all the files selected for deletion to avoid the confirmation sheet getting too tall if there are many. - Julian Phalip
* | | 3575e87 - Sat, 9 Jun 2012 15:37:40 -0700 (11 months ago)
| | | Prevent large files from getting loaded in the commit view to prevent the app from freezing. - Julian Phalip
* | | 748621c - Fri, 8 Jun 2012 12:10:38 -0700 (11 months ago)
| | | Made the "(Un)stage lines" functionality in the commit view work only if the Command key is pressed. - Julian Phalip
* | | d249fd6 - Thu, 7 Jun 2012 19:41:27 -0700 (11 months ago)
| | | When a branch gets selected in the sidebar, make sure its corresponding commit also gets selected in the commit view. - Julian Phalip
* | | 839c9b6 - Thu, 7 Jun 2012 15:18:56 -0700 (11 months ago)
| | | Made the diff tables adapt nicely to the window's size. Fixes #50. - Julien Phalip
* | | 8badd8a - Wed, 25 Jul 2012 10:21:54 -0700 (9 months ago)
| | | Merge pull request #196 from Kyriakis/master - German Laullon
* | | af773ba - Sat, 9 Jun 2012 08:09:55 +0200 (11 months ago)
| | | No check for refs on remotes while deleting them - Robert Kyriakis
* | | 47a8ala - Wed, 25 Jul 2012 10:21:14 -0700 (9 months ago)
| | | Merge pull request #197 from Uncommon/arcfix - German Laullon
* | | dia8ba9 - Fri, 15 Jun 2012 11:18:13 -0600 (11 months ago)
| | | Fix for ARC errors and other warnings - David Catmull
```

# Creating a new branch

- `git checkout -b NEW_BRANCH_NAME`
- This is equivalent to doing
  - `Git branch NEW_BRANCH_NAME` // creates new branch
  - `Git checkout NEW_BRANCH_NAME` // switch to the branch

```
C:\Users\Veda\Documents\cse498\gittest>git checkout -b dev
Switched to a new branch 'dev'
```

- If you do `git status` now, then you should see

```
C:\Users\Veda\Documents\cse498\gittest>git status
On branch dev
nothing to commit, working tree clean
```

# Working on local branch

- Let's supposed I have created some content or changed file:

```
C:\Users\Veda\Documents\cse498\gittest>echo "praise" >> LeToucan.txt

C:\Users\Veda\Documents\cse498\gittest>git status
On branch dev
Untracked files:
  (use "git add <file>..." to include in what will be committed)

    LeToucan.txt

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

- I would want to *stage* the change
- **Staged** files are those that are ready to be **committed** to the repo

# Staging

- Git add . (all local file in the current directory)
  - You can also git add SPECIFIC\_FILE\_NAME
- Git add LeToucan.txt
  - Now lit up green
- To unstage, use:
  - Git rm --cached ...

```
C:\Users\Veda\Documents\cse498\gittest>git add LeToucan.txt
```

```
C:\Users\Veda\Documents\cse498\gittest>git status
```

```
On branch dev
```

```
Changes to be committed:
```

```
(use "git reset HEAD <file>..." to unstage)
```

```
    new file:   LeToucan.txt
```

```
C:\Users\Veda\Documents\cse498\gittest>
```

# Committing

- Once you are ready to commit (finished a function or hit a good save point), you should move from **stage** to **commit**.
- Please always include a descriptive change
  - NOT: “fixed some bugs”
  - NOT: “added some logic”
  - NOT: “changes”
  - GOOD: “implemented logic for calculating Euclidean Distance”
- Git commit –m “initialised the letoucan text file”
- Commit whenever you have new features implemented
  - Code should be working (not a strict rule)

# Committing

- Each commit is a “snapshot” of your working directory
- Hash corresponds to the “name” of the snapshot

```
C:\Users\Veda\Documents\cse498\gittest>git add .

C:\Users\Veda\Documents\cse498\gittest>git commit -m "initialised the letoucan text file"
[dev 4671d14] initialised the letoucan text file
 1 file changed, 1 insertion(+)
 create mode 100644 LeToucan.txt

C:\Users\Veda\Documents\cse498\gittest>git status
On branch dev
nothing to commit, working tree clean

C:\Users\Veda\Documents\cse498\gittest>git log
commit 4671d14842fcae4eeb55a1c206015195f455eafc (HEAD -> dev)
Author: Kira <1██████████.com>
Date:   Tue Jan 28 17:41:15 2025 -0500

    initialised the letoucan text file
```



# Reverting to a previous state

- I made a bad commit here, can i go back?
- Yes, **git checkout 4671d1** (the hash of the commit you want to go back to)

```
C:\Users\Veda\Documents\cse498\gittest>git commit -m "oh no this commit have bugged out the file"
[dev 6131a0b] oh no this commit have bugged out the file
 1 file changed, 2 insertions(+), 1 deletion(-)

C:\Users\Veda\Documents\cse498\gittest>git status
On branch dev
nothing to commit, working tree clean

C:\Users\Veda\Documents\cse498\gittest>git log
commit 6131a0b1f0f060683a3c8f18408489ebe4ab131d (HEAD -> dev)
Author: Kira <[REDACTED].com>
Date:   Tue Jan 28 17:46:22 2025 -0500

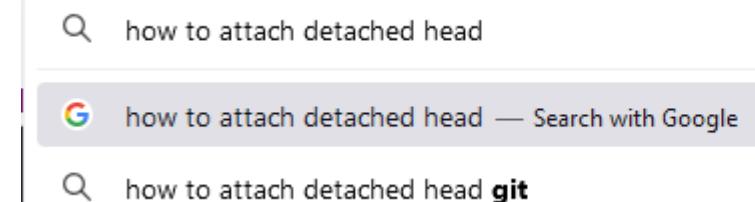
    oh no this commit have bugged out the file

commit 4671d14842fcae4eeb55a1c206015195f455eafc
Author: Kira <[REDACTED].com>
Date:   Tue Jan 28 17:41:15 2025 -0500

    initialised the letoucan text file
```

# Reattaching a detached head

- I am now in a detached state, and I can reattach it through merge
- Git branch tmp (creates a new branch with this commit)
- Git checkout dev
- Git merge tmp



```
C:\Users\Veda\Documents\cse498\gittest>git checkout 4671d1
Note: checking out '4671d1'.

You are in 'detached HEAD' state. You can look around, make experimental
changes and commit them, and you can discard any commits you make in this
state without impacting any branches by performing another checkout.

If you want to create a new branch to retain commits you create, you may
do so (now or later) by using -b with the checkout command again. Example:

    git checkout -b <new-branch-name>

HEAD is now at 4671d14 initialised the letoucan text file
```

# Conflicts

- If you try to merge two branches, you may encounter conflicts
- You must resolve these before merge can continue
  - Select which code segment you want to keep

```
C:\Users\Veda\Documents\cse498\gittest>git merge tmp
Auto-merging LeToucan.txt
CONFLICT (content): Merge conflict in LeToucan.txt
Automatic merge failed; fix conflicts and then commit the result.
```

---

```
<<<<< HEAD
"praise"
OH NO I HAVE CORRUPTED OR SCREWED UP THIS FILE
=====
"praise"
yay we fixed the file!
>>>>> tmp
|
```

# What does my branch now look like?

```
C:\Users\Veda\Documents\cse498\gittest>git log --oneline --graph --decorate
*   22e9092 (HEAD -> dev, origin/dev) fixed conflicts in toucan file from merging
|\ \
| * afc58be (tmp) fixed letoucan file
* | 6131a0b oh no this commit have bugged out the file
| / \
* 4671d14 initialised the letoucan text file
* 8805aa6 (origin/main, main) first commit
```

# Ready to actually upload to server (git)?

- Once you are ready to share your code
- **Git push**
- Now other people on your branch (or really anyone on the repo) can use **git fetch** or **git pull** to get your pushed code.

```
C:\Users\Veda\Documents\cse498\gittest>git push
Counting objects: 6, done.
Delta compression using up to 32 threads.
Compressing objects: 100% (4/4), done.
Writing objects: 100% (6/6), 636 bytes | 636.00 KiB/s, done.
Total 6 (delta 0), reused 0 (delta 0)
To https://github.com/EvilJuiceBox/testrepo.git
 6131a0b..22e9092  dev -> dev
```

# Get updates from main

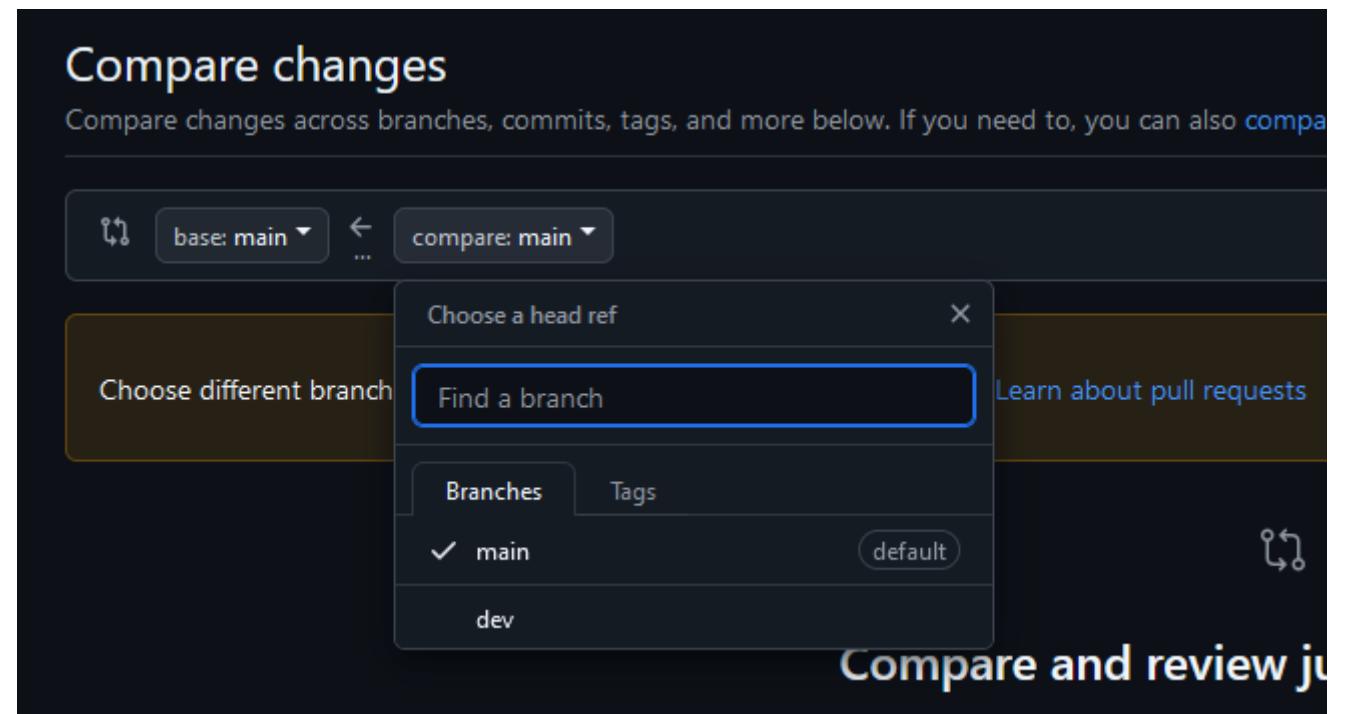
- Git fetch
- Git pull
- Gets upstream and updates your repo with the new code from your parent branch

# Pull request

The screenshot shows a GitHub interface with a dark theme. At the top, there is a navigation bar with links: Code, Issues, Pull requests (which is underlined), Actions, Projects, Security, Insights, and Settings. Below the navigation bar, a warning message is displayed: "⚠ Please configure another 2FA method to reduce your risk of permanent account lockout. If you use SMS for 2FA, we strongly recommend against SMS as it is prone to fraud and delivery may be unreliable depending on your region." On the left side, there is a sidebar with a "Filters" dropdown set to "is:pr is:open", a search bar containing the query "is:pr is:open", and buttons for "Labels 9", "Milestones 0", and "New pull request". The main content area is a large, light-colored box containing the text "Welcome to pull requests! Pull requests help you collaborate on code with other people. As pull requests are created, they'll appear here in a searchable and filterable list. To get started, you should [create a pull request](#)". At the bottom of this box, there is a "ProTip!" section with the text "ProTip! `no:milestone` will show everything without a milestone.".

# Pull request

- Set your target branch and destination branch



## Comparing changes

Choose two branches to see what's changed or to start a new pull request. If you need to, you can also [compare across forks](#) or [learn more about diff comparisons](#).



base: main ▾



compare: dev ▾



Able to merge. These branches can be automatically merged.

Discuss and review the changes in this comparison with others. [Learn about pull requests](#)

[Create pull request](#)

-o- 4 commits

⊕ 1 file changed

1 contributor

-o- Commits on Jan 28, 2025

initialised the letoucan text file

EvilJuiceBox committed 23 minutes ago

4671d14

< >

oh no this commit have bugged out the file

EvilJuiceBox committed 18 minutes ago

6131a0b

< >

fixed letoucan file

EvilJuiceBox committed 6 minutes ago

afc58be

< >

fixed conflicts in toucan file from merging

EvilJuiceBox committed 4 minutes ago

22e9092

< >

⊕ Showing 1 changed file with 2 additions and 0 deletions.

[Split](#) [Unified](#)

▼ 2 LeToucan.txt

...

... ... @@ -0,0 +1,2 @@

1 + "praise"

2 + yay we fixed the file!

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## 21 labels

### BRANCH TO REVIEW

Goal: Bug Fix

Bug has been verified and needs to be repaired

Goal: Documentation

Improvements or additions to documentation

Goal: Enhancement

New feature or request

Goal: Refactor

Code needs to be revised, but no functionality chan

Group 11

Group 12

Group 13

Group 19

Group 12

Group 13

Group 19

Group 20

Group 21

Group 22

Help Wanted

Extra attention is needed

Ignore: Duplicate

This issue or pull request already exists

Ignore: Invalid

This doesn't seem right

Ignore: Out of Scope

This will not be worked on

Ignore: Vague/Unclear

This issue can't be acted upon without more details

Issue: Bug

Something isn't working

Issue: Question

Further information is requested

MERGE: NOT READY

Branch is not ready to merge

MERGE: READY

Ready to be merged to parent branch

 Open

EvilJuiceBox wants to merge 4 commits into `main` from `dev` 

 Conversation 0

 Commits 4

 Checks 0

 Files changed 1

+2 -0 



EvilJuiceBox commented now

Ready for merge to main.

Code reviewers [@EvilJuiceBox](#)



EvilJuiceBox added 4 commits 27 minutes ago

 initialised the letoucan text file

4671d14

 oh no this commit have bugged out the file

6131a0b

 fixed letoucan file

afc58be

 fixed conflicts in toucan file from merging

22e9092



EvilJuiceBox added the [READY FOR MERGE](#) label now



Require approval from specific reviewers before merging

[Rulesets](#) ensure specific people approve pull requests before they're merged.

Add rule



 Continuous integration has not been set up

[GitHub Actions](#) and [several other apps](#) can be used to automatically catch bugs and enforce style.

 This branch has no conflicts with the base branch

Merging can be performed automatically.

[Merge pull request](#)



You can also [open this in GitHub Desktop](#) or view [command line instructions](#).

 Try the new merge experience

Reviewers

No reviews

Still in progress? Learn about draft PRs 

Assignees

No one — assign yourself 

Labels

[READY FOR MERGE](#) 

Projects

None yet 

Milestone

No milestone 

Development

Successfully merging this pull request may close these issues.

None yet 

Notifications

Customize 

 Unsubscribe

You're receiving notifications because you're watching this repository.

1 participant



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# Shows up on main, yay!

A screenshot of a GitHub repository page for 'testrepo'. The repository is private, has 2 branches, and 0 tags. The main branch is selected. A pull request from 'EvilJuiceBox' has been merged. The commit message is 'Merge pull request #1 from EvilJuiceBox/dev'. The commit was made 64d0faf · now by 'EvilJuiceBox' and contains 6 commits. The commit details show changes to 'LeToucan.txt' and 'README.md'. The 'LeToucan.txt' file was updated 10 minutes ago to 'fixed conflicts in toucan file from merging'. The 'README.md' file was updated 1 hour ago to 'first commit'. The README file content is "# testrepo".

testrepo Private

Unwatch 1

main ▾ 2 Branches 0 Tags

Go to file t Add file ▾ Code ▾

EvilJuiceBox Merge pull request #1 from EvilJuiceBox/dev · 64d0faf · now 6 Commits

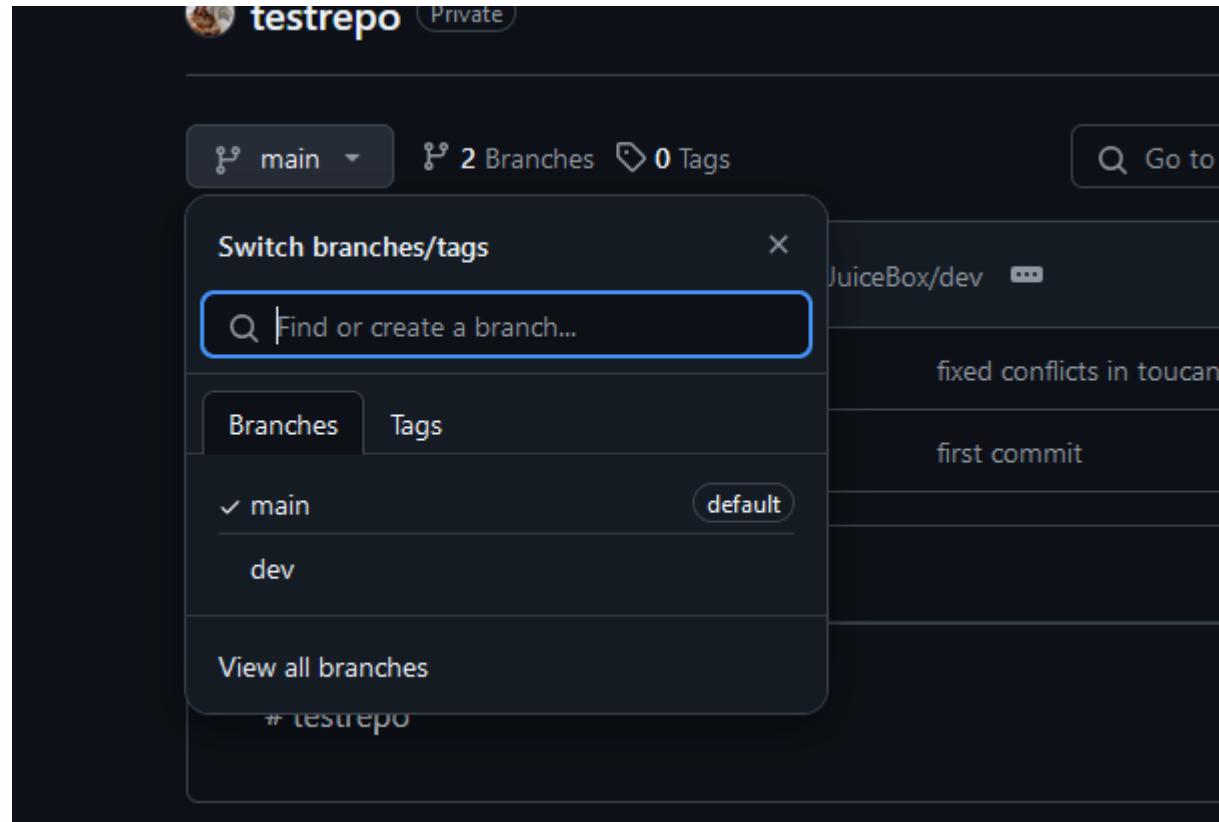
LeToucan.txt fixed conflicts in toucan file from merging 10 minutes ago

README.md first commit 1 hour ago

README

# testrepo

# By the way, you can see all the current branches here as well



# Git Reflog (My cheat command)

- “Shows all your previous states that you have touched
- Check these out to revert to states you lost

```
C:\Users\Veda\Documents\cse498\gittest>git reflog
22e9092 (HEAD -> dev, origin/dev) HEAD@{0}: commit (merge): fixed conflicts in toucan file from merging
6131a0b HEAD@{1}: checkout: moving from tmp to dev
afc58be (tmp) HEAD@{2}: commit: fixed letoucan file
4671d14 HEAD@{3}: checkout: moving from dev to tmp
6131a0b HEAD@{4}: checkout: moving from 3b4f4c969d0f00f8079b5d13b51ca7b1b40b4a5e to dev
3b4f4c9 HEAD@{5}: commit: fixed letoucan file
4671d14 HEAD@{6}: checkout: moving from dev to 4671d
6131a0b HEAD@{7}: checkout: moving from 4671d14842fcae4eeb55a1c206015195f455eafc to dev
4671d14 HEAD@{8}: checkout: moving from dev to 4671d1
6131a0b HEAD@{9}: commit: oh no this commit have bugged out the file
4671d14 HEAD@{10}: commit: initialised the letoucan text file
8805aa6 (origin/main, main) HEAD@{11}: checkout: moving from main to dev
8805aa6 (origin/main, main) HEAD@{12}: Branch: renamed refs/heads/master to refs/heads/main
8805aa6 (origin/main, main) HEAD@{14}: commit (initial): first commit
```

# DANGER ZONE

- **Git reset --hard HEAD**
  - Resets your current working directory to match remote
  - **YOU WILL LOSE ALL PROGRESS**
  - Commits are “gone” (you can check them out in detached state with `git reflog`)
- **Git rebase**
  - Used to “replay” your series of commit on top of another branch
  - **NEVER REBASE COMMITS OTHERS HAVE SEEN**
    - Git will see your version and the version other seen as different
    - Merge is a nightmare to untangle, conflicts appear everywhere

# Comments

- 1) Create your team branch, create a pull request
  - Please name it [TEAMNAME] ... (e.g., [Group 01] Random Class)
- 2) Immediately tag it as **NOT READY TO MERGE**
- 3) Make sure everyone switches to this branch before you work on it (so you do not work on another team's branch or main)
- 4) Mark it as **READY TO MERGE** and tag @CSE498/instructors when you are ready. Feel free to DM us on discord if we do not reply

# Resources if you are not comfortable

- <https://git-scm.com/docs/gittutorial>
- <https://www.w3schools.com/git/>
- <https://learngitbranching.js.org/> << Very good
- <https://gitimmersion.com/>



# Person of the day

## Linus Torvalds

- Creator of Linux operating system
- GNU
- Also created Git
- “I'm an egotistical bastard, and I name all my projects after myself. First Linux, now git.”

# Yes, this is the first version of git's readme

- I choose to believe its so people can type “git gud”

---

```
1      GIT - the stupid content tracker
2
3 "git" can mean anything, depending on your mood.
4
5 - random three-letter combination that is pronounceable, and not
6   actually used by any common UNIX command. The fact that it is a
7   mispronunciation of "get" may or may not be relevant.
8 - stupid. contemptible and despicable. simple. Take your pick from the
9   dictionary of slang.
10 - "global information tracker": you're in a good mood, and it actually
11   works for you. Angels sing, and a light suddenly fills the room.
12 - "goddamn idiotic truckload of sh*t": when it breaks
13
14 This is a stupid (but extremely fast) directory content manager. It
15 doesn't do a whole lot, but what it does do is track directory
16 contents efficiently.
```

# Resources link

- <https://cse.msu.edu/~chanken1/resources.html#git>

