GIT

A distributed version control system

Version control systems

- Version control (or revision control, or source control) is all about managing multiple versions of documents, programs, web sites, etc.
  - Almost all "real" projects use some kind of version control
  - Essential for team projects, but also very useful for individual projects
- Some well-known version control systems are CVS, Subversion, Mercurial, and Git
  - CVS and Subversion use a "central" repository; users "check out" files, work on them, and "check them in"
  - Mercurial and Git treat all repositories as equal
- Distributed systems like Mercurial and Git are newer and are gradually replacing centralized systems like CVS and Subversion

Why version control?

- For working by yourself:
  - Gives you a “time machine” for going back to earlier versions
  - Gives you great support for different versions (standalone, web app, etc.) of the same basic project
- For working with others:
  - Greatly simplifies concurrent work, merging changes
- For getting an internship or job:
  - Any company with a clue uses some kind of version control
  - Companies without a clue are bad places to work

Why Git?

- Git has many advantages over earlier systems such as CVS and Subversion
  - More efficient, better workflow, etc.
  - See the literature for an extensive list of reasons
  - Of course, there are always those who disagree
- Best competitor: Mercurial
  - I like Mercurial better
  - Same concepts, slightly simpler to use
  - In my (very limited) experience, the Eclipse plugin is easier to install and use
  - Much less popular than Git

Git Introduction

- Enter these lines (with appropriate changes):
  - `git config --global user.name "John Smith"`
  - `git config --global user.email` jsmith@seas.upenn.edu
- You only need to do this once

- If you want to use a different name/email address for a particular project, you can change it for just that project
  - `cd` to the project directory
  - Use the above commands, but leave out the `--global`

Create and fill a repository

1. `cd` to the project directory you want to use
2. Type in `git init`
   - This creates the repository (a directory named `.git`)
   - You seldom (if ever) need to look inside this directory
3. Type in `git add .`
   - The period at the end is part of this command!
     - Period means “this directory”
   - This adds all your current files to the repository
4. Type in `git commit –m "Initial commit"`
   - You can use a different commit message, if you like

Clone a repository from elsewhere

- `git clone` *`URL`*
- `git clone` *`URL mypath`*
  - These make an exact copy of the repository at the given URL
- `git clone git://github.com/`*`rest_of_path/file.git`*
  - Github is the most popular (free) public repository
- All repositories are equal
  - But you can treat some particular repository (such as one on Github) as the "master" directory
- Typically, each team member works in his/her own repository, and "merges" with other repositories as appropriate

The repository

- Your top-level **working directory** contains everything about your project
  - The working directory probably contains many subdirectories—source code, binaries, documentation, data files, etc.
  - One of these subdirectories, named `.git`, is your repository
- At any time, you can take a "snapshot" of everything (or selected things) in your project directory, and put it in your repository
  - This "snapshot" is called a commit object
  - The commit object contains (1) a set of files, (2) references to the "parents" of the commit object, and (3) a unique "SHA1" name
  - Commit objects do *not* require huge amounts of memory
- You can work as much as you like in your working directory, but the repository isn't updated until you `commit` something

`init` and the `.git` repository

- When you said `git init` in your project directory, or when you cloned an existing project, you created a repository
  - The repository is a subdirectory named `.git` containing various files
  - The dot indicates a "hidden" directory
  - You do *not* work directly with the contents of that directory; various git commands do that for you
  - You *do* need a basic understanding of what is in the repository

Making commits

- You do your work in your project directory, as usual
- If you create new files and/or folders, they are *not tracked* by Git unless you ask it to do so
  - `git add newFile1 newFolder1 newFolder2 newFile2`
- Committing makes a "snapshot" of everything being tracked into your repository
  - A message telling what you have done is required
  - `git commit –m "Uncrevulated the conundrum bar"`
  - `git commit`
    - This version opens an editor for you the enter the message
    - To finish, save and quit the editor
- Format of the commit message
  - One line containing the complete summary
  - If more than one line, the second line must be blank

Commits and graphs

- A commit is when you tell git that a change (or addition) you have made is ready to be included in the project
- When you commit your change to git, it creates a commit object
  - A commit object represents the complete state of the project, including all the files in the project
  - The *very first* commit object has no "parents"
  - Usually, you take some commit object, make some changes, and create a new commit object; the original commit object is the parent of the new commit object
    - Hence, most commit objects have a single parent
  - You can also merge two commit objects to form a new one
    - The new commit object has two parents
- Hence, commit objects form a **directed graph**
  - Git is all about using and manipulating this graph

Working with your own repository

- A head is a reference to a commit object
- The "current head" is called HEAD (all caps)
- Usually, you will take HEAD (the current commit object), make some changes to it, and commit the changes, creating a new current commit object
  - This results in a linear graph: A ▫ B ▫ C ▫ …▫ HEAD
- You can also take any previous commit object, make changes to it, and commit those changes
  - This creates a branch in the graph of commit objects
- You can merge any previous commit objects
  - This joins branches in the commit graph

Commit messages

- In git, “Commits are cheap.” Do them often.
- When you commit, you must provide a one-line message stating what you have done
  - Terrible message: “Fixed a bunch of things”
  - Better message: “Corrected the calculation of median scores”
- Commit messages can be very helpful, to yourself as well as to your team members
- You can’t say much in one line, so commit often

Choose an editor

- When you “commit,” git will require you to type in a commit message
- For longer commit messages, you will use an editor
- The default editor is probably `vim`
- To change the default editor:
  - `git config --global core.editor /path/to/editor`

- You may also want to turn on colors:
  - `git config --global color.ui auto`

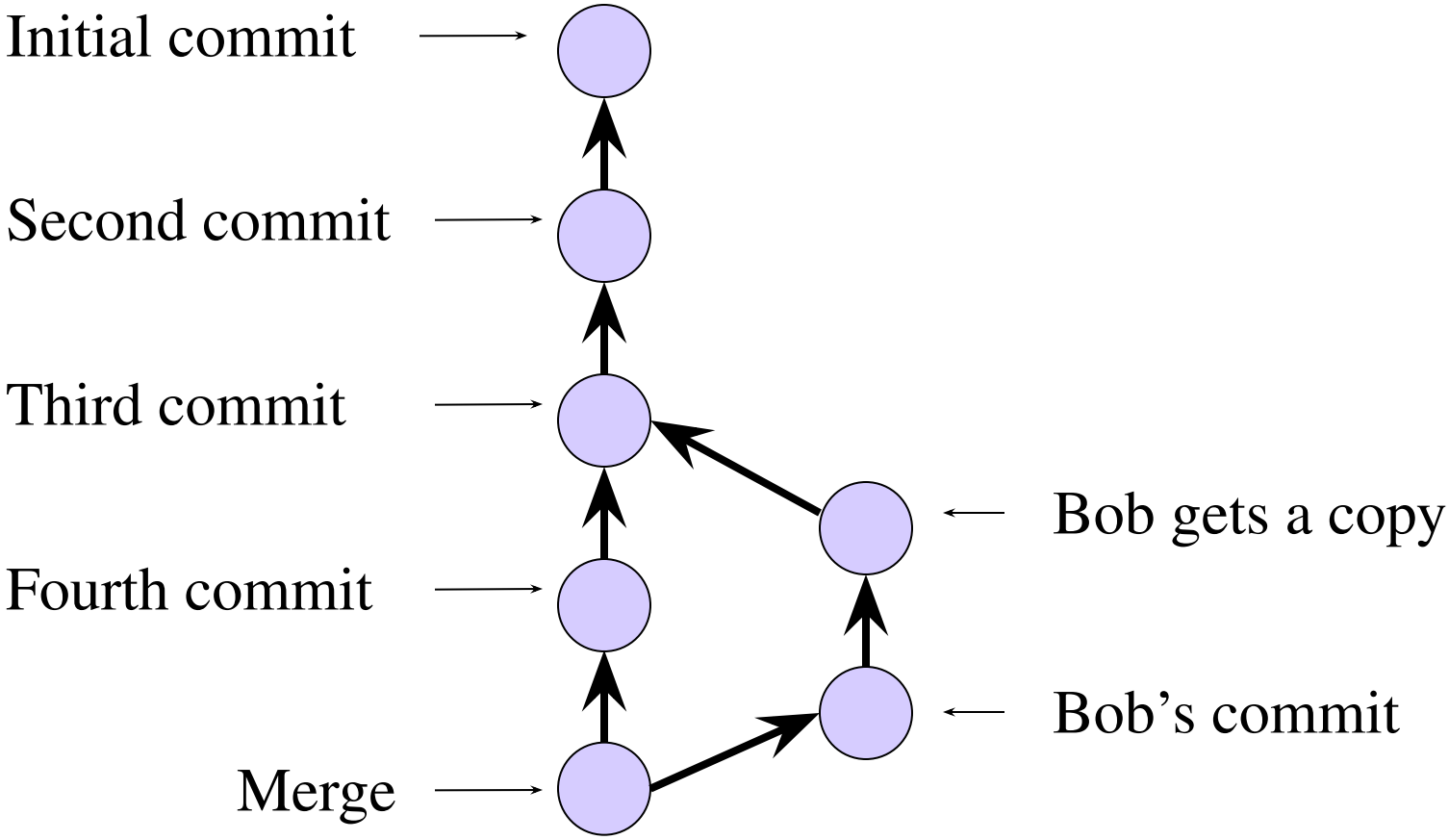
Working with others

- All repositories are equal, but it is convenient to have one central repository in the cloud
- Here's what you normally do:
  - Download the current HEAD from the central repository
  - Make your changes
  - Commit your changes to your local repository
  - Check to make sure someone else on your team hasn't updated the central repository since you got it
  - Upload your changes to the central repository
- If the central repository *has* changed since you got it:
  - It is *your* responsibility to **merge your two versions**
    - This is a strong incentive to commit and upload often!
  - Git can often do this for you, if there aren't incompatible changes

Typical workflow

- `git pull` *`remote_repository`*
  - Get changes from a remote repository and merge them into your own repository
- `git status`
  - See what Git thinks is going on
  - Use this frequently!
- Work on your files (remember to `add` any new ones)
- `git commit -m` *“What I did”*
- `git push`

Multiple versions



Keeping it simple

- If you:
  - Make sure you are current with the central repository
  - Make some improvements to your code
  - Update the central repository before anyone else does
- Then you don’t have to worry about resolving conflicts or working with multiple branches
  - All the complexity in git comes from dealing with these
- Therefore:
  - Make sure you are up-to-date before starting to work
  - Commit and update the central repository frequently
- If you need help: https://help.github.com/