

CSE 374 Lecture 15

Version control and Git



- HW3 revisions due Friday.
- HW4 due this Friday
 - Revision of resubmission rules - we will manually grade once after initial due date, and once after late due date, but you may submit as many times as you want for autograding
 - Still, DO NOT USE THE AUTOGRADER AS YOUR DEBUGGER
- Ask questions on Ed
 - Put in the category for the assignment
 - Include information about when and how the problem occurs

Monday	Tuesday	Wednesday	Thursday	Friday
10:30-11:20 Lecture CSE2 G01 <i>Version Control</i> 07	14:30-15:30 OH Mohit Zoom 08 15:30-16:30 OH Diana Zoom	9:00-10:00 Dr. Hazen, CSE1 212 09 10:30-11:20 Lecture CSE2 G01 <i>More pre-processor, multiple files</i> 12:30-13:30 OH Mohit Zoom / CS2 152 13:30-14:30 OH Dixon Zoom / CSE1 4th Floor Breakout	11:00-12:00 OH Yitian Zoom 10 13:30-14:30 OH Maxim Zoom / CSE1 3rd Floor Breakout	10:30-11:20 Lecture CSE2 G01 <i>Make and Build Dependencies</i> 11 16:00-17:00 OH Yitian 23:00 HW4 due HW4 Spec
10:30-11:20 Lecture 14	14:30-15:30 OH Mohit 15	Test 3: Basic C Programming 16	11:00-12:00 OH Yitian 17	10:30-11:20 Lecture 18

What is version control?

Subversion, perforce, mercurial,
cvs, sourcesafe, **git**

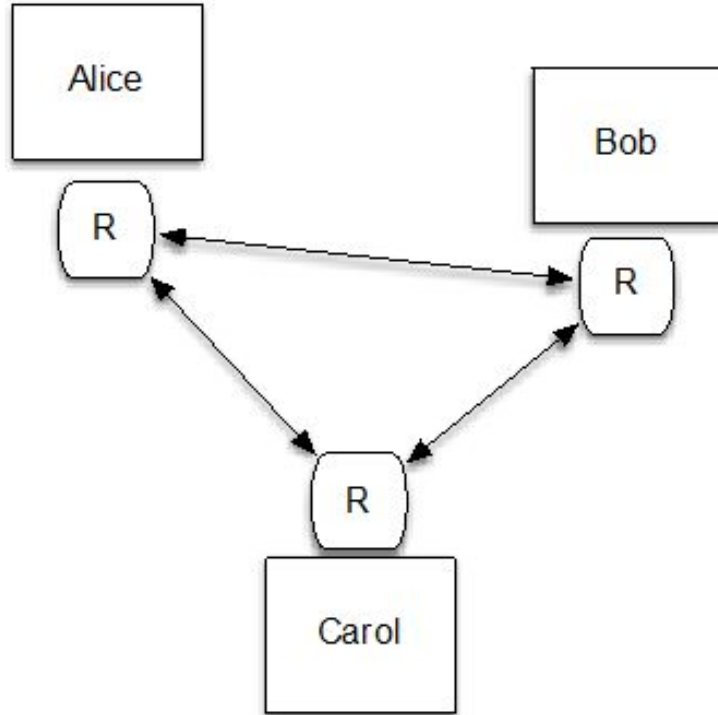
Software system that keeps records of files, changes-to-files, and manages sharing them between collaborators.

Why is version control?

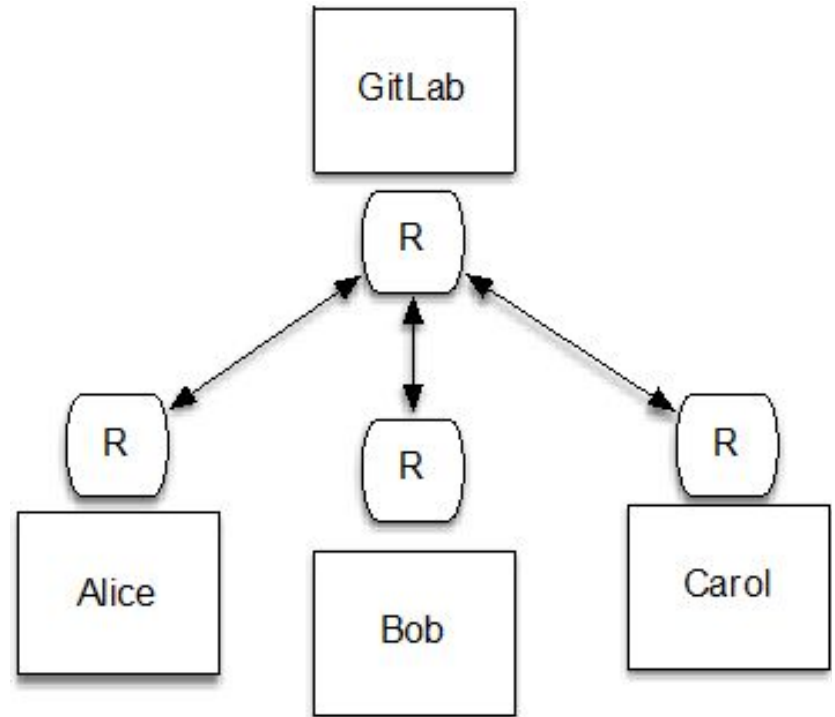
1. **Backups.** Archives a project to keep a safe copy.
2. **Collaboration.** Keeps a shared copy of project that all collaborators can access and update. Manages concurrent and maybe conflicting changes.
3. **Version log.** Keeps copies of previous versions so collaborators can revert if necessary.

Notes: Not language or coding specific; version control is used for all types of documents.

Alternate Models



Distributed System



Centralized System

General Repository Model

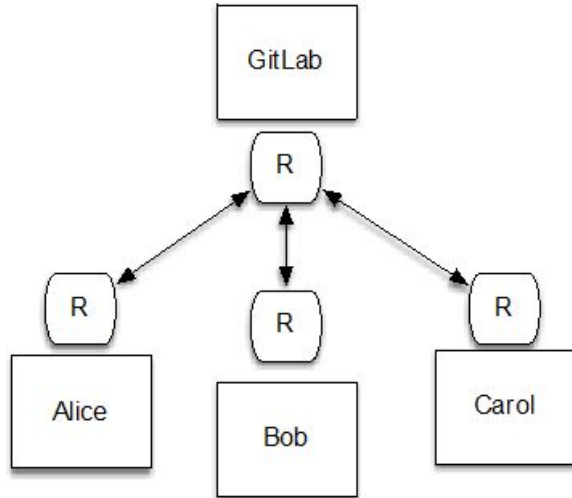
- A project lives in a collection called a "repository" (essentially a folder).
- Each user has their own copy of the repository (in the following diagram notated with "R").
- A user "commits" changes to their copy of the repository to save them.
- Other users can "pull" changes from that repository into their own local repository.

Decentralized: Data is stored in local repositories.

Users can fork from other user's repositories.

Does not scale well to large numbers of users.

Git Centralized Repository



- Users have a shared repository ("origin" or "remote") which lives on a central server.
- Each user "clones" the repository to create a "local" copy.
- A user "commits" changes to their copy to save them.
- To share changes, a user "pushes" their local changes to the origin.
- All users "pull" from the central server periodically to get changes (instead of from each other).
- We call the central repository the "remote" repository; access to the remote repository requires authorization.
- Once code is pushed to the central server, the history of commits is linear. Commits may be reverted.

What is Git?

If that doesn't fix it, `git.txt` contains the phone number of a friend of mine who understands git. Just wait through a few minutes of "It's really pretty simple, just think of branches as..."; and eventually you'll learn the commands that will fix everything.

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.



What do we do with Git?

Learn the common cases; look up the uncommon ones.

- Create
 - a new repository/project (rare – once or twice a year)
 - a new branch (days to weeks; not in cse374, but used in production shops for independent development)
 - a new commit (daily or more, each significant change)
- Push to repo
 - regularly, when you want to back-up or share work – even with yourself on a different computer
- Pull a repo
 - Regularly, to keep up to date with what other people are doing
- Other operations as needed (check version history, differences, ...)

IN CASE OF FIRE



`git commit`



`git push`



`exit building`

IN CASE OF FIRE



git commit



git push



exit building

git pull



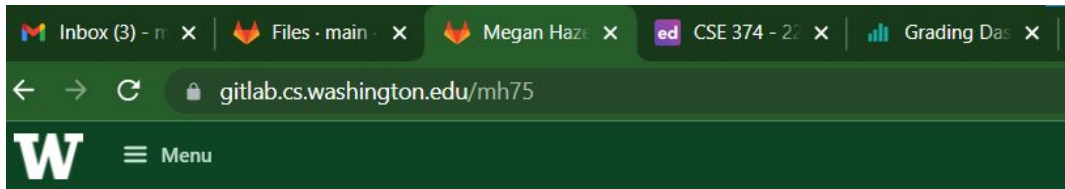
Repository Access





A repository can be:

- Local: run git commands in repo directory or subdirectory
- Remote: lots of remote protocols supported (ssh, https) depending on repository configuration
 - Specify user-id and machine
 - Usually need git and ssh installed locally
 - Need authentication (use ssh key with GitLab)
- cse374 use ssh access to remote GitLab server
- Feel free to experiment with GitLab

Getting Started

- Create local ssh keys (ssh-keygen) and add to your GitLab account (instructions on gitlab, linked from cse374 git tutorial; only need to do this once)
- Set up a repository (we have a few to start with; if you do it yourself you get to pick name, location)
- + New Project (on gitlab dashboard)
- Clone a working copy of the repo to your machine
 - cd where-you-want-to-put-it
 - git clone git@gitlab.cs.washington.edu:path/to/repo
 - url for above comes from gitlab page for your project, find using link in email you get when project created or on by logging in to gitlab
- If git asks for password, keys aren't set up right – fix it







Megan Hazen
@mh75

Set status

Edit profile

Preferences

Sign out



Menu

User Settings > SSH Keys

Search settings

SSH Keys

SSH keys allow you to establish a secure connection between your computer and GitLab.

Add an SSH key

To add an SSH key you need to [generate one](#) or use an [existing key](#).

Key

Paste your public SSH key, which is usually contained in the file '~/.ssh/id_rsa.pub' and begins with 'ssh-ed25519' or 'ssh-rsa'. Do not paste a private key, as this can compromise your identity.

Typically starts with "ssh-ed25519 ..." or "ssh-rsa ..."

Title	Expires at
<input type="text" value="e.g. My MacBook key"/>	<input type="text" value="mm/dd/yyyy"/>

Give your individual key a title. This will be used to identify the key in the future.



CSE374-22WI

Project ID: 73031

3 Commits 1 Branch 0 Tags 113 KB Files 113

Shared project for the 22 WI quarter



Auto DevOps

It will automatically build, test, and deploy your application based on a predefined CI/CD configuration.

Learn more in the [Auto DevOps documentation](#)

Enable in settings

main

cse374-22wi / +

History

Find file

Web IDE

Download

Clone



Merge branch 'mh75-main-patch-35196' into 'main'

Megan Hazen authored 18 hours ago

Upload File

README

Add LICENSE

Add CHANGELOG

Add CONTRIB

Set up CI/CD

Configure Integrations

Clone with SSH

git@gitlab.cs.washington.edu:~\$ git clone git@gitlab.cs.washington.edu:~\$ git clone git@gitlab.cs.washington.edu:~\$ git clone



Clone with HTTPS

https://gitlab.cs.washington.edu/m



Open in your IDE

Visual Studio Code (SSH)

emacs@localhost:localdomain

mh75@localhost:~/cse374-22wi

File Edit View Search Terminal Help

```
[mh75@localhost ~]$ git clone git@gitlab.cs.washington.edu:~$ git clone git@gitlab.cs.washington.edu:~$ git clone
Cloning into 'cse374-22wi'...
remote: Enumerating objects: 7, done.
remote: Counting objects: 100% (7/7), done.
remote: Compressing objects: 100% (5/5), done.
remote: Total 7 (delta 2), reused 0 (delta 0), pack-reused 0
Receiving objects: 100% (7/7), done.
Resolving deltas: 100% (2/2), done.
[mh75@localhost ~]$ git pull
fatal: not a git repository (or any parent up to mount point /)
```

Local Additions & Editing

- Edit a file “stuff.c”
- Add file(s) to list to be saved in repo on next commit

```
git add stuff.c
```

- Commit all added changes

```
git commit -m "reason/summary for commit"
```

- Repeat locally until you want to push accumulated commits to GitLab server to share with partner or for backup...

Git commit -m 'messages should be useful'



	COMMENT	DATE
○	CREATED MAIN LOOP & TIMING CONTROL	14 HOURS AGO
○	ENABLED CONFIG FILE PARSING	9 HOURS AGO
○	MISC BUGFIXES	5 HOURS AGO
○	CODE ADDITIONS/EDITS	4 HOURS AGO
○	MORE CODE	4 HOURS AGO
○	HERE HAVE CODE	4 HOURS AGO
○	AAAAAAAAA	3 HOURS AGO
○	ADKFJ\$LKDFJ\$DKLFJ	3 HOURS AGO
○	MY HANDS ARE TYPING WORDS	2 HOURS AGO
○	HAAAAAAAAAANDS	2 HOURS AGO

AS A PROJECT DRAGS ON, MY GIT COMMIT
MESSAGES GET LESS AND LESS INFORMATIVE.

File *mv* or *rename*

- Once files have been committed to gitlab repository:

```
git mv files
```

```
git rm files
```

- git will make changes locally then update the remote
GitLab repo when you push

~ If you use regular shell mv/rm commands, git will give you all sorts of interesting messages when you run git status and you will have to clean up

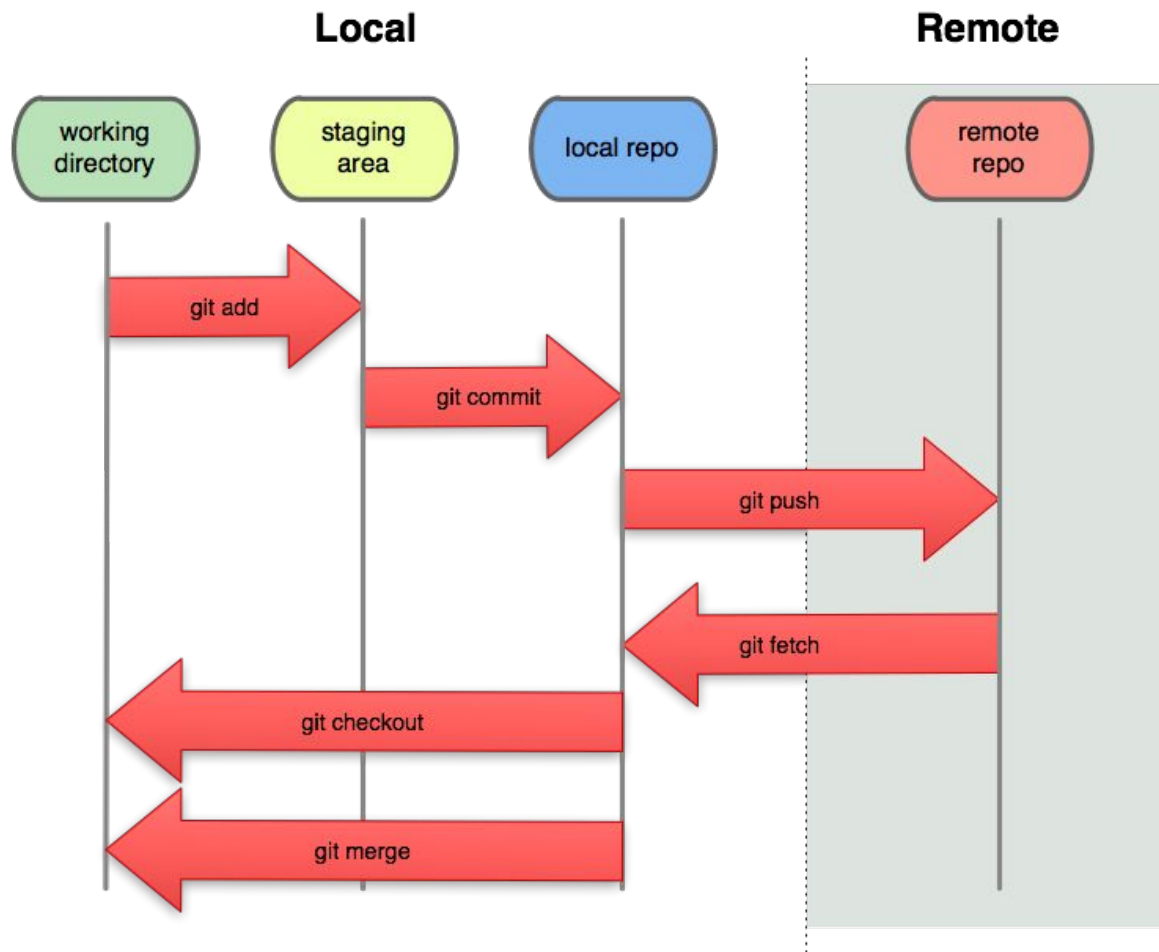
Gitlab remote use: sharing changes

- Good practice – update with remote changes:

```
git pull
```

- Also do this any time you want to merge changes pushed by your partner
- Test, make any needed changes, do git add / git commit to get everything cleaned up locally
- When ready, push accumulated changes to server

```
git push
```
- If push blocks because there are newer changes on server, do a git pull, accept any merge messages, cleanup, add/commit/push again



Resolving Conflicts

git will tell you which files had merge conflicts (use `git status` to see conflicts), and the files will be edited to identify the conflict:

```
<<<<<<< HEAD
for (int i=0; i<10; i++)
=====
for (int i=0; i<=10; i++)
>>>>>>> master
```

You must modify the section to contain the code you want, then save, add, and commit the merge.

When more than one person works on a file you may get ‘merge conflicts’.

A merge conflict occurs when a person ‘git pull’s a file that has been updated on the remote repository since they started editing.

If git detects a merge issue (the same line of code edited in two non-sequential commits, i.e. commits made at the same time), it will attempt to automatically resolve the merge.

But if the commits modified the same portion of a file you will have to fix the conflict manually.

Example Commands

- Update local copy to remote

```
git pull
```

- Make changes

```
git add file.c
```

```
git mv oldfile.c newfile.c
```

```
git rm obsolete.c
```

- Commit changes to local repo

```
git commit -m "fixed segfault in getmem"
```

Examine changes

`git status` (see uncommitted changed files, or how to revert changes, etc.)

`git diff file` (see uncommitted changes in *file*)

`git log` (see history of commits)

- Update GitLab shared repo to reflect local changes

```
git push
```

Fixing Mistakes

- Set local repository to the last commit (forget all changes that you've made), you can run `git reset --hard HEAD`
- Here "HEAD" refers to the most recent commit.
- If one of your past commits was BAD, you can undo it using
`git revert`
- If the second-to-last commit was bad, you can undo it by saying
`git revert HEAD~1`
 - a. HEAD is the most recent commit and "1" signifies the one before it. This will create a NEW commit that is the opposite of the original commit.
- Commits aren't completely static and permanent. If you make a commit but then realize you forgot one little thing, you can "amend"/modify your previous commit
`git commit --amend`

.gitignore

Git may be used to store any types of files.

HOWEVER

Do not store files that are unnecessary.

- Backup files (like *~ emacs backups)
- Files that can be recreated (such as .o files) should not be added.
- System specific files

‘.gitignore’ lists files not to upload to HEAD

```
# emacs backup files  
*~
```

```
# OS X finder info files  
.DS_Store
```

```
# built object files  
*.o
```


374: Gitlab

Resources on line -

<https://gitlab.cs.washington.edu/help>

<https://courses.cs.washington.edu/courses/cse374/22wi/resources/git.html>

<https://git-scm.com/book/en/v2>

<https://about.gitlab.com/images/press/git-cheat-sheet.pdf>

You may choose to work with a partner for HW6, in which case, you must use a CSE GitLab repository to store all of the code and other files associated with the project.

Don't store things like .o files and executable programs that don't belong in a repository.

You must use the provided repository even if you have separate machines or accounts of your own that you use for other projects.

Both partners should be regularly committing and pushing changes to your repository. The git log to reflect reasonable activity by both members of the group.