CSE 374
Programming Concepts & Tools

Hal Perkins

Fall 2017

Lecture 16 – Version control and git

Administrivia

- HW6 writeup posted soon – please read before Wed.
  - Part I due a week from Thur. – skeleton code & makefile
  - Full assignment due Thur. after Thanksgiving
  - Detailed discussion in next couple of classes

- Partner survey posted before class, due 11 pm Wed.
  - *Please* follow instructions – it's not hard!
  - Will create gitlab repositories for groups after that
    - Watch for email from gitlab.cs.washington.edu with repo information and link, then log on, set up keys, clone repo, and try it out

Where we are

- Learning tools and concepts relevant to multi-file, multi-person, multi-platform, multi-month projects
- Today: Managing source code
  - Reliable backup of hard-to-replace information (i.e., sources)
  - Tools for managing concurrent and potentially conflicting changes from multiple people
  - Ability to retrieve previous versions
- Note: None of this has anything to do with code. Like make, version-control systems are typically not language-specific.
  - Many people use version control systems for everything they do (code, papers, slides, letters, drawings, pictures, . . .)
    - Traditional systems were best at text files (comparing differences, etc.); newer ones work fine with others too
      - But be sure to check before storing videos & other media

Version-control systems

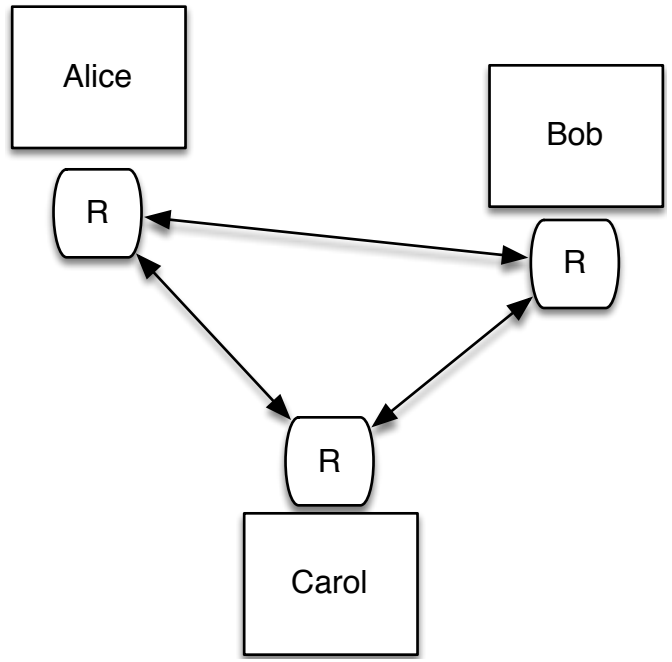
- There are plenty: sccs, rcs, cvs (mostly historical); subversion, git, mercurial, perforce, sourcesafe, …
- Terminology and commands aren't particularly standard, but once you know one, the others aren't difficult – the basic concepts are the same
- svn still used for some old projects – single central repository, users have individual working copies
- git and mercurial: distributed version control
  - Same core ideas, but every user has a full copy of the repository; allows easy branching & merging for large collaborations (e.g., linux kernel)
  - We'll use git, which is widely used these days

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.

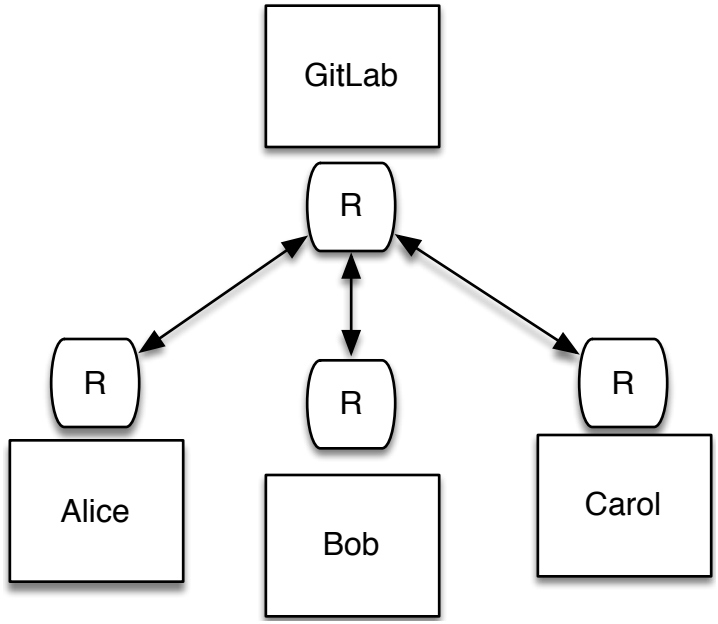
Git basics – general version

- A project lives in a repository
- Each user has their own copy of the repository
- A user *commits* changes to her copy to save them
- Other users can pull changes from that repository



Git basics – central repo (we'll use)

- Users have a shared repository (called *origin* in the git literature; for cse374 it is your group's repository on the CSE GitLab server)
- Each user *clones* the repository
- Users *commit* changes to their local repository (clone)
- To share changes, *push* them to GitLab after verifying them locally
- Other users *pull* from Gitlab to get changes (instead of from each other)



Tasks

Learn the common cases; look up the uncommon ones.

In a production shop using git…

- 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
- Other operations as needed (check version history, differences, …)

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/HW6 use ssh access to remote GitLab server
- Feel free to experiment with private, local repos or private repos on gitlab

Getting started (GitLab)

- 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'll do this for you on hw6; 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!

Routine git/GitLab local use

- Edit a file, say 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/GitLab use (sharing changes)

- Good practice – grab any changes on server not yet in local repo before any local commits

  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

File rename/move/delete

- Once files have been committed to gitlab repository, need to tell git about changes to git-managed files

  git mv *files*

  git rm *files*

  – git will make the changes locally then make corresponding changes to 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 ☺

Demo

Some examples

- Update local copy to match GitLab copy
  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 bug in getmem”
- Examine changes
  git status (see uncommitted changed files, will also show you 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

Conflicts

- This all works great if there is one working copy.
- But if two users make changes to their own local copies, the two versions must be *merged*
  - git will merge automatically when you do a “git pull”
  - Usually successful if different lines or different files changed
- If git can’t automatically merge, you need to fix manually
  - git will tell you which files have conflicts (git status)
  - Look in files, you will see things like

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

  - Change these lines to what you actually want, then add/commit the changes (and push if you want to)

git gotchas

- Do not forget to add/commit/push files or your group members will be very unhappy
- Keep in the repository *exactly* (and *only*) what you need to build the program
  - Yes: foo.c foo.h Makefile
  - No: foo.o a.out foo.c~
  - You don't want versions of .o files etc.:
    - Replaceable things have no value
    - They change a lot when .c files change a little
    - Developers on other machines can't use them
- A simple .gitignore file can be used to tell git which sorts of files should not be tracked (*.o, *~, .DS_Store (OS X))
  - Goes in top-level repo directory; useful to push to GitLab and share

Summary

- Another tool for letting the computer do what it's good at:
  - Much better than manually emailing files, adding dates to filenames, etc.
  - Managing versions, storing the differences
  - Keeping source-code safe
  - Preventing concurrent access, detecting conflicts

- git/Gitlab tutorial for CSE 374 on website
- Links to GitLab on website and in CSE 374 tutorial
  - And in the mail you get when your repo is created
- Full git docs and book are online, free, downloadable
  - Beware of complexity – much of what they describe is beyond what we need for CSE 374. Keep it simple!